

**PRE PhD COURSEWORK**

**2015 – 16**

***COURSE HANDOUTS***

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**JK Lakshmipat University**  
**Institute of Engineering and Technology**

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## *INTRODUCTION*

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This "Course Handout" contains detailed description of the course plan and evaluation component for Pre PhD Programme offered by the IET, JK Lakshmi Pat University during 2015-16. This is based on the course handouts prepared by the course advisors. These courses are made to give an understanding of the subject to the students as per their research interest.

Course Handout is presented in two parts. The first part is common across all the programmes and is presented in Section-I, while in Section-II, "Advanced Professional Communication" is a common course for all PhD students of Institute of Engineering and Technology (IET) and two elective courses have been offered to the students as per their preference.

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## *About PhD Programme*

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The minimum duration for the PhD programme shall be two years/four semesters from the date of confirmation of the registration for the programme to the date of the submission of the thesis. However, a research student may be given relaxation of up to 6 months in the above periods allowing pre-submission of the thesis, provided he/she produces sufficient evidence of having done prior research work resulting in publication of research papers in refereed journals in his/her area of research. Maximum duration of PhD programme is five years/ ten semesters from the date of confirmation of registration into the programme to the date of the submission of the thesis. However, the submission of thesis may be extended by not more than one year by the Chairman Board of Research, under special circumstances, on a written request by the student duly forwarded by his/her supervisor and recommended by the Director of the Institute.

### **Course Work/Credit Requirements**

All candidates admitted for the Ph. D programme are required to undergo a 20 credit course work during the first semester of the programme. The courses offered for the Ph. D programme will be a combination of Lecture Courses, Laboratory Courses, Design Courses, Self-Study Courses, Minor Project work as the case may be, for the candidates registered under each discipline. The course work will be in two parts.

**Part 1:** A common module of courses including Research Methodology, and Statistical Methods carrying eight credits in total has to be taken by every Ph. D candidate irrespective of the discipline under which he/she is registered.

**Part 2:** All lecture courses, laboratory courses, design courses, self-study courses and minor project work shall carry a maximum of twelve credits. The courses, as prescribed by the Director

of the respective Institute, should be based on the recent developments/literature survey in the areas of research in the respective disciplines.

### **Pre-Ph. D Examination**

After the completion of the course work in the first semester, each candidate will be required to take a Pre-Ph. D examination. It will consist of one written test of the duration of 2 hours based on the courses offered in Part I of the course work. For Part II, the candidate is required to produce a term paper based on the literature review or a concept paper on his/her area of research to claim the necessary credits.

### **Dissertation**

After a candidate has passed the Pre-Ph. D written test, he/she is required to submit the research proposal and make a presentation within two months. It is mandatory that every research scholar will have to submit a half yearly progress report at the end of every semester, till the submission of the final thesis, to the Professor In-charge Research, duly reviewed, evaluated and recommended by his/her supervisor(s) and forwarded by the Directors of the respective Institutes. The candidate's progress report for each semester may be graded as Satisfactory or Unsatisfactory. A candidate has to earn 'Satisfactory' grade for all the semesters to be eligible for the final submission of the thesis. If a candidate fails to submit two consecutive half-yearly progress reports on time, or the progress reports submitted by the candidate are not satisfactory, then his/her registration will stand cancelled. Every Ph. D candidate is required to hold a pre-submission open seminar at least six months before the final submission of the thesis. On completion of the research work, he/she is required to publish at least two papers in refereed journals and then submit to the University.

## *Evaluation Scheme*

### **Evaluation Scheme for Section I (Courses Common to all Programmes)**

| <b>EC No.</b> | <b>Component</b> | <b>Duration</b> | <b>Marks</b> |
|---------------|------------------|-----------------|--------------|
| 1.            | Internal*        | --              | 40           |
| 2.            | Minor Project    | --              | 20           |
| 3.            | Written Test     | 2 hrs.          | 40           |
| <b>Total</b>  |                  |                 | <b>100</b>   |

### **Evaluation Scheme for Section II (Elective Courses)**

| <b>EC No.</b> | <b>Component</b>            | <b>Duration</b> | <b>Marks</b> |
|---------------|-----------------------------|-----------------|--------------|
| 1.            | Internal*                   | --              | 40           |
| 2.            | Minor Project               | --              | 20           |
| 3.            | Term Paper (Report)         | --              | 24           |
| 4.            | Term Paper (Presentation**) | --              | 16           |
| <b>Total</b>  |                             |                 | <b>100</b>   |

\*The internal evaluation will be done on Library Assignment, Presentations, Quiz, Test, Case submissions etc. depending upon the nature of the course and the discretion of the course instructor.

\*\* The candidates will be required to present their term paper before RPC after completion of third module.

## *Section - I*

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| <b>Course Code</b> | <b>Course Title</b>     | <b>Name of Instructor(s)</b>           |
|--------------------|-------------------------|--|
| <b>PHDA101</b>     | Research Methodology    | Dr. Swapan Kumar Majumdar              |
| <b>PHDA102</b>     | Statistics for Research | Dr. Umesh Gupta /<br>Dr. Anupam Saxena |

# *PHDA101: Research Methodology*

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**Instructor: Dr. Swapan Kumar Majumdar**

**Course Overview:**

The course has been designed to enable the students irrespective of their discipline in developing the most appropriate methodology for their research studies and to make them familiar with the art of using different research methods and techniques.

**Course contents:**

**Module 1:**

Nature and Scope of Research Methodology in Business Administration / Management Studies/Technical Studies , Problem Formulation and Statement of Research Objectives, Value and Cost of Information, Bayesian Decision Theory, Organization Structure of Research, Research Process.

**Module 2:**

Research Designs-Exploratory, Descriptive and Experimental Research Designs, Methods of Data Collection, Observational and Survey Methods, Questionnaire Design, Attitude Measurement Techniques, Motivational Research Techniques, Administration of Surveys, Sample Design.

**Module 3:**

Selecting an Appropriate Statistical Technique, Field Work and Tabulation of Data, Analysis of Data, Use of SPSS and other Software Packages, Advanced Techniques for Data Analysis, ANOVA, Discriminant Analysis, Factor Analysis, Conjoint Analysis, Multidimensional Scaling, Clustering, Logit and Probit Analysis, Research applications.

**Reference Books:**

- Bryman, Allan and Bell Emma (2003). *Business Research Methods*. Noida: Oxford.
- Kerlinger Fred. N.(2002). *Foundations of Behavioral Research*. USA: Holt and Rinehalt.
- Kothari, C. R. (2004). *Research Methodology: Methods and Techniques*. New Delhi: New Age International
- Murthy, S. N. and Bhojanna,U.(2008). *Business Research Methods*. New Delhi: Excel
- Sekaran, Uma(2006). *Research Methods for Business: A Skill Building Approach*. New Delhi: John Wiley & Sons.



## *PHDA102: Statistics for Research*

**Instructor(s): Dr. Umesh Gupta / Dr. Anupam Saxena**

**Course Description:**

Foundation of Statistics, Probability Distribution, Sampling and Sampling Distribution, Point and Interval Estimators and Estimates, Testing of Hypothesis: Parametric and Non-Parametric Tests, Analysis of Variance, Correlation and Regression, Time Series and Forecasting, Decision Theory.

**Scope & Objective:**

Course introduces the concept of Statistics and familiarizes the student with probabilistic concepts; an in-depth study of statistical inferences will help the students to surmise the data collected from the sample study. Study of Time Series Analysis and Decision Theory will accustom the students with application of statistical concepts into real world.

**Text Books:**

- TB1. Johnson Richard A., *Miller & Freund's Probability & Statistics for Engineers*, Eastern Economy Edition, PHI, 7<sup>th</sup> Edition (2004).
- TB2. Douglas C. Montgomery and George C. Runger, *Applied Statistics and Probability for Engineers*, John Wiley & Sons, Inc., 3<sup>rd</sup> Edition (2004).
- TB3. Prem S. Mann, *Introductory Statistics*, Wiley publication, 7<sup>th</sup> edition.

**Reference Books:**

- R1 Feller, W., *Introduction to Probability Theory & Applications*, John Wiley & Sons, 3<sup>rd</sup> Edition (2000).
- R2 Freund, J. E., *Mathematical Statistics*, PHI, 6<sup>th</sup> Edition (2002).
- R3 Parzen, E., *Modern Probability Theory & Applications*, John Wiley & Sons, 5<sup>th</sup> Edition (2000).
- R4 Meyer, P. L., *Introductory Probability and Statistical Applications*, Oxford & IBH (1970).
- R5 Baisnab, A. P. and Jas, Manoranjan, *Elements of Probability and Statistics*, Tata McGraw Hill, 13<sup>th</sup> Reprint (2006).

**Course Plan:**

| Module No. | Learning Objectives                 | Topics to be covered  |
|------------|-------------------------------------|---|
| <b>1</b>   | Foundation of Statistics            | Meaning, Scope, Limitation and Role of Statistics, Introduction to Measures of Central Tendency and dispersion.   |
|            | Probability Distribution            | Expected Value, Binomial, Poisson and Normal Distributions.   |
|            | Sampling and Sampling Distributions | Introduction to Sampling, Statistics and Parameters, Types of Sampling, Sampling Distributions, Standard Error, Sampling from Normal and Non-normal Populations, Central Limit Theorem, Finite Population Multiplier. |

|          |  |  |
|----------|--|--|
|          | Point and Interval Estimators and Estimates                                    | Point and Interval Estimates, Estimator and Estimates, Confidence Levels and Confidence Intervals, Interval Estimates of Mean and Proportion from Large Samples, Interval Estimation Using t Distribution, Sample Size for Estimating Means and Proportions. |
| <b>2</b> | Testing of Hypothesis (Parametric Tests)                                       | Basic Concepts, Type I and Type II Errors, One Tailed and Two Tailed Tests, One Sample Tests, Hypothesis Testing of Means when Population Standard Derivation is Known and when Unknown  |
|          | Inference about population variance  | Inference about a population variance and about two population variances.  |
|          | Testing of Hypothesis (Parametric Tests)                                       | Hypothesis Testing of Proportions for Large Samples, Two Sample Tests for Equality of Means for Large and Small Samples, Equality of Means for Dependent Samples, Difference between Proportions for Large Samples.  |
|          | Chi Square Test  | Chi Square Test of Independence and Goodness of Fit.   |
| <b>3</b> | Simple Regression & Correlation  | Types of Relationships, Scatter Diagrams, Estimation Using the Regression Line, Method of Least Squares, Standard Error of Estimate, Prediction Intervals, Correlation Analysis.   |
|          | Inference about Population Parameter using Regression and Correlation Analysis | Making Inference about Population Parameters, Using Regression and Correlation Analysis, Coefficients of Determination and Correlation, Making Inferences about Population Parameters.   |
|          | Testing of Hypothesis (Non-Parametric Tests)                                   | Introduction, The Sign Test, Rank Sum Tests: The Mann-Whitney U Test and the Kruskal-Wallis Test, One Sample Runs Test, Rank Correlation.  |

## *Section - II*

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| <b>Course Code</b> | <b>Course Title</b>                 | <b>Name of Instructor(s)</b>               |
|--------------------|-------------------------------------|--|
| PHCS02             | Data Analytics                      | Dr. Devendra Punia                         |
| PHCS03             | Search Based Software Engineering   | Dr. Kavita Choudhary                       |
| PHDM01             | Web Data Management                 | Dr. Sonal Jain                             |
| PHEE02             | Power Quality                       | Dr. Pushpendra Singh                       |
| PHEE03             | Smart Grid Technology               | Dr. Pushpendra Singh                       |
| PHME02             | Material Science                    | Dr. M. L. Gupta                            |
| PHME03             | Advance Heat Transfer               | Dr. Anurag Kumar Tiwari                    |
| PHPC01             | Advanced Professional Communication | Dr. Roshan Lal Raina /<br>Dr. Nupur Tandon |

## PHDM01: Data Analytics

**Instructor: Dr. Devendra Kumar Punia**

### **Course Description:**

Business analytics has found various applications in many domains over last few years. In recent years, business analytics has shown much promise in various domains. Some notable domains have been banking, finance, retail, telecommunications, and social media. Business analytics refers to set of tools, techniques and practices for deriving useful insights from the available data for an organization / industry / domain. This paper discusses various types of analytics, namely descriptive – gain insights from data, predictive – modeling for predictions, and prescriptive – recommend decisions based on data.

### **Scope & Objective:**

The course provides basic knowledge of data analytics, and various tools and techniques used to conduct it. It shall cover management and engineering perspectives of data analytics. An introduction to various types of analytics along with various tools to conduct these will be provided. Data visualization and presentation techniques are also discussed alongwith emerging trend of big data analytics.

The course consists of lectures and a project / paper component, where students use the concepts and techniques from the course to study an application / problem relevant to their research interest.

### **Text Books**

- TB1. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams. Essentials of Business Analytics, Cengage Learning, 2015  
TB2. Ledolter, Johannes. Data mining and business analytics with R. Wiley, 2013.

### **Reference Books:**

- R1 Provost, Foster and Fawcett, Tom. Data science for business, O'Reilly, 2013.  
R2 Weiss, S.M., Indurkha, N., Zhang, T., Damerau, F., *Predictive Methods for Analyzing Unstructured Information*, Springer.  
R3 Ohri, A., R for business analytics, Springer, 2012.

### **Course Plan:**

| Modules | Theme                 | Topic Coverage   | Activities   |
|---------|-----------------------|--|--|
| 1       | Introduction          | Know participants<br>What is data analytics? What is business analytics?<br>Management and engineering perspective<br>Types of analytics<br>Tools of analytics | Participants to tell why they chose this subject?<br>What they expect to learn from this course?<br><br>Project<br>Paper / article |
|         | Descriptive analytics | What happened?<br>Standard report, dashboards, MIS, ad-hoc reporting, analysis, query, drill-down, statistical analysis, factor                                |  |

|   |                              |   |   |
|---|------------------------------|---|---|
|   |                              | analysis<br>Tools – business intelligence, excel,<br>information/data management software   |   |
| 2 | Predictive analytics         | What is going to happen?<br>Data mining, pattern recognition and alerts, monte carlo simulation, forecasting, root cause analysis, predictive modeling  |   |
|   | Prescriptive analytics       | What we should do?<br>Optimization, stochastic optimization   |   |
| 3 | How to do Analytics?         | Problem definition, data preparation, data cleaning, mean centering, normalization / standardization, variance scaling, dimensionality reduction, data exploration, interpretation, implementation, R, how to use R, data loading in R, | R, use of R                               |
|   | Presentation & visualization | Types of charts, graphs and tables, composite charts, visualization of multi dimensional data, effective animation  |   |
|   | Summary                      | Conclude<br>Big Data, way ahead   | Identify projects<br>Identify paper topic |

## ***PHCS03: Search based Software Engineering***

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**Instructor: Dr. Kavita Choudhary**

**Course Description:**

Meta-heuristic Search - Introduction and Overview of Heuristic and Meta-Heuristic Search - General optimization problems, Fitness functions, Local search vs. Meta-heuristic search, Combinatorial algorithms for generic data structures, Visualization of the Search Landscape. Specific Search Algorithms - Hill Climbing, Simulated Annealing, Great Deluge Algorithm, Tabu Search, Genetic Algorithms, Ant Colony Optimization. Applications in Software Engineering - Structural testing, Evolutionary testing, Program maintenance, Software Security, Performance Tuning, Model Checking. Requirements Engineering, Debugging and Maintenance, Testing, Optimizing software, Project Management

**Scope & Objective:**

In the past five years there has been a dramatic increase in work on Search-Based Software Engineering (SBSE), an approach to Software Engineering (SE) in which Search-Based Optimization (SBO) algorithms are used to address problems in SE. SBSE has been applied to problems throughout the SE lifecycle, from requirements and project planning to maintenance and reengineering. The approach is attractive because it offers a suite of adaptive automated and semi-automated solutions in situations typified by large complex problem spaces with multiple competing and conflicting objectives.

**Text Books:**

- TB1. Multi-objective optimization using evolutionary algorithm by Kalyanmoy Deb.
- TB2. Search-Based Software Engineering, Lecture Notes in Computer Science, Volume 8636 2014, Springer.

**Reference Books:**

- R1. Search Based Software Engineering, Volume 6956 of the series Lecture Notes in Computer Science pp 18-32, Springer.
- R2. Optimization Techniques - An Introduction, Authors: L. R. Foulds, ISBN: 978-1-4613-9460-0 (Print) 978-1-4613-9458-7

## Course Plan

| Module No. | Learning Objectives                    | Topics to be covered   |
|------------|--|--|
| 1          | Introduction to course                 | Introduction to SBSE and Meta-heuristic Search.                    |
|            | Possible techniques                    | Hill Climbing and Simulated Annealing                              |
|            | -do-                                   | Tabu Search  |
|            | -do-                                   | Genetic Algorithms   |
| 2          | Understand concept of search space     | Search Landscapes  |
|            | SBSE in Software Testing               | Generating Software Tests Using Genetic Algorithms                 |
|            | -do-                                   | Class projects and project timeline.                               |
|            | Concept of Search engine optimization  | Search Engine capabilities   |
|            | Application area of heuristic approach | Experimenting with Heuristic Methods                               |
| 3          | -do-                                   | Ant Colony Optimization  |
|            | Application in software engineering    | Parallel Meta-Heuristic Search                                     |
|            | -do-                                   | Test Prioritization for Pairwise Interaction Coverage              |
|            | -do-                                   | Fitness Function Design to Improve Evolutionary Structural Testing |
|            | Understanding requirement engineering. | Requirement Engineering, Debugging and Maintenance                 |
| -do-       | Optimizing software project management |  |

## PHDM01: Web Data Management

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**Instructor: Dr. Sonal Jain**

### **Course Description:**

Techniques for retrieving and analyzing web documents, including basic text retrieval method, metadata extraction and sentiment analysis issues. Modern search engine technology, including the use of links and user behavior knowledge. advanced meta-search engine technology, including search engine selection, wrapper generation and result fusion. Web database integration techniques include query interface extraction and understanding query interface integration.

### **Scope & Objective:**

The course provides basic knowledge of new methods in database management particularly web data management such as dealing with semi-structured data and query analysis for semi-structured data. The growth of this immense information source is witnessed by the number of newly connected people, by the interactions among them facilitated by the social networking platforms, and above all by the huge amount of data covering all aspects of human activity. As a consequence, a major trend in the evolution of data management concepts, methods, and techniques is their increasing focus on distribution concerns: since information now mostly resides in the network, so do the tools that process this information to make sense of it. The use of global-area-network distribution is typical for Web data: data relevant for a particular application may come from a large number of Web servers. Mastering the challenges open by data distribution is the key to handle Web-scale data management. The course consists of lectures and a project component, which includes both modeling web data and web data semantics and integration, where students use the techniques from the course to study an application problem relevant to their research interest.

### **Text Books:**

- TB1. Ramez Elmsari, Shamkant Navathe, *Fundamentals of Database Systems*, Fifth edition, Pearson Education
- TB2. Serge Abiteboul, Ioana Manolescu, *Web data management*, Cambridge University Press 2011.

### **Reference Books:**

- R1 Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, *Introduction to Information Retrieval*, Cambridge University Press. 2008.
- R2 Weiss, S.M., Indurkha, N., Zhang, T., Damerau, F., *Predictive Methods for Analyzing Unstructured Information*, Springer



**Course Plan:**

| <b>Module No.</b> | <b>Learning Objectives</b>  | <b>Topics to be covered</b>   | <b>Reference Chap./Sec. (Book)</b> |
|-------------------|---|---|------------------------------------|
| 1                 | Introduction to course  | Introduction  | Ch 1 (T1 & T2)                     |
|                   | Need of data management – Why?  | Understand modeling Concepts of Enhanced conceptual models for various real life problems | Ch-3, Ch-4 (T1)                    |
|                   | Data Management Techniques  | Mapping of Logical Database to Physical Database, Functional Dependencies                 | Ch-7 of T1                         |
|                   | -do-  | Normalization for relational databases  | Ch 10 of T1                        |
|                   | Understand working and implementation of auxiliary data structures called indexes | Indexing  | Ch-14 of T1                        |
| 2                 | Distributed Management Techniques   | Distributed Data Management –Issues and Challenges  | Ch-2 of T2                         |
|                   | -do-  | Service Oriented Architecture   | Ch-3 of T2                         |
|                   | -do-  | Search Engine capabilities  | Ch-4 of T2                         |
|                   | Methods of Data Exchange  | XML Data Model, XLink, XPointer, Xpath  | Ch-6 (T2)                          |
|                   | -do-  | Ontologies  | Ch-6(T2)                           |
| 3                 | Web Query Languages   | Querying data through XML   | Ch-6 (T2)                          |
|                   | -do-  | XML Query evaluation  | Ch-6(T2)                           |
|                   | -do-  | Querying data through Ontologies  | Ch-7(T2)                           |
|                   | Understanding Text Documents  | Text Mining Techniques  | Ch1-2(T3)                          |
|                   | -do-  | Opining mining and Sentiment Analysis   | Material from papers               |

## *PHEE02: Power Quality*

**Instructor: Dr. Pushendra Singh**

**Course Description:**

This course provides the research scholars with introduction to Power Quality, Introduction to Power Quality, Power Frequency Disturbance, Electrical Transients, Harmonics, Power Factor, Electromagnetic Interference, Distributed Generation and Power Quality, Measurement and Solution of Power Quality Issues.

**Scope & Objective:**

Power quality subject is to understand the concept of power quality, different factors causing quality issues, effect of poor power quality, necessity to improve power quality and different methods to improve it. This subject tackles with the perturbations caused by power frequency disturbances, electrical transients, harmonics, power factor issues and electromagnetic interferences. This subject also includes the concept of distributed generation technologies and penetration with existing electric power system.

**Text Books:**

- TB1. C. SANKARAN, “Power Quality”, CRC Press.
- TB2. Roger C Dugan, Mark F McGranhan, Surya Santoso and H Wayne Beaty, “Electrical Power Systems Quality 2nd Edition”, MaGraw-Hill
- TB3. Alexander Kusko and Marc T Thompson, “Power Quality in Electrical Systems”, McGraw Hill

**Course Plan:**

| Module No. | Unit Name                     | Topics to be covered   |
|------------|-------------------------------|--|
| 1          | Introduction to Power Quality | Introduction to power quality, definition, progression, terminology, quality issues, susceptibility criteria, responsibilities of the Suppliers and Users of Electrical Power  |
|            | Power Frequency Disturbance   | Introduction, Common power frequency disturbances, Cures for low frequency disturbances, Voltage tolerance criteria  |
|            | Electrical Transients         | Introduction, Transient system model, Examples of transient models and their response, Power system transient model, Types and causes of transient, Examples of transient waveforms  |
| 2          | Harmonics                     | Definition of harmonics, Even and Odd harmonics, Phase rotation and phase angle relationship, Voltage and current harmonics, Individual and total harmonic distortion, Harmonic signatures, Effect of harmonics on power system devices, Guidelines for harmonic limitations, Harmonic mitigation techniques |
|            | Power Factor                  | Introduction, Active and reactive power, Displacement and true power factor, Power factor improvement, Correction, Penalty, Advantages of Power Factor correction, Voltage rise due to capacitance application of synchronous condensers, Static VAR   |

|   |  |   |
|---|--|---|
|   |  | compensator   |
| 3 | Electromagnetic Interference                     | Introduction, Frequency classification, Electrical fields, Magnetic fields, Electromagnetic interference terminology, Power frequency fields, High-frequency interference and susceptibility, Electromagnetic interference mitigation techniques, Health concerns |
|   | Distributed Generation and Power Quality         | Resources of DG, DG Technologies, Interference to the utility system, Power quality issues, Operating conflicts, DG on distributed networks, Siting DG distributed generation, Interconnection standards  |
|   | Measurement and Solution of Power Quality Issues | Introduction, Power quality measurement devices, Power quality measurements, Number of test locations, Duration, Instrument setup, Instrument set up guidelines   |

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## *PHEE03: Smart Grid Technologies*

**Instructor: Dr. Pushendra Singh**

**Course Description:**

This course provides the research scholars with Power Grids, Modelling Converters in Microgrid, Power Systems, Solar Energy Systems and Microgrid Wind Energy Systems.

**Scope & Objective:**

Smart power grid is the burning topic of power system. World is looking towards the clean and green energy. This subject deals with the utility at all the levels to renewable energy viz. solar and wind, and modeling of smart power grid for both of these. Generating the electrical energy from renewable energy sources is not a difficult task now but modelling this energy into a useable form is cumbersome and a matter of research. This subject focuses how to deal with imposed challenges.

**Text Books:**

TB1. Ali Keyhani, "Design of Smart Power Grid Renewables Energy Systems", IEEE-Wiley Press.

**Course Plan:**

| Module No. | Unit Name                                       | Topics to be covered   |
|------------|---|--|
| 1          | Power Grids                                     | Introduction, Electric power grid, Basic concept of power grid, Load models, Transformers in electrical power grid, Modelling of a microgrid system, Modelling 3-phase Transformers, Tap changing Transformers, Modelling transmission lines   |
|            | Modelling Converters in Microgrid Power Systems | Introduction, Single phase DC/AC inverter with two switches and four switch bipolar, 3-phase DC/AC inverters, Pulse width modulation methods, Analysis of DC/AC 3-phase inverter, Microgrid of renewable energy systems, The DC/DC converters in green energy systems, Rectifiers, PWM rectifiers, Three phase voltage source rectifier using sinusoidal PWM switching, Sizing of an inverter, rectifier, DC/DC converter for microgrid operation  |
| 2          | Solar Energy Systems                            | Introduction, Solar energy conversion process, Photovoltaic power conversion, Photovoltaic materials, Photovoltaic statistics, Photovoltaic efficiency, Design of photovoltaic system, Modelling of a photovoltaic module, Measurement of photovoltaic performance, Maximum power point of a photovoltaic array, Battery storage system, Storage system based on a single cell battery, Energy yield of a photovoltaic module and the angle of incidence, State of photovoltaic generation Technology, Estimation of photovoltaic module, Model parameters |
| 3          | Microgrid Wind                                  | Introduction, Wind power, Wind turbine generator, Modelling of induction machines, Power flow analysis of an induction   |

|  |                |  |
|--|----------------|--|
|  | Energy Systems | machine, Operation of an induction generator, Dynamic performance, Doubly-Fed induction generator, Brushless induction generator systems, Variable speed permanent magnet generator, Generator with a converter isolated from the grid |
|--|----------------|--|

## *PHME01: Materials Science*

**Instructor: Dr. Murari Lal Gupta**

### **Course Description:**

This course provides the research scholars a basic understanding about the scientific concepts behind the structure – property relationships in different engineering materials. Understanding the atomic and molecular structure of materials and relating that to the bulk properties of the materials will be the main objective of this course.

### **Scope & Objective:**

The research nowadays has been increasing in order to develop new and improved engineering applications and performance for the products in every sector be it health, automobile, electronics, construction, food or agriculture. The innovation and improved performance and functionality can be introduced in the products mainly by the innovation in the materials that is by restructuring the existing materials and/or developing new or modified materials. The structure property relationship in the materials is needed to be understood in order to design new materials and to improve the existing materials in order to realize the innovative applications of the variety of products.

### **Text Books:**

TB1. W. D. Callister, Materials Science & Engineering, John Wiley.

TB2. William Smith, Ravi Prakash and Javed Hashemi, Materials Science & Engineering, Tata McGraw Hill.

### **Course Plan:**

| <b>Module No.</b> | <b>Learning Objectives</b>     | <b>Topics to be covered</b>  |
|-------------------|--------------------------------|--|
| 1                 | Introduction                   | Introduction : Historical perspective, importance of materials   |
|                   | Basic science                  | Brief review of modern & atomic concepts in Physics and Chemistry.   |
|                   | Atomic and molecular structure | Atomic models, Chemical bondings.  |
|                   | Crystal structure              | Concept of UNIT cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density, Miller indices and directions.   |
| 2                 | Defects and imperfections      | Imperfections, Defects & Dislocations in solids. Types of dislocations, Burgers vector and its representation; Planar defects, stacking faults, twins, grain boundaries  |
|                   | Mechanical Properties          | Mechanical Properties of Materials, Concepts of stress and strain, Stress-Strain diagrams; Properties obtained from the Tensile test; Elastic deformation, Plastic deformation. Impact Properties, Strain rate effects and Impact behavior. Hardness of materials; |
| 3                 | Phase diagrams                 | Uniary and Binary diagrams, Phase rules; Types of  |

|  |                |   |
|--|----------------|---|
|  |                | equilibrium diagrams: Solid solution type, eutectic type and combination type; Iron-carbon equilibrium diagram.   |
|  | Heat treatment | Various types of carbon steels, alloy steels and cast irons, its properties and uses. Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams |
|  | Composites     | Composite Materials- Introduction, classification; concrete, metal-matrix and polymer –matrix composites; Applications of composite materials.  |

## PHME02: ADVENCE HEAT TRANSFER

**Instructor: Dr. Anurag Kumar Tiwari**

### **Course Description:**

Basic principles of heat transfer and their application. Subject areas include steady-state and transient system analyses for conduction, free and forced convection, boiling, condensation and thermal radiation.

### **Scope & Objective:**

Apply scientific and engineering principles to analyze and design thermos-fluid aspects of engineering systems; use appropriate analytical and computational tools to investigate heat transport phenomena; both competent and confident in interpreting results of investigations related to heat transfer, fluid flow, and thermal design; recognize the broad technological context of heat transfer, especially related to energy technology.

### **Text Books:**

- TB1. William Kays, Michael Crawford, and Bernhard Weigand, "Convective Heat and Mass Transfer", Fourth Ed., 2004, McGraw-Hill.
- TB2. "Fundamentals of Heat and Mass Transfer," by F.P. Incropera & D. P. DeWitt, Wiley (5th ed).

### **Course Plan:**

| Module No. | Topics to be covered   |
|------------|--|
| 1          | <b>Introduction and basics of to heat transfer:</b> Derivation of energy equation for conduction in three dimensions-Initial and boundary conditions. Transient conduction- Concept of Biot number- Lumped capacitance formulation unsteady Conduction from a semi-infinite solid-solution by similarity transformation method. Solution of the general 1D unsteady problem by separation of variables, Laplace equation–solution by variable separable method -concept of superposition and homogeneous boundary conditions. Numerical solution of conduction problems-Basic ideas of finite difference method-forward, backward and central differences – Discretization for the unsteady heat equation. |
| 2          | <b>Introduction to convection</b> Derivation of governing equation for convection. 2D laminar coquette flow and non-dimensional numbers. Concept of Adiabatic wall temperature. Integral methods for momentum and thermal boundary layers. Pipe flow – concept of developed temperature profile and solutions for constant wall flux and constant wall temperature boundary conditions. Solution of entry length problem for constant wall and constant wall flux boundary conditions. Natural convection – governing equation, integral solution for flat surface.  |
| 3          | <b>Boiling, condensation and radiation:</b> Boiling heat transfer, pool boiling, flow boiling, condensation heat transfer, film condensation, heat transfer correlations. Introduction. Concept of black body, derivation of black body radiation laws from first principles Need for view factors, concept of view factors, mathematical definition. Shape factor calculations.   |



## ***PHPC01: Advanced Professional Communication***

**Instructor: Dr. Roshan Lal Raina / Dr. Nupur Tandon**

### **Course Description:**

The course includes elements and tasks related to advanced professional communication such as making effective oral presentations; using proper vocal cues and non-verbal communication; writing effective abstracts, e-mails, business letters, reports, proposals, research papers; drafting captivating speeches; using audio-visual aids appropriately; documenting, proofreading and editing the written text properly; citing sources and preparing bibliography accurately, etc.

### **Scope & Objective:**

In view of the growing importance of communication skills the course has been designed to help researchers express themselves effectively in all forms of professional communication. Offering extensive exposure and practice, the course helps students write with clarity and precision and make effective presentations.

### **Text Books:**

TB Lesikar, Raymond V. et al. *Business Communication: Making Connections in a Digital World*, 11<sup>th</sup> Edition, New Delhi: Tata McGraw Hill Education Pvt Ltd., 2009.

### **Reference Books:**

- R1 Leki, Ilona, *Academic Writing: Exploring Processes and Strategies*, 2<sup>nd</sup> Edition, New Delhi: Cambridge University Press, 2010.
- R2 Arnold, George T., *Media Writer's Handbook: A Guide to Common Writing & Editing Problems*, 4<sup>th</sup> Edition, New Delhi: Tata McGraw Hill, 2010.
- R3 Raman, Meenakshi and Sangeeta Sharma, *Technical Communication: Principles and Practice*, 2<sup>nd</sup> Edition, New Delhi: Oxford University Press, 2011.
- R4 Krishna Mohan and N.P.Singh, *Speaking English Effectively*, New Delhi: Macmillan, 1994.
- R5 Sasikumar and P.V. Dhamija, *Spoken English: A Self-Learning Guide to Conversation Practice*, Tata-McGraw Hill, 2007.
- R6 Lata, Pushp and Sanjay Kumar, *Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews*, 3<sup>rd</sup> Reprint, New Delhi: PHI Learning Pvt Ltd., 2010.
- R7 Rizvi, M. Ashraf, *Effective Technical Communication*, 16<sup>th</sup> Reprint, New Delhi: Tata McGraw Hill Pvt Ltd., 2010.
- R8 Asha Kaul, *Business Communication*, Second Edition, New Delhi: PHI, 2010.

### **Course Plan:**

| <b>Module No.</b> | <b>Learning Objectives</b>  | <b>Topics to be Covered</b>   |
|-------------------|-----------------------------|---|
| 1                 | Introduction to the course. | Defining Communication with emphasis on various stages and skills in language acquisition   |
|                   |                             | Introducing students to characteristic features of effective communication; acquainting them with the barriers to communication and suggesting ways to overcome such barriers |

|   |                           |   |
|---|---------------------------|---|
|   | Oral Presentations        | Helping students learn techniques for making effective professional presentations; helping them observe the nuances of presentations such as using body and voice effectively; drafting captivating beginnings; organizing main body; using statistics; casting emphatic conclusions; using wit and humour; using audio-visual aids appropriately, etc. |
| 2 | Style of Writing          | Helping students develop effective writing style  |
|   | Research Papers           | Orienting students to the nature and process of writing research papers, dissertations and thesis   |
|   | Documentation and Editing | Helping students learn ways to document and edit a written text; helping them cite references appropriately, cast bibliography correctly and edit the text effectively  |
| 3 | Draft documents           | Helping students draft effective reports, proposals, letters, resumes, memos and e-mails  |