Sant Dnyaneshwar Shikshan Sanstha's

ANNASAHEB DANGE COLLEGE OF ENGINEERING & TECHNOLOGY, ASHTA

(An Empowered Autonomous Institute)

Curriculum Structure

M.Tech.
Electrical Power System

Semester-I to Semester-IV

(To be implemented from Academic Year 2025-26 onwards)

Department of Electrical Engineering

Established: 1999

Annasaheb Dange College of Engineering and Technology

Ashta - 416301, Dist. : Sangli, Maharashtra

(An Empowered Autonomous Institute)

F.Y. M.Tech. – Electrical Power System
[Level 6.5, PG Diploma] Semester - I

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	RM	T1	0PSRM501	Research Methodology and IPR	3	1	0	2	4	40	20	40	-	-
02	PC	LIT1	0PSPC502	Advanced Power System Analysis	3	1	2	2	5	40	20	40	50	50
03	MC	T1	0PSMC503	Power System Modeling	3	1	0	2	4	40	20	40	-	-
04	PE	T1	0PSPE5**	Program Elective - I	3	1	0	2	4	40	20	40	-	-
05	PE	T1	0PSPE5**	Program Elective - II	3	0	0	2	3	40	20	40	-	-
06	PC	L1	0PSPC510	Renewable Energy and Grid Integration Lab.	0	0	4	2	2	-	-	-	50	50
07	MA	T2	0PSMA511	Research Paper Writing	2	0	0	0	0	-	50	-	-	-
				Total	**16**	**5**	**6**	**12**	**22**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab): ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective - I		**Program Elective - II**	
0PSPE504	Renewable Energy System	0PSPE507	High Power Converters
0PSPE505	Energy Storage Systems	0PSPE508	Electric and Hybrid Vehicles
0PSPE506	Electrical Power Distribution System	0PSPE509	Distributed Generation

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F.Y. M.Tech. – Electrical Power System
[Level 6.5, PG Diploma] Semester - II

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MS	TA	ESE	CIA	ESE
01	OE	T1	0PSOE5**	Open Elective	3	0	0	2	3	40	20	40	-	-
02	PC	LIT1	0PSPC513	Advanced Power System Protection	3	1	2	2	5	40	20	40	50	50
03	PC	T1	0PSPC514	Smart Grid Technologies	3	0	0	2	3	40	20	40	-	-
04	PE	T1	0PSPE5**	Program Elective - III	3	1	0	2	4	40	20	40	-	-
05	PE	T1	0PSPE5**	Program Elective - IV	3	1	0	2	4	40	20	40	-	-
06	PC	L1	0PSPC521	Advanced Power System Lab.	0	0	2	2	1	-	-	-	50	50
07	VS	L2	0PSVS522	Seminar	0	0	4	2	2	-	-	-	50	-
08	MA	T2	0PSMA523	Pedagogy Studies	2	0	0	0	0	-	50	-	-	-
				Total	**17**	**3**	**8**	**14**	**22**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective - III		**Program Elective - IV**		**Open Elective**	
0PSPE515	Power Quality	0PSPE518	Restructured Power Systems	0PSOE512	Optimization Techniques
0PSPE516	Power System Transients	0PSPE519	High Voltage Technology		
0PSPE517	High Voltage Transmission Systems	0PSPE520	Substation Automation		

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Exit after **F.Y. M.Tech. – Electrical Power System**

Additional Credits to qualify for P. G. Diploma Certificate

- **Need to Complete Domain Specific Internship or Industrial Software Training and Certification for 8 Weeks**

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S.Y. M.Tech. – Electrical Power System

[Level 6.5, PG Degree] Semester - III

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	SL	T1	0PSSL6**	Self Learning Course - I	0	0	0	4	4	40	20	40	-	-
02	VS	L1	0PSVS603	Dissertation Phase – I	0	0	24	10	12	-	-	-	100	100
03	MA	T2	0PSMA604	Internship	-	-	-	-	-	-	50	-	-	-
				Total	**0**	**0**	**24**	**14**	**16**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

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S.Y. M.Tech. – Electrical Power System

[Level 6.5, PG Degree] Semester - IV

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	SL	T1	0PSSL6**	Self Learning Course - II	0	0	0	4	4	30	40	30	-	-
02	VS	L1	0PSVS607	Dissertation Phase – II	0	0	32	10	16	-	-	-	100	100
				Total	**0**	**0**	**32**	**14**	**20**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

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Department : **Electrical Engineering**
Programme : **M.Tech. – Electrical Power Systems**
Curriculum Revision : **Revision: R0, with effect from the AY 2025 - 26 to the students of PG Programme.**

Course Category	Acronym	I	II	III	IV	Total	% of Category
Program Specific Mathematical Course (PSMC)	MC	4	0	0	0	4	5
Research Methodology	RM	4	0	0	0	4	5
Program Core	PC	7	9	0	0	16	20
Program Elective	PE	7	8	0	0	15	18.75
Open Elective	OE	0	3	0	0	3	3.75
Vocational and Skill Enhancement Course (VSEC)	VS	0	2	12	16	30	37.5
Self Learning Course (SLC)	SL	0	0	4	4	8	10
	Total	22	22	16	20	80	100

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Course Information:								
Class, Semester	F. Y. M. Tech, Semester - I						Category	RM
Course Code, Course Title	0PSRM501, Research Methodology and IPR						Type	T1
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study			Credits	
	3	1	-	2			4	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Formulate research problems and hypotheses by defining objectives, reviewing literature, and distinguishing research types.
CO2	Design robust research frameworks using principles of induction, deduction, experimentation, and sample design.
CO3	Apply statistical tools and sampling techniques to collect, analyze, and validate data through hypothesis testing.
CO4	Synthesize research findings using data visualization (Excel) and prepare structured reports with accurate interpretation.
CO5	Uphold ethical standards in research by avoiding plagiarism, respecting intellectual property, and ensuring participant rights.

Syllabus:

Module	Contents	Lecture Hours
I	**Fundamentals of Research:** Meaning, Objectives and Characteristics of research ,Research methods Vs Methodology, Types of research, Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical ,Research process, Criteria of good research, Developing a research plan, Defining the research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining the problem, Importance of literature review in defining a problem, Survey of literature, Primary and secondary sources – Development of working hypothesis.	8
II	**Research Design and Methodology:** Research design and methods – Basic Principles N eed of research design – Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and Explanation, Induction, Deduction, Development of Models, Developing a research plan, Exploration, Description, Diagnosis, and Experimentation, Determining experimental and sample designs.	8
III	**Sampling, Data Collection, and Hypothesis Testing in Research:** Sampling design, Steps in sampling design, Characteristics of a good sample design, Types of sample designs, Measurement and scaling techniques, Methods of data collection – Collection of primary data, Data collection instruments, Testing of hypotheses, Basic concepts, Procedure for hypotheses testing, Flow diagram for hypotheses testing, Data analysis with Statistical Packages – Correlation and Regression, Important parametric test, Chi-square test, Analysis of variance and Covariance.	8
IV	**Data Analysis and Report Writing: Tools ,Techniques ,and Interpretation:** Data Analysis using MS Excel ,Introduction to Spreadsheets, Spreadsheet Functions to Organize Data ,Introduction to Filtering, Pivot Tables, and Charts, Advanced Graphing and Charting, Interpretation and report writing, Techniques of interpretation, Structure and components of scientific reports, Different steps in the preparation, Layout, structure, and language of the report, Illustrations and tables, Types of reports, Technical reports and thesis.	7

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V	**Ethical Considerations in Research: Principles, Plagiarism ,and Intellectual Property:** Ethics in Research: Importance, Principles, Developing a code of ethics, Ethics and Respondents, Ethics and Clients, Ethics and research firm, Plagiarism, Patent and Copyrights, Ethical Issues in Data Collection and Publishing, Step by Step Guide for IPR.	7
VI	**Research Communication and Presentation Skills:** Effective academic and research writing, Writing research papers, abstracts, and proposals, Conference and journal publications, Research presentations, Poster presentations, Communicating research findings to diverse audiences, Using Latex for technical writing.	7
	Total Lecture Hours	**45**

Text Books

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, 4th Edition, New Age International, 2018.
2. John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods*, 4th Edition, SAGE Publications, 2018.

References:

1. Gary D. Bouma & Rosemary Ling, *The Research Process: Methods and Strategies*, 3rd Edition, Oxford University Press, 2020.
2. Charles Teddlie & Abbas Tashakkori, *Foundations of Mixed Methods Research*, 2nd Edition, SAGE Publications, 2021.
3. Sharon L. Lohr, Sampling: *Design and Analysis*, 3rd Edition, Cengage Learning, 2022
4. John W. Creswell & Cheryl Poth, *Qualitative Inquiry and Research Design*, 4th Edition, SAGE Publications, 2018

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Course Information:

Class, Semester	FY. M.Tech, Semester - I						**Category**	**PC**
Course Code, Course Title	**0PSPC502, Advanced Power System Analysis**						**Type**	**LIT1**
Teaching Scheme (per week)	**Lecture**		**Tutorial**	**Practical**	**Self Study**		**Credits**	
	3		1	2	2		5	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		50	50	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Apply** per-unit analysis, model power system components to solve non-linear equations for effective power system analysis and design.
CO2	**Formulate** and solve the power flow problem using different methods and determine optimal power flow solution.
CO3	**Analyze** reactance of synchronous machines; perform symmetrical fault analysis for both symmetrical and unsymmetrical faults in power systems.
CO4	**Construct** and modify bus impedance matrices, and evaluate the resulting changes in bus voltages for contingency scenarios in power systems.
CO5	**Analyze,** transient stability, voltage collapse, construct P-V curves, perform power flow solutions, use continuation power flow, and apply AI in power system analysis

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Preliminaries for Power System Problems** Per unit quantities - Modeling of generators, transformers, off nominal tap setting and phase shifting transformers, transmission lines and loads. Primitive parameters - Bus admittance matrix - bus impedance matrix - reduction due to zero bus currents and zero bus voltages - Solution through factored matrices - Solution of non-linear algebraic equation and non-linear differential equations.	7
II	**Power Flow Analysis** Formulation of power flow problem - solution through Newton Raphson method - decoupled and fast decoupled power flow solutions - DC power flow solution - Power flow solution with FACTS devices - Optimal power flow solution.	7
III	**Short Circuit Analysis** Sub-transient, transient and steady state reactances of synchronous machine - symmetrical fault analysis using bus impedance matrix - symmetrical components and sequence networks - analysis of unsymmetrical fault at generator terminals - analyzing unsymmetrical faults occurring at any point in a power system.	8
IV	**Contingencies Analysis** Importance of contingency analysis - addition / removal of one line - construction of a column of bus impedance matrix from the bus admittance matrix - calculation of new bus voltages due to addition / removal of one line - calculation of new bus voltages due to addition / removal of two lines	7
V	**Transient Stability Analysis** Swing equation - equal area criterion - critical clearing angle - critical clearing time - multi-machine transient stability studies by classical representation - step-by-step solution of swing curve and algorithms for multi-machine transient stability studies.	8
VI	**Voltage Stability:** Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices. Artificial Intelligence applications to Power system analysis	8
	Total Lecture Hours	**45**

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List of Experiments with CO Mapping		
S.No	**Title / Topic of the Experiment**	**CO Mapped**
1	Computation of line parameters	CO1
2	Computer programs for construction of Ybus, Zbus,	CO1, CO4
3	Power flow analysis by Newton-Raphson/ Fast decoupled method	CO2
4	Load flow analysis of two-bus system with STATCOM	CO2
5	Economic load dispatch using lambda-iteration method	CO2
6	Determination of Sequence Impedances of Power Network	CO3
7	Short circuit studies	CO3
8	Contingency analysis	CO4
9	Transient stability studies	CO5
10	Load forecasting and unit commitment	CO5
11	Simulation of FACTS controllers.	CO2
Total Practical Sessions	**15**	
	Total Practical Hours	**30**

Text Books

1. L.P. Singh, *Advanced Power System Analysis and Dynamics*, 6th Edition, New Age International, 2012.
2. I. J. Nagrath and D. P. Kothari, *Modern Power Systems Analysis*, 3rd Edition, Tata McGraw hill, 2009

References:

1. A.J. Wood, *Power generation, operation and control*, 2nd Edition, John Wiley, 2010.
2. A. R. Bergen & Vijay Vittal, *Power System Analysis*, 2nd Edition, Pearson, 2000.
3. P.M. Anderson, *Faulted power system analysis*, IEEE Press, 1995.
4. P. Kundur, *Power System Stability and Control*, 1st Edition, McGraw Hill, 1994.
5. J.J. Grainger &W.D. Stevenson, *Power System Analysis*, 1st Edition, McGraw Hill, 1994.
6. G.L. Kusic, *Computer aided power system analysis*, 1st Edition, Prentice Hall India, 1986.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - I							**Category**	**MC**
Course Code, Course Title	**0PSMC503, Power System Modeling**							**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**	**Self Study**			**Credits**	
	3	1		-	2			4	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**		**ESE**	
		40	20	40		-		-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze need for modeling of power system and models of non-electrical components like boilers, steam turbines, hydro-turbines, and governor systems in power systems.
CO2	Evaluate the current and flux linkage models of synchronous machines using Park's transformation for steady-state and dynamic analysis.
CO3	Explain the behavior of synchronous machines connected to an infinite bus, performing simulations to compare steady-state conditions.
CO4	Illustrate the effectiveness of different excitation systems, such as DC generator exciters and alternator-rectifiers, in terms of their voltage response and system stability.
CO5	Examine detailed models for transmission lines, Static VAR compensators (SVC), and load modeling, integrating them into a power system simulation for dynamic and steady-state conditions.

Syllabus:

Module	Contents	Lecture Hours
I	**Modeling of Power System Components** Need for modeling of power system, different areas of power system analysis, Models of non-electrical components: boiler, steam, hydro-turbine & governor system, Transformer Modeling: auto-transformer, tap-changing & phase shifting transformer.	7
II	**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.	8
III	**Analysis of synchronous machine modeling** Synchronous machine connected to an infinite bus, its simulation for steady-state condition.	7
IV	**Excitation systems** Simplified view of excitation control, Excitation configuration, primitive systems, voltage response ratio & exciter voltage ratings.	8
V	**Excitation system modeling** 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.	7
VI	**Transmission line, SVC and load modeling:** Transmission line modeling, Modeling of static VAR compensators, load modeling	8
	Total Lecture Hours	**45**

Text Books

1. P. Kundur, *Power System Stability and Control*, 1st Edition, McGraw-Hill, 1993
2. R.Ramunujam, *Power System Dynamics Analysis and Simulation*, 1st Edition, PHI Learning Private Limited, 2009

References:

1. B.M. Weddy and B.J. Cory, *Electric Power Systems*, 4th Edition, John Wiely and Sons, 2002
2. J. Duncan Glover, MulukutlaS. Sarma, *Power System Analysis and Design*, 3rd Edition, CENGAGE Learning Custom Publishing, 2003

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - I					**Category**	**PE**
Course Code, Course Title	**0PSPE504, Renewable Energy System**					**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	3	1	-	2	4		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		-	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze the different types of renewable energy systems
CO2	Evaluate the various electrical generators used for Wind Energy Conversion Systems to determine their suitability and effectiveness in different applications.
CO3	Analyze grid technologies, including smart energy integration, automation systems, and PHEV charging concepts, to improve grid efficiency and resilience.
CO4	Determine the importance of standalone, grid-connected, and hybrid operations in renewable energy systems to optimize performance and reliability.
CO5	Examine the various applications of energy storage systems and reliability

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Fundamentals of Renewable Energy Systems** Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources – Environmental aspects of energy – Impacts of renewable energy generation on the environment – Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photo Voltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area	8
II	**Wind Energy Conversion systems** Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) – Permanent Magnet Synchronous Generator (PMSG).	8
III	**Analysis of Solar PV systems** Block diagram of the solar PV systems – Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems – Grid connection Issues, battery sizing, array sizing, selection of inverter, Maximum Power Point Tracking (MPPT).	7
IV	**Hybrid Renewable Energy Systems** Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind PV, Micro hydro-PV, Biomass-Diesel systems	7
V	**Grid Technologies** Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems, Distribution systems, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.	8
VI	**Energy Storage** Necessity of energy storage- Rechargeable batteries - Materials for Energy Storage– types of energy storage –energy storage technologies – Applications	7
	Total Lecture Hours	**45**

Text Books

1. S.N.Bhadra, D. Kastha, & S. Banerjee, *Wind Electrical Systems*, 1st Edition, Oxford university press, 2009
2. Chetan Singh Solanki, *Solar Photovoltaics (Fundamentals, Technologies & Applications)*, 1st Edition, PHI, 2016

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References:
1. B.H.Khan, *Non-conventional Energy Sources*, 1st Edition, Tata McGraw-hill Publishing Company, New Delhi, 2017. 2. Tony Burton, Nick Jenkins, David Sharpe, Ervin Bossanyi, *Wind Energy Handbook*, 1st Edition, Wiley, 2006. 3. Luisa F. Cabeza (Editor), *Advances in Thermal Energy Storage Systems: Methods and Applications*, 1st Edition, Woodhead Publishers, 2020. 4. Ibrahim Dinçer and Marc A. Rosen, *Thermal Energy Storage Systems and Applications*, 1st Edition, Wiley Publishers, 2021. 5. Rashid. M. H, *Power electronics Hand book*, 2nd Edition, Academic press, 2006. 6. Rai. G. D., *Non-conventional energy sources*, 1st Edition, Khanna Publishers, 2010.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - I						**Category**	**PE**
Course Code, Course Title	**0PSPE505, Energy Storage Systems**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**			**Credits**	
	3	1	-	2			4	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Recognize and articulate the importance, key properties, and practical uses of diverse energy storage technologies
CO2	Examine and interpret the operational principles of electrochemical, thermal, and mechanical energy storage systems.
CO3	Assess the design aspects, control strategies, and performance metrics of batteries and battery management systems (BMS).
CO4	Critically compare and select suitable energy storage options for applications in smart grids, electric vehicles, and renewable energy systems.
CO5	Design and formulate models for energy storage systems by accounting for efficiency, durability, and cost-effectiveness considerations

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Energy Storage.** Need for energy storage: Applications and importance, Types of energy storage: Electrical, Mechanical, Thermal, Chemical, Electrochemical Comparison of storage technologies: Specific energy, specific power, life cycle, efficiency Applications in Renewable Energy Systems and Smart Grids	7
II	**Electrochemical Energy Storage** Fundamentals of Electrochemical Cells, Batteries: Primary vs Secondary Batteries, Lead Acid, Nickel-Cadmium, Nickel-Metal Hydride Batteries Lithium-Ion Batteries: Construction, Working, Advantages, and Challenges Battery performance parameters: C-rating, Depth of Discharge (DoD), State of Charge (SoC)	8
III	**Battery Design and Battery Management Systems (BMS)** Design considerations: Capacity, Voltage, Thermal effects Battery degradation mechanisms: Capacity fade, impedance growth, Battery Management System (BMS): Functions and architecture, Safety issues and thermal management in batteries	7
IV	**Mechanical and Thermal Storage Systems** Flywheel Energy Storage (FES): Working, applications, advantages, limitations Compressed Air Energy Storage (CAES) Pumped Hydro Energy Storage (PHES) Thermal Storage systems: Sensible heat storage, latent heat storage, thermochemical storage	8
V	**Advanced Storage Technologies and Applications** Super capacitors: Construction, working principle, characteristics Hydrogen and Fuel Cells: Types, operation, applications Hybrid Energy Storage Systems (HESS) Role of storage in Electric Vehicles (EVs), Microgrids, and Distributed Energy Resources Economic considerations: Cost analysis, lifecycle assessment, policy frameworks	8
VI	**Energy Storage System Integration and Future Trends** This unit will focus on system-level integration of energy storage technologies, emerging trends, and the challenges faced in the practical application of energy storage solutions in modern energy systems.	7
	Total Lecture Hours	**45**

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Text Books
1. Robert Huggins, *Energy Storage Systems: Fundamentals, Materials, and Applications*, 3rd Edition, Springer, 2015. 2. Francisco Díaz-González, et al., *Energy Storage Systems and Applications*, 2nd Edition, Wiley-Blackwell, 2018.
References:
1. Andrei L. Rufer, *Hybrid Energy Storage Systems for Power Management Applications*, 2nd Edition, Wiley, 2017. 2. Monzer Fanous & M. O. G. Ayad, *Advanced Energy Storage Systems for Smart Grids*, 1st Edition, Elsevier, 2021. 3. Gianfranco Pistoia, *Batteries for Sustainability: Selected Entries from the Encyclopedia of Sustainability Science and Technology*, 1st Edition, Springer, 2015. 4. Michael J. Aziz & D. R. Evans, *Energy Storage: Technologies and Applications*, 2nd Edition, Wiley, 2021.

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Department of Electrical Engineering

Course Information:

Class, Semester	F. Y. M. Tech, Semester - I						**Category**	**PE**
Course Code, Course Title	**0PSPE506, Electrical Power Distribution System**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**		**Tutorial**	**Practical**	**Self Study**		**Credits**	
	3		1	-	2		4	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Apply statistical and regression analysis techniques to perform load forecasting and evaluate system performance.
CO2	Design and model distribution system components, including transformers, feeders, and voltage regulators, to optimize system performance.
CO3	Analyze unbalanced three-phase distribution feeders using ladder iterative techniques and allocate loads to ensure system reliability.
CO4	Evaluate the impact of distributed generation and abnormal loads on distribution system stability and propose mitigation strategies.
CO5	Develop a comprehensive distribution system plan, incorporating economic, technical, and environmental considerations, to meet future energy demands

Syllabus:

Module	Contents	Lecture Hours
I	**Electrical Distribution System and forecasting** Distribution of Power, Quality of Supply, System Study, Benchmarking, Electricity Reforms, Power Loads, Connected Load, Load Forecasting, Definitions of Some Basic Concepts in Statistics, Regression Analysis, Correlation Theory, Analysis of Time Series, Factors in Power System Loading, Unloading the System, Forecast of System Peak, Strategic Forecasting, Spatial Load Forecasting, Technological Forecasting	8
II	**Distribution System Planning** Planning Process, Sustainable Planning Criteria and Standards, System Development, Distributed Generation, Distribution System Economics and Finance, Mapping, Enterprise Resource Planning, Modelling, System Calculations, Introductory Methods, Network Elements, Load Flow, Automated Planning, Fault Studies, Effect of Abnormal Loads, Line Circuits, Urban Distribution	8
III	**Structure of Distribution System** Distribution feeder configurations and substation layouts, Nature of loads, Computation of transformer and feeder loading, "K" Factors, voltage drop and power loss calculations, Distribution of loads and various geometric configurations	8
IV	**Modeling of Distribution System components** Overhead lines, feeders and cables, Single and three phase distribution transformers, Voltage regulators, Load models, Capacitor banks, Distributed generation	7
V	**Design and Operation of Sub-station and Feeder** Engineering Design, Operation Criteria and Standards, Sub-transmission, Sub-station and Feeder, Low Voltage Three-phase or Single-phase, Location of Sectionalizer, Voltage Control, Harmonics, Load Variations, Impact Loading of Transformer, Ferro-resonance, System Losses, Energy Management, Model Distribution System	7
VI	**Distribution Feeder Analysis** Power-Flow Analysis- Ladder Iterative Technique -Unbalanced Three-Phase Distribution Feeder-Modified Ladder Iterative Technique- Load Allocation, Applications of distribution system - Grid integration of solar, wind, Smart grid	7
	Total Lecture Hours	**45**

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Text Books
1. A. S. Pabla, *Electrical Power Distribution Systems*, 7th Edition, McGraw-Hill Education, India, 2019.
2. W. H. Kresting, *Distribution System Modeling and Analysis*, 1st Edition, CRC Press, New York, 2002.
References:
1. A. A. Sallam and O. P. Malik, *Electric Distribution System*, IEEE Press, 2011.
2. Turan Gonen, *Electric Power Distribution System Engineering*, 1st Edition, Tata McGraw Hill, 1986.
3. James Northcote – Green, Robert Wilson, *Control and Automation of Electrical Power Distribution Systems*, 2nd Edition, CRC Press, 2007.
4. C.L. Wadhwa, *Electrical Power Systems*, 7th Edition, New Age International, 2022.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - I						**Category**	**PE**
Course Code, Course Title	**0PSPE507, High Power Converters**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**			**Credits**	
	3	-	-	2			3	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	**Compare** the features of SCRs, GTOs, GCTs, and IGBTs, identify voltage unbalance and assess equalization methods.
CO2	**Compute** the harmonic contents of voltage source inverters with modulation parameters in PWM and space vector modulation
CO3	**Evaluate** the performance parameters of cascaded H bridge inverter and diode clamped multilevel inverter with carrier PWM schemes
CO4	**Analyze** discontinuous space vector modulation, two-level SVM with carrier-based PWM, modulation schemes, and neutral point clamped inverter topologies.
CO5	**Design** the snubber and gate drive circuits for power electronics devices

Syllabus:

Module	Contents	Lecture Hours
I	**Review of High-Power Switching Devices** Silicon Controlled Rectifier, Gate Turn-Off (GTO) thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), operation of series connected devices - main causes of voltage unbalance , voltage equalization for GCTs, voltage equalization for IGBTs.	8
II	**Two-Level Voltage Source Inverters** Sinusoidal PWM - modulation schemes, harmonic content over-modulation, third harmonic injection PWM, space vector modulation- switching states, space vectors, dwell time calculation, modulation index switching sequence, spectrum analysis, even-order harmonic elimination, discontinuous space vector modulation	8
III	**Cascaded H-Bridge (CHB) Multilevel Inverters** Introduction, H-Bridge Inverter bipolar pulse-width modulation, unipolar pulse-width modulation, multilevel inverter topologies - CHB inverter with equal dc voltage, H-Bridges with unequal dc voltages, carrier based PWM schemes - phase-shifted multicarrier modulation, level-shifted multicarrier modulation, comparison between phase- and level-shifted PWM schemes, staircase modulation	7
IV	**Diode-Clamped Multilevel Inverters** Three-level inverter - converter configuration, switching state, commutation, space vector modulation - stationary space vectors, dwell time calculation, relationship between Vref, location and dwell times switching sequence design, inverter output waveforms and harmonic content, even-order harmonic elimination, neutral-point voltage control - causes of neutral-point voltage deviation, effect of motoring and regenerative operation, feedback control of neutral-point voltage	7
V	**Advanced Space Vector Modulation Algorithms** Discontinuous space vector modulation , SVM based on two-level algorithm , high-level diode-clamped inverters, four- and five-level diode-clamped inverters, carrier-based PWM, neutral point clamped/H-Bridge inverter: inverter topology, modulation scheme, waveforms and harmonic content	8
VI	**Design of snubber circuits and gate drive circuits** Design of snubber circuits: Snubber circuits – functions and types, need for snubber for thyristor and transistor, GTO, turn off snubber, turn on snubber.	7

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	Gate drive circuits: Design consideration, DC coupled drive circuits, electrically isolated drive circuits, cascade connected drive circuits, thyristor drive circuits and power device protection in drive circuits, Applications of high power converters.	
	Total Lecture Hours	**45**

Text Books

1. Bin Wu, *High power converters and drives*, 2nd Edition, IEEE press, Wiley Enter science, 2017.
2. N. Mohan, T. M. Undeland and W. P. Robbins, *Power Electronics: Converter, Applications and Design*, 3rd Edition, John Wiley and Sons, 2022.

References:

1. Sixing Du, Apparao Dekka, Bin Wu, Navid Zargari, *Modular Multilevel Converters: Analysis, Control, and Applications*, 2nd Edition, Wiley, 2018.
2. Dorin O. Neacsu, *Switching Power Converters, Medium and High Power*, 2nd Edition, CRC Press, 2017.
3. Eric Monmasson, *Power Electronic Converters PWM Strategies and Current Control Techniques*, 2nd Edition, Wiley, 2013.
4. Ersan Kabalci, *Multilevel Inverters Control Methods and Advanced Power Electronic Applications*, 1st Edition, Academic Press, 2021.
5. B. K .Bose, *Power Electronics and A.C. Drives*, 1st Edition, Prentice Hall India, 2001.
6. M.H. Rashid, *Power Electronics: Devices, Circuits, and Applications*, 4th Edition, Pearson Education, 2017.

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ADCET

Course Information:								
Class, Semester	F. Y. M. Tech, Semester - I						**Category**	**PE**
Course Code, Course Title	**0PSPE508, Electric and Hybrid Vehicles**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**	**Self Study**	**Credits**		
	3	-		-	2	3		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	**Comprehend** vehicle fundamentals and environmental impact of IC engine operated vehicles
CO2	**Categorize** the architectures and components of EVs and HEVs
CO3	**Differentiate** the performance and control aspects of EV propulsion motors
CO4	**Interpret** the type and required capacity of battery pack and choose the suitable BMS for EVs and HEVs
CO5	**Compare** the performance and features of integrated charging circuits of conductive and wireless EV chargers

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Environmental Impact and Vehicle Fundamentals** Air pollution, global warming, petroleum resources, induced cost, importance of different transportation development, history of electric and hybrid electric vehicles, general description of vehicle movement, vehicle resistance, power train tractive effort and vehicle speed, vehicle performance, EV policies and incentives	8
II	**Electric Vehicles (EV)** Configurations of EV, Performance of EV, Traction motor characteristics, tractive effort and transmission requirement, vehicle performance, tractive effort in normal driving, energy consumption, Concept of hybrid electric drive trains, architecture of HEV drive trains, series hybrid, parallel hybrid- Torque coupling drive trains, speed coupling drive trains, speed and torque coupling drive trains.	8
III	**EV Propulsion motors and Control techniques** DC Motor Drives: Multi-quadrant Control of Chopper-Fed DC Motor Drives, Induction Motor Drives: Constant Volt/Hertz Control, Induction Machine Vector Control, Rotor-Flux-Oriented Vector Control, Direct and Indirect Vector Controls, PM Synchronous Machine Vector Control, Performance Analysis and Control of BLDC Machines	7
IV	**EV Batteries** Lead Acid Batteries: Lead acid battery basics, Special characteristics of lead acid batteries, Battery life and maintenance, Battery charging, Nickel-based Batteries: Nickel cadmium, Nickel metal hydride batteries, Sodium-based Batteries: Sodium sulphur batteries, Sodium metal chloride (Zebra) batteries, Lithium Batteries: The lithium polymer battery, The lithium ion battery, Metal Air Batteries, Aluminium air battery, Zinc air battery	7
V	**Battery pack and battery management system** Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery Management System, Battery SOC Estimation methods, Battery Cell equalization problem, thermal control, Energy & Power estimation, Battery thermal management system, Battery Standards & Tests, Battery recycling methods.	8
VI	**EV Chargers** Introduction, Classifications of chargers, Integrated charging system, Assessment of existing integrated charging circuits, Working of integrated converter, Design of the battery-charging converter, Control strategy and result analysis, Inductive wireless power transfer, Modelling of coils, types of coils, Compensation networks, Power transfer and efficiency	7
	Total Lecture Hours	**45**

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Text Books

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, 1st Edition, CRC Press, 2004.
2. Iqbal Hussein, *Electric and Hybrid Vehicles: Design Fundamentals*, 2nd Edition, CRC Press, 2003.

References:

1. Sumedha Rajakaruna Farhad Shahnia Arindam Ghosh, *Plug In Electric Vehicles in Smart Grids, Energy Management*, 1st Edition, Springer, 2015.
2. Sumedha Rajakaruna Farhad Shahnia Arindam Ghosh, *Plug In Electric Vehicles in Smart Grids, Integration Techniques*, 1st Edition, Springer, 2015.
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, *Thermal Management of Electric Vehicle Battery Systems*, 3rd Edition, JohnWiley& Sons, 2016.
4. Sanjeev Singh, Sanjay Gairola and Sanjeet Dwivedi, *Electric Vehicle Components and Charging Technologies*, 1st Edition, The Institution of Engineering and Technology, 2023.
5. Junwei Lu and Jahangir Hossain, *Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid*, 1st Edition, The Institution of Engineering and Technology, 2015.

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Course Information:									
Class, Semester	F. Y. M. Tech, Semester - I							Category	PE
Course Code, Course Title	0PSPE509, Distributed Generation							Type	T1
Teaching Scheme (per week)	Lecture		Tutorial		Practical	Self Study		Credits	
	3		-		-	2		3	
Examination Scheme (Marks)	Theory	MSE	TA	ESE		Practical	CIA	ESE	
		40	20	40			-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze the technical and economic impacts of integrating renewable and non-renewable DG sources into power systems, considering current status and future trends.
CO2	Illustrate different operating modes of DG and assess their performance under various grid and isolated conditions.
CO3	Analyze the effects of DG integration on power quality and reliability, including issues such as voltage regulation, harmonics, and transformer connections.
CO4	Explain protection and islanding issues in DG systems, including relay coordination, islanding prevention techniques, and synchronization with utility grids.
CO5	Examine an optimal DG deployment strategy, including site selection, sizing, cost analysis and life-cycle return on investment evaluation.

Syllabus:

Module	Contents	Lecture Hours
I	**DG Technologies** Definitions and terminologies, current status and future trends, Technical and economic impacts, DG from renewable energy sources, DG from non-renewable energy sources.	7
II	**Distributed generation applications, Operating Modes** Base load, peaking, peak shaving and emergency power, Isolated, momentary parallel and grid connection, Sitting and sizing of DGs optimal placement of DG sources in distribution systems.	8
III	**DG interconnection** Characteristics of DG interface: Rotating machines, Characteristics of DG interface: Static power converters, General protection requirement, effect of transformer connections	8
IV	**Power Quality Issues, Reliability** Voltage regulation, harmonics from DG, improving distribution system PQ via the DG interface, Improving reliability with DG, Adverse impacts of DG on utility reliability	8
V	**Protection Issues, Islanding** Utility Issues, Protective relays coordination, Islanding prevention techniques, Safety of personnel, utility-generator load match frequency, utility re-closing, synchronizing	7
VI	**DG Cost Issues** Energy (kWh), demand (kW), power factor penalties and utility standard cost, connection and operating costs and charges; life cycle cost and rate of return analysis.	7
	Total Lecture Hours	**45**

Text Books

1. H. Lee Willis, and Walter G. Scott, *Distributed Power Generation: Planning and Evaluation*, 1st Edition, CRC Press, 2000.
2. Anne-Marie Borbely, and Jan F. Kreider, *Distributed Generation*, 1st Edition, CRC Press, 2019.

References:

1. N. Jenkins, R. Allan, P. Crossley, D. Kirschen and G. Strbac, *Embedded Generation*, The Institute of Electrical Engineering, 2000.
2. Stuart Borlase, *Smart Grid: Infrastructure Technology Solutions*, 1st Edition, CRC Press, 2012.

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ADCET

Course Information:

Class, Semester	FY. M.Tech, Semester - I					**Category**	**PC**
Course Code, Course Title	**0PSPC510, Renewable Energy and Grid Integration Lab.**					**Type**	**L1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	-	-	4	2	2		

Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		-	-	-		50	50

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Model and simulate photovoltaic (PV) systems, including MPPT techniques (P&O and Incremental Conductance) and power electronic converters
CO2	Simulate grid-connected PV systems, including single-stage and double-stage configurations, and analyze their performance under varying conditions.
CO3	Design and simulate electric vehicle (EV) charging systems, including V2G (Vehicle-to-Grid) and G2V (Grid-to-Vehicle) operations, and evaluate their integration with the grid.
CO4	Simulate and analyze wind energy generation systems under different wind profiles and evaluate their performance characteristics.
CO5	Simulate power factor correction (PFC) converters including Boost, Interleaved Boost, and Totem-Pole configurations

List of Experiments with CO Mapping

S.No	**Title / Topic of the Experiment**	**CO Mapped**
1	Modelling of PV system	CO1
2	Simulation of PV MPPT (P&O and Incremental Conductance Method) using Boost Converter.	CO1
3	Simulation of Three Phase Grid Connected Inverter	CO2
4	Simulation of Grid connected PV MPPT (P&O) single stage	CO2
5	Simulation of Grid connected PV MPPT (P&O) double stage.	CO2
6	PV based Battery Charging using Buck Converter	CO1, CO3
7	PV Based Bidirectional Converter for Battery Charging/Discharging.	CO1, CO3
8	Simulation of V2G / G2V operation in Electric Vehicle Charger	CO3
9	Simulation study of wind energy generation	CO4
10	Simulation of PFC Boost Converter	CO5
11	Interleaved Boost PFC Converter with PR Controller	CO5
12	Totem-Pole PFC and Interleaved Totem-Pole PFC Converter	CO5
Total Practical Sessions **30**	**Total Practical Hours**	**60**

Text Books

1. Priyanka Patankar Swapnil Kulkarni, *MATLAB and Simulink In-Depth*, 1st Edition, BPB Publications, 2022.
2. Viktor Perelmuter, *Renewable Energy Systems: Simulation with Simulink and Sim Power Systems*, CRC Press, 2016.

References:

1. Weidong Xiao, *Photovoltaic Power System: Modeling, Design, and Control*, 1st Edition, Wiley, 2017.
2. Ned Mohan, Tore M. Undeland, and William P. Robbins, *Power Electronics: Converters, Applications, and Design*, 3rd Edition, Wiley, 2002.
3. Dr. Shailendra Jain, *Modeling and Simulation Using MATLAB – Simulink*, 2nd Edition, Wiley India Pvt. Limited, 2015.
4. Mukund R. Patel, *Renewable Energy Systems: Design and Analysis with Induction Generators*, 2nd Edition, CRC Press, 2012.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - I							Category	PE
Course Code, Course Title	0PSMA511, Research Paper Writing							Type	T2
Teaching Scheme (per week)	Lecture		Tutorial		Practical	Self Study		Credits	
	2		-		-	-		-	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA		ESE	
		-	50	-		-		-	

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Show conciseness, clarity and avoid redundancy in writing
CO2	Identify good academic writing practices and adopt such practices to maintain academic honesty and avoid plagiarism during the writing process
CO3	Summarize, evaluate literature, and write methodology, results and conclusion
CO4	Describe how to develop title, write abstract, introduction, methodology and results with skills
CO5	Effectively revise and proofread their work to ensure it is of the highest quality for first-time submission.

Syllabus:

Module	Contents	Lecture Hours
I	**Planning of the Paper** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	5
II	**Structure of The Paper** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	5
III	**Preparation of the Paper** Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	5
IV	**Key Skills** Key skills are needed when writing a Title, Key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	5
V	**Results and Discussion** Skills are needed when writing the Methods, Skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	5
VI	**Submission** Research Metrics: Significance of Journal Selection and Impact Factor, SNIP, SJR, IPP, Cite Score Metrics: h-index, g index, i10 index, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	5
	Total Lecture Hours	**30**

Text Books

1. Goldbort R, *Writing for Science*, 1st Edition, Yale University Press (available on Google Books), 2006.
2. Day R, *How to Write and Publish a Scientific Paper*, 1st Edition, Cambridge University Press, 2006.

References:

1. Highman N, *Handbook of Writing for the Mathematical Sciences*, 1st Edition, SIAM. Highman's book, 1998.
2. Adrian Wallwork, *English for Writing Research Papers*, 1st Edition, Springer New York Dordrecht Heidelberg London, 2011.

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Course Information:

Class, Semester	FY. M.Tech, Semester – II					**Category**		**OE**
Course Code, Course Title	**0PSOE512, Optimization Techniques**					**Type**		**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**	**Self-Study**	**Credits**		
	3	-		-	2	3		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:

CO1	**Apply** optimization and meta-heuristic techniques (GA, PSO, etc.) to engineering optimization problems.
CO2	**Analyze** the structure and learning of Artificial Neural Networks using perceptron's and back propagation.
CO3	**Apply** fuzzy logic methods for modeling, reasoning, and control in engineering systems.
CO4	**Evaluate** the performance of Genetic Algorithms, Neural Networks, and Fuzzy Systems against conventional methods.
CO5	**Analyze** hybrid approaches such as Neuro-fuzzy and ANFIS for system optimization.
CO6	**Create** domain-specific AI-based soft computing solutions to complex engineering problems.

Syllabus:

Module	Contents	Lecture Hours
I	**FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES** Definition-Classification of optimization problems - Unconstrained and Constrained optimization - Optimality conditions - Introduction to intelligent systems - soft computing techniques – Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Single solution based and population-based algorithms – Exploitation and exploration in population-based algorithms - Properties of Swarm intelligent Systems	8
II	**ARTIFICIAL NEURAL NETWORKS** Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and training the neural network. Multi – layer perceptron using Back propagation Algorithm (BPA)	8
III	**FUZZY LOGIC** Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control (Mamdani and Sugeno) – Fuzzification, inferencing and defuzzification-Fuzzy knowledge and rule bases-Applications	7
IV	**GENETIC ALGORITHMS** Basic concept of Genetic algorithms - Genetic Algorithm versus Conventional Optimization Techniques – Genetic representations and selection mechanisms; Genetic operators - different types of crossover and mutation operators- Optimization problems using GA.	7
V	**HYBRID CONTROL SCHEMES** Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS – Fuzzy Neuron -Optimization of membership function and rule base using Genetic Algorithm – Particle Swarm Optimization	8

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VI	**APPLICATIONS OF SOFT COMPUTING** **Electrical :** Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control	7
	Total Lecture Hours	**45**

Text Books

1. Laurene V. Fausett, *Fundamentals of Neural Networks: Architectures, Algorithms and Applications*, 1st Edition, Pearson Education, 1993.
2. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, 3rd Edition, Wiley India, 2010.
3. H. J. Zimmermann, *Fuzzy Set Theory and Its Applications*, 4th Edition, Springer International, 2001.
4. David E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning*, 1st Edition, Pearson Education, 1989.
5. S. N. Sivanandam & S. N. Deepa, *Principles of Soft Computing*, 3rd Edition, Wiley India, 2018.

References:

1. S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, 1st Edition, PHI Learning Pvt. Ltd., 2003.
2. Robert J. Schalkoff, *Artificial Neural Networks*, 1st Edition, Tata McGraw Hill, 1997.
3. N. P. Padhy, *Artificial Intelligence and Intelligent Systems*, 1st Edition, Oxford University Press, 2005.
4. D. P. Kothari & J. S. Dhillon, *Power System Optimization*, 2nd Edition, PHI Learning Pvt. Ltd., 2010.

Online Learning Resources

1. **Deep Learning Specialization by Andrew Ng (Coursera)**
   https://www.coursera.org/specializations/deep-learning
2. **Fuzzy Sets, Logic and Systems & Applications (NPTEL)**
   https://onlinecourses.nptel.ac.in/noc22_ee21/preview
3. **Genetic Algorithms (NPTEL)**
   https://nptel.ac.in/courses/112105235
4. **Soft Computing Techniques (NPTEL)**
   https://onlinecourses.nptel.ac.in/noc25_ma54/preview
5. **Machine Learning Specialization (Coursera)**
   https://www.coursera.org/specializations/machine-learning

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Department of Electrical Engineering

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Course Information:

Class, Semester	FY. M.Tech, Semester - II					**Category**	**PC**
Course Code, Course Title	**0PSPC513, Advanced Power System Protection**					**Type**	**LIT1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	3	1	2	2	5		

Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		50	50

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Evaluate the performance of a numerical relay and digital protection schemes for fault detection and protection, considering its accuracy, reliability, and response time.
CO2	Investigate faults in synchronous generators and critically evaluate the effectiveness of various protection schemes in terms of system stability and fault isolation.
CO3	Examine faults in power transformers and evaluate the effectiveness of various protection schemes, taking into account their response time and operational reliability.
CO4	Analyze the settings and coordination of distance and overcurrent relays, and recommend optimized configurations for effective protection.
CO5	Assess short circuit studies, fault types, algorithms, and ultra-high-speed relays, analyzing their application in transmission line protection for enhanced fault detection and system resilience.

Syllabus:

Module	Contents	Lecture Hours
I	**Numerical Protection:** Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference wave, least error squared (LES) technique, digital filtering, numerical overcurrent protection.	8
II	**Digital Protection of Transmission line:** Introduction, Protection scheme of transmission line, distance relays, traveling wave relays, digital protection scheme based upon fundamental signal, hardware design, software design, digital protection of EHV/UHV transmission line based upon traveling wave phenomenon, new relaying scheme using amplitude comparison.	8
III	**Digital protection of Synchronous generator:** Introduction, faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator.	7
IV	**Digital Protection of Power Transformer:** Introduction, faults in a transformer, schemes used for transformer protection, digital protection of transformer	7
V	**Distance and overcurrent relay setting and co-ordination:** Directional instantaneous IDMT over current relay, directional multi-zone distance relay, distance relay setting, co-ordination of distance relays,co-ordination of overcurrent relays, computer graphics display, man-machine interface subsystem, integrated operation of national power system, application of computer graphics.	8
VI	**PC applications in short circuit studies for designing relaying scheme:** Types of faults, assumptions, development of algorithm for short circuit studies, PC based integrated software for short circuit studies, transformation to component quantities, short circuit studies of multiphase systems. Ultra high speed protective relays for high voltage long transmission line.	7
	Total Lecture Hours	**45**

List of Experiments with CO Mapping

S.No	Title / Topic of the Experiment	CO Mapped
1	Simulation of numerical over current relayfor Transformer.	CO1, CO3
2	Simulation of numerical over current relay for synchronous generator.	CO1, CO2

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3	Simulation of differential relay protection of transformer	CO3
4	Virtual lab/ Simulation on fault scenario simulation in a Transformer	CO3
5	Virtual lab/ Simulation on fault scenario simulation in a feeder	CO1, CO4
6	Simulation of digital directional and non-directional over current relay	CO1, CO4
7	Experimentation of microcontroller based over current relay	CO1, CO4
8	Experimentation of microcontroller based over voltage relay	CO1
9	Experimentation of microcontroller based under voltage Relay	CO1
10	Experimentation of microcontroller based impedance Relay	CO4, CO5
11	Simulation of digital distance relay for the protection of transmission line.	CO4, CO5
12	Simulation of different fault types (single-phase, two-phase, three-phase) and analyze their impact on the protection system	CO5
Total Practical Sessions	**15**	**Total Practical Hours** **30**

Text Books

1. L. P. Singh, *Digital Protection Protective Relaying From Electromechanical To Microprocessor*, 2nd Edition, New Age International (P) Limited Publishers, 2018.
2. Yeshwant G. Paithankar, *Transmission Network Protection*, 1st Edition, Marcel & Dekker, New York, 2017.

References:

1. Gerhard Zeigler, *Numerical Distance Protection: Principles and Applications*, 2nd Edition, Siemens Publicis Corporate Publishing, 2006.
2. S.R.Bhide, *Digital Power System Protection*, 1st Edition, PHI Learning Pvt. Ltd, 2014.
3. T.Johns and S.K.Salman, *Digital Protection for Power Systems*, 2nd Edition, Institution of Electrical, 2008.
4. Janaka B. Ekanayake, Vladimir Terzija, Ajith Tennakoon, Athula Rajapakse, *Protection of Modern Power Systems*, 1st Edition, Wiley, 2023.
5. Waldemar Rebizant, Janusz Szfran, Andrzej Wiszniewski, *Digital Signal Processing in Power System Protection and Control*, 2nd Edition, Springer Publication, 2013.
6. A.G. Phadke, James S.Thorp, *Computer Relaying for Power Systems*, 2nd Edition, John Wiley and Sons, 2009.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - II						**Category**	**PC**
Course Code, Course Title	**0PSPC514, Smart Grid Technologies**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**			
	3	-	-	2	3			
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Comprehend smart grid concepts, benefits, and challenges.
CO2	Evaluate communication infrastructure and cybersecurity for smart grids.
CO3	Integrate and analyze renewable energy systems in smart grids.
CO4	Assess the role of energy storage and electric vehicles in modern grids.
CO5	Implement demand-side management strategies and use smart metering systems.

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Smart Grids** Evolution of Power Grids to Smart Grids, Definitions, Need, and Features of Smart Grids, Smart Grid Architectures and Standards, Key Drivers and Challenges for Smart Grids, Case Studies: Global Smart Grid Implementations	8
II	**Communication Systems and Cybersecurity** Communication Infrastructure for Smart Grids, Power Line Communication (PLC), Wireless Communication (RF, ZigBee, 5G), SCADA Systems and Phasor Measurement Units (PMUs), Communication Protocols: IEC 61850, DNP3, Modbus, Cybersecurity Challenges in Smart Grids, Cybersecurity Frameworks and Mitigation Strategies	8
III	**Renewable Energy Integration in Smart Grids** Role of Renewable Energy in Smart Grids, Distributed Energy Resources (DERs): Solar, Wind, and Biomass, Microgrids and Virtual Power Plants (VPPs), Power Electronics for Renewable Integration, Challenges: Stability, Forecasting, and Grid Synchronization	7
IV	**Energy Storage Systems and Electric Vehicles** Importance of Energy Storage in Smart Grids, Energy Storage Technologies: Batteries, Supercapacitors, and Flywheels, Integration of Energy Storage with Renewable Energy Sources, Electric Vehicles (EVs) and Vehicle-to-Grid (V2G) Systems, Challenges of Large-Scale EV Integration	7
V	**Smart Metering and Demand-Side Management** Advanced Metering Infrastructure (AMI), Smart Meters: Features, Functions, and Data Analytics, Demand Response and Load Shifting Strategies, Role of Consumers in Demand-Side Management (DSM), Peak Load Management and Tariff Structures	8
VI	**Emerging Trends in Smart Grid Technologies** Internet of Things (IoT) in Smart Grids, Artificial Intelligence (AI) and Machine Learning (ML) Applications, Blockchain for Energy Trading and Decentralized Control, Big Data Analytics for Grid Optimization, Future Trends: Autonomous Grids, Smart Cities, and Edge Computing	7
	Total Lecture Hours	**45**

Text Books

1. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, 1st Edition, Wiley-IEEE Press, 2012.
2. Ali Keyhani, *Design of Smart Power Grid Renewable Energy Systems*, 2nd Edition, Wiley, 2016.

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References:

1. Janaka Ekanayake, *Smart Grid: Technology and Applications*, 1st Edition, Wiley, 2012.
2. Stuart Borlase, *Smart Grids: Infrastructure, Technology, and Solutions*, 1st Edition, CRC Press, 2012.
3. Tony Flick, Justin Morehouse, *Securing the Smart Grid: Next Generation Power Grid Security*, 1st Edition, Elsevier, 2010.
4. Nick Jenkins, *Distributed Generation and Smart Grids*, 1st Edition, Institution of Engineering and Technology (IET), 2010.
5. Carol L. Stimmel, *Big Data Analytics Strategies for the Smart Grid*, 1st Edition, CRC Press, 2014.
6. Pengwei Du, Ning Lu, *Energy Storage for Smart Grids: Planning and Operation for Renewable and Variable Energy Resources (VERs)*, 1st Edition, Academic Press (Elsevier), 2014.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - II						Category	PE
Course Code, Course Title	0PSPE515, Power Quality						Type	T1
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study			Credits	
	3	1	-	2			4	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Acquire knowledge about the power harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
CO2	Develop analytical skills for modeling and analysis of harmonics in networks and components
CO3	Apply series and shunt active power filtering techniques for harmonics
CO4	Analyze active power factor correction based on static VAR compensators and its control techniques
CO5	Apply the working principles of dynamic voltage restorers and implement NEC grounding requirements

Syllabus:

Module	Contents	Lecture Hours
I	**Fundamentals of Power Quality** 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.	7
II	**Harmonics Analysis** 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.	7
III	**Modeling of Networks and Components** 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	8
IV	**Power factor improvement** 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	8
V	**Analysis of Filters** Static VAR compensators-SVC and STATCOM, Active Harmonic Filtering-Shunt Injection, Filter for single phase, Three-phase three-wire and three-phase four wire systems, d-q domain control of three phase shunt active filters, uninterruptible power supplies constant voltage transformers, Series active power filtering techniques for harmonic cancellation and isolation.	8
VI	**Dynamic Voltage Restorers and Grounding** DVR for sag, swell and flicker problems. Grounding and wiring introduction- NEC grounding requirements-reasons for grounding- typical grounding and wiring problems solutions to grounding and wiring problems	7
	Total Lecture Hours	**45**

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Text Books
1. G.T. Heydt, *Electric power quality*, 1st Edition, McGraw-Hill Professional, 2007. 2. J.Arrillaga, D A Bradey & P S Bodger, *Electrical Power System Quality*, 1st Edition, John Wiley Sons, 2000.
References:
1. Wakileh, George J., *Power system harmonics, Fundamentals, Analysis and Filter Design*, 1st Edition, Springer-Verlag Berlin Heidelberg New York, 2001. 2. Barry W.Kennedy, *Power Quality Primer*, 1st Edition, McGraw hill, 2000. 3. Angelo Baggini, *Handbook of Power Quality*, 1st Edition, John Wiley Sons, 2008. 4. J. Arrillaga, *Power System Quality Assessment*, 1st Edition, John wiley, 2000. 5. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood, *Power system Harmonic Analysis*, 1st Edition, Wiley, 1997. 6. Math H. Bollen, *Understanding Power Quality Problems*, IEEE Press, 2000.

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Course Information:								
Class, Semester	F. Y. M. Tech, Semester - II						**Category**	**PE**
Course Code, Course Title	**0PSPE516, Power System Transients**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**			
	3	1	-	2	4			
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze the mechanism of lightning overvoltage, their impact on power systems, and design protection strategies using grounding and shielding techniques
CO2	Evaluate the causes and effects of switching transients and temporary overvoltage in power systems and propose mitigation techniques.
CO3	Develop mathematical models for travelling waves in transmission lines and analyze their behavior using reflection, refraction, and attenuation principles
CO4	Apply insulation coordination principles to select appropriate insulation strength and protective devices, ensuring compliance with standard BIL requirements
CO5	Implement surge protection methods, controlled switching, and damping techniques to minimize the impact of transient overvoltage on power system components

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**LIGHTNING OVERVOLTAGES** Classification of over voltages- Mechanism and parameters of lightning flash, protective shadow, striking distance, electro geometric model for lightning strike, Grounding for protection against lightning – Steady state and dynamic tower-footing resistance, substation grounding Grid, Direct lightning strokes to overhead lines, without and with shield Wires	8
II	**SWITCHING AND TEMPORARY OVERVOLTAGES** Switching transients – concept – phenomenon – system performance under switching surges-Ferranti Effect, Temporary overvoltages – Load Rejection – line faults – Ferro resonance, VFTO	7
III	**TRAVELLING WAVES ON TRANSMISSION LINE** Circuits and distributed constants, wave equation, reflection and refraction – behaviour of travelling waves at the line terminations – Lattice Diagrams – attenuation and distortion – multiconductor system and multivelocity waves	8
IV	**INSULATION CO-ORDINATION** Insulation Co-ordination –volt–time characteristics, Insulation strength and their selection-Evaluation of insulation strength standard BILs-Characteristics of protective devices, applications, location of arresters – insulation co-ordination in AIS and GIS	7
V	**COMPUTATION OF POWER SYSTEM TRANSIENTS** Computation of transients using electromagnetic transient program-Modelling of power system components- Simple case studies - Application of simplified method: single line station, two-line station, gas insulated substations, comparison with IEEE and IEC guides	8
VI	**MITIGATION TECHNIQUES FOR TRANSIENT OVERVOLTAGE'S** Overvoltage Protection Methods - Surge Arresters and Their Characteristics-Shielding and Grounding Techniques-Controlled Switching for Overvoltage Reduction-Overvoltage damping in GIS and HVDC systems-Case Studies and Real-World Applications	7
	Total Lecture Hours	**45**

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Text Books
1. Pritindra Chowdhari, *Electromagnetic Transients in Power Systems*, 2nd Edition, John Wiley & Sons Inc., 2009. 2. Allan Greenwood, *Electrical Transients in Power Systems*, 2nd Edition, Wiley & Sons Inc., New York,1991 (Reprinted 2012)
References:
1. Andrew R. Hileman, *Insulation Coordination for Power Systems*, 1st Edition, CRC Press, Taylor & Francis Group, 1999. 2. Klaus Ragaller, *Surges in High Voltage Networks*, 1st Edition, Plenum Press, New York, 1980 3. IEEE Standard 80-2013, *IEEE Guide for Safety in AC Substation Grounding*, IEEE, 2013. 4. R. Ramanujam, *Computational Electromagnetic Transients: Modeling, Solution Methods, and Simulation*, 1st Edition, I.K. International Publishing House, 2014. 5. M.S. Naidu, V. Kamaraju, *High Voltage Engineering*, 5th Edition, Tata McGraw-Hill Publishing Co. Ltd., 2020. 6. Rakosh Das Begamudre, *Extra High Voltage AC Transmission Engineering*, 4th Edition, New Age International Pvt. Ltd., Delhi, 2011.

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Course Information:										
Class, Semester	F. Y. M. Tech, Semester - II								**Category**	**PE**
Course Code, Course Title	**0PSPE517, High Voltage Transmission Systems**								**Type**	**T1**
Teaching Scheme (per week)	**Lecture**		**Tutorial**		**Practical**		**Self Study**		**Credits**	
	3		1		-		2		4	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**		**CIA**		**ESE**	
		40	20	40			-		-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze the need and advantages of high voltage AC and DC transmission systems.
CO2	Evaluate the performance and modeling of EHVAC and HVDC transmission systems.
CO3	Design insulation coordination and calculate electric field stresses in EHV systems.
CO4	Examine converter configurations, control strategies, and reactive power compensation in HVDC systems.
CO5	Assess transient phenomena, overvoltage protection and reliability aspects of high voltage transmission.

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Introduction to High Voltage Transmission** Necessity and scope of EHVAC and HVDC transmission, Comparison of EHVAC and HVDC systems, Power handling capacity, costs, and loss aspects Transmission line trends and design considerations, Role of high voltage transmission in smart grids and renewable integration	**7**
II	**EHVAC Transmission Systems** EHVAC line parameters: resistance, inductance, capacitance, Voltage gradient and surface stress on conductors, Corona, radio interference, audible noise, Insulation coordination: Basic Impulse Insulation Level (BIL), lightning and switching overvoltages, Ground return and line transposition	**8**
III	**HVDC Transmission Systems** Basic principles of HVDC systems, Types of HVDC links and configurations, HVDC converter topologies: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC), HVDC control systems: control modes and characteristics, HVDC system components: converters, smoothing reactors, harmonic filters	**8**
IV	**Converter Theory and Reactive Power Control** Converter operation and performance parameters, Reactive power requirements of converters, Reactive power compensation and control, Dynamic reactive power support using FACTS in HVDC systems, Introduction to multi-terminal HVDC systems	**7**
V	**Overvoltages, Insulation Coordination, and Protection** Transient overvoltages in EHV/HVDC systems, Lightning and switching surge protection, Insulation coordination for EHV and HVDC, Surge arresters and their characteristics, Protection of converter stations	**7**
VI	**Stability, Reliability and Recent Trends** Power system stability with HVDC systems, Control interaction between AC and HVDC systems, Reliability and availability of HVDC systems, Environmental considerations and EMI/EMC issues, Emerging trends: hybrid AC/DC systems, offshore wind HVDC transmission, UHVDC technologies.	**8**
	Total Lecture Hours	**45**

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Text Books
1. K.R. Padiyar, *HVDC Power Transmission Systems: Technology and System Interactions*, 2nd Edition, New Age International, 2011. 2. R.D. Begamudre, *EHV-AC Transmission Engineering*, 3rd Edition, New Age International, 2007.
References:
1. E.W. Kimbark, *Direct Current Transmission*, 1st Edition, Wiley-Interscience, 1971. 2. Prabha Kundur, *Power System Stability and Control*, 1st Edition, McGraw Hill Education, 1994. 3. E. Kuffel, W.S. Zaengl, J. Kuffel, *High Voltage Engineering Fundamentals*, 2nd Edition, Elsevier, 2000. 4. D.P. Kothari, I.J. Nagrath, *Modern Power System Analysis*, 4th Edition, McGraw Hill Education, 2011.

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Course Information:

Class, Semester	F. Y. M. Tech, Semester - II					**Category**	**PE**
Course Code, Course Title	**0PSPE518, Restructured Power Systems**					**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	3	1	-	2	4		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		40	20	40		-	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Understand the fundamentals of restructured power systems, market architecture, and load elasticity.
CO2	Apply OPF techniques for effective congestion management
CO3	Comprehend transmission pricing and power tracing methods for efficient market operation.
CO4	Distinguish the role of ancillary services and standard market design in restructured markets.
CO5	Analyze recent developments in India's restructured power markets and the integration of IT applications.

Syllabus:

Module	**Contents**	**Lecture Hours**
I	**Introduction** Fundamentals of restructured system, Market architecture, Load elasticity social welfare maximization	7
II	**Optimal Power Flow** OPF: Role in vertically integrated systems and in restructured markets, congestion management	8
III	**Transmission Pricing** Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power	8
IV	**Ancillary services Management** Ancillary services, Standard market design, Distributed generation in restructured markets	8
V	**IT applications** Developments in India, IT applications in restructured markets	7
VI	**Principles of Restructured Systems** Working of restructured power systems, PJM, Recent trends in Restructuring	7
	Total Lecture Hours	**45**

Text Books

1. Lorrin Philipson, H. Lee Willis, *Understanding electric utilities and de-regulation*, 1st Edition, Marcel Dekker Pub, 1998.
2. Steven Stoft, *Power system economics: designing markets for electricity*, 1st Edition, John Wiley and Sons, 2003.

References:

1. L. L. Lai, *Power System Restructuring and Deregulation*, 1st Edition, John Wiley & Sons Ltd, 2012.
2. S. Hunt, *Making competition work in electricity*, 1st Edition, John Wiley & Sons, Inc., 2002.
3. Ashikur Bhuiya, *Power System Deregulation: Loss Sharing in Bilateral Contracts and Generator Profit Maximization*, 1st Edition, VDM Verlag Publisher, 2008.
4. D. Kirschen and G. Strbac, *Fundamentals of Power System economics*, 2nd Edition, John Wiley & Sons Ltd, 2019.
5. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, *Operation of restructured power systems*, 1st Edition, Kluwer Academic Pub, 2001.
6. Mohammad Shahidehpour, Muwaffaq Alomoush, *Restructured electrical power systems: operation, trading and volatility*, Marcel Dekker.

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Course Information:								
Class, Semester	F. Y. M. Tech, Semester - II						Category	PE
Course Code, Course Title	0PSPE519, High Voltage Technology						Type	T1
Teaching Scheme (per week)	Lecture		Tutorial	Practical	Self Study		Credits	
	3		1	-	2		4	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Analyze the principles and techniques for generating and measuring high DC voltages, ensuring accuracy and compliance with high-voltage testing standards.
CO2	Examine the methods used for generating and measuring high AC voltages, and evaluate their applications in high-voltage equipment testing
CO3	Evaluate the techniques for generating and measuring high impulse voltages, and analyze their role in insulation performance and testing
CO4	Analyze the principles and circuits for generating and measuring high impulse currents, ensuring reliable testing of high-voltage systems
CO5	Examine insulation behavior under high-voltage stress, evaluate testing techniques, and ensure safe practices in high-voltage laboratories.

Syllabus:

Module	Contents	Lecture Hours
I	**Generation of High DC Voltages** Direct Voltages - AC to DC Conversion - Single Phase Rectifier Circuits, Voltage Doubler and Cockcroft Walton Voltage Multiplier Circuit – Voltage Regulation and Ripple Factor Calculation – Electrostatic Machine - Vande Graff Generator	8
II	**Generation of High AC Voltages** Alternating voltages - Testing transformer – single unit testing transformer – Cascade Transformers – Simplified equivalent circuit of cascaded transformer – Resonant circuits for Transformers - Tesla Coils.	7
III	**Generation of Impulse Voltages and Currents** Impulse voltages - Standard Lightning & Switching Impulse Wave shapes, Analysis of Single Stage Impulse Voltage Generator Circuits, Multistage Impulse Voltage Generation- Switching Impulse Voltage Generation Circuits,	8
IV	**Measurement of High AC, DC Impulse Voltages** Voltage Dividers, Generating Voltmeter - Electrostatic Voltmeters, Chubb Fortescue Method, Sphere Gaps for Peak Voltage Measurement of High DC, AC and Impulse Voltage Measurements.	7
V	**Generation and Measurement of High Impulse Currents** Standard Impulse Current Waveshape - Circuit for Producing Impulse Current Waves - Generation of High Impulse Currents and Rectangular Current Pulses- Tripping and Control of Impulse Generators Hall Generators, Electromagnetic Current Transformers- Rogowski Coils.	8
VI	**Non-Destructive Testing and High Voltage Lab** Measurement of dielectric constant and loss Factor and partial discharge measurement techniques, Classification and Layout of High Voltage Laboratories	7
	Total Lecture Hours	**45**

Text Books

1. M.S.Naidu and V.Kamaraju, *High Voltage Engineering*, 5th Edition, Tata McGraw Hill Education (India) Pvt. Ltd.. 2013.
2. C.L.Wadhwa, *High Voltage Engineering*, 3rd Edition, New Age International Pvt. Ltd., 2012.

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References:

1. Subir Ray, *An Introduction To High Voltage Engineering*, 2nd Edition, Prentice Hall India Learning Private Limited, 2013.
2. L.L. Alston, *High Voltage Technology*, 1st Edition, Oxford University Press,, 2011.
3. E.Kuffel and M. Abdullah, *High Voltage Engineering*, 1st Edition, Pergamon Press, 2013.
4. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, RoshdyRadwan, *High-Voltage Engineering: Theory and Practice*, 2nd Edition, Marcel Dekeer, New York, 2000.
5. E. Kuffel, W. S. Zaengl, J. Kuffel, *High Voltage Engineering Fundamentals*, 2nd Edition, Elsevier, 2012.
6. Ravindra Arora and Bharat Singh Rajpurohit, *Fundamentals of High-Voltage Engineering*, 1st Edition, Wiley, 2019.

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Annasaheb Dange College of Engineering and Technology
Ashta - 416301, Dist. : Sangli, Maharashtra
(An Empowered Autonomous Institute)
Department of Electrical Engineering

Established: 1999

Course Information:

Class, Semester	F. Y. M. Tech, Semester - II						**Category**	**PE**
Course Code, Course Title	**0PSPE520, Substation Automation**						**Type**	**T1**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**			
	3	1	-	2	4			
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		40	20	40		-	-	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Explain the architecture, components, and functions of modern substations and automation systems.
CO2	Analyze substation communication protocols including IEC 61850 and SCADA integration.
CO3	Evaluate the role of Intelligent Electronic Devices (IEDs) and their configuration for protection, monitoring, and control.
CO4	Design and assess automation schemes for different types of substations.
CO5	Apply cybersecurity strategies and reliability analysis for substation automation systems.

Syllabus:

Module	Contents	Lecture Hours
I	**Introduction to Substation Automation** Evolution and Need for Substation Automation (SA), Benefits of Substation Automation Systems (SAS), Substation Architectures: Conventional vs Digital, Components of SAS: IEDs, RTUs, HMIs, Gateways, Primary and secondary system overview	7
II	**Communication in Substation Automation** Communication requirements for substations, Standards and protocols: IEC 61850, DNP3, Modbus, GOOSE messaging, SCADA systems and data acquisition, Time synchronization: SNTP and IEEE 1588, Process bus and station bus architectures	8
III	**Intelligent Electronic Devices (IEDs) and Interoperability** Role and types of IEDs: protection relays, bay controllers, meters, Logical Nodes and Data Modeling in IEC 61850, IED configuration tools (ICTs) and System Configuration Language (SCL), Interoperability issues and solutions	8
IV	**Substation Protection, Control and Monitoring** Protection Schemes in SA Systems, Integration of protection and control functions, Automation of switching operations and interlocking schemes, Condition monitoring of equipment: transformers, circuit breakers, Maintenance strategies using SAS data	8
V	**Substation Automation Design and Implementation** SA system architecture design steps, Engineering process for IEC 61850 based substations, Case studies of automated substations (AIS/GIS), Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT)	7
VI	**Cybersecurity, Testing, and Future Trends** Cybersecurity threats in substations, Security standards: IEC 62351, NERC CIP, Substation communication network security, Testing of SAS systems (conformance and functional testing), Emerging trends: Digital substations, virtualized protection, and control functions	7
	Total Lecture Hours	**45**

Text Books

1. Evelio Padilla, *Substation Automation Systems: Design and Implementation*, 1st Edition, Wiley, 2015.
2. M. Shahidehpour, Y. Fu, T. Wiedman, *Communication and Control in Electric Power Systems: Applications of Parallel and Distributed Processing*, 1st Edition, IEEE Press/Wiley, 2003.

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References:
3. Christoph Brunner, *Applications to Electric Power Systems*, 1st Edition, Artech House, 2019.
4. A.P. Sakis Meliopoulos, *Automation in Power System Substations*, 1st Edition, Springer, 2017.
5. John D. McDonald, *Electric Power Substations Engineering*, 3rd Edition, CRC Press, 2012.
6. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, 1st Edition, Wiley-IEEE Press, 2012.

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Department of Electrical Engineering
Established: 1999

Course Information:

Class, Semester	FY. M.Tech, Semester - II						Category	PC
Course Code, Course Title	0PSPC521, Advanced Power System Lab.						Type	L1
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study			Credits	
	-	-	2	2			1	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE	
		-	-	-		50	50	

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Develop simulation models for renewable energy systems (such as wind energy using DFIG) and analyze their integration into the power grid.
CO2	Examine the small-signal stability of single-machine and multi-machine power systems using the classical machine model.
CO3	Model and simulate transmission line parameters and induction motor starting to analyze their impact on power system performance.
CO4	Examine power quality issues and evaluate the performance of STATCOM and active filters for harmonic mitigation.
CO5	Simulate and assess the operation of microgrids in both grid-connected and islanded modes to ensure stable operation.

List of Experiments with CO Mapping

S.No	Title / Topic of the Experiment	CO Mapped
1	Small-signal stability analysis of single machine-infinite bus system using classical Machine model	CO2
2	Small-signal stability analysis of multi-machine configuration with classical machine model	CO2
3	Modeling and Simulation of Transmission Line Parameters	CO3
4	Induction motor starting analysis	CO3
5	Wind Energy System Simulation Using Doubly-Fed Induction Generator (DFIG)	CO1
6	Wind Energy System Simulation Using Doubly-Fed Induction Generator (PMSM)	CO1
7	Simulation of a STATCOM for Reactive Power Compensation	CO4
8	Simulation of a Microgrid in Grid-Connected and Islanded Mode	CO5
9	Computation of harmonic indices generated by a rectifier feeding a R-L load	CO4
10	Simulation of Active Filter for Harmonics Mitigation.	CO4
Total Practical Sessions	**15** **Total Practical Hours**	**30**

Text Books

1. Priyanka Patankar, Swapnil Kulkarni, *MATLAB and Simulink In-Depth*, 1st Edition, BPB Publications, 2022.
2. Viktor Perelmuter, *Renewable Energy Systems: Simulation with Simulink and Sim Power Systems*, CRC Press, 2016.

References:

1. S. Sivanagaraju and G. Sreenivasan, *Power System Operation and Control*, Pearson Publications, 2012.
2. D.P. Kothari and I.J. Nagrath, *Modern Power System Analysis*, 4th Edition, McGraw-Hill, 2011.
3. J. Lewis Blackburn and Thomas J. Domin, *Protective Relaying: Principles and Applications*, 4th Edition, CRC Press, 2014.
4. Hadi Saadat, *Power System Analysis*, 3rd Edition, McGraw-Hill, 2010.

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Established: 1999	**Annasaheb Dange College of Engineering and Technology** **Ashta - 416301, Dist. : Sangli, Maharashtra** **(An Empowered Autonomous Institute)** **Department of Electrical Engineering**	ADCET

Course Information:								
Class, Semester	FY. M.Tech, Semester - II						**Category**	**VS**
Course Code, Course Title	**0PSVS522, Seminar**						**Type**	**L2**
Teaching Scheme (per week)	**Lecture**	**Tutorial**		**Practical**		**Self Study**	**Credits**	
	-	-		4		2	2	
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**	
		-	-	-		50	-	

Course Outcomes (COs) :

Upon successful completion of this course, the student will be able to:

CO1	Conduct a thorough literature review and identify research problems.
CO2	Prepare structured and well-documented technical reports.
CO3	Deliver effective technical presentations with clarity and confidence.
CO4	Critically analyze and discuss technical topics in electrical power systems.
CO5	Exhibit professional ethics during seminar preparation and delivery.

- Individual student must select seminar topic based on recent or emerging topic in electrical engineering, emphasizing research, innovation, and real-world applications. etc.
- It also involves preparing a detailed report, delivering an oral presentation, and answering queries to assess depth of understanding.
- Continuous Evaluation will be through presentation and report writing.

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Department of Electrical Engineering

Established: 1999

Course Information:

Class, Semester	F. Y. M. Tech, Semester - II					**Category**	**MA**
Course Code, Course Title	**0PSMA523, Pedagogy Studies**					**Type**	**T2**
Teaching Scheme (per week)	**Lecture**	**Tutorial**	**Practical**	**Self Study**	**Credits**		
	2	-	-	-	-		
Examination Scheme (Marks)	**Theory**	**MSE**	**TA**	**ESE**	**Practical**	**CIA**	**ESE**
		-	50	-		-	-

Course Outcomes (COs) :
Upon successful completion of this course, the student will be able to:

CO1	Apply pedagogical principles and outcome-based education frameworks to enhance engineering instruction.
CO2	Implement learner-centered strategies to address the diverse learning needs of engineering students.
CO3	Design and deliver effective instructional methods to improve engagement and knowledge transfer in technical education.
CO4	Integrate digital tools and emerging technologies to enrich the teaching-learning process.
CO5	Develop an appropriate assessment techniques to evaluate and improve student learning outcomes and foster industry collaboration for continuous improvement in engineering education.

Syllabus:

Module	Contents	Lecture Hours
I	**Foundations of Pedagogy in Engineering Education:** Introduction of Pedagogy- Importance of Pedagogy in Engineering- Role of a Teacher in Technical Education- Outcome-Based Education (OBE) in Engineering - Bloom's Taxonomy for Engineering Course Design-Importance of Program Outcomes (POs), Course Outcomes (COs), and Graduate Attributes (GAs)	5
II	**Learner-Centered Approaches in Engineering Education** Role of Engineering Educators in the 21st Century-Student Mentoring and Counseling Essentials-Creating Inclusive Classrooms: Activity oriented model, Addressing Diversity, Gender Sensitivity, Cognitive development and Special Needs-Generation Z and Millennial Learners: Expectations & Challenges	5
III	**Instructional Design and Delivery of content** Curriculum Development and Course Planning- Instructional Design- Effective Delivery Strategies: Project based learning, Problem based learning, and Participative based learning. Teaching Strategies: flipped classroom approach and think pair share based approach.	5
IV	**Technology Integration and Digital Tools in Engineering Education** E-Learning Platforms (Moodle, Google Classroom, SWAYAM, NPTEL, MOOCs)- Virtual Labs and MATLAB Simulators in Engineering- Educational Technology Tools-Creating Engaging Multimedia Content (Videos, Animations, Interactive Content)	5
V	**Assessment, Evaluation, and Feedback in Engineering** Designing Effective Formative Assessments - Experiential learning - Continuous Internal Assessment and Summative Assessment Strategies- Developing Rubrics for Courses and Lab Assessments -Academic Integrity: Plagiarism, Ethics, and Fair Assessment	5
VI	**Professional Development, Industry Collaboration in Engineering Education** Soft Skills for Educators: Communication, Emotional Intelligence, Classroom Management, portfolio Management- Time and Stress Management for Faculty - Entrepreneurship and Innovation eco system in Classrooms	5
	Total Lecture Hours	**30**

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Text Books
1. Greg Light, Susanna Calkins, Roy Cox, *Learning and Teaching in Higher Education: The Reflective Professional*, 2nd Edition, SAGE Publications, 2009. 2. Milo D. Larson, Chin-Chung Tsai, *Engineering Education: Future Trends and Advances*, 1st Edition, Nova Science Publishers, 2019.
References:
1. Stephen D. Brookfield, *The Skillful Teacher: On Technique, Trust, and Responsiveness*, 3rd Edition, Jossey-Bass, 2015. 2. Peter L. Schneller, Melinda M. Wilde, *Curriculum Development in Higher Education: Faculty-Driven Processes and Practices*, 1st Edition, Routledge, 2012. 3. John Biggs, Catherine Tang, *Teaching for Quality Learning at University*, 4th Edition, Open University Press, 2011. 4. Phillip C. Wankat, Frank S. Oreovicz, *Teaching Engineering*, 2nd Edition, Purdue University Press, 2015. 5. Richard M. Felder, Rebecca Brent, *Teaching and Learning STEM: A Practical Guide*, 1st Edition, Jossey-Bass, 2016.

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Sant Dnyaneshwar Shikshan Sanstha's

ANNASAHEB DANGE COLLEGE OF ENGINEERING & TECHNOLOGY, ASHTA

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Curriculum Structure

M.Tech.

Electrical Power System

Semester-I to Semester-IV

(To be implemented from Academic Year 2025-26 onwards)

Department of Electrical Engineering

Annasaheb Dange College of Engineering and Technology

Ashta - 416301, Dist. : Sangli, Maharashtra

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Established: 1999

F.Y. M.Tech. – Electrical Power System
[Level 6.5, PG Diploma] Semester - I

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	RM	T1	0PSRM501	Research Methodology and IPR	3	1	0	2	4	40	20	40	-	-
02	PC	LIT1	0PSPC502	Advanced Power System Analysis	3	1	2	2	5	40	20	40	50	50
03	MC	T1	0PSMC503	Power System Modeling	3	1	0	2	4	40	20	40	-	-
04	PE	T1	0PSPE5**	Program Elective - I	3	1	0	2	4	40	20	40	-	-
05	PE	T1	0PSPE5**	Program Elective - II	3	0	0	2	3	40	20	40	-	-
06	PC	L1	0PSPC510	Renewable Energy and Grid Integration Lab.	0	0	4	2	2	-	-	-	50	50
07	MA	T2	0PSMA511	Research Paper Writing	2	0	0	0	0	-	50	-	-	-
				Total	**16**	**5**	**6**	**12**	**22**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab): ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective - I		Program Elective - II	
0PSPE504	Renewable Energy System	0PSPE507	High Power Converters
0PSPE505	Energy Storage Systems	0PSPE508	Electric and Hybrid Vehicles
0PSPE506	Electrical Power Distribution System	0PSPE509	Distributed Generation

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F.Y. M.Tech. – Electrical Power System
[Level 6.5, PG Diploma] Semester - II

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MS	TA	ESE	CIA	ESE
01	OE	T1	0PSOE5**	Open Elective	3	0	0	2	3	40	20	40	-	-
02	PC	LIT1	0PSPC513	Advanced Power System Protection	3	1	2	2	5	40	20	40	50	50
03	PC	T1	0PSPC514	Smart Grid Technologies	3	0	0	2	3	40	20	40	-	-
04	PE	T1	0PSPE5**	Program Elective - III	3	1	0	2	4	40	20	40	-	-
05	PE	T1	0PSPE5**	Program Elective - IV	3	1	0	2	4	40	20	40	-	-
06	PC	L1	0PSPC521	Advanced Power System Lab.	0	0	2	2	1	-	-	-	50	50
07	VS	L2	0PSVS522	Seminar	0	0	4	2	2	-	-	-	50	-
08	MA	T2	0PSMA523	Pedagogy Studies	2	0	0	0	0	-	50	-	-	-
				Total	17	3	8	14	22					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

Program Elective - III		Program Elective - IV		Open Elective	
0PSPE515	Power Quality	0PSPE518	Restructured Power Systems	0PSOE512	Optimization Techniques
0PSPE516	Power System Transients	0PSPE519	High Voltage Technology		
0PSPE517	High Voltage Transmission Systems	0PSPE520	Substation Automation		

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Exit after **F.Y. M.Tech. – Electrical Power System**

Additional Credits to qualify for P. G. Diploma Certificate

- **Need to Complete Domain Specific Internship or Industrial Software Training and Certification for 8 Weeks**

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Established: 1999

S.Y. M.Tech. – Electrical Power System

[Level 6.5, PG Degree] Semester - III

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	SL	T1	0PSSL6**	Self Learning Course - I	0	0	0	4	4	40	20	40	-	-
02	VS	L1	0PSVS603	Dissertation Phase – I	0	0	24	10	12	-	-	-	100	100
03	MA	T2	0PSMA604	Internship	-	-	-	-	-	-	50	-	-	-
				Total	**0**	**0**	**24**	**14**	**16**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

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S.Y. M.Tech. – Electrical Power System

[Level 6.5, PG Degree] Semester - IV

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	SL	T1	0PSSL6**	Self Learning Course - II	0	0	0	4	4	30	40	30	-	-
02	VS	L1	0PSVS607	Dissertation Phase – II	0	0	32	10	16	-	-	-	100	100
				Total	0	0	32	14	20					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : ≥ 8 / 20	MSE + ESE (Theory) : ≥ 32 / 80	TA (Theory) / CIE (Lab) : ≥ 20 / 50	ESE (Lab) : ≥ 20/50

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Established: 1999

Department : **Electrical Engineering**
Programme : **M.Tech. – Electrical Power Systems**
Curriculum Revision : **Revision: R0, with effect from the AY 2025 - 26 to the students of PG Programme.**

Course Category	Acronym	I	II	III	IV	Total	% of Category
Program Specific Mathematical Course (PSMC)	**MC**	4	0	0	0	**4**	**5**
Research Methodology	**RM**	4	0	0	0	**4**	**5**
Program Core	**PC**	7	9	0	0	**16**	**20**
Program Elective	**PE**	7	8	0	0	**15**	**18.75**
Open Elective	**OE**	0	3	0	0	**3**	**3.75**
Vocational and Skill Enhancement Course (VSEC)	**VS**	0	2	12	16	**30**	**37.5**
Self Learning Course (SLC)	**SL**	0	0	4	4	**8**	**10**
	Total	**22**	**22**	**16**	**20**	**80**	**100**

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