

**SYLLABUS**  
**for**  
**PhD Course in Computer Science**



**DEPARTMENT OF COMPUTER SCIENCE**  
**RAVENSHAW UNIVERSITY**

# **PhD Course Work Planner**

## **Paper –1.1.1**

Research Methodology – 75Marks.

ComputerApplication- 25Marks.

(Software tools (Matlab/ Mathematica/ Maple/ R/ Python/ GloMoSim etc.) for research)

## **Paper – 1.1.2**

Elective Course – 100 Marks.

(From the field of research) (75 + 25)

## **Paper -1.1.3**

Research and publication Ethics (RPE)-50 Marks.

## **Paper-1.1.4**

Review of Literature -50 Marks.

**Note:** To be implemented using tools studied in Paper –I.

# PAPER-1.1.1

## Research Methodology

### Course Objective

It is essential and foremost for any research scholar to learn and applied the content addressed in the syllabus. The objective of this course includes for the students:

- able to understand some basic concepts of research and its methodologies
- identify appropriate research topics
- select and define appropriate research problem
- prepare a project proposal
- write a research report and thesis

Outcomes

### Course Outcomes

By the end of the subject students should be able to:

- demonstrate the ability to choose methods appropriate to research aims and objectives
- understand the limitations of particular research methods
- develop skills in qualitative and quantitative data analysis
- develop critical thinking skills
- implement basic data analysis techniques using various programming languages and different software tools.

### Unit I

**Research Methodology: An Introduction:** Meaning and objective of Research Methodology, Motivation in research, types of research, Research Approaches, significance of research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

**Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Illustration and Conclusion

### Unit II

**Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs and Conclusion.

**Methods of Data Collection:** Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

### **Unit III**

**Processing and Analysis of Data:** Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry, Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Curve Fitting,

**Testing of Hypotheses:** What is a Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Important Parametric Tests, Hypothesis Testing of Means, Hypothesis Testing for Comparing Two Related Samples, Hypothesis Testing of Proportions, Hypothesis Testing for Difference between Proportions, Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance, Testing the Equality of Variances of Two Normal Populations, Hypothesis Testing of Correlation Coefficients, Limitations of the Tests of Hypotheses.

## **Unit IV**

**Chi-square Test:** Chi-square as a Test for Comparing Variance, Chi-square as a Non-parametric Test, Conditions for the Application of  $\chi^2$  Test, Steps Involved in Applying Chi-square Test, Alternative Formula, Yates' Correction, Conversion of  $\chi^2$  into Phi Coefficient, Conversion of  $\chi^2$  into Coefficient by Contingency, Important Characteristics of  $\chi^2$  Test.

**Analysis of Variance:** Analysis of Variance (ANOVA), The Basic Principle of ANOVA, ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA

## **Unit V**

**Computer Application -25**

### **Marks**

**Software tool MATLAB:** Introduction to Programming, Programming Environment, Graph Plots, Procedures and Functions, Control Statements, Manipulating Text.

### **References:**

1. Research Methodology Methods and Techniques, Kothari, C. R., Wiley Eastern Ltd.
2. Microsoft Excel Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Press, ISBN:0735619018
3. Research Methodology: a step-by-step guide for beginners, Kumar, Pearson Education.
4. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd. 5. Research Methodology, Sharma, N. K., KSK Publishers, New Delhi.

# PAPER- Paper – 1.1.2

## Elective Courses

### Performance Analysis of Wireless Sensor Network

#### Course Objectives:

The measurement of performance and QoS of sensor network is highly essential over the recent communication protocol and deployment of sensor nodes. Therefore, the objective of the subject for students lies on following:

- Understand basic sensors deployment topologies
- Learn various energy efficient communication protocols.
- Calculate various performance metrics such as QoS parameters of wireless sensor networks packet delivery ratio, throughput, delay, routing overheads, average energy consumed and average residual energy.
- Understand different soft computing techniques require for performance analysis of wireless sensor networks.

#### Course Outcomes:

After successful completion of this course a student can be able to:

- Calculate performance of customized deployed sensor for various topologies.
- Start reading some research papers for future advances of sensor networks.
- Implement various soft computing frameworks towards calculation and analysis of various protocol wireless sensor networks.

#### Unit I

**Introduction:** The vision, Networked wireless sensor devices, Applications, Key design challenges. Network deployment: Structured versus randomized deployment, Network topology.

#### Unit II

**Localization:** issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization, Theoretical analysis of localization techniques. Synchronization: Issues & Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

#### Unit III

**Wireless characteristics:** Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference. Medium-access and sleep scheduling: Traditional MAC

protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Routing: Metric-based approaches, Routing with diversity, multi-path routing.

#### **Unit IV**

**Fundamentals of Genetic Algorithms:** basic concepts, Creation of Offspring, working principle, Encoding, Fitness Function, Reproduction.

#### **Unit V**

**Genetic Modelling:** Inheritance Operators, cross over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used GA, Generational Cycle, Convergence of Genetic Algorithm, Applications, multilevel optimization, Real Life Problems, difference and similarities between GA and Other Traditional Methods, Advances in GA.

#### **Books:**

1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press
2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati, Springer.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms synthesis and Applications by S. Rajasekaran, G.A Vijayalakshmi Pai

# Short Range Wireless Communication

## Course Objective:

The field of short-range wireless communications have been popularized and emerging research among research and students. Therefore, the objective of the course are as follows:

- Student can understand various short range wireless communication technologies.
- Student can identify the advantages and disadvantages of different communication protocols,
- Student able to know the calculation of various performance metrics corresponding different communication systems.

## Course Outcomes:

- The content of the course encourages to student to start reading new research papers.
- A student can outline various challenges of communication protocols.
- One can think to design an energy efficient communication channel.
- This course help to student to calculate various performance metrics corresponding to various communication systems.

## **Unit I**

Data communication, Protocols and standards, Digital Transmission and Analog Transmission, Multiple Access, Wireless LAN

## **Unit II**

TCP/IP model, Routing Protocol: Unicast routing Protocol and Multicast routing Protocols

## **Unit III**

Wireless sensor Network vision, WSN devices, Wireless characteristics: Basics, Wireless link quality, Radio energy consideration

## **Unit IV**

Ad hoc Network, Vehicular ad hoc network: Vehicular Network Applications and requirements Architecture, Challenges, Standards and Solutions: Addressing and Geographical addressing, Risk analysis and Management, Data-centric Trust and Verification and secure localization and Forwarding algorithms

## **Unit V**

Short Range Routing protocol: Topology-based routing, Geography-based routing, Geo Cast-based routing and Broadcast-based routing

## **Books:**

1. Wireless Sensor Networks: Edited by C.SRaghavendra, Krishna M, Sivalingam, Taieb Znati, Springer
2. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley InterScience
3. Computer Networks: A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson 5th.Ed



# Methods of Advanced Wireless Communication Systems

## Course Objectives:

In realistic wireless communication scenario, the signals undergo various obstacles which lead to challenge to improve the communication systems. This course help to student on following aspects:

- Understanding various short-term and long-term communication systems.
- Learn different fading channels.
- Characterizing several fading environments.
- Understand various performance metrics of fading channels.

## Course Outcomes:

The extensive course content of the subject result to following outcomes:

- One can characterize various communication channel over its obstacles.
- The student able to read new research papers in advances of this subject.
- Various performance metric can be calculated and improve corresponding pragmatic communication scenario.

### Unit I

Introduction to wireless communication systems: Evolution of mobile radio communications, examples of wireless comm. systems, paging systems, Cordless telephone systems, comparison of various wireless systems.

### Unit II

Modern wireless communication systems: Generations of wireless networks, types of wireless communications: wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks, comparisons of wirelesscommunications.

### Unit III

Multiple access techniques for wireless communication: Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

### Unit IV

Wireless fading: Causes of fading, basic phenomenon of fading, basic phenomenon of fading, small scale fading (due to multiple time delay spread), flat fading, frequency selective fading, small scale fading (due to doppler spread), fast or long term fading, Lognormal distribution, Gamma distribution, Inverse Gaussian distribution, Rayleigh distribution, Nakagamidistribution

### Unit V

Outage probability, moment analysis different fading models, error probability and its different approximations, composite and mixture distribution fading, performance analysis of different fading models.

### Books

1. Wireless Communications, Theodore S. Rappaport, second Edition, Pearson.
2. Mobile Communications, Jochen Schiller, Pearson
3. Wireless Communications and Wireless Networks, William Stallings, Second Edition, Pearson.

## **PAPER CODE- 1.1.3**

### **Research and publication Ethics (RPE)**

#### **Course Objectives:**

This course provides a lot of essential and foremost things for a researcher. The following can be the objective of the course content:

- How to generate various philosophical of thoughts in different knowledge dimensions of a subject.
- How to avoid falsification, fabrication, redundant, overlapping and plagiarism practices.
- How to find suitable journals and publish research paper corresponding to various research interests.
- Student can learn various publication ethics, resolving conflict of interest, and reduces various violence while placing authorship in the papers.

#### **Course Outcomes:**

After rigorous undergoing the subject content one able to start research by abiding to following best practices:

- Student can able generate multi spectrum philosophical thoughts around any vicinity of research interest.
- A student generates intrinsic moral ethics related to falsification, fabrication, redundant, overlapping and plagiarism practices.
- Student can understand intellectual honesty, research integrity, various publication ethics, resolving conflict of interest, and various violence issues while placing authorship in the papers.

#### **RPE 01: PHILOSOPHY AND ETHICS (10 hrs.)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions
3. Intellectual honesty and research integrity
4. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)
5. Redundant publications: duplicate and overlapping publications, salami slicing
6. Selective reporting and misrepresentation of data

#### **RPE 02: PUBLICATION ETHICS (10HRS)**

1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME etc.
3. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa types.

4. Violation of publication ethics, authorship and contributorship
5. Identification of publication misconduct, complaints and appeals
6. Predatory publishers and journals

## PRACTICE

### RPE 03: OPEN ACCESS PUBLISHING (10 HRS)

1. Open access publications and initiatives
2. Journal finder/journal suggestion tools viz. JANE. Elsevier Journal Finder, Springer Journal Suggester, etc.
3. Complaints and appeals: examples and fraud from India and abroad
4. Use of plagiarism software like Turnitin, Urkund and other open source software tools
5. Conflicts of interest

## References

1. Bird, A. (2006). Philosophy of Science, Routledge
2. MacIntyre, Alasdair (1967) A Short History of Ethics, London
3. P. Chaddah (2018) Ethics in Competitive Research: Do not get sooped: do not get plagiarized, ISBN: 978-9387480865
4. 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 Academies Press.
5. Resnik, D.B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN: 978-81-939482-1-7. <http://www.insaindia.res.in/pdf/EthicsBook.pdf>

## Internet of Things (IoT)

### Course Objectives:

- Students will be able to explore the interconnection and integration of the physical world and the cyber space.
- They will also be able to design & develop IOT models for handling different real-world problems.

### Course Outcomes:

- Students will be able to understand the technological advancements and application areas of IOT
- To realize the revolution of Internet for mobile IoT devices, cloud computing & sensor networks
- To understand building blocks of Internet of Things and its characteristics.

## Unit-I

Internet of Things (IoT) – Introduction, Definitions, Sensors for IoT, Physical Design of IoT, Connectivity in IoT, IoT Protocols – Link Layer, Network Layer, Transport Layer, and Application Layer protocols, Architectural Overview and Applications of IoT, Convergence of M2M and IoT technology.

## **Unit-II**

IoT Reference Models – Introduction, Functional overview, Information layer, Deployment and Operational view of IoT, Areas of IoT development, Standardization for IoT, Real-world design constraints, Automation and Remote Control of IoT data, Representation of data and their visualization.

## **Unit-III**

IoT mechanism and enabling technologies, Structural characteristics – IoT ecosystem concepts, Traffic characteristics, Interoperability, Scalability, and Quality of Service (QoS). Security and Privacy concerns – Security requirements in IoT, Identity and access management, Security concerns for IoT applications, Distributed Denial of Services (DDoS) threats, Trust models in IoT, State-of-the-art security paradigms for IoT – Role of Artificial Intelligence (AI) and Blockchain.

## **Unit-IV**

IoT knowledge management, Storage issues, Big data platforms for IoT – Dissemination of IoT data, Service interoperability, Management of big data for pervasive IoT ecosystems. Introduction to Cloud computing paradigms, Role of Cloud computing for IoT, Distribution of workloads in IoT – Scalability, Dynamicity, Clustering, Service Level Architecture (SLA), QoS management.

## **Unit-V**

IoT service ecosystems – Smart wearables, Wearable Computing, Wireless Body Area Networks (WBANs), Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), Application Areas of IoT – Smart homes, Smart Industries, Smart Cities, Smart Healthcare, Smart Marketing and Businesses.

## **Text Books**

1. Minoli, D. (2013). Building the internet of things with IPv6 and MIPv6: The evolving world of M2M communications. John Wiley & Sons.
2. Vermesan, O., & Friess, P. (Eds.). (2014). Internet of things-from research and innovation to market deployment (Vol. 29). Aalborg: River publishers.
3. Hu, F. (2016). Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations. CRC Press.
4. Stackowiak, R., Licht, A., Mantha, V., & Nagode, L. (2015). Big Data and the Internet of Things: enterprise information architecture for a new age. Apress.
5. Vermesan, O., & Friess, P. (Eds.). (2013). Internet of things: converging technologies for smart environments and integrated ecosystems. River publishers.

## **Reference Study Materials**

1. Iqbal, M. A., Hussain, S., Xing, H., & Imran, M. A. (2020). Enabling the Internet of Things: Fundamentals, Design and Applications. John Wiley & Sons.
2. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of things: A survey on enabling technologies, protocols, and applications. *IEEE communications surveys & tutorials*, 17(4), 2347-2376.
3. Gazis, V. (2016). A Survey of Standards for Machine-to-Machine and the Internet of Things. *IEEE Communications Surveys & Tutorials*, 19(1), 482-511.
4. Cai, H., Xu, B., Jiang, L., & Vasilakos, A. V. (2016). IoT-based big data storage systems in cloud computing: perspectives and challenges. *IEEE Internet of Things Journal*, 4(1), 75-87.
5. Granjal, J., Monteiro, E., & Silva, J. S. (2015). Security for the internet of things: a survey of existing protocols and open research issues. *IEEE Communications Surveys & Tutorials*, 17(3), 1294-1312.
6. Hassan, Q. F. (Ed.). (2018). *Internet of things A to Z: technologies and applications*. John Wiley & Sons.
7. Kamhoua, C. A., Njilla, L. L., Kott, A., & Shetty, S. (Eds.). (2020). *Modeling and Design of Secure Internet of Things*. Wiley-IEEE press.
8. Vermesan, O., & Bacquet, J. (Eds.). (2017). *Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution*. River Publishers.

## **Paper-1.1.4**

### **Review of Literature**

#### **Course Objectives:**

- After successive rigorous undergoing of subject contents of PhD coursework, the objective of a researcher to pick a suitable research subject on recent trends.

#### **Course Outcomes:**

- On following contents of PhD coursework subjects, a student able to produce his/her research outcome on writing a review of literature in respect of recent trends and technologies.
- The outcomes of this paper help to students writing their review papers or research papers.

A review (a minimum of 10,000 words) of published research work in the relevant field of the elective subject area or in proposed area of research to be submitted in bound form (posted on A4 size paper, Times New Roman font, font size 12, 1.5 line spacing). The softcopy of the aforesaid review of published research work submitted in CD/DVD/USB drive will be subjected to concern teacher and it should be verified by the Heads of the Department to avoid plagiarism. The plagiarized review of published research will be rejected, and the candidates will have no claim, whatsoever against the university.