



RK University (Pre-registration coursework for PhD program)

PhD Program – PhD (Computer Engineering)

Concerned Dean – Dr. Ajit Kumar Shukla (email – ajit.shukla@rku.ac.in)

Sr. No.	Subject	Contents	Method of evaluation	Credits
1	Research Methodology	As per syllabus mentioned below	Written examination (3 hrs)	4
2	Subject of specialization:* 1. Soft Computing 2. Cryptography & Network Security 3. Wireless Computer Networks 4. Data Mining & Data Warehousing 5. Digital Image Processing 6. Language Processing and Translators 7. Semantic Annotations in Business Process Modeling 8. Software Engineering 9. Embedded System 10. Wireless Mobile Ad Hock Networks 11. Artificial Intelligence 12. Security in VANET (Vehicular Ad-hoc Network) 13. Big Data 14. Massive Data mining 15. Information Retrieval System	Research topic specific	Written examination (3 hrs)	4
3	Review of literature	Review of literature for the PhD research topic	Presentation + Detailed report in hard copy	3
			Total	11

(\*Shall be decided by the Dean of Faculty, individually, for each PhD scholar)

## **Notes -**

1. The admission process of PhD program will comprise of 2 stages viz. (a) admission to PhD program (b) final registration in PhD program.
2. A successful PhD candidate (RAT examination) will be admitted to PhD program after paying admission fees (Rs.60000/-) and upon allocation of a PhD guide by RK University.
3. An admitted PhD candidate will have to submit synopsis and presentation of his/her actual research project (in consultation with the PhD guide approved and allocated by RK university) before Doctoral Research Committee (DRC) within 6 months from date of admission(date will be declared by university).
4. An admitted PhD candidate will be registered after earning minimum of 11 credits as per above mentioned course-work structure.
5. The candidate will acquire credit of a subject on passing the examination that will be conducted at the end of 6 months (date will be declared by university).
6. On acquiring required credits, an admitted candidate will be issued a certificate of registration(along with project title)by RK University.

Course Title	Research Methodology
<b>Detailed syllabus</b>	
<p><b><u>Research:</u></b>  Meaning, purpose, Types, (Educational, Clinical, Experimental, historical descriptive, Basic applied and Patent oriented Research) and objectives of research, phases of research.</p> <p><b><u>Research Design:</u></b>  Review of Research Literature: Purpose and use of literature review, locating relevant information, use of library &amp; electronic databases, preparation &amp; presentation of literature review, research article reviews, theoretical models and frame work. Identification of gaps in research, formulation of research problem, definition of research objectives.</p> <p><b><u>Documentation:</u></b>  a. "How" of documentation  b. Techniques of documentation c. Importance of documentation  d. Use of computer packages in documentation</p> <p><b><u>Research Publication:</u></b>  Thesis, Research paper, Review Article &amp; Technical Reports: Organization of thesis and reports, formatting issues, citation methods, references, effective oral presentation of research. Quality indices of research publication: impact factor, immediacy factor, H- index and other citation indices</p> <p><b><u>Presentation (especially for oral presentation):</u></b>  Importance and types of different skills, contained, format of model, introduction, Poster, Gestures, eye contact, facial, expressions, stage fright, volume of pitch, speed, pause &amp; language, Visual aids &amp; seating, Questionnaire etc.</p> <p><b><u>Cost analysis of the project:</u></b>  cost incurred on raw materials, Procedure, instrumentations and clinical trials.</p> <p><b><u>Sources for procurement of research grants:</u></b>  International agencies, government and private bodies.</p> <p><b><u>Industrial-institution interaction:</u></b>  Industrial projects, their feasibility reports, interaction with industries.</p> <p><b><u>Research Ethics and Morals:</u></b>  Issues related to plagiarism, collaborative models and ethics, acknowledgements. Intellectual Property Rights: copy rights, copy left: patents, Industrial designs, Trademarks.</p>	

### **Reference Books:**

1. Research Methodology, Methods & Techniques, C. R. Kothari, Vishwa Prakashan
2. Research Methods- A Process of Inquiry, Graziano, A.M., Raulin, M.L, Pearson Publications.
3. How to Write a Thesis:, Murray, R. Tata McGraw Hill
4. Writing For Academic Journals, Murray, R., McGraw Hill International.
5. Writing for Publication, Henson, K.T., Allyn & Bacon.
6. Research Methodology by Bhattacharyya Excel Books 2nd Edition.
7. What is this thing called Science, Chalmers, A.F., Queensland University Press.
8. Methods & Techniques of Social Research, Bhandarkar & Wilkinson, Himalaya publications.
9. Doing your Research project, Bell J., Open University Press, Berkshire.
10. A Handbook of Academic Writing, Murray, R. and Moore, S., Tata McGraw Hill International.
11. Business Research Methods Donald R. Cooper and Pamela S.Schindler Business Research Methods Tata McGraw Hill Publishing Company Ltd
12. Research Methodology: A Guide for Researchers in Management and Social Sciences Taylor, Sinha & Ghoshal

<b>Course Title</b>	<b>Soft Computing</b>
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**Detailed syllabus**

**Introduction:**

What is Soft computing? Necessity of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing

**Evolutionary Computing:**

Basic Concepts of Genetic Algorithms (GA), Working Principle, Encoding methods, Fitness function, GA Operators- Reproduction; Crossover; Mutation, Convergence of GA, Multi-level Optimization, Real Life Problems

**Fuzzy Systems:**

Fuzzy Set theory, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification, Fuzzy Logic, Fuzzy Rule based systems, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification

**Neural Networks:**

Basic Concept of Neural Network, Overview of Learning rules and activation functions, Single layer Perceptrons and Learning, Back Propagation networks- Architecture of Backpropagation(BP) Networks; Backpropagation Learning; Variation of Standard Backpropagation Neural Network, Introduction to Associative Memory, Adaptive Resonance Theory and Self Organizing Map, Recent Applications

**Hybrid Systems:**

Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro- Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

**Evolutionary Design of Neural Networks:**

Genetic Algorithm (GA) based Back propagation Networks, GA based weight determination, Fitness function, Reproduction, Convergence, and Recent Applications.

**Fuzzy Evolutionary Algorithms:**

Introduction, Fuzzy control of Evolution, Evolutionary Algorithms with Fuzzy components, GA in Fuzzy Logic Controller, Recent Applications

**Neural Network Based Fuzzy Systems:**

Neural Realization of Basic Fuzzy Logic Operators, Neural Network Based Fuzzy Logic Inference, Neural Network Driven Fuzzy Reasoning, Rule based Neural Fuzzy Modeling, Neural Fuzzy Relational Systems, Neuro- Fuzzy Controllers, Recent Applications.

Fuzzy Logic Based Neural Network Models: Fuzzy Neurons, Fuzzy Perceptrons, Fuzzy Neural Networks, Fuzzy Backpropagation (BP) Networks, Fuzzy BP architecture, Learning in Fuzzy BP, Inference by Fuzzy BP, Fuzzy ARTMAP, Fuzzy Associative Memories, Recent Applications

## **Reference Books**

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S. Rajasekaran, G. A. Vijayalakshami, PHI.
2. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI
3. Fuzzy Logic and Engineering Application, Tomthy Ross, TMH
4. Elements of Artificial Neural Network, Kishan Mehrotra,
5. Genetic Algorithms: Search and Optimization, E. Goldberg.
6. Recent Articles and Research papers

<b>Course Title</b>	<b>Cryptography &amp; Network Security</b>
<b>Detailed syllabus</b>	
<p><b><u>Introduction:</u></b> Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, Anonymity, Authentication, Authorization, Non-repudiation, Data Security and Database Security</p> <p><b><u>Secret Key Cryptography:</u></b> DES, Triple DES, AES, Key Distribution, Attacks</p> <p><b><u>Public Key Cryptography:</u></b> RSA, ECC, Key Exchange, Attacks</p> <p><b><u>Integrity, Authentication an Non-Repudiation:</u></b> Hash Functions, Message Authentication Code, Digital Signature</p> <p><b><u>Public Key Infrastructure:</u></b> Digital Certificates, Certification Authorities.</p> <p><b><u>Protocols:</u></b> Basic Authentication Protocols, Attacks, Needham Schroeder Protocol, Kerberos, Network Security with IP Security, Web Security using SSL, Ecash and Secure Electronic Transaction</p> <p>System Security using Firewalls and VPNs</p> <p>Worms and Viruses</p> <p>Miscellaneous: Smart Cards and security, Zero knowledge protocols, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. Cryptography and Network Security by William Stallings</li> <li>2. Security in Computing by Pfleeger and Pfleeger, 3rd Edition, PHI,</li> <li>3. Computer Security: Art and Science by Bishop, Pearson Edition</li> <li>4. Computer Security by Gollmall, Willey Publication</li> <li>5. Network Security by Kaufman, Pearson Edition</li> </ol>	

<b>Course Title</b>	<b>Wireless Computer Networks</b>
<b>Detailed syllabus</b>	
<p><b><u>Overview of Wireless Networks and Medium Characteristics :</u></b>  Introduction, Different generations. Introduction to 1G, 2G, 3G and 4G networks  Radio propagation mechanism, Path loss modeling, Effects of Multipath and Doppler.</p> <p><b><u>Physical Layer and Medium Access Alternatives:</u></b>  Short distance base band transmission, Ultra Wide-Band pulse transmission, Carrier modulated transmission, Digital cellular transmission, Broadband and Spread Spectrum transmission, Diversity and Smart receiving techniques. Fixed assignment access for voice oriented networks, Random access for data oriented networks</p> <p><b><u>Wireless Network Planning and Operation:</u></b>  Wireless network topologies, Cell fundamentals and topologies, Signal to Interference ratio calculation, Capacity expansion techniques. Network planning for CDMA systems. Mobility management, Mobile internet protocols, Radio resources and power management, Security in wireless networks</p> <p><b><u>GSM, TDMA, CDMA technology and Mobile Data networks:</u></b>  Mechanism to support mobile environment, Communication infrastructure. Reference architecture for North American Systems, IS-95, IMT -2000. GPRS and higher data rates, Short messaging services in GSM, Mobile application protocols</p> <p><b><u>Wireless Broad band and Ad-hoc networks:</u></b>  IEEE 802.11 WLANs, Ad-Hoc networking, Bluetooth, WPANs, WiMax technology. Wireless Geolocation Systems.</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. Wireless Communications and Networks, 3G and beyond, ITI Saha Misra, TMH.</li> <li>2. Mobile Computing Technology, Application and Service Creation By Asoke K Talukder and Roopa R Yavagal, Tata McGraw Hill</li> <li>3. Mobile and Personal Communication Systems and Services By Raj Pandya ISBN: 81-203-1710-6, PHI</li> <li>4. Principle of wireless Networks by KavehPahlavan and Prashant Krishnamurthy, Pearson 2002.</li> <li>5. Wireless Communication Principles and Practice by Theodore S. Rappaport, PE India.</li> <li>6. Wireless and Mobile Network Architectures: Yi-Bing Lin and ImrichChlamtac, WILEY</li> <li>7. Mobile Computing by Raj Kamal ,Oxford</li> </ol>	



Course Title	Data Mining & Data Warehousing
<b>Detailed syllabus</b>	
<p>Introduction to Data Mining, Importance of Data Mining, Data Mining functionalities, Classification of Data mining systems, Data mining architecture, Major Issues in Data Mining, Applications of Data Mining, Social impacts of data mining.</p> <p>Introduction to Data Warehouse and OLAP Technology for Data Mining, Multidimensional data Model, Data warehouse Data Model, Data warehouse Architecture, Data warehouse Implementation, Development of Data Cube Technology, From Data warehousing to Data Mining.</p> <p>Data Preprocessing, Data cleaning, Data Integration and Transformation, Data reduction, Discretization and Concept Hierarchy Generation.</p> <p>Data Mining primitives, Languages and System Architectures, Concept description: Characterization and Comparison, Analytical Characterization, Mining Class Comparison.</p> <p>Association Rule Mining, Mining of Single dimensional Boolean association rules, Multilevel association rules and Multidimensional association rules, Correlation Analysis, Constraint based association Mining.</p> <p>Classification and Predication: Basic issues regarding classification and predication, Classification by Decision Tree, Bayesian classification, classification by back propagation, Associative classification, Prediction, Classifier accuracy.</p> <p>Cluster Analysis, basic issues, clustering using partitioning methods, Hierarchical methods, Density based methods, Grid based methods and model based methods, Algorithms for outlier analysis.</p> <p>Mining complex Types of data: Multidimensional analysis and descriptive mining of complex data objects, Introduction to spatial mining, multimedia mining, temporal mining, text mining and web mining with related algorithms.</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. Data Mining concepts and Techniques by Jiawei Han, Micheline Kamber– Elsevier.</li> <li>2. Data Mining by Arun K. Pujari – University Press.</li> <li>3. Modern Data Warehousing, Data Mining and Visualization by George M. Marakas –Pearson.</li> <li>4. Data Mining by Vikram Puri And P.Radha Krishana –Oxfrod Press.</li> <li>5. Data Warehousing by ReemaTheraja –Oxford Press</li> </ol>	

<b>Course Title</b>	<b>Digital Image Processing</b>
<b>Detailed syllabus</b>	
<p><b><u>Introduction :</u></b>  Fundamentals, Applications; Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbors of pixel adjacency connectivity, regions and boundaries; Distance measures</p> <p><b><u>Image Enhancement:</u></b>  Frequency and Spatial Domain, Contrast Stretching, Histogram Equalization, Low pass and High pass filtering.</p> <p><b><u>Image Restoration:</u></b>  Noise models, mean, order—statistics, adaptive filters. Band reject, Band pass and notch filters.</p> <p><b><u>Colour Image Processing:</u></b>  Colour models; Pseudo colour, Image processing; colour transformation, segmentation.</p> <p><b><u>Wavelets and Multi-resolution Processing:</u></b>  Image pyramids, subband coding, Harr transform; multi resolution expression, Wavelet transforms.</p> <p><b><u>Image Compression:</u></b>  Fundamentals; models; error free and lossy compression; standards.</p> <p><b><u>Image Compression:</u></b>  Fundamentals; models; error free and lossy compression; standards.</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. Digital Image Processing, Second Edition by Rafel C. Gonzalez and Richard E. Woods, Pearson Education</li> <li>2. Digital Image Processing by BhabatoshChanda and DwijeshMajumder, PHI</li> <li>3. Fundamentals of Digital Image Processing by Anil K Jain, PHI</li> <li>4. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson Education</li> </ol>	

Course Title	Language Processing and Translators
<b>Detailed syllabus</b>	
<p><b><u>UNIT I Introduction to Language Translators</u></b>  Importance of programming languages - brief history and features - attributes of good programming language - Introduction to language translators – Assembler – Compiler – Interpreter – Loader – Linker - Language Processing System – The phases of a Compiler.</p> <p><b><u>UNIT II Lexical Analysis</u></b>  The role of the Lexical Analyzer – Tokens – Patterns – Lexemes – Regular Expressions – Transition Diagram – Finite Automata – Nondeterministic Finite Automata – Deterministic Finite Automata</p> <p><b><u>UNIT III Syntax Analysis</u></b>  The role of the parser – Context Free Grammars – Top Down Parsing – Bottom Up   Parsing – Operator Precedence Parsing – LR Parsers</p> <p><b><u>UNIT IV Intermediate Code Generation</u></b>  Position of intermediate code generator - Intermediate Languages – Graphical   Representations – Three Address Code</p> <p><b><u>UNIT V Code Generation</u></b>  Position of code generator – Issues in the design of a code generator – Input to the Code Generator – Target Programs – Memory Management – Instruction Selection – Register Allocation – The Target Machine</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. Compilers Principles, Techniques and Tools Alfred V. Aho, RaviSethi, Jeffrey D. Ullman</li> <li>2. Compiler Construction: Principles and Practice Kenneth C. Louden</li> <li>3. Art of Compiler Design, The Theory and Practice Thomas Pittman, James Peters, Jim Peters</li> </ol>	

Course Title	Semantic Annotations in Business Process Modeling
<b>Detailed syllabus</b>	
<p>Models in Information System Engineering</p> <p>Modeling Basis Modeling language, Meta model and model semantics  Information System and Semantic Web  Ontology in information system</p> <p>Semantic Interoperability  Semantic heterogeneity  Semantic annotation</p> <p>Business Process Model  Knowledge and process knowledge  Knowledge representation  Knowledge management activities</p> <p>Process Modeling Languages  Petri Nets  EPC – Event-driven Process chain  EEML - Extended Enterprise Modeling Language  UML – Unified Modeling Language  BPMN – Business Process Modeling Notation</p> <p>Semantic Interoperability and Process Ontology  PSL - Process Specification Language  PIF - Process Interchange Format  UEML2 - Unified Enterprise Modeling Language – V2</p> <p>Goal Modeling  GRL – Goal Oriented Requirement Language  GBRAM – Goal Based Requirements Analysis Method</p> <p>Semantic Annotation Methods and Tools  KIM – Knowledge &amp; Information Management  SAWSDL – Semantic Annotations for Web Service Description Language  BPMN – Business Process Modeling Notation</p>	

Course Title	Software Engineering
<b>Detailed syllabus</b>	
<ol style="list-style-type: none"> <li>1. Introduction <ul style="list-style-type: none"> <li>- Introduction : Software and Software Engineering</li> <li>- General Characteristics of Software Process</li> <li>- Phases in Software development</li> <li>- Effort and Error Distribution</li> <li>- Process Models : Waterfall, Prototype, Iterative enhancement, spiral</li> <li>- Software metrics : introduction, product metrics, process metrics</li> </ul> </li>   <li>2. OOAD <ul style="list-style-type: none"> <li>- The Object-Oriented Idea: Data Abstraction, Encapsulation, Polymorphism, and Inheritance - Object-Oriented Analysis - Object-Oriented Design</li> </ul> </li>   <li>3. UML <ul style="list-style-type: none"> <li>Class &amp; Object Diagrams, Use-Case Diagrams – Component &amp; Deployment Diagrams – Sequence and Collaboration Diagrams – State Diagrams – Activity Diagrams</li> </ul> </li>   <li>4. Software Design <ul style="list-style-type: none"> <li>- Introduction : System Design</li> <li>- Design Objectives and Design Principles</li> <li>- Design Concepts - Top down and Bottom up approach, Problem Partition, Abstraction, Modularity, Module Level concept, Coupling, Cohesion</li> <li>- Overview of structured design</li> <li>- Function v/s Object Oriented approach</li> <li>- Design Specification, Verificatic</li> <li>- Introduction: Detailed Design</li> <li>- Module Specification, Desirable properties, functional module specification, Data abstraction specification</li> <li>- Design Verification – Design Walkthrough, Critical Design review, Consistency checkers</li> </ul> </li>   <li>5. Coding and Testing <ul style="list-style-type: none"> <li>- Introduction: Coding, Top Down and Bottom Up approach for coding</li> <li>- Structured programming, Information Hiding</li> <li>- Programming style, Internal documentation</li> <li>- Verification (code reading)</li> <li>- Introduction : Testing, Error, Fault, Failure &amp; Reliability</li> <li>- Testing process, Top down and bottom up approach for testing</li> <li>- Levels of Testing</li> <li>- Functional Testing v/s. Structural testing</li> </ul> </li> </ol>	

### **Reference Books:**

1. System Analysis, Design and Introduction to Software Engineering: By S Parthasarthy
  2. Learning UML: By Sinan Si Alhir, Publisher: O'Reilly
  3. System Analysis and Design: Kendall & Kendall, PHI
  4. An Integrated Approach to Software Engineering : By PankajJalote, Narosa Publishing House, Second Edition,1997
  5. Software Engineering a practitioner's approach : By Roger S. Pressman, Tata McGraw- Hill, 5th Edition
  6. Software Engineering Fundamentals, By Richard Fairley, Tata McGraw Hill
- Software Engineering By Ian Sommerville, Addition- Wesley, 5th Edition, 2000

Course Title	Embedded System
<b>Detailed syllabus</b>	
<ol style="list-style-type: none"> <li>1. Application Domain of Embedded Systems, Desirable Features and General Characteristics of Embedded Systems, Model of an Embedded System, Microprocessor vs Microcontroller, Example of a Simple Embedded System , Figures of Merit for an Embedded System, Classification of MCUs: 4/8/16/32 Bits, History of Embedded Systems, Current Trends</li> <li>2. Embedded Systems—The Hardware Point of View Microcontroller Unit (MCU), A Popular 8-bit MCU, Memory for Embedded Systems, Low Power Design, Pullup and Pulldown Resistors</li> <li>3. Sensors, ADCs and Actuators Sensors, Analog to Digital Converters, Actuators</li> <li>4. Examples of Embedded Systems Mobile Phone, Automotive Electronics, Radio Frequency Identification (RFID), Wireless Sensor Networks (WISENET), Robotics , Biomedical Applications, Brain Machine Interface</li> <li>5. Buses and Protocols Defi ning Buses and Protocols, On-board Buses for Embedded Systems, External Buses Automotive Buses, Wireless Communications Protocols</li> <li>6. Software Development Tools Embedded Program Development, Downloading the Hex File to the Non-volatile Memory, Hardware Simulator</li> <li>7. Real-time Operating Systems Real-time Tasks, Real-time Systems , Types of Real-time Tasks , Real-time Operating Systems, Real -time Scheduling Algorithms, Rate Monotonic Algorithm, The Earliest Deadline First ,Algorithm, Qualities of a Good RTOS</li> <li>8 Programming in Embedded C Brief about Embedded C</li> </ol>	
<p><b><u>Text Book</u></b>  Author: Lyla B Das : Embedded Systems: An Integrated Approach  ISBN:9788131787663</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay Second Edition , Pearson Education</li> <li>2. “Electronic Instrumentation”. By H S Kalsi. Edition-3. Publisher, Tata McGraw- Hill Education, 2010. ISBN, 0070702063, 9780070702066</li> </ol>	

Course Title	Wireless Mobile Ad hoc Networks
<b>Detailed syllabus</b>	
<p><b><u>Introduction</u></b></p>	
<p>Fundamentals of Wireless Networks, Wireless Internet, What is Mobile Ad Hoc Network?, Technical and Research Challenges in MANET</p>	
<p><b><u>MAC Layer Protocols for Ad Hoc Wireless Networks</u></b></p>	
<p>Introduction of MAC Layer Protocols, Important Issues and the Need for Medium Access Control (MAC) Protocols, Classification of MAC Protocols, Multiple-Channel MAC Protocols, Power-Aware or Energy- Efficient MAC Protocols</p>	
<p><b><u>Routing Protocols for Ad Hoc Wireless Networks</u></b></p>	
<p>Introduction of Routing Protocols, Design Issues of Routing Protocols for Ad Hoc Networks, Classification of Routing Protocols, Proactive Routing Protocols, Reactive Routing Protocols, Hybrid Routing Protocols</p>	
<p><b><u>Multicast Routing Protocols for Mobile Ad Hoc Networks</u></b></p>	
<p>Introduction of Multicast Routing Protocol, Issues in Designing a Multicast Routing Protocol Classification of Multicast Routing Protocols, Multicast Ad Hoc On-Demand Distance Vector (MAODV) Routing Protocol, Mesh-Based Routing Protocols, Source Routing-Based Multicast Protocol (SRMP), Multicasting with Quality-of-Service (QoS) Guarantees, Energy-Efficient Multicast Routing Protocols, Application-Dependent Multicast Routing</p>	
<p><b><u>Quality of Service (QoS) in Ad Hoc Networks</u></b></p>	
<p>Introduction to QoS, Issues and Challenges Involved in Providing QoS, Medium Access Control (MAC)-Layer QoS Solutions, Network-Layer QoS Solutions, QoS Model, QoS Frameworks</p>	
<p><b><u>Cross-Layer Design Issues for Ad Hoc Wireless Networks</u></b></p>	
<p>Cross-Layer Design Principle, Proposals Involving Cross-Layer Design, Cross-Layer Design: Is It Worth Applying It?, Cross-Layer Design in Wireless Networks, Performance Objectives, Pitfalls of the Cross-Layer Design Approach</p>	
<p><b><u>Security Issues in Mobile Ad Hoc Networks</u></b></p>	
<p>Various Attacks on MANET, Attacks on Routing Mechanisms, Security Mechanisms in the Network Layer, Security Mechanisms in the Data-Link Layer, Key Management</p>	
<b><u>Reference Books:</u></b>	
<ol style="list-style-type: none"> <li>1. "Mobile Ad Hoc Networking" by Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic [Wiley-IEEE Press]</li> <li>2. "Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications", by Subir Kumar Sarkar, T.G. Basavaraju, C. Puttamadappa [CRC Press]</li> <li>3. "Mobile Ad-Hoc Networking" by by Dr. Humayun Bakht [BookSurge Publishing]</li> <li>4. "Mobile Ad Hoc Networking: The Cutting Edge Directions" by Stefano Basagni , Marco Conti, Silvia Giordano, Ivan Stojmenovic [Wiley-IEEE Press]</li> <li>5. "Mobile Ad Hoc Networks: Current Status and Future Trends" by Jonathan Loo, Jaime Lloret Mauri, Jesús Hamilton Ortiz [CRC Press]</li> </ol>	



**Detailed syllabus****Section - 1****Introduction**

- The AI Problems
- The Underlying Assumption
- AI Techniques
- AI Applications

**Problem, Problem Spaces and Search**

- Defining the problem as a state space search
- Production systems
- Problem Characteristics
- Production system characteristics
- Issues in the design of Search Problems
- Heuristics Search Techniques:
  - o Generate and Test
  - o Hill Climbing
  - o Best First Search
  - o Problem Reduction
  - o Means End Analysis

**Section 2****KnowledgeRepresentation**

- Knowledge Representation Issues
  - o Representation and Mappings
  - o Approaches to knowledge Representation
  - o Issues in knowledge representation
  - o The Frame Problem
- Using Predicate Logic
- Representation Knowledge using rules
  - o Procedural versus Declarative Knowledge
  - o Logic Programming
  - o Forward Versus Backward Reasoning
  - o Matching
  - o Control Knowledge

**Section 3****Game Playing**

- Overview
- The Minimax Search Procedure
- Adding Alpha-beta Cutoffs
- Additional Refinements
- Iterative Deepening
- References on specific games

### **Expert Systems**

- Representing and using Domain knowledge
- Expert system shells
- Explanation
- Knowledge Acquisition

### **Perception and Action**

- Real time search
- Perception
- Action
- Robot Architecture

### **Neural Network & Fuzzy Set Theory**

Introduction: Hopfield Network, Model of Artificial Neuron, Neural Network Architectures, Learning Methods and algorithms in Neural Networks, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI, Introduction to fuzzy theory, fuzzy set: fuzzy membership, fuzzy operation and fuzzy properties, Fuzzy relations.

### **Section 4**

- Case studies of various AI Tools available

### **Reference Books**

1. Artificial Intelligence (2nd Edition). By Elaine Rich & Kevin Knight Tata McGraw-Hill Edition.
2. Introduction to A.I. & Expert System. By Dan W. Patterson, Prentice-Hall India Pvt. Ltd

Course Title	Security in VANET (Vehicular Ad-hoc Network)
<b>Detailed syllabus</b>	
<p><b><u>Introduction:</u></b> Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, Anonymity, Authentication, Authorization, Non-repudiation, Data Security, Security Attacks –Passive and Active Attack</p> <p><b><u>Cryptography:</u></b> Substitution Cipher, Transposition, Symmetric and Asymmetric Encryption Standard, Stream and Block cipher, Confusion and diffusion,</p> <p><b><u>Data Encryption Standard (DES) :</u></b> DES Encryption, DES Decryption, Double and Triple DES. AES (Advanced Encryption Standard): Basic Structure, Comparison between DES and AES.</p> <p><b><u>Classification of Attacks Attacks at Physical layer:</u></b> Interference, jamming, eavesdropping; Data link Layer: Malicious behavior, selfish behavior, active, passive, internal, external ;</p> <p><b><u>Network layer:</u></b> Flooding, Blackhole, Greyhole, wormhole, link spoofing, link withholding, Rushing attack, Byzantine attack, Replay attack, Location disclosure attack, Modification attacks, Fabrication attacks, Impersonation attacks;</p> <p><b><u>Transport Layer:</u></b> Session hijacking, SYN flooding; Application Layer: Malicious code, repudiation</p> <p><b><u>Security:</u></b> Requirement, Challenges, Adversaries, VANET Supporting Properties, Message Authentication and Integrity Using Digital Signatures, Detection of Malicious Data and Secure Position Verification</p> <p><b><u>Security Trust Model in VANETs:</u></b> Framework, Dynamic Factors, Decision Logic</p> <p><b><u>VANET :</u></b> Introduction, Application, Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication, WAVE, Types of Simulators: Mobility Simulator, Network Simulator, VANET Simulator</p>	
<b>Reference Books</b>	
<p>Cryptography and Network Security by William Stallings</p> <p>Security in Computing by Pfleeger and Pfleeger, 3rd Edition, PHI,</p> <p>Security of Self Organizing Networks by Al-Sakib Khan Pathar, CRC Press</p> <p>Vehucular Network from theory to practice by Stephan Olariu,Michele C. Weigle</p>	

Course Title	Big Data
Detailed syllabus	
1	Concept of Big Data. <ul style="list-style-type: none"> <li>1.1 Definitions Of Big Data</li> <li>1.2 Explanations Of Big Data</li> <li>1.3 Why We Need Big Data</li> <li>1.4 Whose generated the Big Data</li> </ul>
2	Difference Between Big Data and Small Data
3	Basic Characteristic and 3V Characteristic of Big Data
	3.1 Basic Characteristics
	3.2 3V Characteristics
	3.2.1 Volume
	3.2.2 Velocity
	3.2.3 Variety
4	Different Types of Big Data.
	4.1 Structured Big Data
	4.2 Un Structured Big Data
	4.3 Semi Structured Big Data
5	When Comes From Big Data?
6	Concept Of Identification, Deidentification, Data Scrubbing, Reidentification
7	Analysis of Big Data
	7.1 Analytic Tasks and Different Algorithms
	7.1.1 Clustering Algorithm
	7.1.2 Classifiers Algorithm
	7.1.3 Recommender Algorithm
	7.1.4 Modeling Algorithm
	7.2 Data Reduction
	7.2.1 Redundancy
	7.2.2 Randomness
	7.3 Normalizing And Adjusting Data
	7.3.1 Adjusting for population differences
	7.3.2 Rendering Data Values Dimensionless
	7.3.3 Converting One Data Type To Another More Useful Data Types
	7.3.4 Converting To a (0, 1) interval.
	7.3.5 Weighting
8	Suggestion or technique for archiving speed and scalability in Big data
9	Special Considerations in Big Data analysis
	9.1 Theory in Search Of Data
	9.2 Data in Search Of Theory
	9.3 Over fitting
	9.4 Bigness Bias
	9.5 Too Much Data
	9.6 Fixing Data
	9.7 Data Subset in Big Data: Neither Additive Nor Transitive
10	Different Additional Big Data Fit falls
11	Different Stepwise Approaches To Big data Analysis
12	Manage Big Data and Different Techniques For Managing Big Data
13	Hadoop and Its Different Parts

- 13.1 Hadoop Distributed File System
- 13.2 Apache Map Reduce Technique
- 14 Hadoop Eco System
  - 14.1 Apache Hive
  - 14.2 Apache HBase
  - 14.3 Apache HDFS
  - 14.4 Apache Map Reduce Frame Works
  - 14.5 Apache Pig
  - 14.6 Apache Sqoop
  - 14.7 Apache Mahout
  - 14.8 Apache Latin
  - 14.9 Apache Flume
- 15 Big Data Challenges and Future Scope?

Reference Book:

Book 1: - Principles of big data Preparing, Sharing and Analyzing Complex Information  
Author: - JULES J. BERMAN  
Book 2: - Hadoop: The Definitive Guide Author: - Tom White

Course Title	Massive Data mining	
Detailed syllabus		
<p><b>Introduction:</b> Introduction to Data Mining, Importance of Data Mining, Data Mining functionalities, Classification of Data mining systems, Data mining architecture, Major Issues in Data Mining, Applications of Data Mining, Social impacts of data mining.</p> <p><b>Pre-processing Techniques and Advances for Massive Data:</b> Data Pre-processing techniques, Data reduction, Discretization and Concept Hierarchy Generation.</p> <p><b>Essentials:</b> Data Mining primitives, Languages and System Architectures, Concept</p> <p><b>Description:</b> Characterization and Comparison, Analytical Characterization, Mining Class Comparison.</p> <p><b>Classification and Prediction for Massive data and related Issues:</b>  <b>Clustering techniques for Massive data:</b>  <b>Data Mining with Big Data:</b></p>		
Reference Books		
<ol style="list-style-type: none"> <li>1. Data Mining concepts and Techniques by Jiawei Han, MichelineKamber–Elsevier (Unit1 &amp;2 are chapter 1-2 from book).</li> <li>2. Papers published in renowned journals on Massive Data, Data Streams. Paper Title and Authors</li> </ol>		
<b>A survey of stream data mining</b>	Elena Ikonovska, Suzana Loskovska, Dejan Gjorgjevik.	
<b>Efficient Data Stream Classification via Probabilistic Adaptive Windows</b>	AlbertBifet, Jesse Read,Bernhard Pfahringer,Geoff Holmes	
<b>A Comparative study of Stream Data mining Algorithms</b>	Tusharkumar Trambadiya, Praveen Bhanodia	
<b>Advances in data stream mining</b>	Mohamed Medhat Gaber	
<b>Clustering Time Series Data Stream – A Literature Survey</b>	V.Kavitha ,M.Punithavalli	
<b>A Novel Approach for Clustering Categorical Data Streams</b>	J. Chandrika and K. R. Ananda Kumar	
<b>Requirements for Clustering Data Streams</b>	Daniel Barbard	
<b>Data Stream Clustering: Challenges and Issues</b>	Madjid Khalilian, Norwati Mustapha	
<b>Data Mining with Big Data</b>	Xindong Wu, Fellow, IEEE, Xingquan Zhu, Senior Member, IEEE, Gong-Qing Wu, and Wei Ding, Senior Member, IEEE	
<b>Challenges and Opportunities with Big Data</b>	A community white paper developed by leading researchers across the United States	

## Detailed syllabus

**1. Boolean retrieval**

- An example information retrieval problem
- A first take at building an inverted index
- Processing Boolean queries
- The extended Boolean model versus ranked retrieval

**2. The term vocabulary and postings lists**

- Document delineation and character sequence decoding
  - Obtaining the character sequence in a document
  - Choosing a document unit
- Determining the vocabulary of terms
  - Tokenization
  - Dropping common terms: stop words
  - Normalization (equivalence classing of terms)
  - Stemming and lemmatization
  - Faster postings list intersection via skip pointers
- Positional postings and phrase queries
  - Biword indexes
  - Positional indexes
  - Combination schemes

**3 Dictionaries and tolerant retrieval**

- Search structures for dictionaries
- Wildcard queries
- General wildcard queries
  - Spelling correction
- Implementing spelling correction
- Forms of spelling correction
- Edit distance
- k-gram indexes for spelling correction
- Context sensitive spelling correction
  - Phonetic correction

**4 Index construction**

- Hardware basics
- Blocked sort-based indexing
- Single-pass in-memory indexing
- Distributed indexing
- Dynamic indexing
- Other types of indexes

**5. Index compression**

- Statistical properties of terms in information retrieval
- Heaps' law: Estimating the number of terms
- Zipf's law: Modeling the distribution of terms
- Dictionary compression
- Dictionary as a string
- Blocked storage
- Postings file compression

- Variable byte codes
- $\gamma$  codes

## **6 Scoring, term weighting and the vector space model**

- Parametric and zone indexes
  - Weighted zone scoring
    - Learning weights
    - The optimal weight  $g$
  - Term frequency and weighting
    - Inverse document frequency
    - Tf-idf weighting
  - The vector space model for scoring
    - Dot products
    - Queries as vectors
    - Computing vector scores
  - Variant tf-idf functions
    - Sublineartf scaling
    - Maximum tf normalization
    - Document and query weighting schemes
    - Pivoted normalized document length

## **7 Computing scores in a complete search system**

- Efficient scoring and ranking
  - Inexact top K document retrieval
  - Index elimination
  - Champion lists
  - Static quality scores and ordering
  - Impact ordering
  - Cluster pruning
- Components of an information retrieval system
  - Tiered indexes
  - Query-term proximity
  - Designing parsing and scoring functions
  - Putting it all together
- Vector space scoring and query operator interaction

## **8 Evaluation in information retrieval**

- Information retrieval system evaluation
- Standard test collections
- Evaluation of unranked retrieval sets
- Evaluation of ranked retrieval results
- Assessing relevance
  - Critiques and justifications of the concept of relevance
- A broader perspective: System quality and user utility
  - System issues
  - User utility
  - Refining a deployed system



- Results snippet

## **9 Relevance feedback and query expansion**

- 9.1 Relevance feedback and pseudo relevance feedback
  - The Rocchio algorithm for relevance feedback
  - Probabilistic relevance feedback
  - When does relevance feedback work?
  - Relevance feedback on the web
  - Evaluation of relevance feedback strategies
  - Pseudo relevance feedback
  - Indirect relevance feedback
  - Summary
- Global methods for query reformulation
  - Vocabulary tools for query reformulation
  - Query expansion
  - Automatic thesaurus generation

### Reference Book:

- “An Introduction to Information Retrieval”, Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, Cambridge University Press
- “**MODERN INFORMATION RETRIEVAL**”, Ricardo Baeza-Yates, [BerthierRibiero-Neto](#), Pearson Education Singapore Pte Ltd
- “**Information Retrieval Architecture and Igorithms**”, Gerald Kowalski, Springer