UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY MAHARSHI DAYANAND UNIVERSITY, ROHTAK

SCHEME AND SYLLABI FOR Ph.D COURSE WORK (ELECTRICAL ENGINEERING)

FOR

DOCTOR OF PHILOSOPHY (Ph.D.) IN ELECTRICAL ENGINEERING

(w.e.f. the session 2025-26)

Program Specific Outcomes:

The students upon completion of Ph.D (Electrical Engineering) coursework program, will be able to:

PSO1 Develop a well-thought-out research proposal, establish an appropriate approach to find the research gap, and defend the proposed research proposal.

PSO2 Identify the different approaches that are essential to conclude the research proposal.

PSO3 Locate the resources required to carry out the research proposal.

PSO4 Documentation and its conclusions within the specific field of research.

PSO5 Recognize the most recent findings in the candidate's field of expertise, electrical engineering.

Scheme for Ph.D. coursework

Sr.No	Course Code	Nomenclature of Course	marks	Hours /Week	Credits
1.	23CCPH11C1 (Compulsory for all Ph.D. Course work)	Research and Publication Ethics	50	2 Hours	2
2.	23CCPH11C2 (Compulsory for all Ph.D. Course work)	Research Methodology	100	4 Hours	4
3.	23EEPH11C1	Review of Literature and Seminar (in Relevant Research Area)	50	4 Hours	2
4.	23EEPH11C2	Departmental – Elective Course (in Relevant Research Area)	100	4 Hours	4
	Total marks/Credits		**300**		**12**

Common courses:

23CCPH11C1: Research and Publications Ethics: The course shall be offered by Chaudhary Ranbir Singh Institute of Social and Economic Change.

23CCPH11C2: Research Methodology: (Quantitative Techniques and Computer Applications in Research).

Departmental course:

i. 23EEEPH11C1: Review of Literature and Seminar (in Relevant Research Area)

ii. Elective Subject (Departmental Elective Subjects): Students can choose any one of the elective papers from each of the following categories:

List of Department Electives Subjects:

1	23EEEPH11C2	POWER SYSTEM PLANNING
2	23EEPH11C3	OPTIMAL OPERATION IN POWER DISTRIBUTION SYSTEMS
3	23EEPH11C4	POWER DISTRIBUTION SYSTEM
4	23EEPH11C5	INTELLIGENT CONTROLLERS
5	23EEPH11C6	POWER SYSTEM PROTECTION

Note: Departmental elective subjects will be offered according to the availability of expertise and the required infrastructure within the department.

Subject: RESEARCH METHODOLOGY & ITS RELEVANCE IN ELECTRICAL ENGINEERING

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	**Research Methodology**	**Course Code**	**23CCPH11C2**
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. To understand the fundamental concepts of the research process, various models of research, and report writing concepts.
2. To learn various statistical analysis techniques for data analysis and hypothesis testing.
3. To understand the concepts of measurement and scaling & their various techniques and sample size determination.
4. To learn various types of data collection techniques, types of data, analysis and interpretation of data.
5. To understand the role of computers in mathematical and statistical analysis in research and to get an idea about applications of relevant research methodologies with special reference to research in computer science.

Course Outcomes:

1. Learn the concept of research, research process, types of research, research models, and basic formats of report writing.
2. Learn the use of statistical analytic techniques for data analysis and testing of hypotheses.
3. Identify the differences between measurement and scaling and how the sample is selected and determined using various approaches.
4. To understand sources of data collection and how data is collected from different sources.
5. To understand the concept of interpretation and the role of the computer in mathematical and Statistical analysis, with applications of relevant research methodologies used in computer science& Engineering.

Unit - I

Element of Research: Scientific process meaning and definition, a brief history of scientific process. Introduction to research methodology- Meaning of research, objective of research, types of research, significance of research, problem encountered by researchers in india, Research problem- Definition, necessity and techniques of defining research problem, formulation of research problem, objective of research problem, research design- Meaning, need and features of good research design, types of research designs, basic principles of Experimental design. Sampling design, census

and sample surveys, different types of sample designs, characteristics of good sample design, Techniques of selecting a random sample. Data collection-primary and secondary data, methods of selecting primary and secondary data,

Unit - II

Sampling Hypothesis & Statistical Analysis: hypothesis- definition, testing of hypothesis, procedures of hypothesis testing, flow diagram for hypothesis testing, parametric and non-parametric tests for testing of hypothesis, limitations of tests of hypothesis.

Hypothesis tests- One sample test-two sample tests/ chi square tests, association of attributes. T-tests, statical analysis, correlation and regression analysis- analysis of variance, completely randomized design, randomized complete block design, Latin square design-partial and multiple correlations – discriminent analysis - cluster analysis – principle component and factor analysis, repeated measure analysis. Probability and probability distributions; Binomial, Poisson, distribution, Basic ideas of testing of hypotheses; Tests of significance based on normal distributions.

Unit - III

Paper Writing and Report Generation: Basic concepts of paper writing and report generation, review of literature, concepts of bibliography and references, significance of report writing, steps of report writing, types of research reports, methods of presentation of report.

Unit - IV

Computer Applications in Research: Computer Applications: Fundamentals of computers-Definition, types of computers, RAM, ROM, CPU, I/O devices, Number systems-Binary, octal and hexadecimal, base conversion, logic gates- AND, OR, NOT, Data structure array, stack (push, pop), queue (insert, delete), linked list-singly, doubly, operating system-definition, types of operating system, uses of software's MS-Office-Power point, word, Excel and Access.

References:

1. C. R. Kothari – Research Methodology Methods and Techniques – WishwaPrakashan Publishers – Second

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	Research and Publication ethics	**Course Code**	23CCPH11C1
Hours/Week	2	**Credits**	2

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 5)	10
Peer discussion / Debate / Extempore speech (2X 10)	20
Role play	05
Essay / Article / Report writing	10
Attendance	05
Total	50

Course Objectives:

1. To study the philosophy of ethics
2. To study the scientific conduct of research
3. To study the publication ethics
4. To know about various journal citation databases
5. To know the importance of quality publications

Course Outcomes:

By completion of course the student is able to

1. Ethics in conduct of scientific research
2. Know the scientific misconducts
3. How to avoid plagiarism and what are the penalties of plagiarism
4. Know the quality of research publications
5. Write research and review articles.

Unit - I

PHILOSOPHY AND ETHICS

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

SCIENTIFIC CONDUCT

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Unit - II

PUBLICATION ETHICS

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Unit - III

DATABASES AND RESEARCH METRICS

(A) Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

(B) Research Metrics

1. Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

Unit - IV

Practice

OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

PUBLICATION MISCONDUCT

(A) Group Discussions

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

(B) Software tools (2 hrs.) :Use of plagiarism software like Tumitin, Urkund and other open source software tools

References:

1. Bird, A. (2006). Philosophy of Science, Routledge
2. P. Chaddah (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarised.
3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019).
4. Beall, J (2012), Predatory publishers are corrupting open access. Nature, 489(7415), 179.
5. National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009). On being a Scientist: A guide to Responsible Conduct in Research, Third Edition, national Academic press.

Name of the Program	Ph.D. Course work in Electrical Enmgineering	**Program Code**	EEPH
Name of the Course	Review of Literature and Seminar (in Relevant Research Area)	**Course Code**	23EEPH11C1
Hours/Week	4	**Credits**	2

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 5)	10
Peer discussion / Debate / Extempore speech (2X 10)	20
Role play	05
Essay / Article / Report writing	10
Attendance	05
Total	50

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	Power System Planning	**Course Code**	23EEEPH11C2
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. To understand basics concepts of planning of power system and Demand/ Energy forecasting
2. To understand Generating System capability Planning
3. To familiarize students with Power System expansion planning
4. To understand Design of Distribution Systems

Course Outcomes:

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

1. Assess the generation adequacy in power system using probabilistic approach
2. Analyze the configuration of substations
3. Evaluate the peak demand and energy requirements of system using forecasting techniques.
4. Develop the solution methodology for optimizing the cost of power system under operation.

Unit - I

Introduction: Power system planning, Objective, Stages in planning and design, load forecasting, Transition from planning to operation.

Unit - II

Generating System capability Planning: Probabilistic models of generating units, Growth rate, Rate of generation capacity, Outage performance and system evaluation of loss of load and loss of energy indices, Power supply availability assessment.

Unit - III

Power System expansion planning: Formulation of least cost optimization problem involving capital, Operation and maintenance costs of candidate units of different types.

Unit - IV

Design of Distribution Systems: Introduction, Optimal conductor selection, Capacitor placement, Reconfiguration, Substation planning, distributed generation.

References:

1. A.S. Pabla, (2008), Electric Power Distribution, Tata McGrawHill.
2. R.Sullivan, (1977), Power System Planning, McGraw Hill
3. U.G. Knight,(1972), Power System Engineering and Mathematics, Pergamon Press (1972).

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	Optimal operation in power distribution systems	**Course Code**	23EEEPH11C3
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. To understand basics concepts of power system and its connection.
2. To understand problem formulation for reconfiguration and its constraints.
3. To familiarize students with power system reliability and its indices.
4. To understand powersystems optimization techniques.

Course Outcomes:

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

1. Ability to formulate problem having single objective in distribution system.
2. Analyze the configuration of distribution system with unbalanced RDS.
3. Evaluate the power loss, voltage and reliability indices.
4. Develop the solution methodology for optimizing the power system under optimal operation.

Unit - I

Introduction: need for load forecasting, electrical power distribution system, type of construction, scheme of connection, ring main distribution system, radial distribution system, Interconnected System

Load flow analysis: radial, ring main and interconnected distribution system, unbalanced load flow analysis in radial distribution system, problem formulation, weather sensitive unbalanced load flow analysis in radial distribution system.

Unit - II

Reconfiguration:Optimal reconfiguration with minimization of total power loss, new voltage stability index in RDS, problem formulation, Constraints.

Unit - III

Reliability of Engineering Systems:

System average interruption frequency index (SAIFI), System average interruption duration index (SAIDI),Energy not supplied (ENS),Average energy not supplied

(AENS),Average service availability index (ASAI),Average service unavailability index (ASAI).

Unit - IV

Power system optimization technique:

Basic concept of technique: Genetic algorithm (GA), Artificial Neural Network (ANN) based method, Ant colony optimization (ACO), Particle swarm optimization (PSO) and Bat algorithm (BA).

References:

1. 1. J. Endreny, Reliability Modeling in Electric Power Systems, John Wiley & Sons.
2. Roy Billinton& Ronald, N allan, Reliability Evaluation of Power Systems, Plenum Press, New York.
3. A.S. Pabla, (2008), Electric Power Distribution, Tata McGrawHill.
4. D.P. Kothari and J.S Dhillon, Power system optimization, PHI, 2nd Edition.
5. James Kennedy and Russell Eberrhart, "Particle swarm optimization"Proceedings of ICNN'95 - International Conference on Neural Networks, 1995.
6. Kalyanmoy Deb, Optimization for Engineering design: Algorithm and Examples,PHI.

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	Power Distribution System	**Course Code**	23EEPH11C4
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. To provide students with understand different types of power distributions systems and their usage in today's life.
2. To familiarize students with protection and coordination of protective devices in distribution systems.
3. To understand students how power factor can be improved and need for its improvement.
4. To provide information on voltage control and how to achieve it.
5. To provide information on faults in power system and how to protect the system.

Course Outcomes:

1. Know different types of distributions systems and their design
2. Usage of protective devices and their installation with coordination.
3. An in-depth knowledge of power factor and voltage control in Distribution systems
4. Ability to discuss design considerations of feeders
5. Ability to express voltage control using series capacitors, AVB,AVR etc.

Unit - I

Review: Steady-state circuit analysis, Phasor, Load and load factor, Three phase circuits, Powers

Utility Distribution System: Utility industry, Utility distribution system, Useful definitions.

Unit - II

Transformers and Regulators: Equivalent circuit, Types, System analysis with per unit system, Regulators.

Unit - III

Application of Capacitors for Distribution Systems: Voltage drop, Voltage regulation, Power factor correction, Voltage improvement.

Unit - IV

Faults and Protection in Power System: Types, Fault calculations, Protection.

Cogeneration: Definition, Types, Examples.

References:

1. James Burke &Deksen (1994), Power Distribution Engineering.

2.L M Faulken Berry and W. Coffer(1996) Electrical Power Distribution and Transmission, PHI
3.H. Lee Willis (2004), Power Distribution Planning Reference Book, Second Edition, CRC Press
4.J.J. Shea,(2005), DOI: 10.1109/MEI.2005.1389282, Electric Power Distribution Handbook [Book Review]
5.TuranGonen (2008), Electric Power Distribution system Engineering 2nd/ed, CRC Press

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	Intelligent controllers	**Course Code**	23EEEPH11C5
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. To provide biological motivation to design intelligent systems and control.
2. To familiarize students with protection and coordination of protective devices in distribution systems.
3. To understand the computer simulation of intelligent control systems to evaluate the performance.
4. To provide Exposure to many real world control problems.

Course Outcomes:

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

1. Develop Neural Networks, Fuzzy Logic, and Genetic algorithms.
2. Implement soft computing to solve real-world problems mainly pertaining to control system applications.
3. Students will be aware of current research trends and issues.
4. Learning analytical approaches to study properties and use of the computer for simulation and evaluation.

Unit - I

Neural Networks – biological neurons – Artificial neurons – activation function – learning rules – feed forward networks – supervised learning –perceptron networks back propagation networks – learning factors – linear separability – Hopfield networks.

Recurrent auto association memory – bi-directional associative memory –temporal – self – organising feature maps – adaptive resonance theory. Network –radial basis function networks.

Unit - II

Genetic Algorithms: Working principles – terminology – Importance of mutation – comparison with traditional methods – constraints and penalty function – GA operators – Real

coded GAS.

Unit - III

Fuzzy set - Crisp set – vagueness – uncertainty and imprecision – fuzzy set – fuzzy operation-properties – crisp versus fuzzy relations – fuzzy relation – cardinality operations, properties – fuzzy Cartesian product and composition – composition of fuzzy relations

Unit - IV

Fuzzy to crisp conversion – Lambda cuts for fuzzy sets and relations –definition methods – structure of fuzzy logic controller – database – rule base – Inference engine

Applications of Neural network and Fuzzy system for power system application. Designing using Simulation Software Fuzzy Logic Toolbox – Use of fuzzy logic, and Neural Network tool box for power system application.

REFERENCE BOOKS

1. Lawrence Fausatt, "Fundamentals of neural networks", Prentice Hall of India, New Delhi, 1994.24
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill International Edition, USA, 1997.
3. Bart kosko, " Neural Networks and Fuzzy Systems", Prentice Hall of India, New Delhi, 1994.
4. Jack M.Zurada, "Introduction to Artificial Neural Systems", Jaico publishing house 2006.
5. Zimmerman H.J. "Fuzzy set theory – and its applications", Kluwer Academic Publishers 1994.
6. Simon Haykin, "Neural Networks – A comprehensive foundation", Pearson Education Asia, 2002.
7. Kalyanmoy Deb, a optimization for engineering design, prentice hall of India 1988.
8. A.Goldberg, "Genetic Algorithms"

Name of the Program	Ph.D. Course work in Electrical Engineering	**Program Code**	EEPH
Name of the Course	**POWER SYSTEM PROTECTION**	**Course Code**	23EEEPH11C6
Hours/Week	4	**Credits**	4

Note: The formative assessment criteria for this course is as follows:

Written test (2 X 15)	:30
MCQs/ Quizzes/ Group Discussion (2 X 10)	:20
Case study / Mini project (1 X 25)	:25
Seminar/ Presentation (2 X 10)	:20
Attendance	:05
Total	**:100**

Course Objectives:

1. Describe role of main, back up and redundant relay protection scheme
2. Identify zones of protection for a given substation or system
3. Model power system equipment in fault programs
4. Set relays for Power transformer protection
5. Select proper protection functions for the protection of generators and motor

Course Outcomes:

1. Upon completing course student understands different protection schemes adopted in power system.
2. Upon completing course student understands operation of various switchgear equipment.
3. Upon completing course student understands protection of different electrical equipments.

Unit - I

Review of basic protection – Static relays – advantages – Basic construction – characteristics of protective relays – Phase & amplitude comparators – Over current relays – different types of time – Over current relays – differentialprotection scheme.

Unit - II

Transmission line protection – fault clearing times – Types of distance relays – Evaluation of distance relay performance during swings– automatic re-closing – Three-zone protection.

Unit - III

Transmission line protection – fault clearing times – Types of distance relays – Evaluation of distance relay performance during swings– automatic re-closing – Three-zone protection.

Unit - IV

Microprocessor based protective relays – Development of Computer relaying –Benefits of computer relaying – Computer relay architecture - analysis and simulation of

protection systems.

References:

1. MadhavaRao.T.S, “Power System protection :Static relay with Microprocessor applications”, Tata McGraw Hill, 1989.10
2. Ram.B, Viswakarma.D.N, “Power System Protection and Switch Gear”, Tata McGraw Hill, 1995.
3. Ram.B, “Fundamentals of Microprocessors and Microcomputers” DhanpatRai& Sons, 1985.
4. Kundur.P, “Power System Stability and Control”, Tata McGraw Hill, 1994.