UNIVERSITY OF KERALA

SCHEME & SYLLABUS
for
M-Tech Degree Programme
in
Computer Science & Engineering
(2013 Scheme)
## University of Kerala

**Scheme of Studies for Master of Technology**

**Stream :  Computer Science & Engineering**

### Semester 1

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs/week</th>
<th>End Sem Exam (Hours)</th>
<th>Marks</th>
<th>Remarks</th>
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<tr>
<td>RCC 1001</td>
<td>Mathematical Foundations of Computer Science</td>
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<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>End-of-Semester Exam by University</td>
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<td>RIC 1001</td>
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*Note:* Out of 40 marks of Internal Continuous Assessment, 25 marks is for tests and 15 marks is for assignments.
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<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs/week</th>
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*Note:* Out of 40 marks of Internal Continuous Assessment, 25 marks is for tests and 15 marks is for assignments.
Electives for Semester 2:

Department Electives

RCD 2001  Data Warehousing & Mining  
RCD 2002  Software Quality Assurance and Testing  
RCD 2003  Simulation & Modeling  
RCD 2004  Data Compression  
RID 2001  Cyber Laws & Ethics  
RID 2002  Advanced Topics in Distributed Systems  
RID 2003  Cloud Computing  

Stream Elective 1  Stream Elective 2

RCE 2001  Parallel Algorithms  
RCE 2001  Parallel Algorithms  
RCE 2002  Information Retrieval  
RCE 2002  Information Retrieval  
RCE 2003  Network Security  
RCE 2003  Network Security  
RCE 2004  Semantic Web Technology  
RCE 2004  Semantic Web Technology  
RCE 2005  Advanced Compiler Design  
RCE 2005  Advanced Compiler Design  
RCE 2006  Computational Geometry  
RCE 2006  Computational Geometry  
RCE 2007  Advanced Graph Theory  
RCE 2007  Advanced Graph Theory  
RCE 2008  Soft Computing  
RCE 2008  Soft Computing  
RCE 2009  Image Processing  
RCE 2009  Image Processing  

* Students can Elective 1, Elective 2 and Elective 3 from the lists of Departmental Electives, Stream Electives 1 and Stream Electives 2, respectively.
### Semester 3

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs / week</th>
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**TOTAL** | 14       | 23        | 09        | 320                | 180                           | 500               |       |                                                  |

*Note:* Out of 40 marks of Internal Continuous Assessment, 25 marks is for tests and 15 marks is for assignments.

**Electives for Semester 3:**

**Stream Elective 3**  
- RCE 3001 Complexity Theory  
- RCE 3002 Distributed Algorithms  
- RCE 3003 Machine Learning  
- RCE 3004 Ad-hoc and Sensor Networks

**Stream Elective 4**  
- RCE 3005 Modern Computing Paradigms  
- RCE 3006 Fuzzy Set Theory & Applications  
- RCE 3007 Decision Support Systems  
- RCE 3008 Natural Language Processing  
- RCE 3009 Advanced Computer Graphics

**Inter-disciplinary Electives:**

- RCI 2001 Object Oriented Modeling and Designing
- RCI 2002 Software Project Management
- RCI 2003 Basic Data Structures and Algorithms
- RII 2001 .NET Programming
- RII 2002 Java Programming

*Students can Elective 3 and Elective 4 from the lists of Stream Electives 3 and Stream Electives 4, respectively as advised by the course coordinator.*
**Non-departmental electives** should be selected from the list of inter-disciplinary electives **offered by other departments**, as advised by the course coordinator.
### Semester 4

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<th>Code No.</th>
<th>Name of Subject</th>
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Note: 6 to 8 hours per week is for department assistance
RCC 1001
MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand the fundamental concepts in
  - theorem proving
  - Recurrence relations
  - Counting and probability
  - Probability distributions
  - Special graphs and circuits
  - Important structures

Learning Outcomes
- Conceptual understanding of the above topics and ability to apply them in practical situations.

MODULE 1
Techniques for theorem proving: Direct Proof, Proof by Contra position, Proof by exhausting cases and proof by contradiction, Linear-time temporal logic and Branching-time logic-Syntax, Semantics, Practical patterns of specifications, Important equivalences, Adequate sets of connectives. Principle of mathematical induction, principle of complete induction. Recursive definitions, Generating functions, function of sequences calculating coefficient of generating function, solving recurrence relation by substitution and generating functions. Solution methods for linear, first-order recurrence relations with constant coefficient, characteristic roots

MODULE 2

MODULE 3
Graphs, Terminology, Euler tours, planar graphs, Hamiltonian graphs, Euler’s formula (proof), four colour problem (without proof) and the chromatic number of a graph, five colour theorem, chromatic polynomials, Warshall’s algorithm, Decision Trees, weighted trees. Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange’s theorem, rings, finite fields, polynomial arithmetic, quadratic residues, reciprocity, discrete logarithms, elliptic curve arithmetic.
References

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 80% analytical/design problems. There will be three questions (with sub-divisions) from each module out of which two questions are to be answered.
RIC 1001
FOUNDATIONS OF INFORMATION SECURITY

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand the founding principles of Information security

Learning Outcomes
- Conceptual understanding of the principles of information security, its significance and the domain specific security issues.

MODULE 1

MODULE 2

MODULE 3
Law and ethics: Intellectual property rights, computer software copyrights, security policy, ethical hacking, security tools.

References:
Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical problems. There will be three questions (with sub-divisions) from each module out of which two questions are to be answered.
RCC 1002
TOPICS IN DATABASE TECHNOLOGY

Lecture :  3 hrs/ Week   Credits :  3
Internal Continuous Assessment :  40 Marks
End Semester Examination :  60 Marks

Course Objectives
• To understand the implementation and management aspects of databases.
• To understand the principles of distributed databases.
• To understand object based data models and their implementation.
• To understand the recent advances in database technology.

Learning Outcomes
• Conceptual understanding of various implementation issues in databases.
• Conceptual understanding of distributed databases.
• Conceptual understanding and ability to work with object based database systems.
• Conceptual understanding of recent technological trends in databases.

MODULE 1

MODULE 2

MODULE 3
References

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) (with sub-divisions) out of which two questions are to be answered.
RCC 1003
ADVANCED DATA STRUCTURES AND ALGORITHMS

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand about advanced data structures.
- To understand how to analyze and establish correctness of algorithms
- To understand theory behind various classes of algorithms.

Learning Outcomes
- The student should have deep conceptual understanding of advanced data structures and their applications
- He should know the theory behind various classes of algorithms.
- He should be able to design, prove the correctness and analyse new algorithms

MODULE 1
Network flow algorithms: properties, Ford-Fulkerson method, maxflow-mincut theorem, Edmonds-Karp heuristics, push-relabel, relabel-to-front algorithms, Dinic’s algorithm, MPM algorithm, maximum bipartite matching - analysis of associated algorithms, applications.

MODULE 2
Probabilistic algorithms: basics of probability theory, pseudorandom generators, Numerical algorithms, integration, counting, Monte-Carlo algorithms - verifying matrix multiplication, min-cut in a network. Las Vegas algorithms – eight-queens problem, selection, quicksort, universal hashing, Dixon’s factorization

MODULE 3
Number-Theoretic algorithms: GCD algorithm, modular arithmetic, primality testing, Miller-Rabin test, Integer factorization - Pollard Rho heuristic.
Overview of Complexity classes – P, NP, Co-NP, NP-hard, NP complete. Space complexity.
Complexity classes in randomized algorithms – RP, PP, ZPP, BPP.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 70% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCC 1004
ADVANCED SOFTWARE ENGINEERING

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To gain a deep understanding of the issues and approaches in modelling, analysing and testing software systems.

Learning Outcomes

• Conceptual understanding of the principles of software modelling and testing.
• Ability to apply the principles in real-cases.

MODULE 1


MODULE 2


MODULE 3


References:


Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with subdivisions) out of which two questions are to be answered by the students.
RCC 1005
ADVANCED COMPUTER ARCHITECTURE

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand issues and techniques in improving performance of processors
- To understand the concepts of pipelining.
- Familiarize with the properties of superscalar processors.
- To understand the multiprocessor systems and cache coherence.

Learning Outcomes
- In-depth knowledge in
  - Measuring performance of processors
  - Instruction level parallelism
  - Vector Architecture
  - Multiprocessor systems and cache coherence.
  - Interconnection networks

MODULE 1
Classes of parallelism and parallel architecture, computer architecture- design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism - concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP.

MODULE 2
Dynamic Scheduling- Tomasulo's approach, Hardware based speculation, ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation, case study- Intel Core i7. Data level parallelism- Vector architecture- Vector instruction types, Vector-Access memory schemes, Graphic processing units

MODULE 3
Multiprocessor system interconnects- hierarchical bus system, Cross bar switch and multiport memory, multistage networks, Centralized shared memory architecture, Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations, Distributed shared memory and Directory based coherence.

References

**Structure of the Question paper**
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCC 1101
SEMINAR

Lecture : 0 hrs/ Week    Credits : 2
Internal Continuous Assessment : 100 Marks
End Semester Examination : 0 Marks

Each student is required to select a topic on advanced technologies in Computer Science and allied subject domains and get it approved by the faculty-in-charge of seminar. He/she should give a presentation with good quality slides. An abstract of the seminar should be submitted to the faculty members well in advance before the date of seminar. He/she should also prepare a well documented report on the seminar in approved format and submit to the department. The seminar presentation and report will be evaluated for the award of sessional marks.
RCC 1102
ALGORITHM DESIGN LABORATORY

Practical : 2hrs/ Week Credits : 1
Internal Continuous Assessment : 100 Marks
End Semester Examination : 0 Marks

The experiments are based on, but need not be limited to, the topics covered in subject RCC 1003: Advanced Data structures and Algorithms and explore the use of the said algorithms and data structures in various application domains.
RCC 2001
OPERATING SYSTEM DESIGN

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To understand the configuration and functions of a typical OS Kernel

Learning Outcomes
• In-depth knowledge in Design and implementation of Kernel modules.

MODULE 1

MODULE 2

MODULE 3
Memory Management - Pages and Zones, Slab Layer, Static Allocation on the Stack, High Memory Mappings, Per-CPU Allocations. The Virtual Filesystem - Filesystem Abstraction Layer, Unix Filesystems, VFS Objects and Data Structures, Superblock Object, Inode Object, Dentry Object, File Object. The Block I/O Layer - Buffers and Buffer Heads, Request Queues, I/O Schedulers. Process Address Space - Address Spaces, Memory Descriptor, Virtual Memory Areas, Page Tables. Devices and Modules - Device Types, Modules, Device Model.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical questions. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCC 2002
ADVANCED COMPUTER NETWORKS

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To impart a deeper understanding of
  o networking design including media, protocols, quality control and congestion management
  o multimedia networking issues and approaches.

Learning Outcomes

- The student becomes aware of the theoretical and practical issues in networking.

MODULE 1

MODULE 2
Addressing in TCP/IP Networks : Address Types, IP Address Format (IPV4 and IPV6), Address Assignment, ARP, DNS, DHCP - Internet Protocol - Packet Format, Routing, IPv6

MODULE 3

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCC 2000  
RESEARCH METHODOLOGY

Lecture : 2hrs/ Week  Credits : 2  
Internal Continuous Assessment : 40 Marks  
End Semester Examination : 60 Marks

Course Objective:
- To formulate a viable research question  
- To distinguish probabilistic from deterministic explanations  
- To analyze the benefits and drawbacks of different methodologies  
- To understand how to prepare and execute a feasible research project

Learning Outcome:
- Students are exposed to the research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing research papers/thesis/dissertation.

MODULE 1  
Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods vs. Methodology. Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical.  
Research Formulation - Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents. Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis.

MODULE 2  

MODULE 3  
Reporting and thesis writing - Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation, Layout, structure and Language of typical reports, Illustrations and tables, Bibliography, referencing and footnotes. Presentation; Oral presentation - Planning - Preparation - Practice - Making presentation - Use of audio-visual aids - Importance of effective communication.  
Application of results of research outcome: Environmental impacts - Professional ethics - Ethical issues - ethical committees. Commercialization of the work - Copy right - royalty - Intellectual property
rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCC 2101
SEMINAR

Lecture : 0 hrs/ Week Credits : 2
Internal Continuous Assessment : 100 Marks
End Semester Examination : 0 Marks

Each student is required to select a topic on advanced technologies in Computer Science and allied subject domains, preferably one which also relevant as his/her thesis topic, and get it approved by the faculty-in-charge of seminar. He/she should give a presentation with good quality slides. An abstract of the seminar should be submitted to the faculty members well in advance before the date of seminar. He/she should also prepare a well documented report on the seminar in an approved format and submit to the department. The seminar presentation and report will be evaluated for the award of sessional marks.
The main objective of the thesis is to provide an opportunity to each student to do an independent study and research in the area of specialization under the guidance of a faculty member. The student is required to explore in depth and a topic of his/her own choice, which adds significantly to the body of knowledge existing in the relevant field. The student has to undertake and complete the preliminary work on the stream of specialization during the semester. The thesis work starts in the second semester and has three parts: Preliminary – Part 1 (in Semester 2), Preliminary – Part 2 (in semester 3) and Final (in semester 4).

In Preliminary – Part 1, the student is expected to identify a domain, do enough exploration by reviewing the literature. The student should also identify his problem and objectives. The progress will be assessed by two seminars. The student is also expected to submit an interim report at the end of the semester.
RCC 2103  
NETWORK & OPERATING SYSTEM LABORATORY

Practical : 2hrs/ Week  
Credits : 1  
Internal Continuous Assessment : 100 Marks

The experiments are based on the topics covered in subjects RCC2001: Operating System Design & RCC2002: Advanced Computer Networks and explore the use of the learned principles in various application domains.
RCC 3101
THESIS PRELIMINARY – PART 2

Hours/week : 15  
Credits : 5
Internal Continuous Assessment : 200 Marks

In Preliminary – Part 2, the student is expected further explore his problem, identify solutions, do initial experimentation and result evaluation. The student should also prepare a literature survey report and submit it for review to a suitable conference/journal as advised by the thesis supervisor. The progress will be assessed by the review committee through two seminars and an end-of-semester report.
RCC 4101
THESIS FINAL

Hours/week : 21       Credits : 12
Internal Continuous Assessment : 300 Marks
External Assessment : 300 Marks

By the first quarter of the semester, the student should compile his/her work by doing the final experimentation and result analysis. Towards the middle of the semester there would be a pre-submission seminar to assess the quality and quantum of work by the department evaluation committee. This would be the pre-qualifying exercise for the students for getting approval for the submission of final thesis. The decision of the departmental committee in this regard is final and binding. The committee can make recommendations to improve the quality or quantity of the work done. The student is expected to publish technical papers related to his/her research in peer reviewed journals/conferences. The final evaluation of the thesis would be done by an external examiner. The external examiner’s comments regarding the quality and quantity of work is an important decisive factor in the final acceptance/rejection of the thesis.
Electives
Departmental Elective

RCD 2001
DATA WAREHOUSING & MINING

Lecture : 3 hrs/ Week   Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To understand the fundamental and advanced concepts Data Warehousing and Data Mining

Learning Outcomes
• Conceptual understanding of
  • Data cleaning, analysis and visualization
  • Data mining techniques.
  • Web mining and Spatial mining

MODULE 1
Data warehousing – Multidimensional data model, OLAP operation, Warehouse schema, Data Warehousing architecture, warehouse server, Metadata, OLAP engine, Data warehouse Backend Process, Data Warehousing to Data Mining. Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective, Knowledge Discovery in Database Vs Data mining. Data Preprocessing: Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization, Concept Hierarchy Generation, Introduction to DMQL.

MODULE 2

MODULE 3

References:
Structure of the Question paper

For the End Semester Examination the question paper will consist of at least 60% analytical/query/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Departmental Elective

RCD 2002
SOFTWARE QUALITY ASSURANCE AND TESTING

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• Understand the theoretical aspects of software testing
• Demonstrate the knowledge of the existing testing methods
• Demonstrate the knowledge of static and dynamic analysis methods
• Demonstrate the knowledge of applying testing and analysis methods in software development and maintenance

Learning Outcomes
• Students get in-depth skill to quantitatively assess the quality of software; they also understand the fundamental principles and tools for software-testing and quality assurance.

MODULE 1
Software Quality Assurance Framework and Standards
SQA Framework: Software Quality Assurance, Components of Software Quality Assurance
Software Quality Metrics: Product Quality metrics, In-process Quality Metrics, Metrics for Software Maintenance, Examples of Metric Programs
Software Quality metrics methodology: establishing quality requirements, Identifying Software quality metrics, Implement the software quality metrics, analyze software metrics results, validate the software quality metrics – Software quality indicators, Fundamentals in Measurement theory.

MODULE 2
Software Testing Strategy and Environment
Establishing testing policy, structured approach to testing, test factors, Economics of System Development Life Cycle (SDLC) Testing Software Testing Methodology
Defects hard to find, verification and validation, functional and structural testing, workbench concept, eight considerations in developing testing methodologies, testing tactics checklist, Software Testing Techniques
Black Box, Boundary value, Bottom up, Branch coverage, Cause Effect graphing, CRUD, Database, Exception, Gray Box, Histograms, Inspections, JADs, Pareto Analysis, Prototyping, Random Testing, Risk based Testing, Regression Testing, Structured Walkthroughs, Thread Testing, Performance Testing, White Box Testing

MODULE 3
Software Testing Tools
Testing Specialized Systems and Applications Testing Client/Server Web applications, Testing off the Shelf Components, Testing Security, Testing a Data Warehouse

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Departmental Elective

RCD 2003
SIMULATION & MODELING

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To understand the methodology for modeling and simulation of continuous, discrete time as well as discrete-event systems.
• To have basic knowledge on simulation software and use it in solving of engineering problems, analysis and validation of the results

Learning Outcomes
• The student attains theoretical and practical skills in modelling and simulation of various genre of systems.

MODULE 1

MODULE 2

MODULE 3

of Stop and wait and sliding window protocols. Simulation of CSMA/CD LAN. Simulation of Wireless LAN.

References:
4. Lecture notes of Professor Raj Jain, Washington University in Saint Louis.

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Departmental Elective

RCD 2004
DATA COMPRESSION

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- Develop theoretical foundations of data compression, concepts and algorithms for lossy and lossless data compression, signal modelling and its extension to compression with applications to speech, image and video processing.

Learning Outcomes
- Awareness about various data compression techniques and their practical significance.

MODULE 1

MODULE 2

MODULE 3

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Departmental Elective

RID 2001
CYBER LAWS & ETHICS

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart sufficient knowledge on the fundamental principles of IPR, various types of cyber crimes and Indian and international cyber laws.

Learning Outcomes
• The student gains insight into ethical issues, cyber crimes and cyber laws.

MODULE 1
Intellectual property rights, computer software copyrights, copyright in databases and electronic publishing, law of confidence, patent laws, trademarks, product designs, international law. Computer contracts, liability for defective hardware and software, software contracts, web and hardware contracts, electronic contracts and torts, liabilities.

MODULE 2
Computer crime, computer fraud, hacking, unauthorized modification of information, piracy, computer pornography and harassment.

MODULE 3
Cyber laws in India, IT Act 2000, Offences under IT act. Protection pf IPR in Cyber space in India. International cyber laws and crimes, COE convention of cyber crimes. data subjects’ rights, ethical issues in computer security, case studies.

References

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Departmental Elective

RID 2002
ADVANCED TOPICS IN DISTRIBUTED SYSTEMS

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart deeper understanding in
  o Architecture and issues of distributed systems
  o Distributed algorithms
  o Hadoop system

Learning Outcomes
• The student gains insight into conceptual and practical aspects of distributed systems.

MODULE 1

MODULE 2

MODULE 3

References:

**Structure of the Question paper**

For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Departmental Elective

RID 2003
CLOUD COMPUTING

Lecture : 3 hrs/ Week   Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- Understanding cloud computing, and compare with existing technologies.
- Understand how to develop a cloud service

Learning Outcomes
- Design and develop cloud services for everyone.
- Use Cloud Service and collaborate it with various application and taking it online.

MODULE 1
Computing – Companies in the Cloud Today – Cloud Services Web-Based Application – Pros and
Cons of Cloud Service Development – Types of Cloud Service Development – Software as a
Service – Platform as a Service – Web Services – On-Demand Computing – Discovering Cloud

MODULE 2
Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists
– Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group
Projects and Events – Cloud Computing for the Corporation.

MODULE 3
Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling
Applications – Exploring Online Planning and Task Management – Collaborating on Event
Management – Collaborating on Contact Management – Collaborating on Project Management –
Collaborating on Word Processing – Collaborating on Databases – Storing and Sharing Files.
Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Evaluating
Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via
Blogs and Wikis.

References
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing.: From
   Parallel Processing to the Internet of Things, 1/e, Morgan Kaufmann, 2011

**Structure of the Question paper**

For the End Semester Examination the question paper will consist of three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 1

RCE 2001
PARALLEL ALGORITHMS

Lecture :  3 hrs/ Week   Credits :  3
Internal Continuous Assessment :  40 Marks
End Semester Examination :  60 Marks

Course Objectives
• Understand the principles and applications of parallel algorithms

Learning Outcomes
• Students gain in-depth theoretical and practical knowledge on parallel algorithms.

MODULE 1

MODULE 2

MODULE 3
Numerical problems – finding roots of nonlinear equations – SIMD and MIMD algorithms, solving partial differential equations, computing eigen values. Graph theoretical problems – solving graph theoretical problems, computing connectivity matrix, finding connected components, all pairs shortest path, traversing combinatorial spaces, sequential tree traversals, Minimal Alpha-Beta tree, MIMD Alpha-Beta algorithms, parallel cutoff storage requirements, recent trends and developments.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 1

RCE 2002
INFORMATION RETRIEVAL

Lecture : 3 hrs/ Week  
Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To understand the principles and techniques of information retrieval

Learning Outcomes
• Students gain in-depth theoretical and practical knowledge of information retrieval techniques and ability to apply them in practical scenarios.

MODULE 1
Introduction: Goals and history of IR. The impact of the web on IR. The role of artificial intelligence (AI) in IR. Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity. Basic Tokenizing Indexing, and Implementation of Vector-Space Retrieval: Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors; python implementation.

MODULE 2
Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure; Evaluations on benchmark text collections. Query Operations and Languages: Relevance feedback; Query expansion; Query languages. Text Representation: Word statistics; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Metadata and markup languages (SGML, HTML, XML). Web Search, Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.

MODULE 3
Text Categorization and Clustering: Categorization algorithms: naive Bayes; decision trees; and nearest neighbor. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to information filtering; organization; and relevance feedback. Recommender Systems: Collaborative filtering and content-based recommendation of documents and products. Information Extraction and Integration: Extracting data from text; XML; semantic web; collecting and integrating specialized information on the web.

References:
Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 1

RCE 2003
NETWORK SECURITY

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart understanding of various hardware and software aspects of security in networks.

Learning Outcomes
• The student gains knowledge in problems and approaches related to secure network management.

MODULE 1

MODULE 2

MODULE 3

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 1

RCE 2004

SEMANTIC WEB TECHNOLOGY

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand the principles, practices and applications of Semantic Web Technology.

Learning Outcomes
- Conceptual and practical understanding of
  - Semantic Web
  - Ontology and its applications
  - Ontology tools

MODULE 1

MODULE 2

MODULE 3

References:
2. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez “Ontological Engineering: with examples from the areas of Knowledge Management, e- Commerce and
the Semantic Web”, Springer, 2004
Driven Knowledge Management”, John Wiley & Sons Ltd., 2003.
Modeling in RDFS and OWL”, Morgan Kaufmann, 2008
7. Steffen Staab, Rudi Studer, “Handbook on Ontologies (International Handbooks on
Information Systems)”, 1/e, Springer, 2004

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical/design
problems/queries. There will be three questions from each module (with sub-divisions) out of which two
questions are to be answered by the students.
Stream Elective 1

RCE 2005
ADVANCED COMPILER DESIGN

Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objectives
- To understand various compiler optimization techniques.
- To understand back end design of compilers.

Learning Outcomes
- Conceptual understanding of theory behind compiler design.
- Ability to build a complete compiler.

MODULE 1
Introduction to Advanced Topics Review of compiler phases, Informal Compiler Algorithm Notation, Symbol Table Structure – local and global symbol tables, Intermediate Representations – HIR, MIR and LIR. Run Time Issues.
Control Flow Analysis – basic blocks, DFS, dominators and postdominators, loops, dominator tree, dominance frontier.

MODULE 2

MODULE 3

References:
Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 2

RCE 2006
COMPUTATIONAL GEOMETRY

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To fill the gap between geometric properties and algorithm design
• To familiarize data structures used for developing efficient algorithms
• To learn efficient techniques for solving geometric problems

Learning Outcomes
• Capable to develop efficient algorithms by exploiting geometric properties
• Capable in identifying properties of objects, expressing them as lemmas and theorems and proving their correctness.
• Capable in applying learned algorithm in diversified fields like data base searching, data mining, graphics, image processing pattern recognition,
• computer vision motion planning and robotics

MODULE 1
Geometric Preliminaries, Data Structures for geometric problems: DCEL (Doubly Connected Edge List), Quad trees, Kd-trees and BSP (Binary Space Partition) trees. Geometric Searching - Planar Straight Line Graph (PSLG), Point Location Problem, Location of a point in a planar subdivision, Plane Sweep Technique-applications- line segment intersection using plane sweep, Slab method, Regularization of PSLG, Monotone polygons, Range Searching using Kd-trees.

MODULE 2

MODULE 3
Introduction to Visibility Problems-- Definition of direct visibility, Point visibility and Edge visibility, Algorithm for computing point-visible region inside a polygon, Kernel of a simple polygon, Linear time algorithm for computing Kernel. Visibility graph, Shortest path for a point Robot

References:
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars “ Computational Geometry, Algorithms & Applications” Springer

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical /design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Course Objectives

- To impart deeper understanding in advanced concepts in graph theory and their practical applications.

Learning Outcomes

- Students become aware of the advanced concepts of graph theory and gain ability to apply those concepts in practical scenarios.

MODULE 1

Graphs, Connectivity and Hamiltonicity: Graphs: Graphs as models- Paths and connectedness-Cutnodes and Blocks- Graph classes and graph operations. Connectivity: Connectivity and edge connectivity - Menger's theorem - Properties of n-connected graphs- Circulants, Hamiltonicity: Necessary or sufficient conditions- Connectivity and Hamiltonicity- Graph operations and Hamiltonicity - Generations of Hamiltonicity. Centers: The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths- Other Generalized Centers

MODULE 2


MODULE 3


References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% problems/proofs. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 2

RCE 2008
SOFT COMPUTING

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To familiarize the salient approaches in soft computing, based on artificial neural networks, fuzzy logic, and genetic algorithms.
• To introduce applications of soft computing to different research areas in Computer Science / Information Technology.

Learning Outcomes

• Understand advantages and disadvantages of soft computing.
• Students will be able to apply soft computing techniques to research problems

MODULE 1
Artificial Neural Network Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer, multilayer, competitive layer; Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent N.N; Application of N.N; Neuron.

MODULE 1
Fuzzy Sets & Logic: Fuzzy versus Crisp; Fuzzy sets – membership function, linguistic variable, basic operators, properties; Fuzzy relations – Cartesian product, Operations on relations; Crisp logic – Laws of propositional logic, Inference; Predicate logic – Interpretations, Inference; Fuzzy logic – Quantifiers, Inference; Fuzzy Rule based system; Defuzzification methods; FAM

MODULE 3
Genetic Algorithm Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over (different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Genetic Programming; Schema theorem; Multi-objective & Multimodal optimization in GA; Applications: Travelling Salesman Problem, Graph Coloring problem.
Hybrid Systems: GA based BPNN (Weight determination, Application); Neuro Fuzzy Systems – Fuzzy BPNN – fuzzy Neuron, architecture, learning, application; Fuzzy Logic controlled G.A.
References:

5. Goldberg David, “Genetic Algorithms”, Pearson Education

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with subdivisions) out of which two questions are to be answered by the students.
Stream Elective 2

RCE 2009
IMAGE PROCESSING

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart understanding of the issues and methodologies in digital image processing

Learning Outcomes
• Student gets deeper understanding of principles and techniques and algorithms for digital image processing

MODULE 1
Introduction digital image representation: fundamental steps in image processing, elements of digital image processing systems, digital image fundamentals, simple image model, sampling and quantization, relationship between pixels – image geometry

MODULE 2
Image transforms : Introduction to Fourier transform – discrete Fourier transform, properties of 2d-fourier transform (DFT), other separable image transforms, Hotelling transform, Image enhancement, point processing, spatial filtering, filtering in frequency domain Image restoration: degradation model, diagonalization of circulant and block circulant matrices, inverse filtering, least mean square filter.

MODULE 3

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 3

RCE 3001
COMPLEXITY THEORY

Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objectives
• To understand fundamental complexity classes, randomized computation and parallel computation.

Learning Outcomes
• Thorough understanding of various complexity classes and computation strategies.

MODULE 1
Review of time and space related complexity classes, hierarchy theorem, reachability method. Space complexity - PSPACE, PSPACE completeness, class L and NL, Co-NL, NL completeness, alternation. NP complete problems - problems in NP, variants of satisfiability, graph theoretic problems, sets and numbers.

MODULE 2

MODULE 3
Approximation and complexity, non-approximability. Parallel computation - algorithms, class NC, P-completeness, RNC algorithms. Polynomial hierarchy - class DP, PNP, FPNP. Computation that counts - class #P, #P-complete, #P, exponential time.

References:
Structure of the Question paper
For the End Semester Examination the question paper will consist of 50% analytical problems and 50% Theory. There will be three questions from each module (with subdivisions) out of which two questions are to be answered by the students.
Stream Elective 3

RCE 3002
DISTRIBUTED ALGORITHMS

Lecture : 3 hrs/Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- Provide an introduction to the most important basic results in the area of distributed Algorithms.
- Should be able to use basic distributed algorithms and impossibility results
- Ability to apply distributed algorithms in large computer networks to multiprocessor shared-memory systems.

Learning Outcomes
- Understand various synchronous algorithms and consensus problems
- Understand various asynchronous shared memory algorithms and asynchronous network algorithms with the help of I/O automata.
- Understand partially synchronous algorithms

MODULE 1

MODULE 2

MODULE 3

References
1. Distributed Systems. S. Mullender (ed.). Addison-Wesley, 1993
**Structure of the Question paper**
For the End Semester Examination the question paper will consist of at least 50% analytical/design problems. There will be three questions from each module (with subdivisions) out of which two question are to be answered by the students.
Stream Elective 3

RCE 3003
MACHINE LEARNING

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To impart a deeper understanding of machine language techniques, tools and applications.

Learning Outcomes
- Students gains understanding of conceptual and practical aspects of machine learning and ability to apply the techniques in real-world scenarios.

MODULE 1

MODULE 2

MODULE 3
Algorithms, Temporal Difference Learning, On-Policy and Off-Policy Learning, Advantages of TD Prediction Methods, Learning Automata.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical/design problems and 60 % Theory. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 3

RCE 3004
ADHOC AND SENSOR NETWORKS

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- The primary objective of this course is to introduce to the area of wireless sensor networks and learn the concepts and principles behind WSN.
- To learn WSN network design, sensor node embedded system design and implementation.
- On WSN network management, the focus is mainly on wireless network security which is a very important issue in WSN.

Learning Outcomes

- After passing the course, a student comprehends the Wireless Sensor Networks (WSN) as a new technology area in research and industry.
- A student is familiar with the main standards and specifications of WSNs and identifies the key building blocks for them.
- A student can define and explain the essential challenges of resource constrained WSN design and implementation, including applications, interfaces, energy-efficient protocols and platform functionalities.
- A student can apply both theoretical and practical tools for WSN design and utilization and design potential application scenarios for WSNs.

MODULE 1
Introduction : Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet. Introduction to adhoc/sensor networks: Key definitions of adhoc/sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

MODULE 2

MODULE 3
QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy
management, classification, battery, transmission power, and system power management schemes.

References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with subdivisions) out of which two questions are to be answered by the students.
Course Objectives

- The ability to work with various computing revolutions like HPC, Cluster, Grid and Cloud computing
- Ability to use virtualization techniques to implement computing approaches like cloud computing

Learning Outcomes

- Understand various computing paradigms, its issues and its applications in the business
- Understand various tools and methods to implement Grid and Cloud computing

MODULE 1


MODULE 2


MODULE 3


References

2. K. Hwang, G. C Fox, J. J. Dongarra, “Distributed and Cloud Computing -From
Parallel Processing to the Internet of things”, Elsevier, 2012.

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 4

RCE 3006
FUZZY SET THEORY AND APPLICATIONS

Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To understand Fuzzy Set Theory and the basis of fuzzy logic and fuzzy logic applications such as fuzzy control and fuzzy decision making

Learning Outcomes
- The students who succeeded in this course should be
  - able to examine the Set Theory problems.
  - able to interpret the systems which include fuzziness within the scope of fuzzy set theory.
  - able to combine the information of decision theory and the information of fuzzy set theory.
  - able to improve the proof techniques of Fuzzy Set Theory.
  - able to solve problems that include uncertainty with using Fuzzy Set Theory.

MODULE 1

MODULE 2

MODULE 3

References

**Structure of the Question paper**
For the End Semester Examination the question paper will consist of at least 60% analytical/design problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 4

RCE 3007
DECISION SUPPORT SYSTEMS

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To understand the theory and applications of various types of DSS

Learning Outcomes

• The student should have conceptual strength in DSS and should be able apply it identify the most apt DSS in a practical scenario.

MODULE 1

MODULE 2

MODULE 3
Data Warehousing Definitions and Concepts, Types of Data warehouse. Business Analytics - Online Analytical Processing (OLAP), Reporting and Queries, Multidimensionality Knowledge Discovery in Databases (KDD), framework of KDD. Data Mining Concepts and Applications, Framework of datamining, Text Mining, Web Mining Usage, Benefits, and Success of Business Analytics.
References:

Structure of the Question Paper
For the End Semester Examination the question paper will consist of at least 50% design/analytical problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
Stream Elective 4

RCE 3008
NATURAL LANGUAGE PROCESSING

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart conceptual and application level aspects of NLP.

Learning Outcomes
• The student gets a thorough understanding of the theory and applications.

MODULE 1

MODULE 2
Statistical Machine Translation (MT), Statistical Alignment Models and Expectation Maximization (EM) and its use in statistical MT alignment models; complete statistical MT system decoding and A* Search. Information Extraction (IE) and Named Entity Recognition (NER). Information sources, rule-based methods, evaluation (recall, precision). Introduction to supervised machine learning methods. Naïve Bayes (NB) classifiers for entity classification, Maximum Entropy Classifiers

MODULE 3

References:
Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 40% analytical problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.
RCE 3009
ADVANCED COMPUTER GRAPHICS

Lecture : 3 hrs/ Week    Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:
• To introduce geometric modeling and modeling transformations
• To learn different techniques for representing Solids
• To learn visible surface determination algorithms
• To learn concepts of global illumination modeling using advanced Ray tracing algorithms and Radiosity methods

Learning Outcomes:
• Be able to apply appropriate mathematical models to solve computer graphics problems

MODULE 1
Geometric modelling :Hierarchy in Geometric models, relationship between model, application program and Graphical System, Defining and Displaying structures, Modelling Transformations, Hierarchical structure networks, Appearance attribute handling in hierarchy, Screen updating and rendering modes, Interaction, Output features, Implementation issues, Optimizing display of hierarchical models, Limitations of SPHIGS. User Interface Software: Basic interaction handling models, Window management systems, Output handling in window systems, Input handling in window systems, User Interface Management systems.

MODULE 2

MODULE 3
References:

Structure of the Question paper
For the End Semester Examination the question paper will consist of at least 50% analytical problems. There will be three questions from each module (with sub-divisions) out of which two questions are to be answered by the students.