INVERTIS UNIVERSITY BAREILLY
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EVALUATION SCHEME & SYLLABUS

For

DOCTOR OF PHILOSOPHY
(Ph. D.)

IN

ELECTRICAL ENGINEERING

(Academic Session: 2020-21)

Department of Electrical Engineering

INVERTIS UNIVERSITY, NH24, BAREILLY - 243123

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

(EFFECTIVE FROM THE ACADEMIC SESSION: 2020-21)

1. Duration of the Pre-Ph.D. course: Six Months
2. Qualifying Marks: 50% (in each paper)

S. No.	CODE	SUBJECT	MARKS DISTRIBUTION			CREDIT
			IAM*	SM	TOTAL	
1.	DRM-101	RESEARCH METHODOLOGY	30	70	100	4
ELECTIVE PAPER (ANY ONE)						
2.	PEE 101	OPTIMIZATION TECHNIQUES	30	70	100	4
3.	PEE 102	ADVANCED POWER ELECTRONICS				
4.	PEE 103	POWER ELECTRONICS APPLICATION TO POWER SYSTEMS				
5.	PEE 104	RENEWABLE ENERGY SYSTEMS				
6.	PEE 105	SMART GRID				
TOTAL			**60**	**140**	**200**	**8**

***** *TWO ASSIGNMENTS OF 10 MARKS EACH AND SEMINAR OF THE CONCERNED PAPER 10 MARK.*

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DRM-101 RESEARCH METHODOLOGY

Course outcome:

Upon successful completion of this course students will be able to,

1. Students will become familiar with the tools and techniques of Research methodology.
2. This course exposes students to the research articles writing and applications of various softwares and statical analysis for research.
3. Students will be able to plan & perform research experiments at the end of course.
4. Students will acquire knowledge of advances in engineering

Syllabus Contents:

UNIT I

Research Topics: Selection of problems, stages in the execution of research, publication of research papers in journals impact factor, citation index, h-index, i10 index, Indian citation index and referencing.

Process of Research: Meaning, Objectives, Characteristics, Significance, and Types, Research Methods vs. Research Methodology. Research Approaches: Positivism, Phenomenology, Ethnography, and Triangulation, Qualitative, Quantitative.

UNIT II

Process of Literature Survey and Review, Techniques of Writing the Review papers. Statement of Research Problem, Process of Formulation of a Research Problem and Research Objectives.

Sample Design: Selecting Appropriate Probability and Non-Probability Sampling Techniques for Qualitative and Quantitative Research Problems. Hypothesis Testing: T-Test, Chi Square Test and ANOVA.

UNIT III

Qualitative Methods: Concept, Type, Technique, and Applications. Quantitative Methods: Concept, Type, Technique, and Applications Mixed Method: Concept, Design, Technique, and Applications, Ms-office

UNIT IV

Technical Writing: Research Proposal, Research Report, Dissertation / Thesis: Citation, Notes, Reference, Bibliography, and Webliography. Common Errors in Writing Research Report: Plagiarism and Copyright Issues, Ethics in Research.

UNIT V

Spectrophotometer: Principal and applications, ultra violet, infrared, 1H, Nuclear Magnetic resonance (NMR), Fundamental and procedure of chromatography, Principal and applications of electron microscopy, scanning electron microscopy, transmission electron microscopy, X- Ray diffraction.

Text/Reference Books:

- Audi, Robert. (2002). Epistemology: A Contemporary Introduction to the Theory of Knowledge. London: Routledge.
- Statstical Methods, Snedecor, G, W. and W. G. Cohran,1978, Oxford and IBH Publishing CO Pvt. Ltd.
- Creswell, John W. (2011). Research Design: Qualitative, Quantitative and Mixed Methods Approaches. Thousand Oaks: Sage Publications.
- De Vaus, D. A. (2002). Surveys in Social Research (5th edn.). London: Routledge.

- Berg, Bruce L. (2001). Qualitative Research Methods for Social Sciences. Boston: Allyn and Bacon, 2001.
- Bernard, H.R. (2000). Social Research Methods: Qualitative and Quantitative Approaches. Newbury Park, Cal.: Sage.
- Bless, Claire, Craig Higson Smith, and Ashraf Kagee. (2006). Fundamentals of Social Research Methods: An African Perspective (4rth ed.). Zambia: Juta & Co. Ltd.
- Authoring a Phd, Thesis: How to plan, draft, write and finish a doctoral dissertation, Duncary, P.2003. Macmillan, pp 256.
- Scientific Courses and presentations, Martha Davis, 2005, Academic Press, Tokyo, pp356.

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PEE101 OPTIMIZATION TECHNIQUES

Course Outcomes

Upon successful completion of this course students will be able to,

1. Explain and use the basic theoretical principles of optimization and various optimization techniques.
2. Develop and select appropriate models corresponding to problem descriptions in engineering and solve them using appropriate techniques
3. Analyze and solve complex optimization problems in power system and machines
4. Design optimization models and use them in solving problems in power system planning and operation
5. To develop and Implement optimization algorithms and use software tools to solve problems in engineering
6. Make sound recommendations based on these solutions, analysis and limitations of these models.

Syllabus Contents:

UNIT I Linear programming- formulation-Graphical and simplex methods-Big-M method Two phase method-Dual simplex method-Primal Dual problems.
UNIT II Unconstrained one-dimensional optimization techniques- Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method Quadratic Interpolation methods, cubic interpolation and direct root methods.
UNIT III Unconstrained n-dimensional optimization techniques- direct search methods – Random search –pattern search and Rosen brooch's hill claiming method, Descent methods, Steepest descent, conjugate gradient, quasi -Newton method.
UNIT IV Constrained optimization Techniques- Necessary and sufficient conditions – Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.
UNIT V Dynamic programming- principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

Text/Reference Books

- 1. Rao S.S., Optimization: Theory and Application Wiley Eastern Press, 2nd edition 1984.
- 2. Taha H.A., Operations Research –An Introduction, Prentice Hall of India,2003.
- 3. Fox R.L., Optimization methods for Engineering Design, Addition Welsey, 1971.

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PEE102 ADVANCED POWER ELECTRONICS

Course Outcomes:

After completing the course, students will be able to,

1. Have good understanding of characteristics of PSDs such as SCRs, GTOs, IGBTs and Use them in practical systems.
2. Have knowledge of working of multi-level VSIs, DC-DC switched mode converters,
3. Cyclo-converters and PWM techniques and the ability to use them properly.
4. Acquire knowledge of power conditioners and their applications.
5. D. Have the ability to design power circuit and protection circuit of PSDs and converters

Syllabus Contents:

UNIT I
Power electronic systems-

Power electronic systems - An overview of PSDs, multi pulse diode rectifier, multi pulse SCR rectifier, phase shifting transformers

UNIT II
Multilevel voltage source inverters-

Three level voltage source inverter, cascaded H bridge multilevel inverter, diode clamped multilevel inverters, flying capacitor multilevel inverter,

PWM current source inverters

UNIT III
DC to DC switch mode converters

UNIT IV
AC voltage controllers:

Cyclo-converters, matrix converter, Power conditioners and UPS, design aspects of converters, protection of devices and circuits.

Text/Reference Books:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989.
- M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994
- B. K. Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
- Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

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PEE103 POWER ELECTRONICS APPLICATION TO POWER SYSTEMS

Course Outcomes:

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

1. Classify and explain the functioning of FACTS devices.
2. Model FACTS devices to control the power flow and optimize transmission capacity.
3. Identify the need for HVDC systems.
4. Identify converters for HVDC application and discuss their control characteristics.
5. Compare the HVAC and HVDC systems.

Syllabus Contents:

UNIT I
The concept of flexible AC transmission-

reactive power control in electrical power transmission lines, uncompensated transmission line, Introduction to FACTS devices and its importance in transmission Network, Introduction to basic types of FACTS controllers

UNIT II
Methods of Var generation-

Shunt Compensation-Thyristor controlled reactor (TCR), Thyristor switched capacitor (TSC), Fixed capacitor- Thyristor controlled reactor (FC-TCR), STATCOM.

Series Compensation: Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC). Static Synchronous Series Compensator (SSSC), modes of operation, Voltage regulator and Phase Angle Regulator (PAR)

UNIT III
Multi-functional FACTS controller-

The Unified Power Flow Compensator (UPFC); circuit and steady-state characteristic; effect on transmission line compensation; Interline Power Flow Controller (IPFC); circuit and steady-state characteristic.

UNIT IV
HVDC-

Introduction, various possible HVDC configurations, components of HVDC system, operation of 6-pulse and 12-pulse converter, Effect of source inductance, Generation of Harmonics, Design of AC filters and DC filters, HVDC light and HVDC PLUS Series and Parallel operation of converters.

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Text/Reference Books:

1. K. R. Padiyar , " HVDC Power Transmission System", Wiley Eastern Limited, New Delhi , First Edition 1990.
2. T.J.E. Miller, "Reactive Power Control in Electrical System", John Wiley and Sons, New York, 1982.
3. N.G.Hingorani, "Understanding FACTS :Concepts and Technology of FACTS Systems", IEEE Press, 2000.
4. K.R.Padiyar "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
5. A.T.John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE) 1999.
6. Colin Adamson and N.G.Hingorani ," High Voltage Direct Current Power Transmission", Garraay Limited, London 1960.
7. J.Arrillaga, " High Voltage Direct Current Transmission", Peter Pregnnus, London 1983.
8. Edward Wilson Kimbark," Direct Current Transmission", Vol.1 ileyInterscience, New York London Sydney 1971.

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PEE104 RENEWABLE ENERGY SYSTEMS

Course Outcomes:

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

1. Appreciate the importance of energy crises and consequent growth of the power generation from the renewable energy sources and participate in solving these problems.
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
3. Demonstrate the knowledge of physics of solar power generation and the associated issues.
4. Identify, formulate and solve the problems of energy crises using wind and solar energy.
5. Identify the possible research avenues in the field of wind and solar.

Syllabus contents:

Historical development and current status, characteristics of wind power generation, network integration issues, generators and power electronics for wind turbines, power quality standards for wind turbines, technical regulations for interconnections of wind farm with power systems, isolated wind systems, reactive power and voltage control, economic aspects, impacts on power system dynamics, power system interconnection experience in the world, introduction of solar systems, merits and demerits, concentrators, various applications, solar thermal power generation, PV power generation, cost effectiveness, tidal power, geothermal, biomass.

Text/Reference Books:

1. Thomas Ackermann, Editor, “Wind power in Power Systems”, John Willy and sons ltd.2005.
2. Siegfried Heier, “Grid integration of wind energy conversion systems”, John Willy and sons ltd., 2006.
3. K. Sukhatme and S.P. Sukhatme, “Solar Energy”, Tata MacGraw Hill, Second Edition, 1996
4. Mukund Patel, “Wind and Solar Power Systems”, CRC Press, 1999.
5. Gilbert M. Master, “Renewable and efficient electric power systems” John Wiley and Sons, 2004.

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PEE105 SMART GRID

Course Outcomes:

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

1. Explain the smart grids components and architecture
2. Describe different measuring methods and sensors used in smart grid
3. summarize various renewable energy technologies.
4. Interpret the role of batteries and energy storages.
5. Summarize the importance of Electric Vehicles in smart grid

Syllabus Contents:

UNIT I
Introduction to Smart Grid-

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

UNIT II
Smart Grid Technologies: Part 1-

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT III
Smart Grid Technologies: Part 2-

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT IV
Microgrids and Distributed Energy Resources-

Concept of microgrid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT V
Power Quality Management in Smart Grid-

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring.

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Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley Blackwell 19
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication