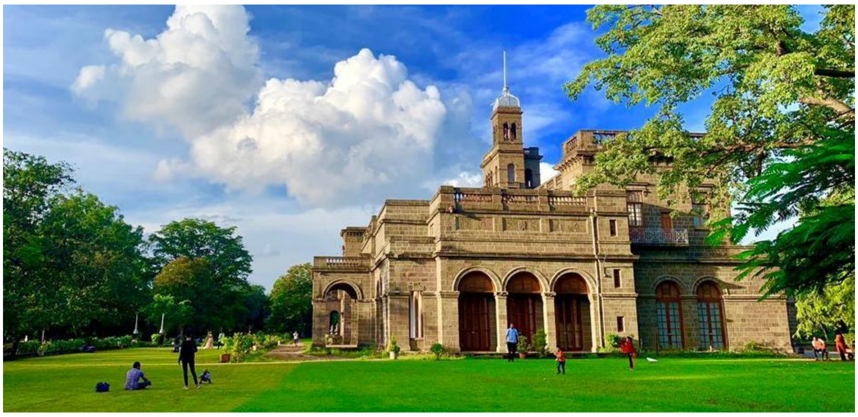
सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology



Master of Engineering (2025 Pattern)

ME-Electrical (Power Systems)

(With effect from Academic Year: 2025-26)

Preface by Board of Studies

Dear Students and Teachers,

We, the members of Board of Studies Electrical Engineering, are very happy to present Master of Engineering (ME Electrical-Power Systems) syllabus effective from the Academic Year 2025-26 (2025 pattern).

This curriculum integrates a blend of core subjects, open electives, on-the-job training, internships, seminars, and research projects. This holistic approach ensures that you not only master the foundational principles of electrical engineering but also have the opportunity to explore specialized areas of interest and gain hands-on experience in real-world applications.

The revised syllabus falls in line with the objectives of Savitribai Phule Pune University, AICTE New Delhi, UGC, and various accreditation agencies by keeping an eye on technological developments, innovations, and industry requirements.

This curriculum is the result of extensive consultation with academic experts, industry professionals, and alumni to ensure relevance and excellence. It is designed not only to meet the current industry standards but also to prepare students for competitive exams, higher studies and research in the field of Electrical engineering.

As you embark on this educational journey, we encourage you to seize every opportunity to expand your horizons, collaborate with peers and faculty, and contribute to advancements in the field of electrical engineering. We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Dr. Sanjay. A. Deokar
Chairman
Board of Studies (Electrical Engineering)

Members of Board of Studies	
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Nomenclature

POS	Power Systems
PEO	Program Educational Objectives
WK	Knowledge and Attitude Profile
PO	Program Outcomes
PCC	Program Core Course
PEC	Program Elective Course
RM	Research Methodology
IN	Internship
OJT	On Job Training
RPR	Research Project
SEM	Seminar

Savitribai Phule Pune University
Master of Engineering (2025 Course)
ME- Electrical (Power Systems)

Table of Contents

Program Educational Objectives (PEO)

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that engineering graduates are expected to achieve 2 years after completing the program.

PEO	PEO Focus	PEO Statements
PEO1	Core Technical Excellence	To prepare globally competent postgraduates with enhanced domain knowledge and skills attaining professional excellence and updated with modern technology to provide effective solutions for engineering and research problems.
PEO2	Breadth	To prepare the postgraduates to work as committed professionals with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
PEO3	Professionalism	To prepare motivated postgraduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking to succeed in the career in industry/academia/research
PEO4	Team Building	To prepare postgraduates with strong managerial and communication skills to work effectively as an individual as well as in teams.

Knowledge and Attitude Profile (WK)

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) In some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

WK1	A systematic, theory-based understanding of natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice are as in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in Engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, attitude and behavior that students acquire through the program. On successful completion graduating students/graduates will be able to:

PO1	Engineering knowledge	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified inWK1 toWK4 respectively to develop to the solution of complex engineering problems
PO2	Problem analysis	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1toWK4)
PO3	Design/Development of Solutions	Design creative solutions for complex engineering problems and design/develop systems/ components/ processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering &IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 & WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual & Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

First Year Master of Electrical Engineering (2025 Pattern)

M.E. Electrical (Power Systems)

Level 6.0															
Course Code	**Course Type**	**Course Name**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
Semester I															
PCC-501-POS	Program Core Course	Power System Modelling	4		-	50	50	-	-	-	100	4	-	-	4
PCC-502- POS	Program Core Course	Advanced Power Electronics	4		-	50	50	-	-	-	100	4		-	4
PCC-503- POS	Program Core Course	Computer Applications in Power Systems	4			50	50				100	4			4
PCC-504- POS	Program Core Course	Power System Economics & Management	4			50	50				100	4			4
PCC-505- POS	Program Core Course	Laboratory Practice-I	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-521- POS	Program Elective Course	Elective –I	3		-	50	50	-	-	-	100	3	-	-	3
PEC-522- POS	Program Elective Course	Elective Lab-I	-	-	2	-	-	25	-	25	50	-	-	1	1
Total			**19**	**-**	**6**	**250**	**250**	**50**	**-**	**50**	**600**	**19**	**-**	**3**	**22**

CCE*: Comprehensive Continuous Evaluation (Refer ME 2025 pattern rules and regulations)

Program Elective Course (Elective-I)
PEC-521A-POS. : Smart Grid Technology
PEC-521B-POS. : Industrial Automation and Control

First Year Master of Electrical Engineering (2025 Pattern)

M.E. Electrical (Power Systems)

Level 6.0															
Course Code	**Course Type**	**Course Name**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
Semester II															
PCC-551-POS	Program Core Course	Power System Planning & reliability	4	-	-	50	50	-	-	-	100	4		-	4
PCC-552- POS	Program Core Course	Advanced Power System Protection	4	-	-	50	50	-	-	-	100	4		-	4
PCC-553- POS	Program Core Course	Power System Dynamics	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-554- POS	Program Core Course	Laboratory Practice-II	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-561- POS	Program Elective Course	Elective –II	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-562- POS	Program Elective Course	Elective –III	3	-	-	50	50	-	-	-	100	3	-	-	3
SEM-581- POS	Seminar	Technical Seminar-I			4			25	-	25	50			2	2
Total			**18**	**-**	**8**	**250**	**250**	**50**	**-**	**50**	**600**	**18**	**-**	**4**	**22**

CCE*: Comprehensive Continuous Evaluation (Refer ME-2025 pattern rules and regulations)

Program Elective Course (Elective-II)	
PEC-561A-POS.	: Distributed generation and micro grid
PEC-561B-POS.	: Application of Power Electronics to Power System

Program Elective Course (Elective-III)	
PEC-562A-POS.	: Digital Signal Processing & Its applications
PEC-562B-POS.	: Artificial Intelligence tools

Second Year Master of Electrical Engineering (2025 Pattern)

M.E. Electrical (Power Systems)

Level 6.5															
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Total	Theory	Tutorial	Practical	Total
Semester III															
RM-601-POS	RM	Research Methodology	4	-	-	50	50	-	-	-	100	4	-	-	4
OJT-602-POS	OJT/ Internship	On job training/ Internship	-	-	10	-	-	100	-	-	100		-	5	5
SEM-603-POS	Seminar	Technical Seminar-II		-	8	-	-	25	-	25	50	-	-	4	4
RPR-604-POS	Research Project	Research Project - I	-	-	18	-	-	25	-	25	50	-	-	9	9
Total			**4**	**-**	**36**	**50**	**50**	**150**	**-**	**50**	**300**	**4**	**-**	**18**	**22**

CCE*: Comprehensive Continuous Evaluation (Refer ME-2025 pattern rules and regulations)

Level 6.5															
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Total	Theory	Tutorial	Practical	Total
Semester IV															
SEM-651-POS	Seminar	Technical Seminar - III	-	-	8	-	-	50	-	50	100	-	-	4	4
RPR-652-POS	Research Project	Research Project- II	-	-	36	-	-	150	-	50	200		-	18	18
Total			**-**	**-**	**44**	**-**	**-**	**200**	**-**	**100**	**300**	**-**	**-**	**22**	**22**

सावित्रीबाई फुले पुणे विद्यापीठ

SEMESTER-I

Master of Engineering (2025 Pattern)

ME-Electrical (Power Systems)

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-501-POS		**Course Name:** Power System Modeling
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite: Basic Electrical Engineering, Power System Fundamentals, Electrical Machines, Control Systems, Engineering Mathematics, Computer Programming / Simulation Tools

Course Objectives:

1. Introduce basic modeling concepts of various power system components.
2. Develop a detailed model of synchronous machine for dynamic studies.
3. Analyze synchronous machine model for steady state & transient state
4. Describe basics of excitation systems, voltage regulators and their parameters.
5. Develop models of different excitation systems.
6. Extend concept of mathematical modeling for transmission line, SVC and loads

Course Outcomes: Student will be able to...

1. CO1: Develop simple models for electrical power system components.
2. CO2: Perform analysis of synchronous machine behavior for steady state & transient state.
3. CO3: Write models of different excitation systems.
4. CO4: Apply concept of modeling for transmission line, SVC and loads.

Course Contents

Unit No: I	**Modeling of Power System Components:**	**10 Hours**

The need for modeling power systems, different models for power system analysis. Simplified models of non-electrical components like boiler, steam, hydro-turbine & governor system. Transformer modeling, tap-changing & phase-shifting transformer modeling.

Unit No: II	**Synchronous machine modeling:**	**10 Hours**

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

Unit No: III	**Analysis of synchronous machine modeling:**	**10 Hours**

Synchronous machine connected to an infinite bus, its simulation for steady-state condition and transient conditions.

Unit No: IV	**Excitation system modeling - I:**	**10 Hours**

Simplified view of excitation control. Block Diagram of Excitation control scheme, effect of change in excitation on system parameters, Exciter with rheostat control, Definitions of voltage response ratio & exciter voltage ratings. Voltage regulators such as electro-mechanical and solid state.

Unit No: V	**Excitation system modeling - II:**	**10 Hours**

Excitation control systems using dc generator exciter, dc generator pilot excitation scheme, modelling of self and separately excited dc generator, AC excitation system: Field controlled alternator rectifier system (stationary diode type), Brushless excitation system (rotating diode type), static excitation system: Potential source-controlled rectifier system, compound source-controlled rectifier system.

Learning Resources

1. Text Books

[T1]. Power Systems Dynamics – K. R. Padiyar, B.S. Publications

[T2]. Power System Control and Stability – Vol. – I – Anderson & Foud, IEEE Press, New York.

[T3]. Power Systems Dynamics-Analysis and simulation –R. Ramanujam, PHI Learning Pvt limited New Delhi.

2. Reference Books

[R1]. Power System Dynamics & Control – Kundur, IEEE Press, New York

[R2]. Power System Operation & Control – P.S.R. Murthy

[R3]. “Electrical Energy System Theory – an introduction” by Olle Elgerd. TMH Publishing Company 2nd Edition, New Delhi

[R4]. “Power System Analysis” – John J. Granier and W.D. Stevenson Jr, 4th Edition, McGraw Hill International student edition.

3. Links to online SWAYAM/NPTEL Courses

[M1]. Modeling, Analysis and Estimation of Three Phase Unbalanced Power Network - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-502-POS		**Course Name:** Advanced Power Electronics
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite: Basic Circuit Theory, Power Electronics, Control Systems, Electrical Machines, Engineering Mathematics

Course Objectives:

1. To learn about various advancements in Power Electronics.
2. To know working of various types of Power Electronic converter configurations.
3. To understand the use of different energy storage systems.
4. To know various advanced control techniques for Power flow control in converter configurations.

Course Outcomes: after successful completion of this course, student will be able to

1. CO1 Select appropriate Power Electronic converter configuration for desired application.
2. CO2 Analyze working and control requirements of the Power Electronic converter configuration.
3. CO3 Choose and apply the suitable control technique for operation of Power Electronic converter configuration.
4. CO4 Select the required energy storage system correctly.
5. CO5 Compare and comment on performance of the chosen Power Electronic converter configuration with other converters for same application.

Course Contents

Unit No: I	**Voltage Source Converters:**	**10 Hours**

Review of 3-ph- full wave bridge converter, operation and harmonics, 3 level voltage source converters. PWM converter. Generalized technique of harmonic elimination and voltage control. Advanced modulation techniques (space vector modulation, 3 harmonic PWM), Converter rating.

Unit No: II	**Current source converter**	**10 Hours**

(i) Self and Line commutated current source converter: Converters with self-commutating devices. Comparison with voltage source converter.
(ii) Matrix Converter: 3×3 matrix converter, principle of working, mathematical treatment, comparison of matrix converter with multi-pulse converter.

Unit No: III	**Multilevel Inverters:**	**10 Hours**

Multilevel concept, Types of multilevel Inverters, diode clamped multilevel inverter, flying- capacitors multilevel inverters, cascaded multilevel inverter, switching device currents, d.c. link capacitor voltage balancing, features of multilevel inverters, comparison of multilevel converters **Applications of multilevel Inverter:** Reactive power compensation Back-to-back intertie system, Utility compatible adjustable speed drives.

Unit No: IV	**Energy Storage Systems:**	**10 Hours**

Flywheel energy storage system, Superconducting magnetic energy storage system, other advance energy storage systems

Unit No: V	**Resonant Pulse Converters:**	**10 Hours**

Types of Resonant pulse converters, Series resonant inverters with unidirectional & Bidirectional switches,

Analysis of half bridge and full bridge configurations, Frequency response of series resonant inverters, Parallel resonant inverters, Voltage control of resonant inverters, Class E Resonant inverter and rectifier, zero current and zero V switching resonant Converters, comparison.

Learning Resources
1. Text Books
[T1]. Power Electronic Control in Electrical Systems by E. Acha, Miller & Others (Newnes, Oxford publication) – first Edition [T2]. Power Electronics by M.H. Rashid Prentice Hall of India Pvt. Ltd. New Delhi, (3rd Edition)
2. Reference Books
[R1]. Understanding FACTS by N.G. Hingorani& L. Gyugyi (IEEE Press, Indian Edition) [R2]. E. H. Watanube, R.M. Stephen and Maurico Ardes "New Concepts of instantaneous active and reactive powers in Electrical systems with Generic loads" (IEEE transaction on Power Delivery Vol.8, no.2 April 1993, PP-697-703. [R3]. Benchaita, S. Sadaate and A. Salemnia – "A comparison of voltage source and current source shunt Active filter by simulation and Experimentation" (IEEE Transaction on Power Systems, Vol 14, No.2, May 99, PP 642-647. [R4]. H. Akagi, E.H. Watanabe and M.Aredes "Instantaneous Power Theory and Applications to Power Conditioning, IEEE Press, New York.
3. Links to online SWAYAM/NPTEL Courses
[M1]. Advance Power Electronics - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-503-POS		**Course Name:** Computer Applications in Power Systems
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite:

Course Objectives: The student will be able to

1. **Understand** the fundamentals and classification of classical and nonlinear optimization techniques.
2. **Apply** mathematical tools for solving constrained and unconstrained optimization problems relevant to engineering.
3. **Analyse** load flow studies using Newton-Raphson and decoupled methods including contingency analysis.
4. **Evaluate** optimal power flow considering system constraints and economic dispatch techniques.
5. **Formulate** and solve optimal power system operation problems using loss coefficients and linear programming.

Course Outcomes: At the end of course, student will be able to

CO1. Formulate and solve single and multivariable optimization problems using classical methods.
CO2. Apply nonlinear programming techniques and search methods for unconstrained optimization.
CO3. Perform and analyze load flow studies and contingency evaluations using different numerical methods.
CO4. Apply optimization techniques for solving optimal power flow problems under various constraints
CO5. Evaluate optimal operation of power systems using loss coefficients and economic dispatch strategies

Course Contents

Unit No: I	**Optimization Techniques:**	**10 Hours**

Introduction, Statement of an optimization problem, design vector, design constraints, constraint surface, objective function, classification of optimization problem. Classical optimization Techniques, single variable optimization, multivariable optimization with equality constraints, Direct substitution method, constrained variation method, Lagrange Multiplier method, formulation of multivariable optimization, Kunh Tucker conditions.

Unit No: II	**Optimization Techniques:**	**10 Hours**

Nonlinear Programming, Unconstrained optimization Techniques, Direct search methods, Indirect search methods, Descent methods, One dimensional minimization method, unimodal function, elimination methods.

Unit No: III	**Load Flow Studies:**	**10 Hours**

Revision of Load flow studies by using Newton Raphson method (polar and rectangular). Contingency evaluation, concept of security monitoring, Techniques of contingency evaluation, Decoupled load flow and fast decoupled load flow.

Unit No: IV	**Optimal Power Flow Analysis:**	**10 Hours**

Optimal power flow analysis considering equality and inequality constraints. Economic dispatch with and without limits (Classical method) Gradient method, Newton's method, Newton Raphson method.

Unit No: V	**Optimal Power System Operation:**	**10 Hours**

Calculation of loss coefficients, loss coefficients using sensitivity factors, power loss in a line, Generation shift distribution factors, Transmission loss coefficients, transmission loss formula as a function of generation and loads, economic dispatch using loss formula, which is function of real and reactive power, linear programming method.

Learning Resources

1. Text Books

[T1]. Computer Aided Power System Operation and Analysis-R.N.Dhar, Tata McGraw Hill New Delhi.

[T2]. Computer Techniques in Power System Analysis- M.A. Pai, Tata Mc-Graw Hill New Delhi.

[T3]. Computer Methods in Power System Analysis- Stagg and El.Abiad, Mc-Graw Hill (International Student Edition.)

2. Reference Books

[R1]. Computer Analysis of Power Systems-J. Arrilinga, C. P. Arnold. Wiely Eastern Ltd.

[R2]. Optimization Techniques-S. S. Rao, Wiely Eastern Ltd, New Delhi.

[R3]. Modern Power System Engineering, Nagrath and Kothari (Tata McGraw Hill)

[R4]. Electrical Energy System Theory–an introduction- Olle Elgerd. TMH Publishing Company, New Delhi.

[R5]. R5. Power System Optimization- D. P. Kothari, J. S. Dhillon, PHI.

3. Links to online SWAYAM/NPTEL Courses

Computer Aided Power System Analysis - Course

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)			
Course Code: PCC-504-POS		**Course Name:** Power System Economics & Management	
Teaching Scheme		**Credits**	**Examination Scheme**
Theory	: 04 Hrs	04	CCE : 50 Marks
Practical	: 00 Hrs	--	ESE : 50 Marks

Prerequisite:

Course Objectives:

1. Learn the scenario of power sector in India
2. Understand the necessity of regulations and power sector economics
3. Understand tariff structure in detail.
4. Understand the concept and types of power market and price of power.
5. Learn the transmission planning and pricing

Course Outcomes: At the end of the course, students will be able to

1. CO1: Explain the structure, institutions, policies, and reforms of the Indian power sector, including regulatory and deregulated environments.
2. CO2: Apply economic principles and financial evaluation techniques (IRR, NPV, cost structures) to analyze power sector projects and regulatory mechanisms.
3. CO3: Analyze tariff structures, subsidies, and restructuring models, and evaluate their impact on consumers, utilities, and renewable integration.
4. CO4: Describe electricity market types, pricing mechanisms, and market operations, and assess the influence of demand elasticity and market power.
5. CO5: Evaluate transmission planning, pricing methods, congestion management, and advanced market operations including ABT, PPAs, and game-theoretic approaches.:

Course Contents

Unit No: I	Indian Power Sector and Policies	10 Hours

Institutions in Indian Power sector: CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, REC, state & central governments, utilities. Critical issues & challenges in Indian power sector.
Electricity Act 2003: salient features, national policies, amendments, Energy policy and guidelines,
Regulation vs Deregulation: Need, conditions favoring deregulation.

Unit No: II	Power Sector Economics and Regulation	10 Hours

Cost components and structure of power sector, Investment analysis: Life cycle cost, IRR, NPV, annual rate of return. Short-term & long-term marginal costs, financing options. Role & evolution of regulatory commissions in India. Regulatory process & tariff determination stages. Economic regulations: cost-plus, performance based, incentive, price/revenue cap, rate of return, sliding scale. Key performance parameters.

Unit No: III	Tariffs, Subsidies and Market Restructuring	10 Hours

Tariff principles: marginal cost, cost-to-serve, average cost. Consumer tariff structures: fixed & variable charges, TOD tariff, interruptible tariff, PF tariff, penalties & incentives. Multi-year tariff, levelized tariff, subsidies, cross subsidies, life-line tariff. Tariff for renewable energy: determination, feed-in tariff, government policies.
Environmental & social considerations in tariff.
Power sector restructuring: vertically integrated vs deregulated structures, ISO, Genco, Transco, Disco, Retailco. Competition: barriers, benefits, challenges. Trading models: single buyer, wholesale competition, retail competition, pool model, bilateral/multilateral models, ISO models.

Indian Energy Exchange: open access, time markets, global electricity reforms.		
Unit No: IV	**Electricity Markets and Pricing**	**10 Hours**
Basics of electricity pricing, demand-price elasticity. Types of power & energy markets: spot, day-ahead, hour-ahead, forward, futures, options, CfD, ancillary markets. Market operation: clearing price, zonal/locational MCPs, efficiency, gate closure, settlement process. Dynamic pricing, spot pricing. Market power: exercising & effects on operations.		
Unit No: V	**Transmission Planning, Pricing and Market Operations**	**10 Hours**
Transmission planning principles, Transmission pricing methods & services, Congestion issues & management. Transmission cost allocation, locational marginal pricing, firm transmission rights. Transmission ownership & control. Transmission pricing model in India. Availability Based Tariff (ABT). Role of Load Dispatch Centers (LDCs). Arbitrage in electricity markets, game theory methods in power systems. Security constrained unit commitment. Power Purchase Agreements (PPAs).		

Learning Resources

1. Text Books

[T1]. Fundamentals of Power System Economics by D.S. Kirschen and G. Strbac, John Wiley & sons.
[T2]. Electricity Economics Regulation and Deregulation, by G. Rothwell and T Gómez, Wiley – InterScience
[T3]. Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc
[T4]. Electric Utility Planning and Regulation, Edward Kahn, American Council for Energy Efficient Economy

2. Reference Books

[R1]. "Know Your Power", A citizens Primer On the Electricity Sector, Prayas Energy Group, Pune.
[R2]. Power System Economics Designing markets for Electricity by Steven Stoft , Wiley- inter Science.
[R3]. Market Operations in Electric Power Systems, Forecasting, Scheduling and Risk Management, by M. Shahidepour, Hatimyamin, Zuyi Li, Wiley InterScience.
[R4]. Deregulation in Power Industry, course hand outs by S.A. Khaparde.
[R5]. Regulation in infrastructure Services: Progress and the way forward - TERI, 2001
[R6]. Maharashtra Electricity Regulatory Commission Regulations and Orders - www.mercindia.com
[R7]. Various publications, reports and presentations by Prayas, Energy Group, Pune www.prayaspune.org
[R8]. Central Electricity Regulatory Commission, Regulations and Orders - www.cercind.org
[R9]. Electricity Act 2003 and National Policies – www.powermin.nic.
[R10]. Bhanu Bhushan, "ABC of ABT - A primer on Availability Tariff" - www.cercind.org

3. Links to online SWAYAM/NPTEL Courses

Economic Operations And Control Of Power Systems - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-505-POS		**Course Name:** Laboratory Practice-I
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 25 Marks
Practical : 04 Hrs	02	PR : 25 Marks

Course Objectives:

1. To enable students to model and analyze electrical machines and excitation systems using simulation tools like SIMULINK.
2. To provide hands-on exposure to advanced power electronic circuits through simulation and hardware-based experiments.
3. To introduce computational techniques for solving power system problems such as load flow, faults, and short circuit analysis.
4. To equip students with skills to assess power system stability and perform economic load dispatch using modern software tools.

Course Outcomes: At the end of course, student will be able to

1. CO1: Model and analyze synchronous and induction machines in steady state using SIMULINK.
2. CO2: Demonstrate the ability to simulate and interpret the performance of three-phase converters and inverters.
3. CO3: Carry out load flow, fault, and short circuit analysis using numerical methods and computational tools.
4. CO4: Evaluate transient and voltage stability and perform economic load dispatch using software-based techniques.

List of Experiments

Minimum of Eight (8) experiments should be performed under Lab Practice – I.

A list of experiments that may be performed under various subjects of semester -I, is given below

A. Power System Modelling

1. Steady state analysis of synchronous machine using SIMULINK
2. Steady state Analysis of synchronous machine connected to infinite bus using SIMULINK.
3. Steady state analysis of excitation control systems using SIMULINK.
4. Induction Motor Modeling and Analysis using SIMULINK.

B. Advanced Power Electronics

5. Three phase converter supplying R (resistive) and R-L load (simulation / hardware).
6. Three phase voltage source Inverter (simulation / hardware).

C. Computer applications in Power System

7. Load flow analysis by using Newton Raphson method on digital computer.
8. Optimal Power flow analysis.
9. AC-DC load flow analysis on digital computers.
10. Analysis of various types of faults on digital computer.
11. Short circuit analysis.

D. Power System Economics & Management

12. Study of institutional framework and policy impact on Indian power sector using case studies of Electricity Act 2003 and its amendments.

13. Calculation of project economics using NPV, IRR, and life cycle cost for a sample power project in Excel/MATLAB.

14. Analysis of different consumer tariff structures (TOU, telescopic, fixed/variable charges) using real load profiles.

15. Simulation of electricity market operations to determine Market Clearing Price (MCP) under different bidding strategies.

16. Case study and simulation of transmission pricing methods including Locational Marginal Pricing (LMP) and congestion management.

Learning Resources

1. Text Books

[T1]. Bimbra P. S. – Electrical Machinery
[T2]. R. Krishnan – Electric Motor Drives: Modeling, Analysis, and Control
[T5]. J. David Irwin, R. M. Nelms – Electric Circuit Analysis
[T6]. Muhammad H. Rashid – Power Electronics: Circuits, Devices and Applications
[T7]. Ned Mohan – Power Electronics: Converters, Applications, and Design
[T8]. Hadi Saadat – Power System Analysis
[T9]. D.P. Kothari & I.J. Nagrath – Modern Power System Analysis

2. Reference Books

[R1]. A. Abdel-Rahman – Modeling and Simulation of Electrical Machines using MATLAB/Simulink
[R2]. Gopal K. Dubey – Fundamentals of Electrical Drives
[R3]. Bimal K. Bose – Modern Power Electronics and AC Drives
[R4]. K. Uma Rao – Computer Techniques in Power System Analysis

3. Softwares/e-Resources

[T1]. MathWorks Documentation – Simscape Electrical and Simulink Examples, https://www.mathworks.com/help/sps/
[T2]. ETAP (Electrical Transient Analyzer Program)
[T3]. **Power World Simulator** https://www.powerworld.com
[T4]. DIgSILENT PowerFactory

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-521A-POS	**Course Name: Smart Grid Technology**	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hrs	03	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite:

Course Objectives:

1. Provide a comprehensive understanding of the evolution, architecture, and key features of Smart Grids.
2. Familiarize students with advanced communication technologies, ICT, and cybersecurity requirements in smart grid applications.
3. Develop knowledge of renewable energy integration and energy storage technologies for modern grid operations.
4. Enable students to apply advanced monitoring, control, and protection techniques for reliable and resilient power systems.
5. Expose students to emerging trends, innovative applications, and global case studies in smart grid technologies.

Course Outcomes: At the end of the course, students will be able to

1. **CO1:** Explain the architecture, functions, and policies of Smart Grids with reference to global and Indian perspectives.
2. **CO2:** Analyse the role of ICT, IoT, smart meters, and communication protocols in enabling smart grid operations while addressing cybersecurity.
3. **CO3:** Evaluate renewable energy integration challenges and apply suitable storage and microgrid solutions.
4. **CO4:** Apply advanced monitoring, control, and protection tools such as PMUs, IEDs, and AI-based analytics for real-time smart grid management.
5. **CO5:** Assess emerging technologies like EVs, V2G, blockchain, and digital twins in shaping the future of smart grids through case studies.

Course Contents

Unit No: I	**Fundamentals of Smart Grids**	**08 Hours**

Evolution of power grids to smart grids – need, scope, and drivers. Smart Grid architecture: generation, transmission, distribution, and consumer interface. Characteristics: self-healing, reliability, resiliency, efficiency, and sustainability. International Smart Grid standards and initiatives (IEEE, NIST, CIGRE, IEC). Indian Smart Grid Mission (ISGM) and policies.

Unit No: II	**Communication and Information Technologies for Smart Grids**	**08 Hours**

Smart grid communication requirements and protocols (SCADA, IEC 61850, DNP3, Modbus). Role of ICT, IoT, and cloud computing in smart grids. Wireless technologies: ZigBee, Wi-Fi, 5G, and AMI (Advanced Metering Infrastructure). Smart meters, demand response, and Home Energy Management Systems (HEMS). Cybersecurity issues in smart grid communication networks.

Unit No: III	**Integration of Renewable Energy and Storage**	**08 Hours**

Challenges of integrating solar, wind, and hybrid systems into the grid. Grid codes and interconnection standards. Forecasting and variability management. Energy Storage Systems (ESS): batteries, pumped hydro, supercapacitors, flywheels. Microgrids and Virtual Power Plants (VPPs). Role of power electronics in RES integration (inverters, FACTS, MMC).

Unit No: IV	Advanced Monitoring, Control, and Protection	08 Hours
Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMUs). Synchro phasor technology and applications. Smart sensors, Intelligent Electronic Devices (IEDs), and digital substations. Adaptive and self-healing protection schemes. State estimation and real-time monitoring in smart grids. AI, Machine Learning, and Data Analytics for predictive maintenance		

Unit No: V	Emerging Trends and Applications	08 Hours
Electric Vehicles (EVs) and Vehicle-to-Grid (V2G) technologies. Distributed Energy Resources (DER) management. Blockchain in energy trading and peer-to-peer markets. Smart grid economics and regulatory challenges. Case studies: Smart grid pilots and implementations in India and abroad. Future trends: Green Hydrogen, Digital Twins, and Artificial Intelligence-driven smart grids.		

Learning Resources

1. Text Books

[T1]. R.C. Bansal, R. Hasan, S. Rahman “Smart Grid: Fundamentals, Technologies and Applications”, CRC Press India Edition, 2019

[T2]. N.V. Ramana, R. Sarath Kumar, K. Rani “Smart Grid: Technology and Applications”, Pearson India, 2017

[T3]. S. Sivanagaraju, G. Sreenivasan “Smart Grid: Concepts and Technologies”, Cengage Learning India, 2016

[T4]. S. K. Srivastava, S.N. Singh “Smart Grid: Technology, Applications and Control”, PHI Learning, New Delhi, 2018

[T5]. Ramesh Bansal, “Smart Grid: Modernizing Electric Power Transmission and Distribution”

2. Reference Books

[R1]. Krishan Arora, M.P. Sharma – Smart Grid: Innovative Solutions for a Modern Power System – S. Chand Publishing, 2020.

[R2]. S. N. Singh, S.C. Srivastava – Smart Grid and Renewable Energy Integration – PHI Learning, 2021.

[R3]. D.P. Kothari, K.P. Singh Parmar – Smart Power Grids 2011 – McGraw Hill India Edition.

[R4]. L. L. Lai (adapted by Indian editors for Indian context) – Power System Restructuring and Deregulation: Trading, Performance and Information Technology – Wiley India Edition.

[R5]. S. Chakrabarti, A. Bose – Electric Power Systems: Smart Grids, Renewable Energy Integration – CRC Press India, 2018.

3. Links to online SWAYAM/NPTEL Courses

Smart Grid: Basics to Advanced Technologies - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-521B-POS	Course Name: Industrial Automation and Control	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hrs	03	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Course Objectives:

1. Introduce the fundamentals and architecture of industrial automation systems.
2. Develop understanding of sensors, actuators, and transducers used in industrial control systems.
3. Explore the use of PLCs, SCADA, and DCS in process automation.
4. Analyze industrial communication protocols and control strategies.
5. Apply automation and control techniques in real-time industrial environments.

Course Outcomes: At the end of the course, students will be able to

1. **CO1**: Understand the architecture and components of industrial automation systems.
2. **CO2**: Analyse the role and selection of sensors and actuators in industrial processes.
3. **CO3**: Develop PLC-based control logic and implement SCADA/DCS systems for automation.
4. **CO4**: Evaluate industrial communication protocols and control networks.
5. **CO5**: Design and implement industrial control strategies using modern automation tools.

Course Contents

Unit No: I	Introduction to Industrial Automation and Control Systems	08 Hours

Need and scope of automation, Types of control systems: open loop and closed loop, Hierarchy of automation: field level, control level, supervisory level, Introduction to industrial control devices: relays, contactors, switches, sensors, Overview of standards (IEC, ISA)

Unit No: II	Sensors, Actuators, and Signal Conditioning	08 Hours

Types of sensors: temperature, pressure, flow, level, proximity, position, Working principles and selection criteria, Actuators: electrical, pneumatic, hydraulic, Signal conditioning, isolation, filtering, and noise reduction, Interfacing with control systems

Unit No: III	Programmable Logic Controllers (PLC)	08 Hours

PLC architecture and working, I/O modules, memory organization, PLC programming languages (Ladder Logic, FBD, STL), Timers, counters, data handling functions, PLC-based control applications: motor control, conveyor systems, process control

Unit No: IV	Supervisory Control and Data Acquisition (SCADA) and DCS	08 Hours

SCADA system architecture and components, Communication with RTUs and PLCs, Human Machine Interface (HMI) design and functions, Overview of Distributed Control Systems (DCS): structure and applications, Case studies of SCADA/DCS implementation in industries

Unit No: V	Industrial Communication and Automation Applications	08 Hours

Communication protocols: Modbus, Profibus, CAN, Ethernet/IP, Fieldbus, Network topologies and industrial networking standards, Industrial IoT (IIoT) basics and integration, Automation in manufacturing, process industries, and energy systems, Safety, cybersecurity, and future trends in industrial automation

Learning Resources
Text Books
[T1]. Industrial Instrumentation and Control, S.K. Singh, McGraw Hill [T2]. Industrial Automation and Robotics, R.P. Venkata Krishna, , University Science Press [T3]. Industrial Electronics and Control, M.P. Grover, Dhanpat Rai & Co. [T4]. Programmable Logic Controllers and Industrial Automation, K. Krishna Reddy, SCITECH [T5]. SCADA: Supervisory Control and Data Acquisition, K. L. Saini, Khanna Publishers
2. Reference Books
[R1]. Lingefeng Wang, Kay Chen Tan, "Modern Industrial Automation and Software Design" John Wiley & Sons Inc. [R2]. K. L.S. Sharma, "Overview of Industrial Process Automation" Elsevier [R3]. Kok Kiong "Drives and Control for Industrial Automation" Springer
3. Links to online SWAYAM/NPTEL Courses
Industrial Automation And Control - Course NPTEL :: Electrical Engineering - Industrial Automation and Control

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-522-POS			**Course Name: Elective Lab-I**
Teaching Scheme		**Credits**	**Examination Scheme**
Theory	: 00 Hrs	--	TW : 25 Marks
Practical	: 02 Hrs	01	OR : 25 Marks

Course Objectives:

1. To enable students to analyse and process discrete-time signals and systems using Z-transforms and digital filter techniques.
2. To develop competency in designing FIR and IIR filters using windowing, frequency sampling, and transform-based methods.
3. To introduce adaptive signal processing using LMS algorithms and explore real-time implementation on DSP hardware.
4. To provide practical skills in industrial automation through PLC programming, sensor interfacing, and actuator control.
5. To familiarize students with SCADA, DCS, and industrial communication protocols for process monitoring and control.

Course Outcomes: At the end of course, student will be able to

CO1. Analyse discrete-time signals and compute Z-transforms using MATLAB/Python.
CO2. Design and evaluate FIR and IIR digital filters for signal processing applications.
CO3. Implement adaptive filters like LMS and apply them to real-time signal processing problems.
CO4. Develop and test automation logic using PLCs and interface with industrial devices.
CO5. Design and simulate SCADA/DCS systems and configure communication using industrial protocols like MODBUS.

List of Experiments

- **Minimum of Eight (6) experiments should be performed under Elective Lab -1.**

Smart Grid Technology

1. Modeling and comparison of a conventional power grid vs. smart grid architecture in MATLAB/Simulink, highlighting improvements in reliability indices (SAIFI/SAIDI).
2. Simulation of data acquisition and control using SCADA/IEC 61850 protocol for a sample smart substation.
3. Implementation of smart metering and demand response using Advanced Metering Infrastructure (AMI) data for residential load management.
4. Forecasting solar/wind generation using real-time/weather datasets and evaluating prediction accuracy (ARIMA/ML-based).
5. Simulation of a grid-connected PV/Battery hybrid microgrid with islanding and resynchronization capabilities.
6. Phasor Measurement Unit (PMU) data simulation and application for wide-area monitoring and oscillation detection.
7. Adaptive protection scheme demonstration using Intelligent Electronic Devices (IEDs) for a distribution feeder with renewable penetration.
8. Case study and simulation of Electric Vehicle (EV) smart charging and Vehicle-to-Grid (V2G) operation to minimize feeder peak load.

Industrial Automation and Control

PLC program using combination of timer and counter.

1. Study of Open Loop and Closed Loop Control Systems using Simulation Tools (MATLAB Simulink / Proteus / LabVIEW)
2. Interfacing Temperature and Proximity Sensors with Arduino/PLC (Arduino IDE / TinkerCAD / PLC hardware)
3. Control of DC Motor or Solenoid Using Actuators and Relay Module
4. PLC-based Traffic Light Control System using Ladder Logic (Siemens LOGO! Soft / Allen Bradley RSLogix / Factory I/O)
5. PLC-based Conveyor Belt System with Start/Stop and Emergency Logic
6. SCADA-Based Water Tank Level Monitoring and Control (iFIX, Wonderware, LabVIEW, or OpenSCADA)
7. Case Study or Demonstration of DCS for Process Control
8. Communication Between Two Devices using MODBUS RTU or TCP/IP (Modbus simulator (ModScan / ModSim) with PLC or RS485 modules)

Learning Resources

1. Text Books

[T1]. S. K. Srivastava, S. N. Singh – Smart Grid: Technology, Applications and Control – PHI Learning, 2018.

[T2]. N. V. Ramana, R. Sarath Kumar, K. Rani – Smart Grid: Technology and Applications – Pearson India, 2017.

[T3]. Ramesh Bansal – Smart Grid: Modernizing Electric Power Transmission and Distribution – I.K. International, 2017.

[T4]. Terry Borden & Richard Cox – Introduction to Programmable Logic Controllers

[T5]. T. R. Padmanabhan, Industrial Instrumentation, Springer India

[T6]. Rajesh A. Rajguru, SCADA: Supervisory Control and Data Acquisition, Shroff Publishers

2. Reference Books

[R1]. Krishan Arora, M. P. Sharma – Smart Grid: Innovative Solutions for a Modern Power System – S. Chand Publishing, 2020.

[R2]. S. N. Singh, S. C. Srivastava – Smart Grid and Renewable Energy Integration – PHI Learning, 2021.

[R3]. D. P. Kothari, K. P. Singh Parmar – Smart Power Grids 2011 – McGraw Hill India Edition, 2011.

[R4]. John W. Webb & Ronald A. Reis – Programmable Logic Controllers: Principles and Applications

[R5]. S. Sundar Rajan, Modeling and Simulation Using MATLAB – Simulink, Mc Hall

[R6]. Ashwin Pajankar, Getting Started with Arduino and Raspberry Pi, BPB Publications

[R7]. Krishna Kant, Computer-Based Industrial Control, PHI Learning

3. E-Resources/ software tools

[E1]. MATLAB/Simulink (Simscape Power Systems toolbox),

[E2]. PowerWorld Simulator / DIgSILENT PowerFactory (optional)

[E3]. ZigBee / Wi-Fi-based Home Energy Management System kit

[E4]. PV emulator + Battery storage system

[E5]. **MATLAB Signal Processing Toolbox** https://www.mathworks.com/help/signal/

[E6]. Siemens TIA Portal & S7-1200 Manuals **https://support.industry.siemens.com**

[E7]. **Allen-Bradley (Rockwell Automation) Manuals & RSLogix** https://literature.rockwellautomation.com

सावित्रीबाई फुले पुणे विद्यापीठ

SEMESTER-II

Master of Engineering (2025 Pattern)

ME-Electrical (Power Systems)

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-551-POS		**Course Name:** Power System planning & reliability
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Course Objectives:

1. To provide knowledge of load forecasting methods and their role in power system planning.
2. To develop understanding of probability, statistics, and mathematical models used in reliability analysis.
3. To explain the concepts of power system reliability and associated indices for generation and distribution.
4. To analyze generation planning approaches with economic and reliability evaluation.
5. To study transmission and distribution planning techniques ensuring secure and reliable operation.

Course Outcomes: Students will be able to

CO1. Apply load forecasting techniques for short, medium, and long-term system planning.
CO2. Use probability distributions and stochastic models for reliability analysis of power systems.
CO3. Evaluate generation and distribution system reliability indices and associated costs.
CO4. Perform generation planning using economic assessment and optimization methods.
CO5. Assess transmission and distribution planning strategies considering failures, reconfiguration, and protective devices.

Course Contents

Unit No: I	**Load Forecasting and System Planning**	**10 Hours**

Introduction to load forecasting and system planning, Factors affecting load forecasting, Load research and growth characteristics, Classification of load and its characteristics, Forecasting methods: extrapolation, correlation techniques, Types of load forecasting: energy, peak, reactive, weather-sensitive, non-weather-sensitive, Objectives and factors affecting planning, Short, medium, and long-term system planning

Unit No: II	**Mathematical Foundations for Reliability Analysis**	**10 Hours**

Probability concepts and random variables, Distribution functions: Binomial, Normal, Exponential, Gaussian, Mathematical expectation, Regression analysis, Markov process and its applications in reliability, Basics of stochastic modeling for power systems

Unit No: III	**Power System Reliability Concepts and Indices**	**10 Hours**

Concept of reliability and failure analysis, Reliability indices of distribution systems: SAIDI, SAIFI, CAIDI, ASAI, ASUI, Reliability indices of generation systems: LOLP, LOLE, EENS, Causes of interruption and failure modes, Customer Composite Damage Function (CCDF), Reliability cost evaluation

Unit No: IV	**Generation Planning and Reliability Evaluation**	**10 Hours**

Generation models and functional economic analysis, Economic assessment methods: NPV, Internal Profit Rate, Minimum Cost, Annual Equivalent Value, Capacity expansion and optimization models, Mathematical models of generation investment decisions, Algorithms: Ranking algorithm, Steepest Descent method, Reliability evaluation for generation planning

Unit No: V	**Transmission and Distribution Planning**	**10 Hours**

Interregional transmission systems in India, Failure analysis of transmission lines, towers, and substations, Monitoring and evaluation of transmission projects, Long-term and short-term transmission planning studies,

Evaluation of system and load point indices in transmission networks, Distribution systems: concept and types, Interruptions and reconfiguration algorithms, Role of protective devices (disconnectors, CBs, isolators), Partial load transfer and weather effects, Evaluation of distribution system reliability indices

Learning Resources
1. Text Books
1. Reliability Evaluation of Power System - Roy Billinton & Ronald N. Allan, Springer Publication. 2. Probability and Statistic for Engineers, Miler & Freund's, Pearson Education, Richard Johnson. 3. Electricity Economics & Planning – T.W.Berrie, Peter Peregrinus Ltd., London
2. Reference Books
[R1]. Modern Power System Planning – X. Wang & J.R. McDonald, McGraw Hill [R2]. Electrical Power Distribution Engineering - T. Gönen, McGraw Hill Book Company [R3]. Electrical Power Distribution A.S. Pabla, Tata McGraw Hill Publishing Company Ltd.
3. Links to online SWAYAM/NPTEL Courses
Operation And Planning Of Power Distribution Systems - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-552-POS	**Course Name:** Advanced Power System Protection	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite:
Basic Power system, basic protection schemes

Course Objectives:

1. Understand the fundamentals of modern protection schemes for electrical power systems.
2. Learn the operation and implementation of digital/numerical relays.
3. Analyse protection strategies for major power system components.
4. Study advanced techniques in wide-area protection and smart grid applications.
5. Develop the ability to coordinate and design effective protection systems for reliable grid operation

Course Outcomes:

At the end of course, the student will be able to

CO1. Explain and compare traditional and advanced protection principles used in power systems.
CO2. Analyse and design digital/numerical protection schemes using modern algorithms.
CO3. Evaluate protection strategies for transmission lines, feeders, and equipment.
CO4. Integrate communication and automation technologies into protection systems.
CO5. Apply wide-area monitoring, PMUs, and cybersecurity measures to power system protection.

Course Contents

Unit No: I	**Protection System Fundamentals and Relay Coordination**	**10 Hours**

Review of protection system elements: relays, CTs, PTs, circuit breakers, Zones of protection and fault classification, Types of relays: Electromechanical, static, and numerical, Primary and backup protection, Relay coordination and time grading, Protection reliability, security, and dependability

Unit No: II	**Digital and Numerical Protection**	**10 Hours**

Introduction to digital relaying: advantages and architecture, Signal acquisition and conditioning: Sampling, filtering, Algorithms: Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Overcurrent, distance, and differential protection using numerical methods, Fault detection logic and microprocessor-based relays

Unit No: III	**Protection of Transmission Lines and Feeders**	**10 Hours**

Time, current, and distance-based protection, Distance protection characteristics: impedance, mho, reactance, Carrier-aided protection: DCB, POTT, PUTT, Pilot protection schemes using fiber optics and PLCC, Auto-reclosing and sectionalizing

Unit No: IV	**Protection of Power System Components**	**10 Hours**

Transformer protection: differential, REF, Buchholz, inrush discrimination, Generator protection: stator and rotor faults, reverse power, loss of excitation, Motor protection: overload, single phasing, locked rotor, Busbar protection: differential and zone protection, Reactor and capacitor bank protection

Unit No: V	**Modern Trends and Wide-Area Protection**	**10 Hours**

Substation automation and IEC 61850, Phasor Measurement Units (PMUs) and Synchro phasors, Wide Area Monitoring System (WAMS), Smart grid protection architecture, Cybersecurity threats and mitigation in protection systems, Intelligent relays and AI in protection

Learning Resources

1. Text Books

[T1]. Digital Protection- L. P. Singh, New Age International (P) Limited Publishers, New Delhi, 2nd Edition

[T2]. Transmission Network Protection- Paithankar Y. G. (Marcel & Dekker, New York)

[T3]. Fundamentals of Power System Protection- Paithankar Y. G. & Bhide (PHI New Delhi)

2. Reference Books

[R1]. Protective Relaying for Power System II-Stanley Horowitz (IEEE press , New York)

[R2]. Digital Relay / Numerical relays – T.S.M. Rao, Tata Mc Graw Hill, New Delhi

[R3]. NPTEL course on power system protection by S. A. Soman.

[R4]. IEEE C37 series and IEC 61850 Standards

3. Links to online SWAYAM/NPTEL Courses

Power System Protection - Course

Digital Protection of Power System - Course

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PCC-553-POS	**Course Name:** Power System Dynamics	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite: Basic Mathematics and Differential Equations, Basic Power Electronics, Power System Analysis, Basic Simulation Tools

Course Objectives:

1. Introduce the fundamental concepts of dynamic behavior in power systems.
2. Develop mathematical models of synchronous machines and associated control systems.
3. Provide insight into stability problems and their classifications.
4. Analyze single and multi-machine power system dynamic behavior.
5. Equip students with tools to study and simulate power system dynamics.

Course Outcomes: Students will be able to

1. **CO1**: Understand the fundamentals and need for dynamic analysis in power systems.
2. **CO2**: Develop mathematical models of synchronous machines and excitation systems.
3. **CO3**: Classify and analyse different types of power system stability.
4. **CO4**: Apply modelling techniques to single-machine and multi-machine systems.
5. **CO5**: Use analytical and simulation tools to study power system dynamics and suggest mitigation methods

Course Contents

Unit No: I	**Introduction to Power System Dynamics**	**10 Hours**

Importance of dynamic studies in modern power systems, Classification of stability: steady-state, dynamic, transient, voltage, Overview of system components affecting dynamics, The swing equation: derivation and significance, Equal area criterion for stability assessment, Introduction to time-domain simulation

Unit No: II	**Synchronous Machine Modeling**	**10 Hours**

Review of synchronous machine operation, Rotor reference frame transformation (Park's transformation), d–q axis modeling of synchronous generators, Flux linkage model, voltage and current models, Machine equations for dynamic studies, Simplified and detailed models for system-level studies

Unit No: III	**Excitation Systems and Turbine-Governor Modeling**	**10 Hours**

Types and role of excitation systems in dynamic performance, IEEE standard models of excitation systems (Type 1, 2, 3), Static and dynamic performance of excitation systems, Turbine-governor system models (steam, hydro, gas), Load modelling for dynamic analysis (static & dynamic characteristics)

Unit No: IV	**Stability Analysis of Power Systems**	**10 Hours**

Transient stability: numerical solution of swing equation, Small-signal stability: linearization, state-space models, Eigenvalue analysis for stability assessment, Damping of oscillations and rotor angle stability, Single Machine Infinite Bus (SMIB) system analysis, Introduction to multi-machine systems and coherency

Unit No: V	**Tools, Simulation & Case Studies**	**10 Hours**

MATLAB/Simulink for dynamic modeling, Software tools for dynamic simulations eg. DigSilent, Case study: generator instability under fault conditions, Role of Power System Stabilizers (PSS), Basics of Wide-Area Monitoring and Control (WAMC), Challenges in renewable-integrated systems

Learning Resources

1. Text Books

1. Power System Dynamics- K.R. Padiyar, B.S. Publications
2. Power System Dynamics Control – Prabha S. Kundur, IEEE Press , New York

2. Reference Books

R1.Power System Stability – E.W. Kimbark, IEEE press, N.Y, Vol.

R2. Power System Control and Stability – Vol. – I – Anderson &Foud, IEEE Press, New York.

R3. Power System Voltage Stability – C. W. Taylor., McGraw Hill International student edition

R4. Distributed Generation Islanding – implication on power system dynamics performance. –

R5. R.A. Walling, N. W. Miller, Power Engineering Society, Summer Meeting, 2002, IEEE Publication, 25 July 2002, Vol. I, PP 92-9

3. Links to online SWAYAM/NPTEL Courses

Power System Dynamics, Control and Monitoring - Course

NPTEL :: Electrical Engineering - Power System Dynamics

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-554-POS		**Course Name:** Laboratory Practice-II
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 25 Marks
Practical : 04 Hrs	02	PR : 25 Marks

Course Objectives:

1. To introduce students to modelling and control of electric drives including DC, induction, stepper, and BLDC motors using MATLAB/Simulink and microcontrollers.
2. To develop proficiency in designing and simulating advanced protection schemes for transmission lines, transformers, and substations using relays and IEC 61850 protocols.
3. To enable students to implement closed-loop control of electric machines and real-time drive systems using Arduino and PWM techniques.
4. To provide a foundation in simulating and analysing power system dynamic behaviour including rotor angle and small-signal stability.
5. To equip students with hands-on skills in modelling excitation systems and synchronous generators using d-q axis and swing equation techniques.

Course Outcomes: At the end of course, student will be able to

1. CO1: Simulate and analyse four-quadrant operations and speed control strategies for various electric drives.
2. CO2: implement V/f control and BLDC/stepper motor control using Simulink and microcontroller platforms.
3. CO3: model and evaluate protection schemes like overcurrent, differential, and distance protection using digital tools.
4. CO4: simulate power system stability phenomena and evaluate synchronous machine behavior using dynamic models.
5. CO5: demonstrate the ability to design, simulate, and implement real-time control and monitoring solutions for electric drives and power systems

List of Experiments

- **Minimum of Eight (8) experiments should be performed under Lab Practice – II.**

Power System planning & reliability

1. Short- and long-term forecasting using regression and time-series in MATLAB/Python.
2. Reliability analysis with probability distributions (Exponential, Normal, Weibull).
3. Evaluation of indices (LOLP, LOLE, EENS) and economic assessment (NPV).
4. Simulation of reliability indices (SAIFI, SAIDI, CAIDI) and contingency analysis.
5. Feeder reconfiguration and protective device coordination for reliability improvement.

Advanced Power System Protection

1. Time-Current Characteristic Coordination of Overcurrent Relays
2. Implementation of Digital Overcurrent Protection using Microcontroller
3. Simulation of Distance Protection for Transmission Line Using Impedance Characteristics
4. Transformer Differential Protection and Inrush Discrimination using Simulink
5. Substation Automation and IEC 61850 Messaging Simulation

Power System Dynamics

6. Simulation of Rotor Angle Stability Using the Swing Equation

7. d-q Axis Modeling of a Synchronous Generator Using MATLAB/Simulink
8. Modeling and Performance Evaluation of IEEE Type-1 Excitation System
9. Small Signal Stability Analysis Using Eigenvalue Analysis
10. Real-Time Monitoring and Control of Generator Load Variation Using Arduino

Learning Resources

1. Text Books

[T1]. R. N. Dhar – Power System Reliability Evaluation – Tata McGraw Hill.
[T2]. S. S. Rao – Power System Planning: Principles and Applications – Tata McGraw Hill.
[T3]. P. S. R. Murty – Power System Operation and Control – BS Publications.
[T4]. Badri Ram, D.N. Vishwakarma, Power System Protection and Switchgear, McGraw Hil
[T5]. J. Lewis Blackburn, Protective Relaying: Principles and Applications
[T6]. K.R. Padiyar, Power System Dynamics: Stability and Control, BS Publications

2. Reference Books

[R1]. S. K. Soonee, S. R. Narasimhan, and R. S. Verma – Power System Operation and Reliability: Practical Aspects – PHI Learning.
[R2]. P. K. Kalra & S. C. Gupta – Power System Planning and Reliability – Tata McGraw Hill.
[R3]. B. R. Gupta – Power System Analysis and Design – S. Chand Publishing
[R4]. Agam Kumar Tyagi, MATLAB and Simulink for Engineers, University Science Press
[R5]. Ned Mohan, Electrical Machines and Drives Using MATLAB
[R6]. V.R. Moorthi, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press
[R7]. Rajesh Singh, Anita Gehlot, Arduino and Motor Control, CRC Press India

3. Other References

1. Gnanavadivel, P., Power Electronics and Drives Lab Manual, Charulatha Publications
2. P.S. Bimbhra, Electrical Machines Lab Manual, Khanna Publishers (for synchronous & induction motors)
3. Dr. Rajesh Singh et al., Embedded System Design Using Arduino, PHI India (for Arduino-based control systems)

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-561A-POS		**Course Name:** Distributed Generation and Microgrid
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hrs	03	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite: Basic Electrical Engineering, Fundamentals of Energy Systems, Power System Basics (generation, transmission, distribution), Knowledge of centralized vs decentralized power systems, Basic understanding of energy economics

Course Objectives:

1. Introduce various renewable energy sources and their potential for sustainable electricity generation.
2. Explain the fundamentals and operational philosophy of Distributed Generation (DG) and its role in modern power systems.
3. Discuss technical, economic, and regulatory issues related to integrating distributed generation into the power grid.
4. Present the architecture, operation, and control of microgrids including both grid-connected and island modes.
5. Highlight power quality problems associated with DG and microgrids, along with suitable mitigation techniques.

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

1. CO1: Understand exploration of renewable energy sources
2. CO2: Understand philosophy of distributed generation
3. CO3: Understand various issues of DG with grid integration
4. CO4: Understand the concept of micro grid
5. CO5: Understand various power quality issues.

Course Contents

Unit No: I	**INTRODUCTION**	**08 Hours**

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

Unit No: II	**DISTRIBUTED GENERATIONS (DG)**	**08 Hours**

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

Unit No: III	**IMPACT OF GRID INTEGRATION**	**08 Hours**

Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Unit No: IV	**MICROGRIDS**	**08 Hours**

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and

communication based techniques.		
Unit No: V	**POWER QUALITY ISSUES IN MICROGRIDS**	**08 Hours**
Power quality issues in microgrids- Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids.		

Learning Resources

1. Text Books

[T1]. Renewable Energy Sources and Emerging Technologies, D.P. Kothari and K.C. Singal, PHI Learning

[T2]. Non-Conventional Energy Resources, B.H. Khan, McGraw Hill Education

[T3]. SMART GRID: FUNDAMENTALS & APPLICATIONS, JHA, I.S, SEN SUBIR, RAJESH KUMAR, KOTHARI, D.P, NEW AGE INTERNATIONAL 2019

[T4]. Energy Technology: Non-Conventional, Renewable and Conventional, S.Rao and B.B. Parulekar, Khanna Publishers

2. Reference Books

[R1]. Voltage Source Converters in Power Systems: Modeling, Control and Applications, AmirnaserYezdani, and Reza Iravani, IEEE John Wiley Publications,2009.

[R2]. Power Switching Converters: Medium and High Power, Dorin Neacsu, CRC Press, Taylor & Francis, 2006.

[R3]. Solar Photo Voltaic, Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009.

[R4]. Wind Energy Explained, theory design and applications, J.F. Manwell, J.G. McGowan Wiley publication,2002.

[R5]. Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York, 1987. R6. Renewable Energy Resources, John Twidell and Tony Weir, Tyalor and Francis Publications, 2005.

3. Links to online SWAYAM/NPTEL Courses

DC Microgrid and Control System - Course

NPTEL :: Electrical Engineering - NOC:Smart Grid: Basics to Advanced Technologies

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-561B-POS		**Course Name:** Applications of Power Electronics to Power System	
Teaching Scheme		**Credits**	**Examination Scheme**
Theory	: 03 Hrs	03	CCE : 50 Marks
Practical	: 00 Hrs	--	ESE : 50 Marks

Prerequisite: Basic Power Electronics, Fundamentals of Power Systems, Control Systems, Electrical Machines, Analog and Digital Electronics

Course Objectives:

1. Understand the role and importance of power electronics in modern power systems.
2. Analyze different power electronic converters and their applications in power generation, transmission, and distribution.
3. Study FACTS devices, HVDC systems, and custom power solutions for improving power quality and reliability.
4. Explore control strategies for power electronic systems in grid applications.
5. Apply advanced power electronics in renewable energy integration and smart grid systems.

Course Outcomes:

1. CO1: Explain the importance of power electronics in enhancing the performance of power systems.
2. CO2: Analyze power electronic converters used in HVDC and FACTS devices.
3. CO3: Understand the operation and control of various FACTS controllers.
4. CO4: Evaluate power quality and reliability improvements using custom power devices.
5. CO5: Apply power electronics for renewable energy integration and smart grid operation.

Course Contents

Unit No: I	**Power Electronic Converters in Power Systems**	**08 Hours**

Overview of power electronics in power systems, AC-DC, DC-DC, and DC-AC converters: topologies and control, PWM techniques and modulation strategies, Role of converters in transmission and distribution, Case studies of converter-based applications

Unit No: II	**HVDC Transmission Systems**	**08 Hours**

Introduction to HVDC systems: Need and benefits, Types of HVDC links, Line-commutated and voltage-source converters, Control of HVDC systems, Applications in long-distance and asynchronous interconnections

Unit No: III	**FACTS Devices and Their Applications**	**08 Hours**

Concept of Flexible AC Transmission Systems (FACTS), Classification and comparison of FACTS controllers, Static VAR Compensator (SVC), TCSC, STATCOM, SSSC, UPFC, Control schemes for FACTS devices, Impact on system stability, power flow, and voltage control

Unit No: IV	**Power Quality and Custom Power Devices**	**08 Hours**

Power quality issues in distribution systems, Custom power devices: DVR, DSTATCOM, UPS, Active Filters, Design and control of custom power equipment, Mitigation of harmonics, sags, swells, and flicker, Coordination with FACTS and DG systems

Unit No: V	**Power Electronics in Renewable and Smart Grids**	**08 Hours**

Interface converters for solar PV, wind, and hybrid systems, Grid synchronization and MPPT control, Role of inverters in smart grid systems, Distributed generation and microgrid control, Energy storage integration using power electronics

Learning Resources

1. Text Books

[T1].HVDC Power Transmission Systems, K. R. Padiyar, New Age International

[T2].Applications of Power Electronics in Power Systems, Dr. N. Nedumparambil, University Science Press

2. Reference Books

[R1]. Understanding of FACTs., Hingorani, N. G.; IEEE Press 1996.

[R2]. Power Quality.; Heydt G.T.; Stars in a Circle Pblications , Indiana, 1991.

[R3]. Static Reactive Power Compensation.; Miller T.J.E.; John Wiley & Sons, New York, 1982

[R4]. Flexible AC Transmission System. (FACTs).; Yong Hua Song.; IEE 1999.

[R5]. Recent Publications on IEEE Journals.

3. Links to online SWAYAM/NPTEL Courses

Power Electronics Applications in Power Systems - Course

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: PEC-561B-POS	**Course Name:** Digital Signal Processing and its Applications	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hrs	03	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite:

Course Objectives:

1. To develop fundamental understanding of discrete-time signals, systems, and Z-transform analysis.
2. To analyze signals and systems using Fourier and Fast Fourier Transform techniques.
3. To study and evaluate time-domain and frequency-domain responses of discrete-time systems.
4. To design and implement digital IIR and FIR filters for signal processing applications.
5. To apply DSP techniques for power system measurement, protection, control, and monitoring.

Course Outcomes:

CO1. Represent and analyze discrete-time signals and systems using Z-transform.

CO2. Apply DTFT, DFT, and FFT for frequency analysis of signals.

CO3. Evaluate time and frequency responses of discrete-time systems and design ideal filters.

CO4. Design and realize IIR and FIR digital filters using appropriate methods and structures.

CO5. Implement DSP techniques for real-world power system applications such as measurement, control, and protection.

Course Contents

Unit No: I	Discrete-Time Signals, Systems & Z-Transform	08 Hours

Sampling of continuous time signals, quantization, aliasing, Sampling Theorem.
Elementary discrete-time signals, classification, sequence operations.
Discrete-time systems: classification, impulse response, convolution, difference equations.
Z-transform: definition, properties, inverse Z-transform (power series, partial fractions).
Solution of difference equations, analysis of LTI systems.

Unit No: II	Frequency Analysis of Discrete-Time Signals	08 Hours

Discrete-Time Fourier Transform (DTFT): definition, properties, frequency spectrum, numericals.
Discrete Fourier Transform (DFT): definition, properties, circular and linear convolution.
Fast Fourier Transform (FFT): radix-2 DIT and DIF algorithms.

Unit No: III	Time & Frequency Response of Systems	08 Hours

Time response: natural, forced, and total response, impulse and step response.
Frequency response of first and second order systems, transfer function.
Steady-state and transient response, phase and group delays.
Ideal filters: pole-zero locations, zero phase and linear phase transfer functions.

Unit No: IV	Digital Filter Design – IIR Filters	08 Hours

Digital vs. analog filters, FIR vs. IIR characteristics.
Design of analog low-pass Butterworth and Chebyshev filters.
IIR filter design using bilinear transformation and impulse invariance.
Realization structures: direct form I, direct form II, cascade and parallel.

Unit No: V	Digital Filter Design – FIR Filters & DSP Applications	08 Hours
FIR filter design: symmetric/antisymmetric FIR filters, linear phase FIR filters. Design using windows (rectangular, Hanning, Kaiser). Realization structures: direct form, cascade, parallel forms. Applications of DSP in power systems: Power & frequency measurement, PWM generation. Condition monitoring & machine speed control. Transformer protection synchronized phasor measurement. Harmonic analysis, discrete PID controller design.		

Learning Resources

1. Text Books

[T1]. A. Anand Kumar – Digital Signal Processing – PHI Learning.

[T2]. P. Ramesh Babu – Digital Signal Processing – Scitech Publications.

[T3]. Nagoor Kani – Digital Signal Processing – McGraw Hill Education India.

[T4]. S. Salivahanan, A. Vallavaraj, C. Gnanapriya – Digital Signal Processing – McGraw Hill Education.

[T5]. S. K. Mitra – Digital Signal Processing: A Computer-Based Approach – Tata McGraw Hill (Indian Edition).

2. Reference Books

[R1]. D. Ganesh Rao & C. Ramesh Babu – Digital Signal Processing Laboratory Using MATLAB – Scitech Publications.

[R2]. N. K. Sinha & B. P. Lathi (Indian Edition Adapted) – Signals, Systems and Communications – Wheeler Publishing.

[R3]. B. Venkata Ramana – Digital Signal Processing – Tata McGraw Hill.

[R4]. D. Roy Choudhury – Linear Integrated Circuits and Digital Signal Processing – New Age International.

[R5]. M. A. Pai – Computer Techniques in Power System Analysis – Tata McGraw Hill (useful for DSP applications in power systems).

3. Links to online SWAYAM/NPTEL Courses

Digital Signal Processing and its Applications - Course

Savitribai Phule Pune University Board:
Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: PEC-562B-POS	**Course Name: Artificial Intelligent Tools**	
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hrs	03	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Course Objectives:

1. To introduce the fundamentals and importance of Artificial Intelligence (AI) in engineering applications.
2. To explore various AI tools and techniques including expert systems, fuzzy logic, and neural networks.
3. To develop proficiency in applying AI methods to solve electrical engineering problems.
4. To provide exposure to machine learning, deep learning, and data-driven decision-making.
5. To equip students with practical experience using AI development environments and tools like MATLAB, Python, and TensorFlow.

Course Outcomes: At the end of this course student is able to

CO1: Understand the fundamentals and scope of Artificial Intelligence and its relevance to electrical engineering.

CO2: Apply expert systems and fuzzy logic for intelligent decision-making in engineering systems.

CO3: Design and train artificial neural networks for real-time control and predictive tasks.

CO4: Use machine learning and deep learning techniques to solve energy and automation-related problems.

CO5: Evaluate and implement AI-based solutions in modern electrical systems aligned with Industry 4.0 trends

Course Contents

Unit No: I	**Introduction to Artificial Intelligence**	**08 Hours**

Definition and Evolution of AI, Characteristics of Intelligent Agents, Applications of AI in Electrical Engineering (Power Systems, Control, Fault Detection), AI Programming Languages and Tools Overview (MATLAB, Python, TensorFlow, SciKit-learn), Introduction to AI Techniques: Search, Reasoning, Knowledge Representation

Unit No: II	**Expert Systems and Fuzzy Logic**	**08 Hours**

Architecture and Components of Expert Systems, Rule-based Systems and Inference Engines, Applications of Expert Systems in Fault Diagnosis, Introduction to Fuzzy Sets and Fuzzy Logic, Fuzzy Inference Systems (FIS), Applications of Fuzzy Logic in Control Systems and Load Forecasting

Unit No: III	**Artificial Neural Networks (ANNs)**	**08 Hours**

Biological Neuron and Artificial Neuron Models, Perceptron and Multi-Layer Perceptron (MLP), Learning Algorithms: Backpropagation, Gradient Descent, Activation Functions, Applications of ANN in Power System Load Forecasting, Protection and Control, Hands-on with ANN Toolbox (MATLAB/Python)

Unit No: IV	**Machine Learning and Deep Learning**	**08 Hours**

Introduction to Machine Learning (ML): Supervised, Unsupervised, Reinforcement Learning, Decision Trees, Support Vector Machines (SVM), K-NN, Introduction to Deep Learning: Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Applications in Condition Monitoring, Energy Management, Tools: Scikit-learn, Keras, TensorFlow (Basic hands-on)

Unit No: V	**AI Applications in Electrical Engineering and Industry 4.0**	**08 Hours**

Smart Grid and Energy Management Systems, Fault Detection and Classification in Power Systems using AI, Predictive Maintenance and Health Monitoring, AI for Industrial Automation and Robotics, Integration of AI with IoT and Edge Computing, Case Studies: Renewable Energy Forecasting, EV Battery Management

Learning Resources
1. Text Books
[T1]. M. Ganesh "Introduction to Fuzzy Sets and Fuzzy Logic", Prentice Hall, India. [T2]. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
2. Reference Books
[R1]. KOSKO B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994. [R2]. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993. [R3]. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.
3. Links to online SWAYAM/NPTEL Courses
An Introduction to Artificial Intelligence - Course

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: SEM-581-POS		**Course Name: Technical Seminar-I**
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 25 Marks
Practical : 04 Hrs	02	OR : 25 Marks

Course Description:

The seminar aims to enhance students' research, presentation, and critical thinking skills, preparing them for advanced academic pursuits and professional careers.

The objectives are,

1. **Deepen Technical Knowledge**: To enable students to explore a specialized topic within Electrical Engineering beyond the regular curriculum, fostering in-depth understanding.
2. **Develop Research Skills**: To provide practical experience in identifying, acquiring, evaluating, and synthesizing information from various technical sources (research papers, standards, technical reports).
3. **Enhance Communication Skills**: To cultivate effective oral and visual presentation skills, enabling students to articulate complex technical concepts clearly and concisely to a knowledgeable audience.
4. **Foster Critical Thinking:** To encourage students to critically analyze existing research, identify challenges, propose solutions, and engage in constructive discussions.
5. **Promote Independent Learning**: To encourage self-directed learning and the ability to stay updated with emerging technologies and research trends.
6. **Prepare for Thesis/Dissertation:** To serve as a foundational step for the Master's thesis/dissertation, allowing students to explore potential research areas.

Course Outcomes: At the end of the course, the student will be able to

1. **CO1:** Formulate the goals and objectives of scientific research.
2. **CO2:** Search, evaluate and analyze information about the achievements of science and technology in the target area and beyond.
3. **CO3**: Interpret data from different fields of science and technology.
4. **CO4:** Build the logic of reasoning and statements.
5. **CO5:** Create, design and edit text documents in accordance with the requirements of the organization or publisher.

Course description

- **Responsibility of the students**
  - The Seminar should be carried out individually by each student.
  - A student should identify the area or topics in recent trends and developments in consultation with the guide
  - A student should report to his/her respective guide regularly (at least once a week) and report the progress of the seminar work.
  - A student should follow the timelines and deadlines and inform the supervisor in case of any difficulty/delay.
  - Students should maintain the record of all the meetings, remarks given by guide/reviewers and progress of the work in the project diary. The project diary must be presented during each review presentation to the reviewers.
  - A student should conduct the research ethically, adhere to the academic integrity standards, and cite sources

whenever using any existing results

- A student should Incorporate constructive feedback to improve the quality and rigor of the research
- For final examination, students should complete the Seminar Report in all aspects including formatting and citation.
- Each student should prepare the report, get it approved by his/her guide and submit the duly signed copy within the deadline.
- A student should invest time and effort in preparing seminar presentations and the oral defense of the seminar

- **Topic Selection**
  - **Relevance:** Topics must be directly related to Electrical Engineering, encompassing cur- rent research trends, emerging technologies, advanced concepts, or interdisciplinary applications
  - **Scope:** The topic should be sufficiently focused to allow for in-depth exploration within the seminar timeframe, yet broad enough to demonstrate a comprehensive understanding. Avoid overly narrow or excessively broad topics.
  - **Novelty (Desired):** While not strictly a research paper, students are encouraged to explore topics that have recent advancements, open problems, or areas where their unique insights can be presented. Avoid merely summarizing introductory textbook material.
  - **Guide / Supervisor Approval**: Each student must select a seminar topic in consultation with and obtain approval from an assigned faculty supervisor. The supervisor will guide the student in refining the topic and identifying relevant resources.
  - **Examples of Broad Areas:** Artificial Intelligence tools, Smart Grid, Power system modelling, Power System Dynamics, Power System Planning and reliability, Power System Protection, Industrial Automation, Digital Signal Processing

- **Seminar Structure and Deliverables:**

  The technical seminar typically involves the following stages and deliverables
  - Topic Proposal (2-3 weeks after topic approval):
  - A concise document (1-2 pages) outlining:
  - Proposed Seminar Title
  - Brief Description/Abstract of the Topic
  - Motivation and Relevance to Electrical Engineering
  - Preliminary List of Key References (at least 5-7 reputable sources)
  - Tentative Scope and Outline of the Presentation
  - Submission: To the faculty supervisor for approval.
  - Literature Review and Research (Ongoing): Sources: Students must primarily rely on peer-reviewed academic sources (IEEE Xplore, ACM Digital Library, SpringerLink, arXiv, Google Scholar), reputable conference proceedings, and established industry standards. Wikipedia and unverified blogs are generally not acceptable as primary sources.
  - Critical Analysis: Beyond mere summarization, students are expected to critically analyze the literature, identifying different approaches, their advantages/disadvantages, open issues, and potential future directions.
  - Note-Taking & Organization: Maintain systematic notes and organize research material effectively.

- **Seminar Report**
  - A written report (typically 15-25 pages, excluding references and appendices) detailing the seminar

content.

- Format: Follow a professional academic paper format (e.g., IEEE transaction style).
- **Sections**
  - **Abstract:** A concise summary of the seminar topic and key findings.
  - **Introduction**: Background, motivation, problem statement (if applicable), and outline of the report.
  - **Literature Review/Background**: Detailed discussion of relevant concepts, theories, and existing work.
  - **Core Content:** In-depth exploration of the chosen topic, presenting different methodologies, architectures, algorithms, or challenges as relevant.
  - **Analysis/Discussion**: Critical evaluation of the presented material, comparing different approaches, discussing implications, and identifying gaps.
  - **Future Trends/Conclusion:** Summarization of key takeaways, potential future directions, and concluding remarks.
  - **References:** A comprehensive list of all cited sources properly formatted.
  - Appendices (Optional): Supplementary material if necessary.

- **Oral/ Presentation**
  - Duration: Typically, 25-30 minutes for presentation, followed by 10-15 minutes for Q&A. (Specific timings will be announced)
  - Audience: Faculty members, peers, and potentially other interested individuals.
  - Content: The presentation should effectively convey the key aspects of the seminar topic.
  - It should not simply be a reading of the report.
  - Visual Aids: High-quality presentation slides (e.g., PowerPoint, Google Slides, LaTeX Beamer) are mandatory. Slides should be clear, concise, visually appealing, and support the oral delivery. Avoid excessive text on slides.
  - Delivery: Clear articulation, confident posture, good eye contact, and appropriate pace.
  - Practice the presentation thoroughly.
  - Q&A Session: Be prepared to answer questions from the audience on all aspects of the seminar topic. Demonstrate a strong understanding and ability to defend your perspectives.
- **Evaluation Criteria:** The technical seminar will be evaluated based on the following criteria:
  - Topic Selection and Scope (10%): Relevance, timeliness, and appropriate depth of the chosen topic. Clarity and focus of the topic proposal.
  - Literature Review and Research (25%): Breadth and depth of literature surveyed. Quality and credibility of sources used. Critical analysis and synthesis of information.
  - Seminar Report/Paper (30%): Clarity, organization, and logical flow of content. Technical accuracy and depth of discussion. Adherence to academic writing standards (grammar, spelling, formatting, referencing). Originality in synthesis and critical insights. Absence of plagiarism.
  - Oral Presentation (35%): Content: Clarity, completeness, and accuracy of the presented material. Organization: Logical flow, effective use of time. Visual Aids: Quality, clarity, and effectiveness of slides. Delivery: Confidence, clarity of speech, enthusiasm, engagement with the audience. Q&A: Ability to answer questions accurately, comprehensively, and confidently.

Learning Resources
Text Books
[T1]. "Engineering Communication" by Charles W. Knisely & Karin I. Knisely [T2]. "Technical Communication: Principles and Practice" by Meenakshi Raman & Sangeeta Sharma [T3]. "The Craft of Scientific Presentations" by Michael Alley
Swayam/ NPTEL Courses
[1]. https://nptel.ac.in/courses/109/106/109106180/ [2]. https://www.udemy.com/course/technical-writing/ [3]. https://www.edx.org/course/writing-in-the-sciences

सावित्रीबाई फुले पुणे विद्यापीठ

SEMESTER-III

Master of Engineering (2025 Pattern)

ME-Electrical (Power Systems)

Savitribai Phule Pune University
Board: Electrical Engineering
ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)

Course Code: RM-601-POS		**Course Name:** Research Methodology
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 04 Hrs	04	CCE : 50 Marks
Practical : 00 Hrs	--	ESE : 50 Marks

Prerequisite:

1. Familiarity with project-based learning (e.g. mini projects, seminars, undergraduate theses)
2. Knowledge of basic statistics (mean, median, variance, standard deviation, probability concepts)
3. Basic skills in technical writing (reports, presentations, documentation).
4. Sound fundamentals of the core engineering/science domain

Course Objectives:

1. Understand the philosophy of research in general
2. Understand basic concepts of research and its methodologies
3. Learn the methodology to conduct the Literature Survey
4. Acquaint with the tools, techniques, and processes of doing research
5. Learn effective report writing skills and allied documentation
6. Become aware of ethics in research, academic integrity and plagiarism

Course Outcomes:

1. CO1: Define research and explain its essential characteristics with examples from engineering and science fields.
2. CO2: Identify and apply different types of research (basic, applied, qualitative, quantitative, exploratory, descriptive, etc.) to specific problems.
3. CO3: Analyse the outcomes of research such as publications, patents, and technological contributions, and understand their societal and industrial impacts.
4. CO4: Apply ANOVA and ANCOVA techniques for effective experimental data analysis and interpretation of results.
5. CO5: Understand and apply the basics of Intellectual Property Rights (IPR) to safeguard innovative research and prevent unethical practices.

Course Contents

Unit No: I	**Definition and Characteristics of Research**	**10 Hours**

Basic of Research: Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Philosophy and validity of research. Objective of research. Various functions that de- scribe characteristics of research such as systematic, valid, verifiable, empirical and critical approach. Types - Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.

Engineering Research: Why? Research Questions, Engineering Ethics, conclusive proof-what constitutes, A research project-Why take on?

Case Study: Code of Ethics, IEEE Code of Ethics, ACM Software Engineering Code of Ethics and Professional Practice, Code of Ethics especially covering Engineering discipline, various aspects- environment, sustainable outcomes, employer, general public, and Nation, Engineering Disasters.

Unit No: II	**Literature Search and Review**	**10 Hours**

Literature Review, Types of Review, Developing the objectives, Preparing the research design including sample

Design, Sample size. Archival Literature, why should engineers be ethical? Types of publications- Journal papers, conference papers, books, standards, patents, theses, trade magazine, newspaper article, infomercials, advertisement, Wikipedia & websites, Measures of research impact, publication cost.
Case Study: Engineering dictionary, Shodhganga, The Library of Congress, Research gate, Google Scholar, Bibliometrics, Citations, Impact Factor, h-index, I-index, plagiarism, copyright infringement

Unit No: III	Analysis of Variance and Covariance	10 Hours

Basic principle of Analysis of Variance, ANOVA Technique, Setting up Analysis of Variance Table, short-cut method for oneway ANOVA, Coding method, Two-way ANOVA, ANOVA in Latin-square design, analysis of co-variance (ANCOVA), assumptions in ANCOVA. Academic Ethics: Plagiarism, exposure on anti-plagiarism tools.

Unit No: IV	Technical Writing and IPR	10 Hours

Academic writing, sources of information, assessment of quality of journals and articles, writing scientific report, structure and component of research report, types of report – technical reports and thesis, SCOPUS Index, citations, search engines beyond google, impact factor, H-Index. IPR: What is IPR? The importance of patents, types of IPR, and process of patent.

Unit No: V	Outcome of Research and Research Presentation	10 Hours

Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis, Preparation of the Report on conclusions reached, testing validity of research outcomes, Suggestions and recommendations, identifying future scope.
Research presentation: Introduction, Standard terms, Standard research methods and experimental techniques, Paper title and keywords, Writing an abstract, Paper presentation and review, Conference presentations, Poster presentations, IPR, Copyright, Patents.
Case Study: Intellectual Property India- services, InPASS - Indian Patent Advanced Search System, US patent, IEEE / ACM Paper templates.

Learning Resources

1. Text Books

[T1]. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International
[T2]. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology, RBSA Publishers
[T3]. Suresh Sinha, Anil K Dhiman, Research Methodology, ESS Publications,Volumes 2.
[T4]. Day R.A., How to Write and Publish a Scientific Paper, Cambridge University Press
[T5]. Wadehra, B.L. Law relating to patents, Trademarks, copyright designs and geographical indications. Universal Law Publishing
[T6]. Shail Jain, R.K. Jain, Patents: Procedures and Practices, Universal Law Publishing Co., New Delhi, 2011.
[T7]. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.

2. Reference Books

[R1]. Louis Cohen, Lawrence Manion and Keith Morrison, Research Methods in Education, 7th Edition, Cambridge University Press, ISBN – 978-0415-58336-7
[R2]. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon
[R3]. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, APH Publishing Corporation.
[R4]. Leedy, P.D. and Ormrod, J.E., Practical Research: Planning and Design, Prentice Hall

[R5]. Fink, A., Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
[R6]. Satarkar, S.V., Intellectual Property Rights and Copy Right. ESS Publications.
[R7]. Royston M. Roberts, Serendipity: Accidental Discoveries in Science, Wiley Publication, 1989

3. Links to online SWAYAM/NPTEL Courses

1. Research Methodology - Course
2. Research Methodology - Course
3. https://www.youtube.com/playlist?list=PLm-zueI9b64QGMcfn5Ckv_8W5Z1d3vMBY

Practical Assignments / Mini Project Problem Statements

Sr.	Title	Objectives
1	Problem Identification Exercise	Identify and clearly define a real-world research problem in your engineering discipline.
2	Literature Review Report	Conduct a detailed literature survey (minimum 30 research papers) and summarize gaps in existing research.
3	Research Proposal Drafting	Prepare a structured research proposal including problem statement, objectives, scope, and methodology.
4	Hypothesis Formulation	Develop testable hypotheses based on selected research problems.
5	Design of Experiment	Design a detailed experimental plan or simulation for validating hypotheses.
6	Sampling Techniques	Select and justify a sampling method for data collection in your project.
7	Data Collection Tools Development	Design a survey questionnaire or sensor-based data collection method.
8	Statistical Data Analysis	Perform statistical analysis (ANOVA, regression, t-tests) on sample data.
9	Research Paper Writing	Draft a full research paper based on hypothetical or preliminary data.
10	Research Ethics and Plagiarism Check	Analyze ethical aspects and conduct a plagiarism check for your paper.

Mini Project statement list for Research Methodology (ANYONE)

Sr.	Project Title	Description/Deliverable
1	AI-based Systematic Literature Review Tool	Build a tool that automates screening and organizing research papers.
2	Comparison of Research Methodologies	Compare qualitative vs. quantitative methods through case studies.
3	Development of a Research Gap Identification Model	Create an algorithm that detects research gaps from published articles.
4	Design of a Predictive Analytics Model	Design a model that predicts the future trend of research in a selected field.
5	Big Data Analysis for Research Trends	Analyze publication data from Scopus/IEEE/Google Scholar to identify top emerging topics.
6	AI-based Systematic Literature Review Tool	Build a tool that automates screening and organizing research papers.

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: OJT-602-POS	**Course Name:** On Job Training/ Internship	
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 10 Hours/Week	05	TW : 100 Marks

Prerequisite: Core Technical Knowledge, Software & Tools Proficiency, Understanding of Industry Practices, Prior Academic Work

The objectives are,

1. To put theory into practice. And expand thinking and broaden the knowledge and skills acquired through course work in the field.
2. To relate to, interact with, and learn from current professionals in the field.
3. To understand and adhere to professional standards in the field.
4. To gain insight into professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
5. To develop the initiative and motivation to be a self-starter and work independently.

Course Outcomes:

At the end of course, the student will be able to

1. **CO1**: Gain practical experience within the industry in which the internship is done.
2. **CO2:** Acquire knowledge of the industry in which the internship is done.
3. **CO3:** Apply knowledge and skills learned to classroom work.
4. **CO4**: Develop and refine oral and written communication skills.
5. **CO5:** Acquire knowledge of administration, marketing, finance and economics.

Course description

1. Internship/On Job Training provides students with the opportunity of hands-on experience that in- clues personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc.
2. An internship is the phase of time for students when they are trained for their skills, they are good at, and it gives them a chance to apply their knowledge practically in industries
3. The internship can be carried out in any industry/R&D Organization/Research Institute/Institute of national repute/R&D Centre of Parent Institute.
4. The Department/college shall nominate a faculty to facilitate, guide and supervise students under internship.

Guidelines

- **Purpose:**

  Internships are designed to bridge the gap between academic learning and industry practice. They aim to provide hands-on experience, expose students to the industrial environment, develop technical and soft skills (communication, teamwork, problem-solving), and help in career exploration.

- **Internship Duration and Academic Credentials**
  - Students can take internship work in the form of Online/Offline mode from any of the Industry / Government Organization Internship Programs approved by SPPU/AICTE/UGC portals
  - An intern is expected to spend 10 - 12 hours per week on Internship, Training will result in about 160-170 hours of total internship duration.
  - The minimum requirement regarding Internship duration should not be below 8 weeks

- **Type of Internship**
  - Industry/Government Organization Internship: Working directly with a company or government body.
  - Research Internship: Focused on research projects, often in collaboration with academic institutions or R&D labs.
  - Innovation/Entrepreneurship: Working on developing new products, processes, or even starting a venture.
  - Social Internship: Engaging in community-based projects.
- **Assessment Details (TW and Practical)**
  - Term work for 100 marks
  - A daily log submitted by the student and a work log signed by the office HoDs where the student has interned will be considered towards the TW marking.
- **Indicative list of areas for OJT**
  - Trade and Agriculture
  - Economy & Banking Financial Services and Insurance
  - Logistics, Automotive & Capital Goods
  - Fast Moving Consumer Goods & Retail
  - Information Technology/Information Technology Enabled Services & Electronics
  - Handcraft, Art, Design & Music
  - Healthcare & Life Science
  - Sports, Wellness and Physical Education
  - Tourism & Hospitality
  - Digitization & Emerging Technologies (Internet of Things / Artificial Intelligence / Machine
  - Learning / Deep Learning / Augmented Reality / Virtual Reality etc.)
  - Humanitarian, Public Policy and Legal Services
  - Communication
  - Education
  - Sustainable Development
  - Environment
  - Commerce, Medium and Small-Scale Industries
- **Faculty Supervision**

  Students are usually assigned an internal faculty guide/mentor who supervises their internship activities. This faculty member acts as a teacher, mentor, and critic, and ensures the internship aligns with academic goals. External Supervision: In many cases, an external expert from the host organization also guides the student.
- **Documentation and Reporting**
  - Joining Report: To be submitted within a specified time frame (e.g., one week from joining).
  - Daily/Periodical Diary: Students are often required to maintain a daily or weekly record of their observations, work, and learning.
  - Internship Report: A comprehensive report detailing the work done, learning outcomes, and achievements during the internship. This report needs to be duly signed by the company official and faculty mentor.
  - Completion Certificate: Issued by the host organization upon successful completion.
- **Evaluation**
  - Evaluation is typically done by the institute, often within a short period after the internship ends
  - It may involve presentations, viva-voce examinations, and assessment of the internship report and daily diary.
  - Performance-based feedback from the industry mentor is usually a key component.

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: SEM-603-POS		**Course Name: Technical Seminar-II**
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 25 Marks
Practical : 08 Hrs	04	OR : 25 Marks

Course Description:

The seminar aims to enhance students' research, presentation, and critical thinking skills, preparing them for advanced academic pursuits and professional careers.

The objectives are,

1. Deepen Technical Knowledge: To enable students to explore a specialized topic within Electrical Engineering beyond the regular curriculum, fostering in-depth understanding.
2. Develop Research Skills: To provide practical experience in identifying, acquiring, evaluating, and synthesizing information from various technical sources (research papers, standards, technical reports).
3. Enhance Communication Skills: To cultivate effective oral and visual presentation skills, enabling students to articulate complex technical concepts clearly and concisely to a knowledgeable audience.
4. Foster Critical Thinking: To encourage students to critically analyze existing research, identify challenges, propose solutions, and engage in constructive discussions.
5. Promote Independent Learning: To encourage self-directed learning and the ability to stay updated with emerging technologies and research trends.
6. Prepare for Thesis/Dissertation: To serve as a foundational step for the Master's thesis/dissertation, allowing students to explore potential research areas.

Course Outcomes: At the end of the course, the student will be able to

1. Formulate the goals and objectives of scientific research.
2. Search, evaluate and analyze information about the achievements of science and technology in the target area and beyond.
3. Interpret data from different fields of science and technology.
4. Build the logic of reasoning and statements.
5. Create, design and edit text documents in accordance with the requirements of the organization or publisher.

Course description

- **Responsibility of the students**
  - The Seminar should be carried out individually by each student.
  - A student should identify the area or topics in recent trends and developments in consultation with the guide
  - A student should report to his/her respective guide regularly (at least once a week) and report the progress of the seminar work.
  - A student should follow the timelines and deadlines and inform the supervisor in case of any difficulty/delay.
  - Students should maintain the record of all the meetings, remarks given by guide/reviewers and progress of the work in the project diary. The project diary must be presented during each review presentation to the reviewers.
  - A student should conduct the research ethically, adhere to the academic integrity standards, and cite sources whenever using any existing results

- A student should Incorporate constructive feedback to improve the quality and rigor of the research
- For final examination, students should complete the Seminar Report in all aspects including formatting and citation.
- Each student should prepare the report, get it approved by his/her guide and submit the duly signed copy within the deadline.
- A student should invest time and effort in preparing seminar presentations and the oral defense of the seminar

- **Topic Selection**
  - **Relevance:** Topics must be directly related to Electrical Engineering, encompassing cur- rent research trends, emerging technologies, advanced concepts, or interdisciplinary applications
  - **Scope:** The topic should be sufficiently focused to allow for in-depth exploration within the seminar timeframe, yet broad enough to demonstrate a comprehensive understanding. Avoid overly narrow or excessively broad topics.
  - **Novelty (Desired):** While not strictly a research paper, students are encouraged to explore topics that have recent advancements, open problems, or areas where their unique insights can be presented. Avoid merely summarizing introductory textbook material.
  - **Guide / Supervisor Approval**: Each student must select a seminar topic in consultation with and obtain approval from an assigned faculty supervisor. The supervisor will guide the student in refining the topic and identifying relevant resources.
  - **Examples of Broad Areas:** Artificial Intelligence tools, Smart Grid, Power system modelling, Power System Dynamics, Power System Planning and reliability, Power System Protection, Industrial Automation, Digital Signal Processing.

- **Seminar Structure and Deliverables:**

  The technical seminar typically involves the following stages and deliverables

  - Topic Proposal (2-3 weeks after topic approval):
  - A concise document (1-2 pages) outlining:
  - Proposed Seminar Title
  - Brief Description/Abstract of the Topic
  - Motivation and Relevance to Electrical Engineering
  - Preliminary List of Key References (at least 5-7 reputable sources)
  - Tentative Scope and Outline of the Presentation
  - Submission: To the faculty supervisor for approval.
  - Literature Review and Research (Ongoing): Sources: Students must primarily rely on peer-reviewed academic sources (IEEE Xplore, ACM Digital Library, SpringerLink, arXiv, Google Scholar), reputable conference proceedings, and established industry standards. Wikipedia and unverified blogs are generally not acceptable as primary sources.
  - Critical Analysis: Beyond mere summarization, students are expected to critically analyze the literature, identifying different approaches, their advantages/disadvantages, open issues, and potential future directions.
  - Note-Taking & Organization: Maintain systematic notes and organize research material effectively.

- **Seminar Report**
  - A written report (typically 15-25 pages, excluding references and appendices) detailing the seminar content.

- Format: Follow a professional academic paper format (e.g., IEEE transaction style).
- **Sections**
  - **Abstract:** A concise summary of the seminar topic and key findings.
  - **Introduction**: Background, motivation, problem statement (if applicable), and outline of the report.
  - **Literature Review/Background**: Detailed discussion of relevant concepts, theories, and existing work.
  - **Core Content:** In-depth exploration of the chosen topic, presenting different methodologies, architectures, algorithms, or challenges as relevant.
  - **Analysis/Discussion**: Critical evaluation of the presented material, comparing different approaches, discussing implications, and identifying gaps.
  - **Future Trends/Conclusion:** Summarization of key takeaways, potential future directions, and concluding remarks.
  - **References:** A comprehensive list of all cited sources properly formatted.
  - Appendices (Optional): Supplementary material if necessary.

- **Oral/ Presentation**
  - Duration: Typically, 25-30 minutes for presentation, followed by 10-15 minutes for Q&A. (Specific timings will be announced)
  - Audience: Faculty members, peers, and potentially other interested individuals.
  - Content: The presentation should effectively convey the key aspects of the seminar topic.
  - It should not simply be a reading of the report.
  - Visual Aids: High-quality presentation slides (e.g., PowerPoint, Google Slides, LaTeX Beamer) are mandatory. Slides should be clear, concise, visually appealing, and support the oral delivery. Avoid excessive text on slides.
  - Delivery: Clear articulation, confident posture, good eye contact, and appropriate pace.
  - Practice the presentation thoroughly.
  - Q&A Session: Be prepared to answer questions from the audience on all aspects of the seminar topic. Demonstrate a strong understanding and ability to defend your perspectives.

- **Evaluation Criteria:** The technical seminar will be evaluated based on the following criteria:
  - Topic Selection and Scope (10%): Relevance, timeliness, and appropriate depth of the chosen topic. Clarity and focus of the topic proposal.
  - Literature Review and Research (25%): Breadth and depth of literature surveyed. Quality and credibility of sources used. Critical analysis and synthesis of information.
  - Seminar Report/Paper (30%): Clarity, organization, and logical flow of content. Technical accuracy and depth of discussion. Adherence to academic writing standards (grammar, spelling, formatting, referencing). Originality in synthesis and critical insights. Absence of plagiarism.
  - Oral Presentation (35%): Content: Clarity, completeness, and accuracy of the presented material. Organization: Logical flow, effective use of time. Visual Aids: Quality, clarity, and effectiveness of slides. Delivery: Confidence, clarity of speech, enthusiasm, engagement with the audience. Q&A: Ability to answer questions accurately, comprehensively, and confidently.

Learning Resources
Textbooks
[T1]. "Engineering Communication" by Charles W. Knisely & Karin I. Knisely [T2]. "Technical Communication: Principles and Practice" by Meenakshi Raman & Sangeeta Sharma [T3]. "The Craft of Scientific Presentations" by Michael Alley
Swayam/ NPTEL Courses
[1]. https://nptel.ac.in/courses/109/106/109106180/ [2]. https://www.udemy.com/course/technical-writing/ [3]. https://www.edx.org/course/writing-in-the-sciences

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: RPR-604-POS		**Course Name:** Research Project- I
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 25 Marks
Practical : 18 Hrs	09	OR : 25 Marks

Course Description:

The master's degree culminates in a research project of the student's own design. This research project is documented by a final research report or dissertation. The student's work is guided by an academic supervisor. Students are expected to choose real-world contemporary problems and apply the engineering principles learned, to solve the problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. Students are expected to construct a research project that includes original research, deliberate and well considered methodological choices, and shows relevance to significant conversations within the discipline. The dissertation should represent the very best research and analysis a student can produce.

Course Objectives:

1. Demonstrate an ability to plan a research project, such as is required in a research proposal prior to the launch of their work
2. Demonstrate an ability to comply with ethical, safety, and documentation processes appropriate to their project
3. Demonstrate expert knowledge in the subject of their research project, such as through an integrated literature survey
4. Demonstrate expert knowledge in the research methods appropriate to generating reliable data for their research questions
5. Demonstrate the ability to manage projects and to make constructive use of expertise associated with their project, while working as an independent learner
6. Demonstrate an ability to relate their original data to existing literature, or to create an novel synthesis of existing materials
7. Demonstrate an ability to assemble their findings into a substantial piece of writing that presents a clear thesis and a cohesive, evidence-based argument
8. Demonstrate an ability to balance description, analysis, and synthesis within their project report
9. Demonstrate an ability to reflect on the strengths and weaknesses of their research and methodology, with constructive advice on how they might improve their efforts in future work

Course Outcomes: At the end of the course, the student will be able to

1. CO1: Demonstrate how to search the existing literature to gather information about a specific problem or domain.
2. CO2: Identify state-of-the-art technologies and research in the chosen domain, and high- light open problems that are relevant to societal or industrial needs.
3. CO3: Evaluate various solution techniques to determine the most feasible solution within given constraints for the chosen dissertation problem.
4. CO4: Apply software engineering principles related to requirements gathering and design to produce relevant documentation.
5. CO5: Write a dissertation report that details the research problem, objectives, literature review, and solution architecture.

Guidelines

1. **General Guidelines:**
   a. The dissertation is a year-long project, conducted and evaluated in two phases. It can be carried out either in-house or within an industry as assigned by the department. The project topic and internal advisor (a faculty member from the department) are determined at the beginning of Phase I.
   b. Students are expected to complete the following activities in Phase-I:
      (a) Literature survey
      (b) Problem Definition
      (c) Motivation for study and Objectives
      (d) Preliminary design / feasibility / modular approaches
      (e) Design of the research project

2. **Research Project Stage-I, Phases**

Phase 1: Informal conversations

Students are strongly encouraged to discuss possible research project ideas with the internal guide, fellow students, and other research professionals. All research projects begin with open-ended conversations and scoping exercises. These should be non-committal.

Phase 2: Identify topic

The first formal step in the module involves identifying a preliminary project title and writing an abstract of no more than 200 words. This requires submitting a completed registration form. Writing an abstract for a research proposal or for completed research work is an important transferable skill. Students who do not submit a completed registration form will be assigned a project. The project title is understood to be provisional. Supervisors will be assigned to students after the project title/ abstract forms have been submitted. Supervision: A supervisor is required. The main responsibilities of the supervisor are to assist the student with project management and to advise the student on criteria for assessment. You can expect your supervisor to read and comment on a full draft of your research proposal and of your project.

It is a good idea to discuss a timeline for your project with your supervisor, and to establish a definite timetable.

Some key points in our advice to students on compliance:

1. Allow at least two weeks between submitting an ethics application and the date of your first data collection,
2. Your supervisor must approve (and sign!) your ethics application before you submit it at departmental level
3. After your protocols have been approved, append a copy of your ethical approval certificate to the dissertation and project proposal.

Phase 3: Project proposal

The proposal should reflect a student's best effort. At the same time, we recognize research often raises new questions. Some redefinitions of topics and titles are common later in the research process. Students should keep their supervisors up to date on these developments, and they can expect a reasonable amount of adaptation.

Phase 4: Term-1 research

Students are expected to commit substantial time during the term to their research project. The principal form of academic input for the research project normally comes through discussions with the designated supervisor. The majority of these meetings should be face-to-face, either in person or via video- or audio-conferencing technology.

Students are expected to respect these periods of absence and plan their needs accordingly. One distinction is crucial.

(1) when staff are on leave, they are off work (i.e., not expected to maintain contact with their supervisees or to undertake their duties); however,

(2) when staff are working remotely, they are at work (i.e., expected to maintain contact and to be available for normal duties).

A student's supervisor is not the only person who may advise on projects and writing. Others include peers and subject experts.

Phase 5: Submit Project report

The project report with the specific due date must be submitted to the Department.

Additional Information

- **Research notebook**: Students are strongly advised to maintain a research notebook, either digital or paper, and to keep this up to date. A research notebook can prove useful should examiners query research methods, research integrity, or research process.
- **Preventing data loss**: Protect yourself against loss of research material and writing by maintaining a system for secure, redundant, up-to-date back-up of research material and writing. Loss cannot be accepted as a reason for failing to meet a deadline. A copy of written notebooks can be stored by supervisors for the duration of the project. Loss of project materials through accidents and theft have occurred in the past; these have had devastating effects on the un- prepared. All students are warned to create redundancies to protect their project from similar calamities.
- **Extensions:** This is a long-term research project, and time management is a learning objective. Short-term extensions normally are not considered. Applications for extension must be made through the processes described in the STS Student Handbook. Personal Tutors are the first point of contact on extension requests.
- **Word counts:** Words counted towards the total word count include the main body of the report and supporting footnotes or endnotes. The word count does not include bibliography, front matter (title page, keywords, abstract, table of contents, acknowledgments), appendix material, supplemental data packages, table and figure legends, or documentation of ethics protocols or approvals. Otherwise, University standard policy on word counts will apply.
- **Re-using coursework from other modules:** Text and ideas in the research proposal may reappear in the dissertation if significantly developed or further elaborated; however, Universities policy on self-plagiarism prevents the same work receiving credit twice. This means rote duplication is not allowed.
- **Citation format:** The style must be clear, explicit, and meaningful. In every instance, it must allow an examiner to locate efficiently and specifically material referred to. As a recommendation, students should use a style frequently used in the literature relevant to their research project. Most journals have style guides in their notes to contributors. Students should discuss options with their supervisors, and they should keep in mind that efficient citation is one element in the criteria for assessment.

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SEMESTER-IV

Master of Engineering (2025 Pattern)

ME-Electrical (Power Systems)

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)			
Course Code: SEM-651-POS		**Course Name: Technical Seminar-III**	
Teaching Scheme		**Credits**	**Examination Scheme**
Theory	: 00 Hrs	--	TW : 50 Marks
Practical	: 08 Hrs	04	OR : 50 Marks

Course Description:

The seminar aims to enhance students' research, presentation, and critical thinking skills, preparing them for advanced academic pursuits and professional careers.

The objectives are,

1. Deepen Technical Knowledge: To enable students to explore a specialized topic within Electrical Engineering beyond the regular curriculum, fostering in-depth understanding.
2. Develop Research Skills: To provide practical experience in identifying, acquiring, evaluating, and synthesizing information from various technical sources (research papers, standards, technical reports).
3. Enhance Communication Skills: To cultivate effective oral and visual presentation skills, enabling students to articulate complex technical concepts clearly and concisely to a knowledgeable audience.
4. Foster Critical Thinking: To encourage students to critically analyze existing research, identify challenges, propose solutions, and engage in constructive discussions.
5. Promote Independent Learning: To encourage self-directed learning and the ability to stay updated with emerging technologies and research trends.
6. Prepare for Thesis/Dissertation: To serve as a foundational step for the Master's thesis/dissertation, allowing students to explore potential research areas.

Course Outcomes: At the end of the course, the student will be able to

1. Formulate the goals and objectives of scientific research.
2. Search, evaluate and analyze information about the achievements of science and technology in the target area and beyond.
3. Interpret data from different fields of science and technology.
4. Build the logic of reasoning and statements.
5. Create, design and edit text documents in accordance with the requirements of the organization or publisher.

Course description

- **Responsibility of the students**
  - The Seminar should be carried out individually by each student.
  - A student should identify the area or topics in recent trends and developments in consultation with the guide
  - A student should report to his/her respective guide regularly (at least once a week) and report the progress of the seminar work.
  - A student should follow the timelines and deadlines and inform the supervisor in case of any difficulty/delay.
  - Students should maintain the record of all the meetings, remarks given by guide/reviewers and progress of the work in the project diary. The project diary must be presented during each review presentation to the reviewers.
  - A student should conduct the research ethically, adhere to the academic integrity standards, and cite sources whenever using any existing results

- A student should Incorporate constructive feedback to improve the quality and rigor of the research
- For final examination, students should complete the Seminar Report in all aspects including formatting and citation.
- Each student should prepare the report, get it approved by his/her guide and submit the duly signed copy within the deadline.
- A student should invest time and effort in preparing seminar presentations and the oral defense of the seminar

- **Topic Selection**
  - **Relevance:** Topics must be directly related to Electrical Engineering, encompassing cur- rent research trends, emerging technologies, advanced concepts, or interdisciplinary applications
  - **Scope:** The topic should be sufficiently focused to allow for in-depth exploration within the seminar timeframe, yet broad enough to demonstrate a comprehensive understanding. Avoid overly narrow or excessively broad topics.
  - **Novelty (Desired):** While not strictly a research paper, students are encouraged to explore topics that have recent advancements, open problems, or areas where their unique insights can be presented. Avoid merely summarizing introductory textbook material.
  - **Guide / Supervisor Approval**: Each student must select a seminar topic in consultation with and obtain approval from an assigned faculty supervisor. The supervisor will guide the student in refining the topic and identifying relevant resources.
  - **Examples of Broad Areas:** Artificial Intelligence tools, Smart Grid, Power system modelling, Power System Dynamics, Power System Planning and reliability, Power System Protection, Industrial Automation, Digital Signal Processing Data.

- **Seminar Structure and Deliverables:**

  The technical seminar typically involves the following stages and deliverables
  - Topic Proposal (2-3 weeks after topic approval):
  - A concise document (1-2 pages) outlining:
  - Proposed Seminar Title
  - Brief Description/Abstract of the Topic
  - Motivation and Relevance to Electrical Engineering
  - Preliminary List of Key References (at least 5-7 reputable sources)
  - Tentative Scope and Outline of the Presentation
  - Submission: To the faculty supervisor for approval.
  - Literature Review and Research (Ongoing): Sources: Students must primarily rely on peer-reviewed academic sources (IEEE Xplore, ACM Digital Library, SpringerLink, arXiv, Google Scholar), reputable conference proceedings, and established industry standards. Wikipedia and unverified blogs are generally not acceptable as primary sources.
  - Critical Analysis: Beyond mere summarization, students are expected to critically analyze the literature, identifying different approaches, their advantages/disadvantages, open issues, and potential future directions.
  - Note-Taking & Organization: Maintain systematic notes and organize research material effectively.

- **Seminar Report/ Paper (Due 2-3 weeks before presentation)**

- A written report (typically 15-25 pages, excluding references and appendices) detailing the seminar content.
- Format: Follow a professional academic paper format (e.g., IEEE transaction style).
- **Sections**
  - **Abstract:** A concise summary of the seminar topic and key findings.
  - **Introduction**: Background, motivation, problem statement (if applicable), and outline of the report.
  - **Literature Review/Background**: Detailed discussion of relevant concepts, theories, and existing work.
  - **Core Content:** In-depth exploration of the chosen topic, presenting different methodologies, architectures, algorithms, or challenges as relevant.
  - **Analysis/Discussion**: Critical evaluation of the presented material, comparing different approaches, discussing implications, and identifying gaps.
  - **Future Trends/Conclusion:** Summarization of key takeaways, potential future directions, and concluding remarks.
  - **References:** A comprehensive list of all cited sources properly formatted.
  - Appendices (Optional): Supplementary material if necessary.

- **Oral/ Presentation**
  - Duration: Typically, 25-30 minutes for presentation, followed by 10-15 minutes for Q&A. (Specific timings will be announced)
  - Audience: Faculty members, peers, and potentially other interested individuals.
  - Content: The presentation should effectively convey the key aspects of the seminar topic.
  - It should not simply be a reading of the report.
  - Visual Aids: High-quality presentation slides (e.g., PowerPoint, Google Slides, LaTeX Beamer) are mandatory. Slides should be clear, concise, visually appealing, and support the oral delivery. Avoid excessive text on slides.
  - Delivery: Clear articulation, confident posture, good eye contact, and appropriate pace.
  - Practice the presentation thoroughly.
  - Q&A Session: Be prepared to answer questions from the audience on all aspects of the seminar topic. Demonstrate a strong understanding and ability to defend your perspectives.

- **Evaluation Criteria:** The technical seminar will be evaluated based on the following criteria:
  - Topic Selection and Scope (10%): Relevance, timeliness, and appropriate depth of the chosen topic. Clarity and focus of the topic proposal.
  - Literature Review and Research (25%): Breadth and depth of literature surveyed. Quality and credibility of sources used. Critical analysis and synthesis of information.
  - Seminar Report/Paper (30%): Clarity, organization, and logical flow of content. Technical accuracy and depth of discussion. Adherence to academic writing standards (grammar, spelling, formatting, referencing). Originality in synthesis and critical insights. Absence of plagiarism.
  - Oral Presentation (35%): Content: Clarity, completeness, and accuracy of the presented material. Organization: Logical flow, effective use of time. Visual Aids: Quality, clarity, and effectiveness of slides. Delivery: Confidence, clarity of speech, enthusiasm, engagement with the audience. Q&A: Ability to answer questions accurately, comprehensively, and confidently.

Learning Resources
Textbooks
[T1]. "Engineering Communication" by Charles W. Knisely & Karin I. Knisely [T2]. "Technical Communication: Principles and Practice" by Meenakshi Raman & Sangeeta Sharma [T3]. "The Craft of Scientific Presentations" by Michael Alley
Swayam/ NPTEL Courses
[1]. https://nptel.ac.in/courses/109/106/109106180/ [2]. https://www.udemy.com/course/technical-writing/ [3]. https://www.edx.org/course/writing-in-the-sciences

Savitribai Phule Pune University Board: Electrical Engineering ME ELECTRICAL (POWER SYSTEMS) (2025 Pattern)		
Course Code: RPR-652-POS		**Course Name:** Research Project- II
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 00 Hrs	--	TW : 150 Marks
Practical : 36 Hrs	18	OR/Presentation : 50 Marks

Course Description:

The master's degree culminates in a research project of the student's own design. This research project is documented by a final research report or dissertation. The student's work is guided by an academic supervisor. Students are expected to choose real-world contemporary problems and apply the engineering principles learned, to solve the problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. Students are expected to construct a research project that includes original research, deliberate and well considered methodological choices, and shows relevance to significant conversations within the discipline. The dissertation should represent the very best research and analysis a student can produce.

Course Objectives:

1. Demonstrate an ability to plan a research project, such as is required in a research proposal prior to the launch of their work
2. Ability to manage projects and to make constructive use of expertise associated with their project, while working as an independent learner
3. Ability to relate their original data to existing literature, or to create a novel synthesis of existing materials
4. Identify and formulate a problem of research interest in the chosen area of computing.

Course Outcomes: At the end of the course, the student will be able to

1. **CO1: Undertake** independent research that makes an original contribution to knowledge, or produces a novel synthesis of existing materials relevant to significant conversations in the discipline
2. **CO2: Plan** their project in advance, using a proposal to describe their undertaking, describe how it will be managed, and reflect upon its value
3. **CO3: Relate** their original research to existing literature on the subject and relate their work to general themes in their relevant scholarly literature
4. **CO4: Assemble** their rationale, methods, findings, and analysis into a substantial piece of writing that presents a clear thesis and a cohesive evidence-based argument or analysis
5. **CO5: Reflect** on the strengths and weaknesses of their research and methodology, understanding how they might improve their efforts in future work

Guidelines

1. **General Guidelines:**

- The student shall consolidate and complete the remaining part of the research work started in Semester III. This will consist of Selection of Technology, Installations, implementations, testing, Results, measuring performance, discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems, comparative anal- ysis, validation of results and conclusions.
- The student shall prepare the duly certified final report of dissertation in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.
- The students are expected to validate their study undertaken by publishing it on standard platforms.
- The investigations and findings need to be validated appropriately at standard platforms like conference

and/or peer reviewed journal.

- The student has to exhibit continuous progress through regular reporting and presentations and proper documentation of the frequency of the activities in the sole discretion of the PG coordination/Head of the department. The continuous assessment of the progress needs to be documented unambiguously.
- Supervisor Interaction: Minimum one meeting per week.
- Logbook: Maintain a record of work progress and supervisor comments.
- Ethics: No plagiarism, false results, or unethical practices allowed.
- Backup: Keep source code, datasets, and reports backed up securely.
- Submission Format: Soft copy (PDF) + Hard copy as per institute norms.

2. Key Components

Implementation

- Students Complete development/simulation/testing of the system or model.
- Ensure correctness, efficiency, and validation of results.

Results & Analysis

- Include experimental setup, datasets used, performance metrics.
- Graphs, tables, and comparison with existing techniques.
- Highlight key findings and their significance.

Conclusion and Future Work

- Summarize outcomes, contributions, and applications.
- Suggest extensions or improvements for future research.

Paper Publication

- At least one paper (optional/encouraged) in peer-reviewed conference/journal.
- Attach publication/proof as appendix (if available).

Final Report Format

- Revised version of Stage 1 report with added implementation, results, and conclusion chapters.
- Maintain academic writing standards and include all necessary references.

Plagiarism Report

- The final version must again be checked and should not exceed 15% similarity.

Evaluation Parameters

- Completeness and quality of implementation
- Analysis and originality of results
- Quality of documentation and adherence to format
- Viv-voce performance and clarity of understanding
- Contribution to knowledge or innovation

Savitribai Phule Pune University, Pune

Maharashtra, India

सावित्रीबाई फुले पुणे विद्यापीठ

Task Force for Curriculum Design and Development

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