Curriculum
for
Master of Technology
in
Electrical Power Systems
(MTech EPS)
(Pattern 2024)

With Effect from A.Y. 2024-25

Matoshri Education Society's

Matoshri College of Engineering and Research Centre, Eklahare, Nashik
(Autonomous)

NBA and NAAC Accredited, Approved by All India Council for Technical Education, New Delhi, Affiliated to Savitribai Phule Pune University, College Code: 5177
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Eklahare, Near Odhagaon, Off Nashik-Aurangabad Highway, Nashik, Maharashtra 422105

Curriculum for Post Graduate Programmes- MTech EPS
(Pattern 2024)

Matoshri College of Engineering and Research Centre, Eklahare, Nashik has been granted the academic autonomous status from academic year 2024-25 by University Grant Commission. The Academic autonomous status has been considered as an opportunity for imparting comprehensive education. The academic autonomous status can be utilized to implement the National Education Policy (NEP 2020) effectively. The institute has a prudent plan to incorporate necessary dynamism in academic structure to march towards the vision of the institute and develop the research and skill oriented human resources contributing to the development of the nation.

With a focus on staying at the forefront of educational innovation, the institution diligently prepares curricula that are both dynamic and industry-aligned. This process entails meticulous planning and collaboration to ensure the development of comprehensive programs catering to the evolving needs of students and industries alike.

The highlights of Master of Technology (MTech) curriculum:
- Every Post Graduate programme is of two years duration with four semesters.
- The curricula have been designed adhering to the NEP guidelines and norms.
- Efforts have been taken to design the curricula which are unambiguous and self explanatory.
- Students have to earn 84 credits for the award of MTech degree.

Credit Requirement and Eligibility for the PG Programme
Eligibility first year PG admissions will be as per guidelines provided by Admission Regulating Authority of Government of Maharashtra and guidelines of NEP2020.

Examination and Passing
Rules of Passing
- To pass the course, the student has to earn a minimum of 40 percent marks in End Semester exam and 40 percent average marks (In-Semester marks + End-Semester marks) in the exam head.
- Students can earn the credit of the course if he/she passes the course with appropriate grade.
- The student is declared as PASS in the corresponding year if he/she earns the credits of all the courses of the year.
- A student will be awarded the master's degree if he/she earns 84 credits.

Rules of A.T.K.T.
The students who is not detained to appear in examination either in first semester or second semester of First year and, has filled the form of examination is eligible to take admission in second year of PG course.

Exit Point
For those who join 2 year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

This document includes-

Matoshri College of Engineering and Research Centre (Autonomous)
Curriculum for
Master of Technology in Electrical Power Systems (MTech EPS) 2024-25

Table of Contents

Table 1: Total Credit and Total Marks for Master of Technology (MTech)		
Semester	**Total Credits**	**Total Marks**
I	22	650
II	22	650
III	20	600
IV	20	600
Total	**84**	**2500**

Table 2: Nomenclature for Course Codes

Format for Course Codes-

YY - Year of Course launch

U/P- U : Undergraduate **P**- Postgraduate

NN- Branch Code **MM**- Course Number

YY	U/P	NN	MM

NN	Post Graduate Programme	NN	Post Graduate Programme
10	MTech Geotechnical Engineering	13	MTech Electrical Power Systems
11	MTech Data Science	14	MTech Heat Power Engineering
12	MTech VLSI and Embedded System	15	Master of Computer Applications (MCA)

Table 3: Examination Heads and Assessment Schemes				
Exam Head	**Abbreviation**	**In Semester Exam (40% of Total Marks)**		**End Semester Exam (60% of Total Marks)**
		In_Sem_Exam_1 (20%)	**In_Sem_Exam_2 (20%)**	
Theory	**TH**	CAT/CCE based on 20% curriculum	CAT/CCE based on 20% curriculum	Theory examination based on 60% curriculum
Project	**PROJ**	Progress Review I with Demonstration, Presentation, Oral & Report	Progress Review II with Demonstration, Presentation, Oral & Report	Activity, Presentation, Demonstration, Oral & Report as applicable
Internship	**INT**	Progress Review I with Activity, Presentation, Demonstration, Oral & Report as applicable	Progress Review II with Activity, Presentation, Demonstration, Oral & Report as applicable	Activity, Presentation, Demonstration, Oral & Report as applicable
Practical	**PR**	Mid-semester exam based on experiment/ activity performance, demonstration, Presentation, Oral and Journal, Report as applicable		Experiment, activity performance, demonstration, Presentation, Oral & Report, journal as applicable
Term work	**TW**	Mid-semester exam based on experiment/ activity performance, demonstration, Presentation, Oral and Journal, Report as applicable		Activity, Experiment performance, demonstration, Presentation, Oral & Report, journal as applicable
Seminar	**SEMI**	Mid-semester review based on topic of study, literature study, draft of paper manuscript, report(s) and other as applicable		Discussions, Presentation, Report(s), publication as applicable
Continuous Assessment Test	**CAT**	Class test examination to assess and evaluate a student's progress with descriptive or objective questions as measure of the student's knowledge and skills in online or offline mode.		

Continuous and Comprehensive Evaluation	**CCE**	Examination that evaluate learners' abilities based on various dimensions viz- academic performance, work experience, skills, coordination, agility, innovation, teamwork, public speaking, behavior, and similar as a measure of knowledge, skills and attitude.

Table 4: Various Courses' Categories, Description and Abbreviation		
Broad Category	**Description**	**Abbreviations**
Program Courses	Programme Core Course	PCC
	Programme Core Course Lab	PCCL
	Programme Elective Course	PEC
	Programme Elective Course Lab	PECL
Multidisciplinary Courses	Multidisciplinary Course	MDC
	Generic Elective	GE
Experiential Learning Courses	Project	PROJ
	Internship / On Job Training	INT / OJT
Course Type/ Teaching Learning Schemes / Examination Heads	Practical	PR
	Internship	INT
	Theory	TH
	Tutorial	TUT
	Lecture	Lect
	Laboratory Course	Lab
	Term work	TW
	Seminar	SEMI
MOOC	Massive Open Online Courses by NPTEL under SWAYAM	MOOC
Project Management, Finance and Governance	Project Planning/ Entrepreneurship Development / Engineering Economics / Management/ Corporate Laws/ Corporate Governance	PMFG
In Semester Examination	In_Sem_Exam	ISE
Continuous Assessment Test	Continuous Assessment Test	CAT
End Semester Examination	End_Sem_Exam	ESE
Continuous & Comprehensive Evaluation	Continuous & Comprehensive Evaluation	CCE
Bloom's Taxonomy	Bloom's Taxonomy	BL
Course Outcome	Course Outcome	CO
Program Outcome	Program Outcome	PO

Table 5: Program Outcomes At the end of Post Graduate Program, a student would have:	
PO1	**Problem Solving and Research Skill:** An ability to independently carry out research /investigation and development work to solve practical problems
PO2	**Communication:** An ability to write and present a substantial technical report/document
PO3	**Lifelong Learning:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4	**Critical Thinking, Project Management and Finance, Scholarship of knowledge:** Demonstrate advanced knowledge and skills understanding management principle to analyze complex engineering problems critically, and apply the same to, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors while working as individual or in teams or as a leader in a team.
PO5	**Collaborative and Multidisciplinary work:** An ability to think critically and apply appropriate logic, analysis, judgment and decision making and to function as an effective member or leader of engineering teams to achieve common goals.
PO6	**Usage of Modern Tools, Ethical Practices and Social Responsibility:** An ability to use appropriate techniques, skills, and modern engineering tools necessary for engineering practice and commit to professional ethics and responsibilities

Program Specific Outcomes At the end of Post Graduate Program,	
PSO1	To analyze and solve the problems related to electric grid using modern techniques and tools.
PSO2	To design and develop power electronics hardware and its control to cater the needs of industry such as renewable interconnections.

Matoshri College of Engineering and Research Centre (Autonomous)
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Table 6: First Year MTech Electrical Power Systems (FYMTech EPS) Semester I

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CAT	CCE	ESE	Total	TH	TUT	PR	Total
24P1301	MDC	Computer Applications in Power System	TH	4	-	-	20	20	60	100	4	-	-	4
24P1302	PCC	MOOC_1	TH	4	-	-	20	20	60	100	4	-	-	4
24P1303	PCC	Research Methodology	TH	2	-	-	20	20	60	100	2	-	-	2
24P1304	PCC	Power System Economics and Management	TH	4	-	-	20	20	60	100	4	-	-	4
24P1305	PEC	Program Elective Course I	TH	4	-	-	20	20	60	100	4	-	-	4
24P1306	PCCL	Program Core Course Lab I	PR	-	-	4	20		30	50	-	-	2	2
24P1307	PECL	Program Elective Laboratory I	PR	-	-	2	20		30	50	-	-	1	1
24P1308	PMFG	Study of Indian Constitution	SEMI	-	1	-	20		30	50	-	1		1
Total				**18**	**01**	**6**	**260**		**390**	**650**	**18**	**1**	**3**	**22**
Total Hours/ Week				**25**			**650**				**22**			

Course Code	**Course Name**
24P1305-A	Partial Discharges in Electrical Equipments
24P1305-B	Industrial Automation and Control
24P1305-C	Smart Grid Technologies
24P1305-D	Advanced Power Electronics
24P1305-E	Generic Elective **

MOOC_1: NPTEL Courses under SWAYAM for AY 2024-25	
Course Code	**Course Name**
24P1302-A	High Power Multi level Converters
24P1302-B	Power Management Integrated Circuits
24P1302-C	Power Quality Improvement Techniques
24P1302-D	Power System Dynamics control and Monitoring

Note: If a student has already learnt a course marked with #, then a course marked with ## is offered instead. Otherwise, the # marked course is mandatory.

****GE:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek. A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa.

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Table 7: First Year MTech Electrical Power Systems (FYMTech EPS) Semester II

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CAT	CCE	ESE	Total	TH	TUT	PR	Total
24P1309	PCC/MDC	MOOC_2	TH	4	-	-	20	20	60	100	4	-	-	4
24P1310	PCC	Power System Modeling	TH	4	-	-	20	20	60	100	4	-	-	4
24P1311	PCC	Power System Planning & Reliability	TH	4	-	-	20	20	60	100	4	-	-	4
24P1312	PEC	Program Elective Course II	TH	4	-	-	20	20	60	100	4	-	-	4
24P1313	PCCL	Program Core Course Lab	TW+ PR	-	-	4	40		60	100	-		2	2
24P1314	PECL	Program Elective Laboratory II	TW+ PR	-	-	4	40		60	100	-	-	2	2
24P1315	PMFG	Project and Finance Management	SEMI	-	1	2	20		30	50	-	1	1	2
Total				**16**	**01**	**10**	**260**		**390**	**650**	**16**	**1**	**5**	**22**
Total Hours/ Week				**27**			**650**				**22**			

Course Code	**Course Name**
24P1312-A	EHV AC Transmission
24P1312-B	Energy Storage Systems
24P1312-C	Communication Protocols in SCADA system
24P1312-D	Electrical Power Distribution Systems
24P1312-E	Generic Elective **

MOOC_2: NPTEL Courses under SWAYAM for AY 2024-25	
Course Code	**Course Name**
24P1109-A	**^Note:** Course Names will be declared as per availability of NPTEL courses of 12/16 weeks available in that particular year for the semester.
24P1109-B	
24P1109-C	
24P1109-D	

Note: If a student has already learnt a course marked with #, then a course marked with ## is offered instead. Otherwise, the # marked course is mandatory.
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Table 8: Second Year MTech Electrical Power Systems (SYMTech EPS) Semester III

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CCE	CCE	ESE	Total	TH	TUT	PR	Total
24P1316	PCC	MOOC_3	TH	4	-	-	20	20	60	100	4	-	-	4
24P1317	PCC	Power Quality Assessment and Mitigation	TH	4	-	-	20	20	60	100	4	-	-	4
24P1318	PEC	Program Elective Course III	TH	4	-	-	20	20	60	100	4	-	-	4
24P1319	PCCL	Program Core Course Lab III	PR	-	-	2	20		30	50	-	-	1	1
24P1320	PMFG	Company Law and Corporate Governance	SEMI	-	1	-	20		30	50	-	1	-	1
24P1321	PROJ	Dissertation Stage-I	PROJ	-	-	12	40	40	120	200	-	-	6	6
Total				**12**	**01**	**14**	**240**		**360**	**600**	**12**	**1**	**7**	**20**
Total Hours/ Week				**27**			**600**				**20**			

Program Elective Course 3	
Course Code	**Course Name**
24P1318-A	Artificial Neural Network and its applications in Power System

MOOC_3: NPTEL Courses under SWAYAM for AY 2025-26	
Course Code	**Course Name**
24P1316-A	**^Note:** Course Names will be declared as per availability of NPTEL courses of 12/16 weeks available in that particular year for the semester.
24P1316-B	
24P1316-C	
24P1316-D	

24P1318-B	Advance Processors and Applications
24P1318-C	Renewable Energy
24P1318-D	Intelligent Sensors and Instrumentation
24P1318-E	Generic Elective **

. **Note:** If a student has already learnt a course marked with #, then a course marked with ## is offered instead. Otherwise, the # marked course is mandatory.

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Table 9: Second Year MTech Electrical Power Systems (SYMTech EPS) Semester IV

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CCE	CCE	ESE	Total	TH	TUT	PR	Total
24P1322	INT	Internship$	TW	-	-	$	50	50	150	250	-	-	8	8
24P1323	PCC	MOOC _4	TH	4	-	-	20	20	60	100	4	-	-	4
24P1324	PROJ	Project Stage-II	PROJ	-	-	16	50	50	150	250	-	-	8	8
Total				**4**	**-**	**16**	**240**		**360**	**600**	**4**	**-**	**16**	**20**
Total Hours/ Week				**-**			**600**				**20**			

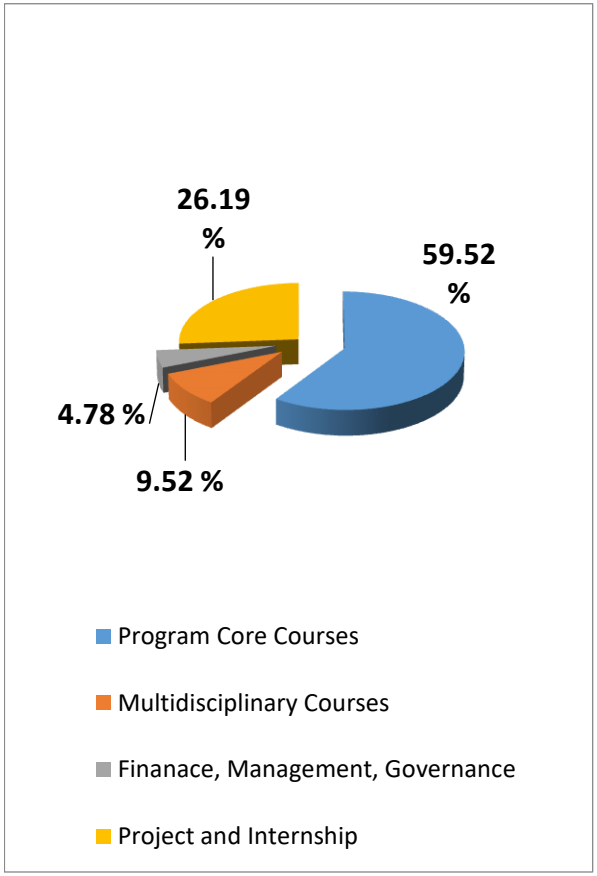
MOOC_4: NPTEL Courses under SWAYAM for AY 2025-26	
Course Code	**Course Name^**
24P1323-A	^Note: Course Names will be declared as per availability of NPTEL courses of 12/16 weeks available in that particular year for the semester.
24P1323-B	
24P1323-C	
24P1323-D	

$ Internship:

- Internship corresponding to major courses is to be completed after semester III Examinations and before commencement of semester IV of at least 180 hours/ 6 weeks; and it is to be assessed and evaluated in semester IV.
- It is almost imperative that the commencement of Semester IV needs to be approx. 3 weeks beyond the schedule.

Dr. Shridhar S. Khule
Chairman, BoS
Electrical Engineering

Table 10: Broad Courses' Categories, and Credit Distribution				
Broad Category	**Description**	**Credit**	**Total Credit**	**%**
Program Courses **Total Credit= 50** **59.52%** **(19.00 % in online mode)**	Programme Core Course	30	35	**41.66**
	Programme Core Course Lab	05		
	Programme Elective Course	12	15	**17.85**
	Programme Elective Course Lab	03		
Multidisciplinary Courses **Total Credit = 26** **09.52%**	Multidisciplinary Course	08	08	**09.52**
Project Management, Finance, and Governance **Total Credit =04** **04.78%**	Study of Indian Constitution	01	04	**04.78**
	Project Management and Finance	02		
	Company Law and Governance	01		
Experiential Learning Courses **Total Credit =22** **26.19%**	Project	14	22	**26.19**
	Internship / On Job Training	08		
Total		**84**	**84**	**100**



Matoshri College of Engineering & Research Centre, Nashik
Master of Technology in in Electrical Power Systems (MTech EPS) 2024-25
First Year MTech in Electrical Power Systems (MTech EPS)

24P1301 Computer Applications in Power System

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:

- Learn mathematical functions of various optimization techniques
- Understand the necessity of load flow studies and various methods of load flow studies
- Understand the applications of various methods for optimal power flow analysis

Course Outcomes: On completion of the course, learner will be able to–	BL
CO1: Conversant with various optimization techniques	2
CO2: Use methods of power flow analysis, optimal power flow analysis	3
CO3: Elaborate optimal power system operation	4
CO4: Review optimal power flow analysis	5
CO5: Estimate loss coefficients for optimal power system operation	4
CO6: Develop an optimal power system by case study	6

Course Contents

Unit I	Optimization Techniques	07 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 II	Load Flow Studies	07 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 III	AC- DC and Three Phase Load flow	07 Hours

Three Phase Load Flow: Three phase load flow problem notation, specified variables, derivation of equations. **AC-DC load flow**: Introduction, formulation of problem, D.C. System model, converter variables, Derivation of equations, Inverter operation, generalized flow chart for equation solution.

Unit IV	Estimation	06 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 V	Optimal Power System Operation	7 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.

Case Studies (if any)	

Books:

Textbooks:

1. Computer Aided Power System Operation and Analysis-R.N.Dhar, Tata McGraw Hill New Delhi..
2. Computer Techniques in Power System Analysis- M.A. Pai, Tata Mc-Graw Hill New Delhi.
3. Computer Methods in Power System Analysis- Stagg and El.Abiad, Mc-Graw Hill (International Student Edition.)

Reference Books:

1. Optimisation Techniques-S.S.Rao, Wiely Eastern Ltd, New Delhi.
2. Modern Power System Engineering, Nagrath and Kothari (Tata McGraw Hill).
3. Computer Analysis of Power Systems-J.Arrilinga, C.P.Arnold. Wiely Eastern Ltd.
4. Electrical Energy System Theory–an introduction- Olle Elgerd. TMH Publishing Company, New Delhi.

e-Books:

- An Introduction to Statistical Learning by Gareth James https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf

MOOC Courses:

- Power Systems Operation and Control, IIT Kanpur. Dr. S.N. Singh. https://archive.nptel.ac.in/courses/108/104/108104052/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	3	3	2	2	2	3
CO2	3	1	3	3	2	2	2	3
CO3	3	1	2	3	2	2	3	2
CO4	2	1	2	3	2	2	2	2
CO5	3	1	3	3	2	2	2	3
CO6	3	3	3	3	3	3	2	3

Matoshri College of Engineering & Research Centre, Nashik Master of Technology in in Electrical Power Systems (MTech EPS) 2024-25 First Year MTech in Electrical Power Systems (MTech EPS)		
24P1302 : MOOC-1		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 04 Hours/Week	**04**	**ISE: CAT: 20 Marks** **CCE: 20 Marks** **ESE: 60 Marks**
Course Contents		

MOOC-1: Udemy Courses for AY 2024-25#	
Course Code	**Course Name**
24P1302-A	Electrical Power Distribution system fundamentals
24P1302-B	Modern Electric Vehicle technology
24P1302-C	Power Electronics Drives
24P1302-D	Renewable Energy Sources.

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24P1303: Research Methodology

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:

1. To understand basic concepts of research and its methodologies
2. To learn the methodology to conduct the Literature Survey
3. To acquaint with the tools, techniques, and processes for statistical analysis
4. To effectively use and compare optimization techniques for solving problems involving single and multi-parameter cost functions.
5. To understanding sampling theory and its application in research

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1: Identify fundamental concepts, purposes, processes, and motivations of research, encompassing various paradigms, types, and scientific postulates.	1
CO2: Conduct a literature survey, define a clear research statement, develop a comprehensive research plan, identify diverse research tools, and present the report.	3
CO3: Conduct comprehensive statistical analyses, including error and uncertainty assessments, and perform hypothesis testing on research data.	3
CO4: Apply various optimization techniques to solve complex research problems involving single and multi-parameter cost functions and, present the results and methodologies in a comprehensive technical report.	3
CO5: Apply sampling theory and estimation techniques to determine sample size for estimating population parameters in research by presenting the findings.	3
CO6: Develop the skills to conduct comprehensive research, encompassing the definition of research statements, literature surveys, and the application of statistical analyses, optimization techniques, and sampling methods. Use these skills to provide innovative solutions for complex, real-life problems, and present your findings in a substantial technical report.	6

Course Contents

Unit I	Introduction	07 Hours

Evolution of Research Methodology: Meaning, nature, scope, and significance of research; Research paradigm; The purpose and Products of Research; Reasons for doing research, Objectives of research, Motivation for research; Postulates underlying scientific investigations; Types of research; Research process and work flow. **Engineering Research-**Why? Research Questions, Engineering Ethics, conclusive proof-what constitutes A research project-Why take on?		
Case Studies (if any)	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, & Nation, Engineering Disasters.	
Unit II	**Literature Search and Review, developing Research Plan**	**07 Hours**
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, Literature review, publication cost. Developing Research Plan: Research Proposals, Finding a suitable research questions, The elements of research proposals-title, details, budget, Design for outcomes-1D data, 2D data, 3D data, N-D data, The research tools- Experimental measurements, numerical modeling, theoretical derivations & Calculations, curve matching.		
Case Studies (if any)	Engineering dictionary, Shodhganga, The Library of Congress, Research gate, Google Scholar, Bibliometrics, Citations, Impact Factor, h-index, I-index, plagiarism, copyright infringement.	
Unit III	**Statistical Analysis**	**07 Hours**
Statistical Analysis: Introduction, Sources of error and uncertainty, One-Dimensional Statistics: combining errors and uncertainties, t-test, ANOVA statistics, example, Two-Dimensional Statistics: example, Multi-Dimensional Statistics: partial correlation coefficients, example, Null hypothesis testing		
Case Studies (if any)	GNU PSPP Tool, SOFA, NOST-Dataplot	
Unit IV	**Optimization Techniques**	**07 Hours**
Optimization Techniques: Introduction, Two-parameter optimization methods: sequential uniform sampling, Monte Carlo optimization, Simplex Optimization method, Gradient Optimization method, Multi- parameter optimization methods, The cost function.		
Case Studies (if any)		
Unit V	**Data Sampling**	**7 Hours**
Sampling Fundamentals: Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean (μ), Estimating Population Proportion, Sample Size and its Determination		
Case Studies (if any)	Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level	
Books:		

Textbooks:

1. David V Thiel, "Research Methods- for Engineers", Cambridge University Press, ISBN:978-1-107-61019-4
2. Kothari C.R., "Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978-81-224-1522-3.

Reference Books:

1. Caroline Whitbeck, "Ethics in Engineering Practice and Research", 2nd Ed., Cambridge University Press; ISBN :978-1-107-66847-8
2. Gordana DODIG-CRNKOVIC, "Scientific Methods in Computer Science", Department of Computer Science Malardalen University, Vasteas, Sweden; ISBN:91-26-97860-1

E-books:

1. Research Methodology- https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf

Research Methodology Tools and Techniques- https://www.euacademic.org/BookUpload/9.pdf

MOOC Courses

- Introduction to Research- https://onlinecourses.nptel.ac.in/noc23_ge36/preview
- Research Methodology- https://onlinecourses.nptel.ac.in/noc22_ge08/preview
- Introduction to Research- https://nptel.ac.in/courses/121106007

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	3	2	2	2	1	1
CO2	3	3	3	2	3	3	2	1
CO3	3	3	2	2	2	2	1	1
CO4	3	3	3	2	2	3	2	2
CO5	3	3	3	2	2	3	2	2
CO6	3	3	3	2	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik
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24P1304: Power System Economics and Management

Teaching Scheme	Credit	Examination Head: TH
		Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:

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

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1:- Analyze the effect of power sector reform in India as well as globally.	4
CO2 :- Evaluate the economic aspects of power project.	5
CO3 :- Differentiate between types of power-markets.	2
CO4:- Workout methods of Transmission Pricing.	3
CO5 :-Design a basic transmission plan and evaluate pricing strategies for transmission services, taking into account system constraints and economic factors.	6
CO6: Understanding Management Practices in Power Systems	3

Course Contents

Unit I	Power Sector in India	07 Hours

Introduction to various institutions in Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, state and central governments, REC, utilities and their roles. Critical issues / challenges before the Indian power sector, Salient features of Electricity act 2003, Various national policies, Energy policy and guidelines under this act latest amendments in Indian Power Sector. Need of regulation and deregulation of power industry. Conditions favouring deregulation in power sector.

Unit II	Power sector economics and regulation	07 Hours

Typical cost components and cost structure of the power sector, Different methods of comparing investment options, Concept of life cycle cost , annual rate of return , methods of calculations of Internal Rate of Return(IRR) and Net Present Value(NPV) of project, Short term and long term marginal costs, Different financing options for the power sector . Role of regulation and evolution of regulatory commission in India, Regulatory process in India, stages of tariff determination. Economic regulations – cost plus, performance based, incentive, Price and Revenue cap, Rate of return , sliding scale regulation. Key performance parameters.

Unit III	Power Tariff	07 Hours

Different tariff principles (marginal cost, cost to serve, average cost), objectives and components of tariff. Consumer tariff structures and considerations, different consumer categories, telescopic tariff, fixed and variable charges, time of day, interruptible tariff, power factor tariff, different tariff based penalties and incentives etc., tariff linked to quality of supply and service. Multi year tariff, levelised tariff. Subsidy and cross subsidy, life line tariff. Comparison of different tariff structures for different load patterns. Government policies in force from time to time. Effect of renewable energy and captive power generation on tariff. Determination of tariff for renewable energy. Feed in tariff for renewable. Non price issues in electricity restructuring, environmental and social considerations.

Unit IV	Power sector restructuring models and global reforms	07 Hours

Different industry structures (vertically integrated, regulated and deregulated), key market entities- ISO, Genco, Transco, Disco, Retailco. Competition in the electricity sector- conditions, barriers, different types, benefits and challenges. Different market trading models, single buyer model, Wholesale competition, retail completion model. Models based on contractual arrangement – pool model, bilateral/multilateral model, pool and bilateral contracts. ISO models- micro, mini and max ISO. Global experience with electricity reforms in different countries. Open access, Introduction to Indian Energy Exchange and its operation time markets, market power and exercising it and its effect on market operations.

Unit V	Electricity Markets and Pricing	7 Hours

Electricity price basics, Demand and price elasticity. Types of power and energy markets- spot market, day ahead, hour ahead market, forward contract future contract, option contract, contract for differences, ancillary market. Market operation market clearing price, market efficiency, effect gate closure, settlement process. Market Clearing price (MCP), Zonal and locational MCPs. Dynamic/ spot pricing, Market power and exercising market power.

Books:

Textbooks:

1. Fundamentals of Power System Economics by D.S. Kirschen and G. Strbac, John Wiley & sons.
2. Electricity Economics Regulation and Deregulation, by G. Rothwell and T Gómez, Wiley – InterScience.
3. Sally Hunt, “Making Competition Work in Electricity”, 2002, John Wiley Inc.
4. Electric Utility Planning and Regulation, Edward Kahn, American Council for Energy Efficient Economy.

Reference Books:

1. "Know Your Power", A citizens Primer On the Electricity Sector, Prayas Energy Group, Pune.

2. Power System Economics Designing markets for Electricity by Steven Stoft , Wiley- inter Science.

3. Market Operations in Electric Power Systems, Forecasting, Scheduling and Risk Management, by M. Shahidepour, Hatimyamin, Zuyi Li, Wiley InterScience.

4. Deregulation in Power Industry, course hand outs by S.A. Khaparde.

Other references:

1. Regulation in infrastructure Services: Progress and the way forward - TERI, 2001
2. Maharashtra Electricity Regulatory Commission Regulations and Orders -www.mercindia.com

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	3	3	2	2	2	3
CO2	3	1	3	3	2	2	3	3
CO3	2	1	3	3	2	2	2	2
CO4	3	2	3	3	3	2	2	2
CO5	3	3	3	3	3	2	3	3
CO6	3	1	3	3	3	3	2	2

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24P1305- A: Partial Discharges in Electrical Equipment

Teaching Scheme	Credit	Examination Head: TH
		Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:

- Understand the phenomenon of Partial discharge and techniques for its measurement.
- Learn various problems associated with partial discharge measurement.
- Know the effects of partial discharge on insulating material.
- Evaluate and locate the partial discharge.

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1: Identify the occurrence of partial discharge.	1
CO2: Measure and evaluate partial discharge.	5
CO3: Know the effects of partial discharge.	2
CO4: Proficiency in PD Data Analysis.	3
CO5: Assessment of Equipment Reliability and Lifespan.	4
CO6: Knowledge of PD Testing Standards and Compliance.	3

Course Contents

Unit I	The Phenomenon of Partial Discharge (PD):	07 Hours

Introduction, Definition of terms, typical electrode configurations with PD, internal discharges and surface discharges, external discharges, equivalent circuits, PD characteristics of parameters, waveform and characteristics of an individual PD pulse, train of PD current pulses, train of PD pulses in relation to the temporarily assigned instantaneous value of the high voltage, non electrical PD characteristics parameters.

Unit II	The Phenomenon of Partial Discharge (PD):	07 Hours

Wave form and spectrum of PD, PD charge measuring equipment, integration in the frequency domain, selectively wide band system, narrow band system, integration in the time domain with very large wide band systems, measuring impedance or coupling 4 terminal device, PD measuring circuits, calibration, calibration pulses, calibration of PD measuring setup, calibration of the complete test set up, uncertainty of measurements.

Unit III	Screening and Filtering Problems during Partial Discharge Measurements:	07 Hours

Need for screening, design of screens, completely enclosed screen, screen interruptions, effect of corners, cavity resonance, design of filters, measurement of screening efficiency, lead through bushings.

Unit IV	Power sector restructuring models and global reforms	07 Hours

Effects of PD on gaseous insulating materials, liquid insulating materials, solid insulating materials, surface discharges, internal discharges, mixed dielectrics.

Unit V	Electricity Markets and Pricing	7 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.

Books:

Textbooks:

1. Kreuger F. H. Partial Discharge Measurements.
2. Dieter Konig & Y Narayan Rao, PD in Electrical Apparatus. Vde-Veriag gmph Berlin.

Reference Books:

1. High Voltage Engineering, O. Kuffel E, Zaengl W. S, Oxford, Pergamon.
2. IEC – Publication 270 (1981) Partial Discharge Measurements.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	3	3	2	3	2	3
CO2	3	1	3	3	2	3	3	3
CO3	3	2	3	3	3	2	2	2
CO4	3	2	3	2	3	2	2	2
CO5	3	3	3	3	2	2	3	3
CO6	3	1	3	3	2	3	2	2

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24P1305- B: Industrial Automation and Control

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:

1. Understand the phenomenon of industrial automation.
2. Learn various industrial measurement characteristics.
3. Know the various techniques of automatic control.
4. Understand various hardware required for industry- automation.

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1: Understand the fundamental concepts and components of PLC systems.	2
CO2: Analyze industrial measurement system characteristics and their applications in PLC systems.	4
CO3: Apply principles of automatic control in the design and implementation of PLC systems.	3
CO4: Evaluate different types of PLC architectures and their suitability for various industrial applications.	5
CO5: Design and implement PLC programs for controlling industrial processes and machinery.	6
CO6 (Generic): Understand and analyze management practices in PLC systems, including safety and performance considerations.	2

Course Contents

Unit I	Introduction	07 Hours

Architecture of industrial automation system, development trends in industrial automation, classification of existing systems, and functionality of industrial automation system. Relay and contactor logic, AC and DC relays and their role for load control. Power and Auxiliary contactors and their usage for load control.

Unit II	Industrial Measurement System Characteristics	07 Hours

Sensors and control logic, control using potential free output sensors, Control using PO, PC, NO, NC type output sensor, 2W (2 wire), 3W (3 wire), 4W (4 wire) and 4WC sensors, Linear potentiometer Timer hardware architecture, Controlling industrial system using timers, Controlling industrial system using counters. Temperature measurement, Pressure, Force and Torque Sensors, Motion Sensing, Flow measurement, Signal Conditioning, Data Acquisition Systems.

Unit III	Automatic Control	07 Hours

Introduction, P-I-D Control, manual and auto PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures. Temperature controller hardware architecture.

Unit IV	PLC	07 Hours

Introduction to Sequence Control, PLC, RLL (Relay Ladder Logic), Sequence Control. Scan Cycle, Simple RLL Programs, Sequence Control. More RLL Elements, RLL Syntax, A Structured Design Approach to Sequence, PLC Hardware Environment, Introduction To CNC Machines, Contour generation and Motion Control, Allen Bradley PLC and SIEMEN PLC.

Unit V	Industrial Control	7 Hours

Basics of hydraulics, Hydraulic components their functions and symbols Hydraulic actuators, Pumps and its operation, pump control, Hydraulic valves (Direction control, pressure and flow control), special valves, pressure gauges and switches, hydraulic logic circuits, Hydraulic Control System, Multiple pressure and speed operations, Industrial Hydraulic Circuit, Pneumatic systems and components Pneumatic Control Systems, compressor operation and control, air treatment.

Books:

1	Lingefeng Wang, Kay Chen Tan, "Modern Industrial Automation and Software Design" John Wiley & Sons Inc.
2	K. L.S. Sharma, " Overview of Industrial Process Automation" Elsevier
3	Kok Kiong "Drives and Control for Industrial Automation" Springer

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	3	3	2	3	2	3
CO2	3	1	3	3	2	3	3	3
CO3	3	2	3	3	3	2	2	2
CO4	3	1	3	3	2	3	3	3
CO5	3	2	3	3	3	3	3	3
CO6	3	2	3	3	3	3	2	2

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24P1305- C: Smart Grid Technologies

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

Course Objectives:
Objectives:

1. Understand the fundamental concepts, architecture, and components of smart grids.
2. Analyze the role of smart grids in enhancing the efficiency, reliability, and sustainability of power systems.
3. Explore the integration of renewable energy sources and energy storage systems in smart grids.
4. Learn about advanced communication and control technologies used in smart grids.
5. Understand the importance of cybersecurity in protecting smart grid infrastructure.
6. Investigate the economic, regulatory, and policy aspects of smart grid development.

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1: Understanding of Smart Grid Concepts: Students will be able to explain the basic concepts, architecture, and evolution of smart grids, and their role in modern power systems.	2
CO2: Application of Smart Grid Technologies: Students will demonstrate the ability to identify, analyze, and apply smart grid technologies for improving grid performance and reliability.	3
CO3: Communication and Control in Smart Grids: Students will be able to implement and evaluate communication protocols and control systems in smart grids for real-time monitoring and management.	4
CO4: Integration of Renewable Energy and Energy Storage: Students will evaluate the integration of renewable energy sources and energy storage systems into the smart grid, considering technical and operational challenges.	5
CO5: Assessment of Economic, Regulatory, and Policy Aspects: Students will critically analyze the economic, regulatory, and policy implications of smart grid implementation	4
CO6: Development of Smart Grid Solutions: Students will be able to independently research and develop innovative smart grid solutions to solve current and future grid challenges.	6

Course Contents

Unit I	Introduction to Smart Grids	07 Hours

Definition and Concept of Smart Grids, Evolution of Power Systems to Smart Grids, Drivers and Benefits of Smart Grids, Smart Grid Standards and Regulations.

Unit II	Smart Grid Technologies	07 Hours

Smart Meters and Advanced Metering Infrastructure (AMI), Phasor Measurement Units (PMUs) and Wide-Area Monitoring Systems (WAMS), Sensors and Smart Devices for Grid Monitoring Advanced Distribution Management Systems (ADMS).

Unit III	Communication and Control in Smart Grids	07 Hours

Communication Technologies: Wired and Wireless Protocols and Standards for Smart Grid, Communication Supervisory Control and Data Acquisition (SCADA) Systems, Distributed Control and Automation in Smart Grids.

Unit IV	Integration of Renewable Energy and Energy Storage	07 Hours

Challenges of Renewable Energy Integration, Role of Energy Storage in Smart Grids, Microgrids and Distributed Generation, Grid-Interactive Inverters and Power Electronics.

Unit V	Economic, Regulatory, and Policy Aspects of Smart Grids	7 Hours

Case Studies on Smart Grid Implementations, Emerging Trends: Blockchain, AI, and Machine Learning in Smart Grids, Review and Discussion on Current Research in Smart Grids, Consumer Engagement and Behavioral Aspects, Role of Electric Vehicles in Smart Grids.

Books:

1	"Smart Grid Handbook" edited by Xiao-Ping Zhang.
2	"Cybersecurity and Privacy in Smart Grids: Challenges, Solutions, and Future Directions" by Sanjay Goel and Enrique R. Villa-Cubero.
3	"Renewable Energy Integration: Practical Management of Variability, Uncertainty, and Flexibility in Power Grids" by Lawrence E. Jones.
4	Power System Restructuring and Deregulation: Trading, Performance and Information Technology" by Loi Lei Lai.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	3	3	2	3	2	3
CO2	3	1	3	3	2	3	2	3
CO3	3	2	3	3	2	3	2	2
CO4	3	1	3	3	2	3	3	3
CO5	3	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	3	3

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24P1305- D: Advanced Power Electronics

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

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 use of different energy storage systems.
4. To know various advanced control techniques for Power flow control in converter configurations.

Course Outcomes: On completion of the course, learner will be able to–	BL
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 the same application.	4
CO6: Understand and analyze management practices in power electronics, including safety, efficiency, and regulatory considerations.	6

Course Contents

Unit I	Voltage Source Converters	07 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 II	Self and Line commutated current source converter	07 Hours

Basic concepts of CSC, 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 multipulse converter.

Unit III	Multilevel Inverters:	07 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 IV	Energy Storage Systems:	07 Hours

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

Unit V	Akagi's p-q theory:	7 Hours

Conventional concepts of active and reactive power in single phase and three phase circuits- equation of power with sinusoidal voltage source and non-linear loads - αβo transformation of three phase four wire system- Akagi's instantaneous power (pq) theory- relationship between Akagi's components and conventional active and reactive power application of pq theory to reactive and harmonic power compensation in simple circuits.

Books:

1	Power Electronic Control in Electrical Systems by E. Acha, Miller & Others (Newones, Oxford publication) – first Edition
2	Power Electronics by M. H. Rashid Prentice Hall of India Pvt. Ltd. New Delhi, (3rd Edition)
3	Understanding FACTS by N.G. Hingorani & L. Gyugyi (IEEE Press, Indian Edition)
4	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.
5	L. 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.
6	H.Akagi, E.H. Watanabe and M.Aredes "Instantaneous Power Theory and Applications to Power Conditioning, IEEE Press, New York.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	3	3	3	2	3	2	3
CO2	3	2	3	3	3	3	3	3
CO3	2	2	3	3	2	3	2	3
CO4	3	2	3	3	2	3	3	3
CO5	3	2	3	3	3	3	2	3
CO6	2	3	3	3	2	3	3	2

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24P1305- E: Generic Elective (GE)

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 04 Hours/Week	04	ISE: CAT: 20 Marks CCE: 20 Marks ESE: 60 Marks

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek. A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa

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24P1306- : Program Core Course Lab I

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
PR: 04 Hours/Week	02	CCE: 20 Marks END SEM: 30 Marks Total : 50 Marks

24P1406: Electrical Power System Lab

Companion Course: Computer Applications in Power Systems, Power System Economics and Management

Course Outcomes: On completion of the course, learner will be able to– **BL**

CO Mapping: CO1 to CO5 for all Lab Assignments

Sr. No.	Experiments/Assignments	
1	**CO1: Understanding of Power Sector Structure and Regulations**	2
2	**CO2: Application of Financial and Economic Evaluation Techniques in Power Projects**	5
3	**CO3: Simulation and Analysis of Power System Operations**	4
4	**CO4: Optimization of Power Systems and Economic Dispatch**	4
5	**CO5: Evaluation of Electricity Markets and Pricing Mechanisms**	5
6	**CO6: Integration of Renewable Energy and Policy Implications**	6

Suggested List of Laboratory Experiments/Assignments
(Any 8 laboratory assignments)

1	**Analysis of Indian Power Sector Institutions and Regulations** • Objective: To study the roles and challenges of institutions in the Indian power sector, and understand the impact of regulatory frameworks like the Electricity Act of 2003.
2	**Economic Analysis and Financing Options for Power Projects** • Objective: To apply financial evaluation methods like IRR, NPV, and life cycle costs for power projects, and analyze different financing options.
3	**Analysis of Tariff Structures and Consumer Categories** • Objective: To evaluate and compare different tariff structures for various consumer categories, and analyze the impact of tariffs on energy consumption and renewable energy integration.

4	**Study of Power Sector Restructuring Models and Global Reforms** • Objective: To explore various power sector restructuring models (regulated, deregulated) and study global power sector reforms.
5	**Electricity Market Operations and Pricing Mechanisms** • Objective: To simulate electricity market operations, study market clearing prices, and understand pricing mechanisms like zonal and locational pricing.
6	**Three-Phase Load Flow Analysis Using Newton-Raphson Method** • Objective: To simulate three-phase load flow problems using the Newton-Raphson method in both polar and rectangular forms.
7	**AC-DC Load Flow Simulation** • Objective: To model and analyze AC-DC load flow and evaluate the role of DC components using MATLAB.
8	**Classical Optimization Techniques for Power System Operation** • Objective: To apply optimization techniques such as the Lagrange Multiplier method, constrained variation method, and Kuhn-Tucker conditions to power system problems.
9	**Contingency Evaluation and Security Monitoring** • Objective: To simulate and analyze power system contingencies using fast-decoupled load flow methods and evaluate system security.
10	**Economic Dispatch Using Loss Formula and Linear Programming** • Objective: To perform economic dispatch considering transmission losses using linear programming methods and MATLAB simulations.
@The CO-PO Mapping Matrix	

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	2	2	3	2	1	1	1
CO2	3	2	2	3	1	1	2	2
CO3	2	2	2	3	1	2	3	2
CO4	3	2	3	3	3	2	2	2
CO5	1	2	1	1	2	3	2	2
CO6	3	1	2	3	2	3	2	3

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24P1307 : Program Elective Laboratory I

Teaching Scheme:	Credit	Examination Head: PR Examination Scheme:
PR: 02 Hours/Week	01	CCE: 20 Marks End_Sem: 30 Marks Total: 50 Marks

Companion Course: Elective -I

Syllabus Contents:

- The lab practice consists of the tutorials / experiments / Case Study / industrial visit / Industry base Mini project related to Electrical Power systems as decided by the course supervisors of the Program Elective Core Lab (PECL) as follows

24P1305-A	Partial Discharges in Electrical Equipments
24P1305-B	Industrial Automation and Control
24P1305-C	Smart Grid Technologies
24P1305-D	Advanced Power Electronics
24P1305-E	Generic Elective **

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24P1308 Study of Indian Constitution

Teaching Scheme	Credit	Examination Head: SEMI Examination Scheme & Marks
TUT: 01 Hour/Week	01	ISE: 20 Marks ESE: 30 Marks

Prerequisite: Any graduate

Course Objectives:

- To acquaint with the basic principles of Constitution and Constitutionalism
- To understand the reasons, operation and justification of the growth of Fundamental Rights in India
- To learn the Directive Principles of India.
- To understand the powers, functions and structures of various Constitutional bodies.
- To study the constitutional operations in the context of social, economic and political.

Course Outcomes: On completion of the course, learner will be able to–	**BL**
CO1: Apply knowledge of the historical background, key features, and provisions related to citizenship in the Indian Constitution to assess its relevance to contemporary governance.	3
CO2: Analyze and present findings for study of - the structure and classification of fundamental rights, directive principles of state policy, and fundamental duties enshrined in the Constitution.	6
CO3: Comprehend the roles, powers, and functions of the Union executive, Union Legislature, and Union judiciary, with a focus on parliamentary procedures and the Supreme Court.	**2**
CO4: Survey the composition, powers, and functions of the State executive, State Legislature, and State judiciary, including the role of Governors and High Courts.	**4**
CO5: Discover the legislative, administrative, and financial relations between the Union and State governments, including provisions for emergency, trade, and amendments to the Constitution.	**4**
CO6: Elaborate the Indian Constitution's framework and its role in governing the structure and functioning of both the Union and State governments, fostering responsible citizenship.	**6**

Course Contents

Unit I	**Introduction and Citizenship**	**04 Hours**

Definition of constitution, historical back ground, salient features of the constitution. Preamble of the constitution, union and its territory. Meaning of citizenship, types, termination of citizenship.

Unit II	**Rights in the Constitution and Directive Principles of State Policy**	**06 Hours**

Definition of state, fundamental rights, general nature, classification, right to equality, right to freedom, right against exploitation. Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences. Directive principles of state policy, classification of directives, fundamental duties.

Unit III	Structure, Powers and Functions of Union Legislature	05 Hours

The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions. The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament. Union judiciary, the supreme court, jurisdiction, appeal by special leave.

Unit IV	Structure, Powers and Functions of State Legislature	05 Hours

The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories. The State Legislature, composition, qualification and disqualification of membership, functions. The state judiciary, the high court, jurisdiction, writs jurisdiction.

Unit V	Legislative Relation between Union and State	05 Hours

Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission. Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals. Official language, elections, special provisions relating to certain classes, amendment of the Constitution.

Books:

Text Books:

1. D. D. Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019.
2. P. M. Bhakshi, The constitution of India, Universal Law, 14e, 2017.

Reference Books:

1. Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.
2. J. N. Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019.
3. M. V. Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016.

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	-	2	2	-	-	1	-	-
CO2	-	2	-	-	-	2	-	-
CO3	-	3	2	-	-	2	-	-
CO4	-	2	-	-	-	1	-	-
CO5	-	3	2	-	-	1	-	-
CO6	-	2	-	-	-	2	-	-