SYLLABI

OF

PhD (Electrical Engineering)

2020 - 2021

DEPARTMENT OF ELECTRICAL ENGINEERING

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA, FARIDABAD

3/3/2022

Chairperson
Department of Electrical Engineering
J.C. Bose University of Science & Technology, YMCA, Faridabad

J.C. Bose University of Science & Technology, YMCA, Faridabad
(A Haryana State Government University)
(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)
Accredited 'A' Grade by NAAC

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CERTIFICATE

This is to certify that the scheme & syllabi of PhD (Electrical Engg) (course name) is duly approved by the competent body/authority and to the best of my knowledge the contents of the same, are correct in all respect.

Date: 3/3/2022

Chairperson
Department of Electrical Engineering
J.C. Bose University of Science & Technology, YMCA, Faridabad

Signature & Stamp of Chairperson

Name: Prof. Poonam Singhal.

Deptt. Name Electrical Engg.

J.C. Bose University of Science and Technology, YMCA, Faridabad

Ph.D. (Electrical Engineering)

Scheme of Studies / Examination

Course Code	Course Title	Teaching Schedule			Marks for sessionals	Marks for End Term Examination	Total Marks	Credits
		L	T	P				
PHD-100A	Research Methodology	4	0	0	25	75	100	4
CPE-RPE	Research and Publication Ethics	2	0	0	25	75	100	2
PHEL	Discipline Elective	4	0	0	25	75	100	4
-	Total	10	0	0	75	225	300	10
Note: Exam duration will be of 3 hours.								

	Course Code	Course Title
Discipline Elective	PHEL-01	Advance Power Electronics Converters
	PHEL-02	Energy Auditing and Conservation
	PHEL-03	Renewable Energy Systems
	PHEL-04	Electric and Hybrid Vehicles

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PHD – 100A

RESEARCH METHODOLOGY

PhD (Common Subject)

No. of Credits: 4		Sessional:	25 Marks
L | T | P | Total		Theory:	75 Marks
4 | 0 | 0 | 4		Total:	100 Marks
		Duration of Exam:	3 Hours

Course Objectives:

- Understand research process in order to plan a research proposal
- Learn methods to devise and design a research set-up
- Plan and perform data collection methods and its analysis
- Conclude research in report writing

Course Outcomes: The research scholar shall be able to

CO1	Plan a research proposal and design the research.
CO2	Collect data through experiments or surveys as per research requirement.
CO3	Understand and apply sampling and sampling distributions.
CO4	Understand and perform quantitative and qualitative data analysis.
CO5	Write research report with proper citations.

Unit 1 **Introduction to Research**: Definition, need and purpose of research, types of research, research process, approaches to research, planning a research proposal, literature review.

Unit 2 **Measurement Scales**: Indexes vs. Scales, Types of Scale, construction of Scale, Bogardus social distance scale, Thurstone Scale, Likert Scale, Semantic Differential Scale, Guttmann Scale.

Unit 3 **Data Collection Methods:** Experiments and Surveys, Experiments: Classical Experiments, Independent & Dependent Variables, Pre Testing & Post Testing, Double Blind Experiment, Subject Selection, Variation on Experiment Design. Survey Research: Topics appropriate for survey research, Guidelines for asking questions, Questionnaire Construction, Strengths & Weakness of Survey Research,

Types of Surveys.

Unit 4 **Sampling**: Types of sampling methods: Non Probability Sampling, Probability Sampling, Theory & Logic of Probability Sampling, Sampling Distributions & Estimates of Sampling Error.

Unit 5 **Data Analysis**: Qualitative v/s Quantitative data analysis, Qualitative Data Analysis: Discovering Patterns, Grounded Theory Method, Semiotics, Conversation Analysis, Qualitative Data Processing. Quantitative Data Analysis: Quantification of Data, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Regression Analysis, Description Analysis. Hypothesis. Multiple Attribute Decision Making.

Unit 6 **Report Writing, Ethical Issues and Outcomes**: Report Preparation, Structure of Report, Report Writing Skills, Citations, Research Papers, Intellectual Property Rights, Plagiarism, Patent, Commercialization, Ethical Issues.

References:

1. Research Methodology by R. Panneerselvam, 2nd Ed. PHI
2. Research Methodology by C.R. Kothari & Gaurav Garg, 3rd Ed. New Age Publishers
3. Research Methodology and Scientific Writing by C. George Thomas, Ane Books
4. The practice of social research by Earl Babbie, 14th Ed. Cengage
5. Multiple Attribute Decision Making, Gwo-Hshiung Tzeng and Jih-Jeng Huang, CRC Press

PHD – CPE-RPE

RESEARCH AND PUBLICATION ETHICS

PhD (Common Subject)

Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
Practice		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	Total	**30**

Syllabus in detail

THEORY

- **RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**

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

- **RPE 02: SCIENTIFICCONDUCT (5hrs.)**

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

- **RPE 03: PUBLICATION ETHICS (7 hrs.)**

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

PRACTICE

- **RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

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 Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

A. Group Discussions (2 hrs.)

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 Turnitin, Urkund and other open source software tools

- **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**

A. Databases (4 hrs.)

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

B. Research Metrics (3 hrs.)

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

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PHEL 01	ADVANCED POWER ELECTRONIC CONVERTERS	4L:0T:0P	4 Credits

Course Outcomes:

Students will be able to:

1. Analyze the operation of DC to AC converters
2. Understand the concept of space vector modulation
3. Examine and analyze the concept of switched mode power supplies
4. Analyze the working of Resonant converter topologies
5. Design and understand the multilevel inverters and their applications
6. Apply the concept of Advanced power electronic converters in various applications

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	Syllabus
Unit	**content**
1	• DC to AC converters: Basic operation and working • Pulse width modulated inverters • Single pulse width modulation • Multiple pulse width modulation, • Sinusoidal Pulse width modulation
2	• Advanced Modulation Techniques: • Space Vector Modulation • Space vector transformation • Concept of space vector • Time Averaging of reference vector
3	• SMPS: Modes of operation Push-Pull and Forward Converter Topologies Voltage Mode Control. • Half and Full Bridge Converters
4	• Introduction to Resonant Converters. • Load Resonant Converter. Zero Voltage Switching and zero currentswitching converter Topologies. • Resonant DC Link Inverters
5	• Multi-level inverters, advantages, • configurations: Diode clamped, Flying capacitor and cascaded Multi-level inverters, applications.
6	• Applications of power electronic converter: UPS, Induction heating ,HVDCTransmission system • Few power electronic circuits used in practice for controlling electric drives.DC-DC Converters for various renewable energy conversion. • GATE Driver Circuits

Suggested reading

- Rashid "Power Electronics" Prentice Hall India 2007.
- G. K. Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.

- Dewan & Straughen “Power Semiconductor Circuits” John Wiley &Sons., 1975.
- B. K Bose “Modern Power Electronics and AC Drives” Pearson Education (Asia).,2007
- Abraham I Pressman “Switching Power Supply Design” McGraw Hill PublishingCompany.
- Mohan, Undeland and Robbins, “Power Electronics: Converters, Applications and Design”, John’s Wiley and Sons

PHEL 02	Energy Auditing and Conservation

L T P Cr **Sessional-25**
4 0 0 4 **End Sem-75**
Total-100

Course Objectives:-Students will be able to:

1. To revive energy scenario, energy sources, energy utilization and energy efficiency.
2. To understand different terms and types of energy audit.
3. To identify energy conservation measures in different sector.
4. To prepare energy audit reports.

UNITS	CONTENT	HOURS
1.	Sources of Energy: Energy resources, Stored & running resources, Non- Conventional energy sources, Necessity of conserving resources, Cogeneration- Types of schemes.	6
2.	Energy in Industries: Energy inputs in industry, Comparison of various energy inputs, use of electric energy in industries for motive power, Electric Water heating, Solar Water heater, Water treatment Plant& Efficient treatment Plant load. Fire fighting Pump loads, Air-conditioning & Refrigeration	8
3.	Transformer Loading/Efficiency analysis Feeder/cable loss evaluation, case study, Reactive Power management-Capacitor Sizing-Degree of Compensation-Capacitor losses, Location-Placement Maintenance ,Case study	6
4.	Energy Audit: Audit, A prerequisite for energy conservation, Principles of Energy Audit, Measurement & measuring devices, Analysis of data, Flow diagram, its use, ABC Analysis	6
5.	Energy conservation in Utilities: Energy conservation in generation, transmission, distribution & utilization, Demand side energy Management, Energy efficient lighting system, Energy efficient drives- critical study & analysis of certain case studies.	6
6.	Economics of Energy Conservations: Energy Conservation: Energy Conservation using energy audit data, Principles of energy conservation in industrial, commercial, domestic agricultural & municipal sectors. Planning, Implementation & monitoring of energy conservation project, payback period calculations.	8

Suggested reading:

1. Sukhatme S.P., 'Solar Energy : Principles of thermal collection and storage' Tata- McGraw Hill
2. Keth & Fetcher, 'Energy Efficiency Handbook' CRC Publication.
3. Sinha H.P., 'Power System- I' Khanna Publication.
4. Anthony J. Pansini, Kenneth D. Smalling, Guide to Electric Load Management., Pennwell Pub; (1998)
5. Howard E. Jordan, Energy-Efficient Electric Motors and Their Applications., Plenum PubCorp; 2ndedition (1994)
6. Giovanni Petrecca, Industrial Energy Management: Principles and Applications., TheKluwer international series -207,1999
7. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI,2006

8. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 2009

Course Outcomes:-Students will be able to:

1. Acquire the background required for engineers to meet the role of energy managers and toacquire the skills and techniques required to implement energy management
2. Identify and quantify the energy intensive business activities in an organization
3. Able to perform Basic Energy Audit in an Organization

PHEL-03	RENEWABLE ENERGY SYSTEMS	Credits: 4
L T Cr 3 0 4		

Course Objectives: To impart knowledge about renewable energy resources, their control, Modes of operation and other energy storage systems

Introduction: Energy resources: renewable energy: solar, wind, hydropower, biomass, geothermal, ocean wave; benefit, costs, and policies of renewable energy; Environmental issues of energy services, renewable sources integration – overcoming intermittence; centralized vs. distributed generation.

Solar Photovoltaic Power System: Photovoltaic Cell, electrical equivalent circuit, Solar PV cell panel, IV characteristics, MPPT operation, solar thermal System, Stand-alone & Grid connected systems: Optimal economic coordinated operation of conventional and renewable sources, Operational issues and challenges. Economics of solar based energy systems.

Fundamentals of Wind Energy: Speed and Power Relations, Power Extracted from the Wind, Maximum rotor efficiency, Horizontal- and Vertical-Axis Wind Turbines, Fixed-and Variable-Speed Turbine, Aerodynamic Power Control: Passive Stall, Active Stall, and Pitch Control, Tip Speed Ratio

Wind Energy Conversion Systems: Wind energy system configurations, Wind turbine generators, Fixed Speed Induction Generator, variable-speed squirrel cage and Doubly Fed Induction Generator (DFIG) , Variable-speed wind energy systems with synchronous, Permanent Magnet Generator (PMG). Control of DFIG & PMG. Wind power economics. Bio-gas energy conversion Systems, Integrated Energy Systems

Energy storage systems and their applications; Energy Storage systems, Fuel Cells, Superconducting magnetic systems, Pumped storage unit, Compressed Air storage unit, Plug-in Hybrid Electric Vehicle (PHEV). Standards: Standards of Power converters for solar PV system, Standards for energy storage systems.

Course Outcome: after the completion of the course the student will be able to

- Identify various renewable energy resources available for power generation
- Realize working fundaments and economics of different renewable energy systems
- Analyze wind and solar based energy systems
- Conceptualize operation of renewable sources in standalone mode and grid connected mode
- Be familiarize with different energy storage systems.

Recommended books

1. Simon , Christopher A., Alternate Source of Energy, Rowman and Little Field Publishers Inc.(2007).

2. Patel, M. R., Wind and Solar Power Systems. Boca Raton, FL: CRC Press, (1999)

3. Venikov, V.A. and Putyain, E.V., Introduction to Energy Technology, Mir Publishers (1990).

4. Masters G. M., Renewable And Efficient Electric Power Systems, John Wiley & Sons, (2004).

5. Freris, L.L., Wind Energy Conversion Systems, Prentice Hall, London, (1990).

PHEL-04	ELECTRIC AND HYBRID VEHICLES

Sessional - 25

L T P Cr **End Sem – 75**

4 0 0 4 **Total – 100**

Course Objectives: Students will be able to:

1. To understand upcoming technology of hybrid system.
2. To understand different aspects of drives application.
3. Learning the Electric traction.

Syllabus

Units	Content	Hours
1.	History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drivetrains on energy, Basics of vehicle performance, Vehicle power source characterization transmission characteristics.	**8**
2.	Basic concept of hybrid traction, Introduction to various hybrid drive train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.	**8**
3.	Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC motor drives, Configuration and control of Induction motor drives motor drives, Configuration and control of permanent magnet motor drives, Configuration and control of Switch Reluctance motor drives, drive system efficiency.	**10**
4.	Fundamental of batteries, different types of batteries, dry cell and wet cell battery, Construction and working of Li-ion, Zinc Chloride and lead acid batteries, Vehicle charging technologies, Battery management system, Electric vehicle cooling system.	**8**
5.	Introduction to energy management and their strategies in hybrid and electric vehicles, Classification of different energy management strategies, Comparision of different energy management strategies	**6**

Suggested Reading

1. Iqbal Husain, ELECTRIC and HYBRID VEHICLES, Design Fundamentals, CRC Press, 2003.
2. M. Ehsani, Y. Gao, S. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2005.

Course Outcomes: Students will be able to;

1. Acquire knowledge about fundamental concept, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drives in vehicles/ traction.