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| M.Sc., nET WORKING & INFORMATION TECHNOLOGY |
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| **SYLLABUS** |
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| **FROM THE ACADEMIC YEAR**  **2023 - 2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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**CONTENTS**

1. **Preamble**
2. **Structure of Course**
3. **Learning and Teaching Activities**
4. **Tutorial Activities**
5. **Laboratory Activities**
6. **Field Study Activities**
7. **Assessment Activities**
	1. **Assessment principles**
	2. **Assessment Details**
8. **Teaching methodologies**
9. **Faculty Course File**
10. **Template for PG Programme in Mathematics**
11. **Template for Semester**
12. **Instructions for Course Transaction**

# Testing Pattern

# Different Types of Courses

# Elective Courses (ED from other Department Experts)

# Skill Development Courses

# Institution-Industry-Interaction

1. **Model Syllabus**

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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** |
| **Programme** | **M.Sc. NETWORKING AND IFORMATION TECHNOLOGY** |
| **Programme Code** |  |
| **Duration** | **2 years for PG** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.**PO2: Decision Making Skill**Foster analytical and critical thinking abilities for data-based decision-making.**PO3: Ethical Value**Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.**PO4: Communication Skill**Ability to develop communication, managerial and interpersonal skills.**PO5: Individual and Team Leadership Skill**Capability to lead themselves and the team to achieve organizational goals.**PO6: Employability Skill**Inculcate contemporary business practices to enhance employability skills in the competitive environment.**PO7: Entrepreneurial Skill**Equip with skills and competencies to become an entrepreneur.**PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society.**PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and  a global perspective.**PO 10: Moral and ethical awareness/reasoning**Ability to embrace moral/ethical values in conducting one’s life.  |
| **Programme Specific Outcomes****(PSOs)** | **PSO1 – Placement**To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.**PSO 2 - Entrepreneur**To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.**PSO3 – Research and Development**Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.**PSO4 – Contribution to Business World**To produce employable, ethical and innovative professionals to sustain in the dynamic business world.**PSO 5 – Contribution to the Society**To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

 **Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I  | 5 | 7 | 2.1. Core-IV  | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI  | 5 | 6 |
| 1.2 Core-II  | 5 | 7 | 2.2 Core-V  | 5 | 6 | 3.2 Core-VII  | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III  | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric Elective -I | 3 | 5 | 2.4 Discipline Centric Elective – III | 3 | 4 | 3.4 Core – X  | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship) 20% Theory80% Practical  | 3 | 4 |
| 1.5 Generic Elective-II:  | 3 | 5 | 2.5 Generic Elective -IV:  | 3 | 4 | 3.5 Discipline Centric Elective - V  | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill  | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity [Credits] | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship)  | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **PO1** |  |  |  |  |  |  |
| **PO2** |  |  |  |  |  |  |
| **PO3** |  |  |  |  |  |  |
| **PO4** |  |  |  |  |  |  |
| **PO5** |  |  |  |  |  |  |
| **PO6** |  |  |  |  |  |  |

**Mapping of Course Learning Outcomes (CLOs)** with Programme Outcomes (POs) and Programme Speciﬁc Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grid

**Component wise Credit Distribution**

**Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree**

**Credit Distribution for PG Programme in Networking & Information Technology**

**M.Sc Networking & Information Technology**

**First Year:Semester-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **CORE/ELECTIVE** | **SUBJECT TITLE** | **Credit** | **Hours per week**  |
| Core - I | Applied Mathematics for Information Technology | 5 | 7 |
| Core - II | Advanced Data Structures and Algorithms | 5 | 7 |
| Core - Iii | Advanced Data Structures – Practical | 4 | 6 |
| Elective I |  (Generic / Discipline Specific)(One from GroupA)Cryptography and Network Security | 3 | 5 |
| Elective II |  (Generic / Discipline Specific)(One from Group B)Cyber Forensics | 3 | 5 |
|  | **Total** | **20** | **30** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Semester-II** | **Credit** | **Hours per week** |
| Core-IV  | Machine Learning | 5 | 6 |
|  Core-V  | Advanced Database Systems | 5 | 6 |
| Core – VI | Advanced Database Management Systems Lab | 4 | 6 |
| Discipline Centric Elective – III | (Generic / Discipline Specific)(One from Group C)Advanced Computer Networks | 3 | 4 |
| Generic Elective -IV:  |  (Computer / IT related) (One from Group D)Embedded Systems in Computing | 3 | 4 |
| 2.6 NME I | Skill Enhancement Course -SEC 2 (One from Group G) | 2 | 4 |
|  | **Total** | **22** | **30** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Second Year - Semester-III** | **Credit** | **Hours per week** |
| Core-VII | Deep Learning  | 5 | 6 |
| Core-VII  | Deep Learning and Mini Project Lab Learning  | 5 | 6 |
| Core – IX | Wireless Networks and Mobile Computing | 5 | 6 |
| Core – X  | Big data Analytics  | 4 | 6 |
| Discipline Centric Elective - V  | (Generic / Discipline Specific) (One from Group E)Natural Language processing / Core Industry Module | 3 | 3 |
| NME II | Skill Enhancement Course -SEC 3 :Professional Communication Skill -Term paper & Seminar presentation | 2 | 3 |
| Internship/ Industrial Activity | Internship / Industrial Activity (Carried out in Summer Vacation at the end of I year – 30 hours) | 2 | - |
|  | **Total** | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Status** | **Subjects** | **Credit** | **Hours perweek** |
| Core – XI | Advanced Java Programming  | 5 | 6 |
| Core – XII | Advanced Java Programming Lab | 5 | 6 |
| Project  | Project with viva voce  | 7 | 10 |
| Elective - VI  |  (Generic / Discipline Specific)(One from Group F)Distributed and Cloud Computing (Industry / Entrepreneurship) 20% Theory, 80% Practical | 3 | 4 |
| Skill Enhancement  | Professional Competency Skill Enhancement Course Training for Competitive Examinations * Computer Science for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours)
* General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours)

OR Advanced Research Studies in computer science (4 hours) | 2 | 4 |
| Extension Activity |  | 1 |  |
|  |  |  |  |
|  | **Total** | **23** | **30** |

**TOTAL CREDITS: 91**

**Consolidated Table for Credits Distribution**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PART A  | Category of Courses | Credits foreach Course | Number ofCourses | Number of Credits in each Category of Courses | Total Credits | Total Credits for the Programme |
| Core |  |  | 57 |  | 80 (CGPA) |
| Project with viva voce | 7 | 1 | 7 |
| Industry aligned Programmes-  | 3 | 1 | 3 |
| Elective (Generic and Discipline Centric) | 3 | 5 | 15 |
| PART B (i) | Skill Enhancement (Term paper and Seminar &Generic / Discipline -Centric Skill Courses)(Internal Assessment Only) | 2 | 2 | 4 |  |
| PART B (ii) (iii) |  |  |  | 0 |  | 11(Non CGPA) |
| Summer Internship | 2 | 2 | 4 |
| PART C | Extension Activity | 1 | 1 | 1 | 1 |
| 91 |  | 91 |

**Elective Courses**

**Courses are grouped (Group A to Group F) so as to include topics from Networking & Information Technology, Applied Networking and Information Technology concepts, Industrial components and IT oriented courses for flexibility of choice by the stakeholders / institutions.**

**Semester I : Elective I and Elective II**

**Elective I** to be chosen from Group A and **Elective II** to be chosen from Group B

**Group A:**

1. Cryptography and Network Security
2. Problem Solving Techniques and Applications

**Group B:**

1. Cyber Forensics
2. Parallel Algorithms and Programming

**Semester II : Elective III & Elective IV**

**Elective III** to be chosen from **Group C** and **Elective IV** to be chosen from **Group D**

**Group C**:

1. Advanced Computer Networks
2. Theory of Computation

**Group D :**

1. Embedded Systems in Computing
2. Advanced Image Processing

**Semester III : Elective V**

**Elective V** to be chosen from Group E.

**Group E:**

1. Artificial Intelligence
2. Natural Language Processing
3. Data Science
4. Social Network Analysis

**Semester IV : Elective VI**

**Elective VI** to be chosen from Group F.

**Group F:**

1. Distributed and Cloud Computing
2. Data Mining and Warehousing
3. Principles of protocol management
4. TCP/IP socket Programming

**Skill Enhancement Courses**

**Skill Enhancement Courses are chosen so as to keep in pace with the latest developments in the academic / industrial front and provides flexibility of choice by the stakeholders / institutions.**

**Group G (Skill Enhancement Courses) SEC:**

* Web Development using word Press
* Data security for web developers
* Palo Alto Networks and Cyber Security
* Networking and Storage
* Cloud AWS
* Research Tools and Techniques

**Ability Enhancement Courses**

* Soft Skill courses

**Extra Disciplinary Courses for other Departments (not for Networking & Information Technology students)**

Students from other Departments may also choose any one of the following as Extra Disciplinary Course.

ED-I: Principles of Information Technology

ED-II: Networking Fundamentals

ED-III: Cyber Security

ED-IV: Digital Forensics

ED-V: Designing tools (Flash/ Photoshop)

**Model Syllabus for different Courses of M.Sc Networking & Information Technology**

|  |  |
| --- | --- |
| Title of the Course | APPLIED MATHEMATICS FOR INFORMATION TECHNOLOGY |
| Paper Number  | CORE I |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Under graduate allied/ancillary level Mathematics.  |
| **Objectives of the Course** | 1. Learn and recall allied level mathematics for application problems.
2. To understand the role of linear algebra and matrix in computer science problem solving.
3. Learn and understand unit step function and Dirac delta function. To study orthogonal functions and Fourier transforms and understand their use in computational problems.
4. Learn the concepts of number theory for cryptography.
5. Critically analyze and implement programs for the methods studied for a set of selected example problems.
 |
| **Course Outline** | **UNIT-I** Set theory: Operations on sets – Basic set identities – Relations and orderings – Functions |
| **UNIT-II :**Linear algebra Part I: Linear vector spaces - Linear operators – vectors in *n*-dimensions – matrix representation of vectors and operators in a basis – linear independence, dimension – inner product – Orthonormal basis –Eigenvalues and eigenfunctions of operators/matrices – Eigen basis, Diagonalizing matrix – Quadratic forms – Complex matrices and forms - Hermitian and Unitary operators/matrices.  |
| **UNIT-III :**Linear algebra Part II: Cayley-Hamilton Theorem - Gram-Schmidt process –Eigen values using QR transformations – QR factorization - generalized eigenvectors –– singular value decomposition and applications - pseudo inverse – least square approximations -Toeplitz matrices and some applications. |
| **UNIT-IV :**Laplace Transforms : Solution of linear differential equations with constant coefficients- – Unit step function and Dirac delta function. Sturm-Liouville theory: Second order linear differential equations . Strum-Liouville theory: Orthogonality of eigenfunctions – Illustration with Legendre, Laguerre, Hermite, Chebyshev differential equations - expansion of polynomials. Fourier Transforms: Fourier sine and cosine transforms – Fourier transform - convolution theorem - Discrete Fourier transform and Fast Fourier transform. |
| **UNIT-V:**Number Theory: Modular arithmetic - Fermat’s and Euler’s theorem – Testing for primality - Chinese remainder theorem – Discrete logarithms – Groups – Rings – Fields - Finite fields – GF(*p*) - Polynomial arithmetic – Finite fields of the form GF(2n).  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course | Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. J P Tremblay and R Manohar, *Discrete Mathematical Structures with Applications to Computer Science****,*** International Edition (McGraw*-*Hill, Singapore, 1987; Tata McGraw*-*Hill, New Delhi, 1997).
 |
| Reference Books | 1. K.Trivedi,“ProbabilityandStatisticswithReliability,Queuing,andComputerScienceApplications”,Wiley, 2016.
2. M. MitzenmacherandE.Upfal,“ProbabilityandComputing:RandomizedAlgorithmsandProbabilisticAnalysis”,CambridgeUniversityPress, 2005.
3. AlanTucker,“AppliedCombinatorics”,6thEdition,Wiley2012.
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/106/106106183/ https://nptel.ac.in/courses/111/105/111105035/ https://nptel.ac.in/courses/111/102/111102133/ https://nptel.ac.in/courses/106/103/106103015/  |

**Course Learning Outcome (for Mapping with POs and PSOs)**

|  |
| --- |
| Students will be able to **CLO 1:** ApplymathematicalconceptforInformationTechnologyproblem solving.**CLO 2:** Designmathematical modelsforrealtimeprojectsand applications.**CLO 3:** Analyzeeachlearningmodelfromadifferent algorithmicapproach**CLO 4:** Acquire knowledge of relations, functions and mathematical logic**CLO 5:**Understand the basic concepts ofGraph Theory |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **2** | **2** | **3** | **3** | **2** |
| **CO2** | **3** | **2** | **2** | **3** | **3** | **2** |
| **CO3** | **3** | **2** | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **2** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **2** | **3** | **3** | **3** |
| **Weightage ofcoursecontributedtoeachPSO** | **15** | **10** | **12** | **15** | **15** | **13** |

|  |  |
| --- | --- |
| Title of the Course | ADVANCED DATA STRUCTURES AND ALGORITHMS |
| Paper Number  | CORE II |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | The Prerequisites for Data Structures And Algorithms is one must be aware of at least one programming language.  |
| **Objectives of the Course** | By the end of the course the students will be able to Enumerate the Sorting Quick and Heap Sort, Radix Sort, AVL trees and Graph Traversals Summaries the Search Trees, building Optimal search trees, Height balanced and Weight balanced trees Interpret the problems using B –trees, Red Black Trees and Splay trees To Differentiate Interval Trees , Segment Trees, Trees for Weighted Intervals and Higher dimensional Segment Trees To Conceive various algorithmic paradigms for solving various kinds of problems  |
| **Course Outline** | **UNIT-I :****Primary Data Structures**, Time and Space Complexity Analysis Sorting – Quick and Heap Sort, Radix Sort, AVL trees, Graph Traversals Asymptotic notations, conditional asymptotic notations, Amortized analysis, NP complete and NP hard Time and Space complexity analysis by solving recurrence equations  |
| **UNIT-II :****Optimization Data structures** Search Trees, building Optimal search trees, Height balanced and Weight balanced trees B –trees, Red Black Trees and Splay trees  |
| **UNIT-III :** **Data Structures for sets of Intervals** Interval Trees - Segment Trees, Trees for Weighted Intervals, Higher dimensional Segment Trees. Range Counting and Semi group model. K-d trees, Orthogonal Range trees, Leftist heap, Skew heap, Binomial heap and Fibonacci heaps. |
| **UNIT-IV :****Data structures for Strings & Transformations** Dynamic Structures, Persistent Structures, Tries, Compressed Tries, Suffix Trees and Suffix Arrays  |
| **UNIT-V:** **Advanced Algorithm Design** Dynamic Programming - Rod Cutting, Matrix chain multiplication, Longest Common Subsequence .Greedy Algorithms – Activity selection problem, Matroids and Greedy methods  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms: Third Edition”, The MIT Press, 2014.
 |
| Reference Books | 1. Thomas H.Cormen, “Algorithms Unlocked”, The MIT Press, 2013
2. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2014
 |
| **Website and** **e-Learning Source** | https://goalkicker.com/AlgorithmsBook/ https://nptel.ac.in/courses/106/102/106102064/ https://nptel.ac.in/courses/106/102/106102064/.  |

**Course Learning Outcome (for Mapping with POs and PSOs)**

|  |
| --- |
| Students will be able to **CLO1:**Explain how the choice of data structures and algorithm design methods impacts the performance of programs. **CLO 2:**Describe the concept of Range Counting and Semi group model. K-d trees, Orthogonal Range trees, Leftist heap. **CLO 3**: Design and implement an appropriate hashing function for an application. **CLO 4:**Compare alternative implementations of data structures with respect to performance. **CLO 5:**Contrast the benefits of dynamic and static data structures implementations.  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **2** | **2** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **3** |
| **Weightage ofcoursecontributedtoeachPSO** | **15** | **13** | **11** | **15** | **15** | **15** |

|  |  |
| --- | --- |
| Title of the Course | ADVANCED DATA STRUCTURES - PRACTICAL |
| Paper Number  | CORE III |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| -- |  | 5 | 5 |
| **Pre-requisite** | The Prerequisites For Data Structures And Algorithms is, one must be aware of at least one programming language.  |
| **Objectives of the Course** | The main objectives of this course are to: * Describe the concept of Activity selection of Huffman coding Implementations
* Design and implement of Spanning tree Implementations
* Explain the Implementation of Binary Search Tree
* Identify the Red Black tree Implementation
 |
| **Course Outline** | **UNIT-I :** 1. Implementation of Merge sort and quick sort Algorithms 2. Implementation of Binary Search Tree  |
| **UNIT-II :** 3. Red Black Tree Implementation 4. Implementation of Heap Implementation  |
| **UNIT-III :**5. Implementation of Fibonacci Heap Implementation 6. Implementation of Graph Traversals  |
| **UNIT-IV :**7. Implementation of Spanning Tree Implementation 8. Shortest path Algorithms( Dijkstra’s, Bellman Ford Algorithms)  |
| **UNIT-V** :9. Implementation of Matrix Chain Multiplication 10. Activity selection and Huffman coding Implementation  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms: Third Edition”, The MIT Press, 2014. |
| Reference Books | Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2014 |
| **Website and** **e-Learning Source** | 1. https://goalkicker.com/AlgorithmsBook/
2. http://algs4.cs.princeton.edu/home/
3. techread.dev/en/books/about/algori...
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| By the end of the course the students will be able to **CLO 1:** Define how the design of data structures and algorithm design methods impacts the performance of programs. **CLO 2**: Implement the applications using Fibonacci Heap and shortest path Algorithms **CLO 3:** Identify various algorithmic for Implementation of Matrix Chain Multiplication algorithms **CLO 4 :** Demonstrate the creation of Graph Traversals methods and the concepts of Binary Search tree **CLO 5:** Construct Data structure programs using Merge sort and Quick sort. Develop programs for implementing trees and their traversal operations.  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO2** | **2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **2** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **3** |
| **Weightage ofcoursecontributedtoeachPSO** | **13** | **15** | **13** | **15** | **15** | **12** |

|  |  |
| --- | --- |
| Title of the Course | MACHINE LEARNING |
| Paper Number  | CORE IV |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | - | 5 |
| **Pre-requisite** | The Prerequisites for Machine learning is to understand, and practice machine learning approaches and familiarity with data handling techniques.  |
| **Objectives of the Course** | By the end of the course the students will be able to Gain knowledge about basic concepts of Machine LearningSolve the problems using various machine learning techniquesApply Dimensionality reduction techniques. |
| **Course Outline** | **UNIT-I :Introduction:** Machine Learning - Machine Learning Foundations –Overview – Applications - Types of Machine Learning - Basic Concepts in Machine Learning - Examples of Machine Learning –Applications. Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison.  |
| **UNIT-II** :**Supervised Learning**Linear Models for Classification - Discriminant Functions - Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression - Decision Trees - Classification Trees - Regression Trees – Pruning - Neural Networks - Feed-Forward Network Functions - Error Back-Propagation - Regularization - Mixture Density and Bayesian Neural Networks - Kernel Methods - Dual Representations - Radial Basis Function Networks - Ensemble methods - Bagging - Boosting.  |
| **UNIT-III :Unsupervised Learning**Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model Selection for Latent Variable Models - High-Dimensional Spaces - The Curse of Dimensionality - Dimensionality Reduction - Factor Analysis - Principal Component Analysis - Probabilistic PCA- Independent Components Analysis.  |
| **UNIT-IV :Probabilistic Graphical Models**Directed Graphical Models - Bayesian Networks - Exploiting Independence Properties - From Distributions to Graphs - Examples - Markov Random Fields - Inference in Graphical Models - Learning – Naive Bayes Classifiers - Markov Models – Hidden Markov Models – Inference – Learning- Generalization – Undirected graphical models - Markov Random Fields- Conditional Independence Properties - Parameterization of MRFs - Examples - Learning - Conditional Random Fields (CRFs) - Structural SVMs  |
| **UNIT-V :Advanced Learning** Sampling – Basic sampling methods – Monte Carlo - Reinforcement Learning - K-Armed Bandit Elements - Model-Based Learning - Value Iteration- Policy Iteration - Temporal Difference Learning- Exploration Strategies- Deterministic and Non- deterministic Rewards and Actions Eligibility Traces- Generalization- Partially Observable States- The Setting- Example - Semisupervised Learning - Computational Learning Theory - Mistake Bound Analysis - Sample Complexity Analysis - VC Dimension - Occam Learning - Accuracy and Confidence Boosting. |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006
 |
| Reference Books | 1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
2. EthemAlpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005
3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
4. Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning” (2nd ed)., Springer, 2008
5. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/106/106106139/ https://www.coursera.org/learn/machine-learning https://onlinecourses.nptel.ac.in/noc21\_cs24/preview  |

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| **CLO 1:** To introduce students to the basic concepts and techniques of Machine Learning. **CLO 2:** To become familiar with regression methods, classification methods, clustering methods. **CLO 3:** To become familiar with Dimensionality reduction Techniques. **CLO 4:** Identify machine learning techniques suitable for a given problem**CLO 5:** Design application using machine learning techniques |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO2** | **2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **2** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **3** |
| **Weightage ofcoursecontributedtoeachPSO** | **13** | **15** | **13** | **15** | **15** | **12** |

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| Title of the Course | ADVANCED DATABASE SYSTEMS |
| Paper Number  | CORE V |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course requires a broad understanding of database concepts, database management system software, and the method of handling object relational, temporal, multimedia, spatial, logic based, mobile databases and Emerging Trends in it.  |
| **Objectives of the Course** | Students will try to learn: ● Define the study of database system usage and design Object oriented models. Outline introductory knowledge about the query processing in object-based databases and its usage. ● Interpret the basics of spatial, temporal and mobile databases and their applications. ● Review an idea about emerging databases such as XML, Data warehouse and NoSQL. ● Compare and contrast various indexing strategies in different database systems and appraise how advanced databases differ from traditional databases. ● To conceive inquisitive attitude towards research and current trend topics in databases.  |
| **Course Outline** | **UNIT-I :****Database System:** Introduction-Data Independence-Database System Architecture- The External Level – The Conceptual Level – The Internal Level – Mappings – The Database Administrator – Data Dictionary – Data Models – Record-Based Data Models – Object based Data Models – Physical Data Models-Hierarchical Data Models – Network Data Models-Relational Data Model Entity-Relationship Models – Object Oriented Data Model-Comparison Between Data Models.  |
| **UNIT-II :** **Object And Object Relational Databases:** Concepts for Object Databases Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL –  |
| **UNIT-III :** **Temporal Databases:** Introduction-Intervals-Packing and Unpacking relations- Generalizing the relational operators – Database Design – Integrity Constraints – **Multimedia Databases:** Multimedia Sources – Multimedia Database Queries – Information Retrieval- Data Warehousing- Data mining- Text Mining. Multimedia Database Applications. **Spatial Databases:** Spatial Data- Spatial Database Characteristics – Spatial Data Model-Spatial Database Queries – Techniques of Special Database Query.  |
| **UNIT-IV :** **Logic based Databases:** Introduction Overview-Proportional calculus – Predicate Calculus – Deductive Database Systems – Recursive Query Processing. **Mobile Databases:** Architecture of Mobile Databases – Characteristics of Mobile Computing – Mobile DBMS -Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols.  |
| **UNIT-V :** **Advanced Topics :** Overview of Distributed Databases – Data Fragmentation – Replication – XML Databases – XML Schema – NOSQL Database: Characteristics – CAP theorem – Types of NoSQL **Data stores:** Column Oriented, Document, Key-Value and Graph Types – Applications. **Emerging Database Technologies:** Introduction – Internet Databases: Internet Technology – The World Wide Web-Web Technology – Web Databases – Cloud Based Databases Advantages -Current Trends.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill, 2014.
2. C.J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, 8th Edition, Pearson Education,2006.
3. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2017.
 |
| Reference Books | 1. S.K. Singh,” Databse Systems: Concepts, Design and Applications”, 2nd Edition, Person Eduction, 2008.
2. Abraham Silberschats, HentryF.Korth and S.Sudarshan,”Database Management System Concepts”, McGraw Hill International Edition,2006.
3. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, Fourth Edition, Tata McGraw Hill, 2010.
4. G. K. Gupta, “Database Management Systems”, Tata McGraw Hill, 2011.
5. Carlos Coronel, Steven Morris, Peter Rob, “Database Systems: Design, Implementation and Management”, Ninth Edition, Cengage
 |
| **Website and** **e-Learning Source** | 1. https://people.inf.elte.hu/miiqaai/elektroModulatorDva.pdf.
2. https://www.youtube.com/watch?v=SdW5RKUboKc&list=PLSE8ODhjZXjasmrEd2\_Yi1deeE360zv5O
3. https://nptel.ac.in/courses/106/106/106106093/
4. https://nptel.ac.in/courses/106/106/106106095/
5. https://nptel.ac.in/courses/106/104/106104135/
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| Students will able to: **CLO 1**: Explain the features of database management systems and Object relational database **CLO2** : Students will be able to understand the needs and concepts of object-oriented database, spatial database, multimedia database, mobile database, data warehousing and data mining and etc... **CLO 3**: Students will be able to understand NOSQL concepts and XML. **CLO 4**: Explain Emerging trends and function of advanced database systems. **CLO 5**: Demonstrate design and develop a database application system as part of a team.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **1** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO3** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO4** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributedtoeachPSO** | **15** | **15** | **11** | **15** | **15** | **14** |

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| Title of the Course | Advanced Database Management Systems Lab |
| Paper Number  | CORE VI |
| **Category** | Core | Year | I | **Credits** | 4 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
|  |  | 5 | 5 |
| **Pre-requisite** | Good understanding of DBMS concepts and SQL queries  |
| **Objectives of the Course** | * Describe the validity of user defined requirements summarize the usage of normal forms
* Interpret the SQL statements and its results
* Summarize the working of the file storage structure using different methods
* Conceive and critically assess the real time data base systems
 |
| **Course Outline** | **UNIT-I :**Implementing DDL, DML commands - Using Key constraints  |
| **UNIT-II :**Using Foreign key with multiple set of Tables - Incorporate Referential Integrity  |
| **UNIT-III :**Query the DB using Different where clause - implemented the Aggregate Functions - Using different In built Functions of SQL-Explore Join Operations  |
| **UNIT-IV :** Implementing Sub queries - Exploring Complex DB transaction using DCL, TCL commands - SQL trigger -Creating Views and Index - Create XML DB and validate using XML Schema  |
| **UNIT-V :** Create Documents, Columns using NOSQL DB tools - Develop GUI to incorporate all the above mentioned features. Perform ER model and Normalization.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Abraham Silberschatz, Henry F. Korth and S. Sudarshan- “Database System Concepts”, Sixth Edition, McGraw-Hill, 2020.  |
| Reference Books | * RamezElmasri and Shamkant B. Navathe, “Fundamental Database Systems”, Third Edition, Pearson Education, 2003.
* Raghu Ramakrishnan, “Database Management System”, Tata McGraw-Hill Publishing Company, 2003.
 |
| **Website and** **e-Learning Source** | www.sqltutorials.com https://www.javatpoint.com/nosql-databases  |

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| **CLO 1:** Understand the usage of C# programming **CLO 2:** Generalize data base connectivity procedure **CLO 3:** Identify the purpose of design data base systems and web-based applications**CLO 4:** Demonstrate SQL, XML and NOSQL statements usage **CLO 5:** Design simple applications with interactive queries  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **2** | **3** | **1** | **1** | **2** | **2** |
| **CO2** | **3** | **3** | **2** | **2** | **2** | **2** |
| **CO3** | **3** | **2** | **2** | **3** | **2** | **2** |
| **CO4** | **3** | **2** | **2** | **2** | **2** | **3** |
| **CO5** | **3** | **3** | **2** | **3** | **2** | **3** |
| **Weightage ofcourse contributedtoeachPSO** | **14** | **13** | **9** | **11** | **10** | **12** |

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| Title of the Course | Deep Learning |
| Paper Number  | CORE VII |
| **Category** | Core | Year | II | **Credits** | 4 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Good understanding of Python and Deep Learning Concepts  |
| **Objectives of the Course** | By the end of the course the students will be able to ● To recall the concepts of Artificial intelligence and Machine Learning ● To appreciate the use of Deep Learning Applications |
| **Course Outline** | UNIT-I **Introduction:** Neural Network and Genetic Algorithm -Neural Network Representation - Problem - Perceptrons - multilayer network and back propagation Algorithm - Hypothesis space search - Genetic Algorithm - genetic programming - models of evaluation and learning.  |
| **UNIT-II :****Introduction to Deep learning** : Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.  |
| **UNIT-III :****Convolutional Neural Network and Architecture of Deep learning :** CNN and RNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – State space model – Computational power of RNN – Real-time recurrent learning -  |
| **UNIT-IV :**Deep learning Architecture : LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM  |
| **UNIT-V: Application of Deep Learning** : Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.  |
| Reference Books | Michael Nielsen - " Neural Network and Deep Learning " , Determination Press, 2015  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106106224 https://nptel.ac.in/courses/106105215  |

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| **CLO1:** To understand the basic ideas and principles of Neural Networks **CLO 2:** To know the basic concepts of Big Data and Statistical Data Analysis **CLO 3:** To familiarize the student with The Image Processing facilities like Tensorflow and Keras**CLO 4:** To understand and implement Deep Learning Architectures**CLO 5:** To implement the Techniques of Neural network on Data analytics |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **2** | **2** | **2** |
| **CO2** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO3** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO4** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** |
| **Weightageof course****contributedtoeachPSO** | **15** | **13** | **13** | **12** | **14** | **13** |

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| Title of the Course | Deep Learning and Mini Project Lab Learning |
| Paper Number  | CORE VIII |
| **Category** | Core | Year | II | **Credits** | 4 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
|  |  | 5 | 5 |
| **Pre-requisite** | Good understanding of Python and Deep Learning Concepts  |
| **Objectives of the Course** | ● To implement the concepts of regression model and feed forward neural network. ● To implement the CNN techniques .● To implement Deep Learning Applications using LSTM and CNN ● To understand and implement recurrent neural networks  |
| **Course Outline** | **Unit I** Implementing vector addition  Regression Model Perceptrons |
| **Unit II**Feed Forward Network Image Classifier Using CNN Implementing Transfer learning concepts in Image Classification  |
| **Unit III**Auto encoder-Implement simple LSTM  Implement Object Detection using CNN  Improve Deep learning model by tuning hyper parameter  |
| **Unit IV**Sentiment Analysis in Graph using Recurrent Neural Network  Image generation using GAN |
| **Unit V**Mini Project. |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | https://www.datacamp.com/tutorial/deep-learning-python  |
| Reference Books | "Deep Learning with Python", Nikhil Ketkar, JojoMoolayil, Second Edition.  |
| **Website and** **e-Learning Source** | https://www.datacamp.com/tutorial/deep-learning-python  |

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| **CLO1:** Understand the usage of Python Programming **CLO 2:** Understand the Models of Python **CLO 3:** To Use and familiarize with the Image Processing facilities like Tensor flow and Keras. **CLO 4:** To understand and implement Deep Learning Architectures **CLO 5:** To implement a mini-project case study using the Deep Learning Architectures.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **2** | **3** | **2** | **2** |
| **CO3** | **3** | **2** | **3** | **3** | **2** | **2** |
| **CO4** | **3** | **2** | **3** | **2** | **3** | **2** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **2** |
| **Weightageofcoursecontributed to eachPSO** | **15** | **13** | **12** | **14** | **13** | **11** |

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| Title of the Course | Wireless Networks and Mobile Computing |
| Paper Number  | CORE IX |
| **Category** | Core | Year | II | **Credits** | 4 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course requires the understanding of Wireless Mobile computing and applications environment.  |
| **Objectives of the Course** | Students will try to learn: * Define the fundamentals of wireless networks. Summarize about Learning and analyzing the different wireless technologies.
* Interpret the process of building and mobile networks applications.
* Understand and evaluate emerging wireless technologies and computing environments
* Critically asses the design considerations for wireless networks and J2ME
* Conceive the security threats and related security standards on Wireless computing
 |
| **Course Outline** | **UNIT-I :** **Mobile Computing Architecture:** Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Wireless Networks : Global Systems for Mobile Communication ( GSM and Short Service Messages (SMS): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Introduction to SMS, SMS Architecture, SM MT, SM MO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS, Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Introduction to WiMAX  |
|  | **UNIT-II :**Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6  |
| **UNIT-III :****Mobile OS and Computing Environment :**Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators  |
| UNIT-IV :**Building, Mobile Internet Applications :** Thin client: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXML |
| **UNIT-V:****J2ME:**Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP |
| Extended Professional Component (is a part ofinternal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.  |
| Reference Books | 1. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003
2. Raj kamal: Mobile Computing, Oxford University Press, 2007.
3. ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/108/106/106106167/ https://nptel.ac.in/courses/117/104/117104099/ https://nptel.ac.in/courses/106/106/106106147/  |

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| Students will able to: **CLO1:** Explain the basic concepts of wireless network and wireless generations **CLO 2:** Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc **CLO 3:** Appraise the importance of mobile computing networks and mobile client IP- Protocols **CLO 4:** Explain the design considerations for deploying the wireless network infrastructure **CLO 5:** Differentiate and support the security measures, standards. Services and layer wise security considerations  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **2** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **2** | **3** | **2** | **2** | **3** | **3** |
| **CO3** | **2** | **3** | **2** | **2** | **3** | **3** |
| **CO4** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO5** | **3** | **3** | **2** | **2** | **3** | **3** |
| **Weightage of coursecontributed to eachPSO** | **12** | **15** | **10** | **10** | **15** | **15** |

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| Title of the Course | Advanced Java Programming |
| Paper Number  | CORE XI |
| **Category** | Core | Year | II | **Credits** | 4 | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Students should able to know the concept of Java Fundamentals, Applet, Swings, JDBC, JavaBeans.  |
| **Objectives of the Course** | The main objectives of this course are to: To Identify the students with the introduction to OOPs and advantages of object oriented programming Understand the advanced concepts of Java Programming. The Explain the concepts of OOPs make it easy to represent real world entities. Design interactive applications using Java Servlet, JSP and JDBC. Summaries the syntax of programming language Java for solving the real world problems. Explain the concept of features and Characters of JAVA.  |
| **Course Outline** | **UNIT-I :****Introduction** Basic Concept: JAVA – Features and Characters of JAVA - Object-Oriented Programming – Encapsulation – Inheritance – Polymorphism - Overriding– Constants -Variables – Types – Swing features – Difference between Swing and AWT components  |
| **UNIT-II :****RMI** Distributed Application and Networking: Client/Server communication - Overview of the RMI – Advantages of RMI – RMI Architecture – Developing RMI Applications – Parameters in RMI - Java Virtual Machine - Java Serialization - Java Networking.  |
| **UNIT-III :****Event Handling** Applets and Events: Applets - HTML applet tags – Order of Applet initialization – Sizing graphics – Mouse Event Handling – Examples of key event handling - The Delegation Event Model – Event class and event listener.  |
| **UNIT-IV :****Operation on Servlets** JDBC and Servlets: JDBC Vs ODBC – Types of JDBC Drivers – Basic operations on JDBC. Features of Servlets – Servlet lifecycle service – Steps to run the servlet program – Cookies Vs Session – Database Connectivity with JDBC using Servlet.  |
| **UNIT-V:** **JSP and EJB** JSP and EJB: Define JSP – Advantages of JSP – JSP tags - Servlet Vs JSP – JSP Syntax Basics – JSP Directories – EJB Benefits – Types of Enterprises Beans – Session Bean with types – Entity Bean – Entity Beans Vs Session Beans – Message Driven Beans.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Subrahmanyan Allamaraju and Cedric Bues, Professional Java Server Programming, Apress, SPD, 2005
 |
| Reference Books | 1. Dr.AshwinMetha and Sarika Shah, Advanced Java for Students, The X team, Published by SPD Pvt. Ltd, 2012.
2. Campione, Walrath and Huml, “The Java Tutorial”, Addison Wesley, 1999.
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105191/ https://onlinecourses.nptel.ac.in/noc19\_cs84/preview  |

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| **CLO1:** To Identify the development of small to medium sized application programs that demonstrate professionally acceptable coding **CLO 2:** To Explain the concept of object oriented programming through Java**CLO 3:** Revise the concept of Inheritance, Modularity, Concurrency, Exceptions handling and data persistence to develop java program**CLO 4:** Describe the java programs for applets and graphics programming**CLO 5:** Display the fundamental concepts of AWT controls, layouts and events |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **2** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **2** |
| **Weightage of coursecontributed to eachPSO** | **15** | **15** | **10** | **15** | **15** | **10** |

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| Title of the Course |  ADVANCED JAVA PROGRAMMING LAB |
| Paper Number  | CORE XII |
| **Category** | Core | Year | II | **Credits** | 4  | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| - |  | 5 | 5 |
| **Pre-requisite** |  Students should able to know the concept of Java Fundamentals, Applet, Swings, JDBC, JavaBeans.  |
| **Objectives of the Course** | * Using Graphics, Animations and Multithreading for designing Simulation and Game based applications.
* Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
* Design and develop Web applications
* Designing Enterprise based applications by encapsulating an application’s business logic.
* Designing applications using pre-built frameworks.
 |
| **Course Outline** | **UNIT-I :**  Java Database Connectivity (JDBC): JDBC Product, Types of Drivers, Two-Tier Client/Server Model, Three-Tier Client/Server Model, Basic Steps of JDBC, Creating and Executing SQL Statement, The Result Set Object, Working with Database MetaData Interface |
| **UNIT-II :** Java Servlets: Servlet Interaction & Advanced Servlets, Life cycle of Servlet, Java Servlet Development Kit, Javax.servlet package, Reading Servlet Parameters, Reading Initialization Parameters, The javax.servlet.http Package, Handling HTTP |
| **UNIT-III :**  Java Server Pages (JSP): JSP Technologies, Understanding the Client-Server Model, Understanding Web server software, Configuring the JSP Server, Handling JSP Errors, JSP Translation Time Errors, JSP Request Time Errors, Creating a JSP Error Page |
| **UNIT-IV :** Remote Method Invocation (RMI): RMI Architecture, Designing RMI application, Executing RMI application |
| **UNIT-V :** Enterprise Java Beans (EJB): Types of EnterpriseJava beans, Session Bean & Entity Bean, Features of Session Bean, Life-cycle of Stateful Seession Bean, Features of Entity Bean, Life-cycle of Entity Bean, Container-managed Transactions & Bean-managed Transactions, Implementing a container-managed Entity Bean |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Java the Complete Reference, ninth edition by Herbert Schild, Publisher: McGraw Hills |
| Reference Books | 1. Head First EJB 3.0 by Kathy Sierra, Bert Bates, Publisher: O'Reilly Media
2. Head First Servlets and JSP by Bryan Basham, Kathy Sierra & Bert Bates, Publisher: O'Reilly Media
3. Just Hibernate, A Lightweight Introduction to the Hibernate Framework by Madhusudhan Konda, Publisher: O'Reilly Media
4. Programming Jakarta Struts, 2nd Edition by Chuck Cavaness, Publisher: O'Reilly Media
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105191/ https://onlinecourses.nptel.ac.in/noc19\_cs84/preview  |

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| **CLO1:** Learn the Internet Programming, using Java Applets **CLO 2:** Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings **CLO 3:** Apply event handling on AWT and Swing components. **CLO 4:**learn to access database through Java programs, using Java Data Base Connectivity (JDBC) **CLO 5:** Create dynamic web pages, using Servlets and JSP.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **CO1** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO3** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO4** | **3** | **3** | **2** | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **2** | **3** | **3** | **3** |
| **Weightageofcoursecontributedtoeach****PO/PSO** | **15** | **15** | **10** | **15** | **15** | **15** |

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| Title of the Course | **BIG DATA ANALYTICS**  |
| Paper Number  | CORE XIII |
| **Category** | Core | Year | II | **Credits** | 4 | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course provides an in-depth understanding of terminologies and the core concepts behind big data problems, applications, systems and the techniques, that underlie today's big data computing technologies.  |
| **Objectives of the Course** | By the end of the course the students will be able to Identify and distinguish big data analytics applications.Describe big data analytics tools.Present cases involving big data analytics in solving practical problems. |
| **Course Outline** | **UNIT-I :****Overview of Big Data and Data Analytics** Overview of Big Data: Characteristics of Big Data-Big Data Sources- Challenges in Big Data processing-Scalability issues; Business Intelligence v/s Data Analytics-Need of Data Analytics- Data Analytics in Industries- Role of the Data Scientist. The Design of HDFS- HDFS Concepts- Blocks – Name nodes and Data nodes; The Command- Line Interface: Basic File system Operations; Hadoop File systems: Interfaces-The Java Interface-Data Flow; Hadoop I/O: Data Integrity-Compression-Serialization-File-based data structures.  |
| **UNIT-II :****MapReduce and its application** Analyzing the Data with Unix Tools- Analyzing the Data with Hadoop- Map and Reduce- Java Map Reduce; Data Flow- Combiner Functions- Running a Distributed Map Reduce Job; Hadoop Streaming; Hadoop Pipes.  |
| **UNIT-III** :**Application development using MapReduce framework** The Configuration API- Configuring the Development Environment- Writing a Unit Test- Running Locally on Test Data- Running on a Cluster- Tuning a Job- MapReduce Workflows.  |
| **UNIT – IV :****Working of MapReduce** Mining Data Streams: The Stream Data Model- Sampling data in a stream- Filtering Streams- The Bloom filter; Counting distinct elements in a stream- The Flajolet-Martin Algorithm. How stream works-Streams Processing Language; Apache Spark - Introduction- Features of Apache Spark- Components of Spark- Resilient Distributed Datasets- Data Sharing using Spark RDD-Spark Streaming.  |
| **UNIT-V:****Analytics for Big Data in motion** Mining Data Streams: The Stream Data Model- Sampling data in a stream- Filtering Streams- Mining Social Network Graphs: Clustering of Social Network Graphs- Direct Discovery of Communities- Partitioning of Graphs- Finding overlapping communities- Simrank; Sentimentanalysis- Document sentiment classification- Rules of Sentiment Composition- Sentiment analysis using Twitter data.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, UK, 2011.
 |
| Reference Books | 1. Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw-Hill, 2012.
2. Liu, Bing. "Sentiment analysis and opinion mining." Synthesis lectures on human language technologies, Cambridge University Press, 2015.
3. Holden Karau, Andy Konwinski, Patrick Wendell, MateiZaharia, " Learning Spark: Lightning- Fast Big Data Analysis", O'Reilly Media, 2015.
4. David Loshin, Morgan, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL and Graph”, Kaufman Publishers, 2013.
 |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105166/ https://onlinecourses.nptel.ac.in/noc21\_ee85/preview  |

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| **CLO1:** To understand the basic knowledge of big data analytics. **CLO 2:** To learn the techniques and tools for big data analytics. **CLO 3:** To conduct application case studies to show the usage of big data analytics. **CLO 4:**Design and develop program to big data analytics techniques.**CLO 5:** Conduct big data analytics using system tools.  |

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| **CO/PSO** | **PSO****1** | **PSO****2** | **PSO****3** | **PSO****4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | PROJECT WITH VIVA VOCE |
| Paper Number  | CORE IVX |
| **Category** | Core | Year | II | **Credits** | 3 | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| -- | -- | 4 | 4 |
| **Pre-requisite** |  UG Level Computer Science |

**Elective Course Syllabus**

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| --- | --- |
| Title of the Course | CryptographyandNetworkSecurity |
| Paper Number  |  |
| **Category** | Elective I | Year | I | **Credits** | 3 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | The Prerequisites of Cryptography and information security is to understand the principles and practices of cryptographic techniques |
| **Objectives of the Course** | the students will be able to* Understand a variety of generic security threats and vulnerabilities, and identify.(K1)
* Appreciate the application of security techniques and technologies in solving real life security problems in practical systems.(K2)
* Apply appropriate security techniques to solve security problem(K3,K4)
* Design security protocols and methods to solve the specific security problems. K5,K6)
 |
| **Course Outline** | **UNIT-I :**Fundamentals and Mathematics of Cryptography Overview - Classical Crypto Systems – Substitution Ciphers – Transposition Ciphers- Stream and Block Ciphers – Introduction to Number Theory – Congruences – Chinese Remainder theorem – Modular Arithmetic - Modular Exponentiation – Fermats and Eulers Theorem - FiniteFields – GF(2n ) Fields. |
| **UNIT-II :**Encryption Techniques Symmetric Encryption Techniques – DES – AES - Public-Key Cryptography and RSA – Key Management - Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Symmetric Key Distribution – Kerberos - X.509 Authentication Service - differential cryptanalysis - linear cryptanalysis - side channel attack - lattice reduction attack - MerkleHellman knapsack attack - Hellman's time-memory tradeoff (TMTO) attack. |
| **UNIT-III :** Hash Functions and Signatures Message Authentication and Hash Functions – Description of MD Hash Family – Secure Hash Algorithms – SHA 512 - Digital Signatures and Authentication Protocols – Digital Signature Standard – Process, Services, Attacks on Digital Signature- Digital Signature Schemes. |
| **UNIT-IV :** Security Practices Vulnerability Analysis - Flaw Hypothesis Methodology, NRL taxonomy and Aslam’s model - Auditing - Anatomy of an Auditing System - Design of Auditing Systems - Posteriori Design - Auditing mechanisms - Risk Analysis and Management - Disaster Recovery Planning/Incident Response Planning - Intrusion Detection System |
| **UNIT-V:** Secure Development Secure Coding - OWASP/SANS Top Vulnerabilities - Buffer Overflows - Incomplete mediation - XSS - Anti Cross Site Scripting Libraries - Canonical Data Format - Command Injection - Redirection - Inference – Application Controls - Secure Software Development Life Cycle - Testing, Maintenance and Operation - Evaluation of Security Systems. |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. William Stallings, “Cryptography And Network Security – Principles And Practices”, PearsonEducation, Fourth Edition, 2006.
 |
| Reference Books | 1. Wade Trappe And Lawrence C. Washington, “Introduction To Cryptography With Coding Theory” Second Edition, Pearson Education, 2007.
2. Mark Stamp, “Information Security: Principles And Practice”, Wiley Inter Science, 2011.
 |
| **Website and** **e-Learning Source** | 1. http://nptel.ac.in/courses/106105031/lecture by Dr. Debdeep Mukhopadhyay IIT Kharagpur
2. https://ocw.mit.edu/courses/electrical-engineering-andcomputer-science/6-033-computer-system-engineering-spring2009/video-lectures/ lecture by Prof. Robert Morris and Prof. Samuel Madden MIT.
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| **CLO1:**To provide students with contemporary knowledge in Cryptography and Security.**CLO 2:**To understand how cryptography can be used as an effective tool in providing assurance  concerning privacy and integrity of information**CLO 3:**To provide skills to design security protocols for security problems.**CLO 4:** Analyze particular security problems for given application**CLO 5:**Familiar with current research issues and directions of security |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | Problem Solving Techniques and Applications |
| Paper Number  |  |
| **Category** | Elective I | Year | I | **Credits** | 3 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | The Prerequisites of Problem solving techniques and applications to solve the real world problem through programming in an efficient manner. This course provides adequate knowledge to solve the problems in respective domains. |
| **Objectives of the Course** | * Describe the basics of computer and understand the problem solving aspect.
* Demonstrate the algorithm and flow chart for the given problem. Design and develop program to evaluate simple expressions and logical operations.
 |
| **Course Outline** | **UNIT-I :**: Introduction Notion of algorithms and programs – The problem-solving aspect – General problem-solving strategies - Problem solving using topdowndesign. Programming in C: Data types - Control statements – Functions – Arrays – Structures – Pointers – Pointers and Functions - Pointers and Arrays – Pointers and Structures - Dynamic memory allocation. |
| **UNIT-II :** Fundamental Algorithms Exchanging the values of two variables – Counting - Summation of a set of numbers - Factorialcomputation - Sine function computation - Fibonacci Series generation - Reversing the digits of an integer – Base Conversion |
| **UNIT-III :** Factoring Methods Finding the square root of a number - Generating prime numbers - Generating the prime factorsof an integer – Generation of pseudorandomnumbers - Raising a number to a large power – Computing the nth Fibonacci number |
| **UNIT-IV :**Array Techniques Array order reversal – Removal of duplicates from an ordered array - Array counting or histogramming – Partitioning an array – Finding thekth smallest element – Longest monotonesubsequence. |
| **UNIT-V:** Text Processing and Pattern Searching Text line length adjustment – Left and right justification of text – Keyword searching in text – Text line editing – Linear pattern search. Recursive algorithms: Towers of Hanoi – Permutation generation. |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. R. G. Dromey, How to Solve it by Computer, Prentice Hall ofIndia, 2009. 2.
2. B.W. Kernighan and D.M. Ritchie, The C Programming Language, Second Edition, PHI, NewDelhi, 1990.
 |
| Reference Books | 1. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, 5th Edition,Pearson Education, 2009.
2. Herbert Schildt, The Complete Reference – C, Fourth Edition, McGraw Hill, 2010
 |
| **Website and** **e-Learning Source** | https://onlinecourses.nptel.ac.in/noc20\_cs81/preview https://nptel.ac.in/courses/106/101/106101208/ |

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| **CLO1:**Develop technical project reports and present them orally among the user.**CLO 2:**Understand how technological advances impact society and the social, legal, ethical and cultural ramifications of computer technology and their usage.**CLO 3:**Communicate computer science concepts, designs, and solutions effectively and professionally.**CLO 4:** Demonstrate the concept of pointer and perform I/O operations.**CLO 5:**Develop & Implement programs with suitable modules to solve the given problem |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| --- | --- |
| Title of the Course | Cyber Forensics |
| Paper Number  |  |
| **Category** | Elective II | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course provides to use various forensic investigation approaches and tools necessary to start a computer forensics investigation. It also aims at increasing the knowledge and understanding in cyber security and ethical hacking.  |
| **Objectives of the Course** | The main objectives of this course are to: By the end of the course the students will be able to Understand the fundamentals of Computer Forensics K1) Learn the issues of Data Acquisition and Data Recovery.(K2) Explore networking in cyber forensics.(K3) Learn to analyze and validate forensics data.(K4,K5) Be familiar with forensic tools and case studies. (K6)  |
| **Course Outline** | **UNIT-I :** **Overview of Computer Forensics Technology** Computer Forensics Fundamentals - Types of Computer Forensics Technology - Types of Vendor and Computer Forensics Services.  |
| **UNIT-II :** **Computer Forensics Evidence and Capture** Data Recovery **-** Evidence Collection and Data Seizure – Duplication and Preservation of Digital Evidence – Computer Image Verification and Authentication.  |
| **UNIT-III :** **Computer Forensics Analysis** Discover of Electronic Evidence – Identification of Data – Reconstructing Past Events – Networks  |
| **UNIT-IV :** **Counter Measures for Information Warfare:** Fighting against Macro Threats: Defensive Strategies for Governments and Industry Groups - Information Warfare Arsenal: Tactics of the Military – Tactics of Terrorist and Rogues – Tactics of Private Companies  |
| **UNIT-V:** **Information Warfare Arsenal of the Future** Surveillance Tools for Information Warfare of the Future – Civilian Casualities: The Victims and Refugees of Information Warfare Results and Future Directions: Advanced Computer Forensics.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Chad Steel, Windows Forensics: The Field Guide for Conducting Corporate Computer Investigations, John Wiley & Sons, New Delhi 2006  |
| Reference Books | Majid Yar, Cybercrime and Society, Sage Publications, New Delhi, 2006. Robert M Slade, Software Forensics, Tata McGraw Hill, New Delhi, 2004.  |
| **Website and** **e-Learning Source** | https://onlinecourses.swayam2.ac.in/cec21\_ge10/preview https://nptel.ac.in/courses/106/105/106105031/  |

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| **CLO1:** To learn about the knowledge and techniques to computer forensics practices and evidence analysis. **CLO 2:**To learn the issues of data acquisition, data recovery and networking in cyber forensics. **CLO 3:**To analyze and validate forensics data using forensic tools and case studies **CLO 4:** Understand about theDefensive Strategies for Governments and Industry Groups**CLO 5:** Identify the Surveillance Tools for Information Warfare of the Future |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Parallel Algorithms and Programming**  |
| Paper Number  |  |
| **Category** | Elective II | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | I |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course requires the understanding of Parallel Algorithms - Data Structures, Algorithms and Discrete Mathematics of optimization and bit computations.  |
| **Objectives of the Course** | The main objectives of this course are to: Students will try to learn: * Identify the basic construction and use of parallel computers,
* Describe the content and use of the terminology for how one measures the performance of parallel algorithms and parallel computers,
* Interpret the process to develop computer programs for different types of parallel algorithm and computers.
* Review an idea and use basic parallel algorithms and specifications
* Conceive the factor of computing and use basic data structures; know about the existence of advanced data structures.
 |
| **Course Outline** | **UNIT-I :** **INTRODUCTION :** Need for Parallel Processing - Data and Temporal Parallelism - Models of Computation - RAM and PRAM Model – Shared Memory and Message Passing Models- Processor Organizations - PRAM Algorithm – Analysis of PRAM Algorithms- Parallel Programming Languages.  |
| **UNIT-II :** **PRAM ALGORITHMS** : Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting - Merging Two Sorted Lists – Matrix Multiplication - Graph Coloring - Graph Searching.  |
| **UNIT-III :** **SIMD ALGORITHMS –I:** 2D Mesh SIMD Model - Parallel Algorithms for Reduction - Prefix Computation - Selection - Odd-Even Merge Sorting - Matrix Multiplication  |
| **UNIT-IV :** **SIMD ALGORITHMS-II:** Hypercube SIMD Model - Parallel Algorithms for Selection- Odd-Even Merge Sort- Bitonic Sort- Matrix Multiplication Shuffle Exchange SIMD Model - Parallel Algorithms for Reduction -Bitonic Merge Sort - Matrix Multiplication - Minimum Cost Spanning Tree  |
| **UNIT-V:** UMA Multiprocessor Model -Parallel Summing on Multiprocessor- Matrix Multiplication on Multiprocessors and Multicomputer - Parallel Quick Sort - Mapping Data to Processors.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017. 2. V. Rajaraman, C. Siva Ram Murthy, "Parallel computers - Architecture and Programming ", PHI learning, 2016.  |
| Reference Books | 1. M Sasikumar, Dinesh Shikhare and P Ravi Prakash , " Introduction to Parallel Processing", PHI learning , 2013  2. Seyed H Roosta, “Parallel Programming and Parallel Algorithms” Springer Series New York 2001  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/103/106103188/ https://nptel.ac.in/courses/106/104/106104120/ https://nptel.ac.in/courses/106/106/106106112/ https://nptel.ac.in/courses/106102163  |

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| **CLO1:**Understand the differences among several algorithms solving the same problem and recognize which one is better under different conditions;**CLO 2:**Understand the difference between sequential and parallel algorithms**CLO 3:**This applies both to computers with shared memory and with distributed memory.**CLO 4:** Analyse efficiency of different parallel algorithms.**CLO 5:**Develop parallel algorithms for standard problems and application |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | Advanced Computer Networks |
| Paper Number  |  |
| **Category** | Elective III | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | While the course has no formal prerequisites, some background in computer networking is useful. |
| **Objectives of the Course** | The main objectives of this course are to: * Briefly explain the basic components of Networking
* To Identify an understanding of different components of computer networks, various protocols, modern technologies and their applications
* To explain and exemplify current QoS architectures and mechanisms, and the QoS support challenges in future networks
* To Evaluate Cryptography technique knowledge for understanding various Algorithms for security
* To Conceive relevant management issues and devise adequate network management solutions
 |
| **Course Outline** | **UNIT-I :**Foundation Applications – Requirements – Network Architecture and Performance. Perspectives on connecting – Encoding – Framing – Error Detection – Reliable Transmission – Ethernet and Multiple Access Networks. |
| **UNIT-II :**Internet working Design Principles, IP Design, Intra domain Routing (RIP, OSPF), Inter-domain Routing (BGP), Adaptive Routing, Multipath and QoS Routing. Implementation and Performance. |
| **UNIT-III :** Simple Demultiplexer (UDP) – Reliable Byte Stream (TCP) – Remote Procedure Call Fundamentals – Overview of Transport for Real-Time Application (RTP) |
| **UNIT-IV :** Congestion Control and Resource Allocation Issues in Resource Allocation – Queuing Disciplines- Congestion control principles, Hop-by-hop vs. End-to-end congestion control, Explicit vs. Implicit Feedback, Fair Queuing, Flow control, TCP variants (Tahoe, Reno, Vegas, New-Reno, SACK), Load balancing using Multipath TCP. – Congestion Avoidance Mechanisms – Quality of Service |
| **UNIT-V:** Applications Traditional Applications – Infrastructure Services – Overview of Multimedia Applications and Overlay Networks. |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Larry L Peterson and Bruce S Davie, “Computer Networks – A Systems Approach”, MK Publishers, Fifth Edition, 2012James F Kurose and Keith W Ross, “Computer Networking – A Top Down Approach”, Sixth Edition, Pearson Education, 2013 |
| Reference Books | M. Barry Dumas, Morris Schwartz, “Principles of Computer Networks and Communications”, First Edition, Pearson, 2013. |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105031/ https://nptel.ac.in/courses/106/105/106105081/ https://www.tutorialspoint.com/cryptography/index.h |

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| **CLO1:**Describe how computer networks are organized with the concept of layered approach**CLO 2:**Assess the contents in a given data link layer packet, based on the layer concept.**CLO 3:**Describe how packets in the Internet are delivered.**CLO 4:** Design logical sub-address blocks with a given address block**CLO 5:**Implement a simple LAN with hubs, bridges and switches. |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | Theory of Computation |
| Paper Number  |  |
| **Category** | Elective III | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Students should possess basic knowledge on Discrete Mathematics and Data Structures  |
| **Objectives of the Course** | The main objectives of this course are to: * Identify the mathematical proofs for testing the computation.
* Explain the finite automata for solving computational problems
* Interpret the types of grammar recognized by different machines
* Differentiate P and NP problems
* Evaluate the problems based on pumping lemma
* Conceptualize the complexity of computational problems
 |
| **Course Outline** | **UNIT-I :** Understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine. Be aware of Decidability and Un-decidability of various problems. Learn types of grammars. Finite Automata Introduction - Basic Mathematical Notation and techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with €- moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NDFA‟s with and without €-moves – Equivalence of finite Automaton and regular expressions –Minimization of DFA- – Pumping Lemma for Regular sets – Problems based on Pumping Lemma.  |
|  | **UNIT-II :** Grammar Introduction– Types of Grammar – Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols – Unit productions – Null productions – Greiback Normal form – Chomsky normal form – Problems related to CNF and GNF.  |
| **UNIT-III :** Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL – pumping lemma for CFL – problems based on pumping Lemma.  |
| **UNIT-IV :** Definitions of Turing machines – Models – Computable languages and functions –Techniques for Turing machine construction – Multi head and Multi tape Turing Machines – The Halting problem – Partial Solvability – Problems about Turing machine- Chomskian hierarchy of languages.  |
|  | **UNIT-V:** Unsolvable Problems and Computable Functions – Primitive recursive functions – Recursive and recursively enumerable languages – Universal Turing machine. MEASURING AND Classifying Complexity: Tractable and Intractable problems- Tractable and possibly intractable problems – P and NP completeness – Polynomial time reductions.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | Hopcroft J.E., Motwani R. and Ullman J.D, “Introduction to Automata Theory, Languages and Computations”, Second Edition, Pearson Education, 2008.  |
| Reference Books | John C Martin, “Introduction to Languages and the Theory of Computation”, Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105031/ https://nptel.ac.in/courses/106/105/106105081/ https://www.tutorialspoint.com/cryptography/index.h |

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| **CLO1:**Understand the concepts of mathematical proofs, finite automata and regular expressions. **CLO 2:**Understand and critically assess the problems related to turing machine. **CLO 3:** Comprehend the context free grammar and to represent the derivations using parse trees. **CLO 4:** To conceptualize and differentiate the problems by evaluating its complexity. **CLO 5:**Evaluate the problems for context free language based on pumping lemma.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Embedded Systems in Computing**  |
| Paper Number  |  |
| **Category** | Elective IV | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course requires the understanding of Embedded computing - memory management, programming processes and IOT streams.  |
| **Objectives of the Course** | The main objectives of this course are to: * Define the concepts and architecture of embedded systems
* Describe Basic of microcontroller 8051 and ARM Architecture
* Employ the concepts of memory input and output process of operating systems and microcontroller interface.
* Generalize the concepts of C programming basic and function
* Oriented to Embedded systems.
* Review an idea of real time operating system and design issues of Software development tools and Emulators in Embedded Computing
* Conceptualize the introduction about IOT and Design methodologies platforms used for an embedded systems application with case studies.
 |
| **Course Outline** | **UNIT-I :** **Embedded Computing:** Challenges of Embedded Systems – Embedded system design process. Embedded processors – 8051 Microcontroller, ARM processor – Architecture, Instruction sets and programming.  |
|  | **UNIT-II :** **Memory and Input / Output Management :**Programming Input and Output – Memory system mechanisms – Memory and I/O devices and interfacing – Interrupt handling.  |
| **UNIT-III :** **Processes and Operating Systems :**Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Performance issues.  |
| **UNIT-IV :** **Embedded C Programming :** Programming embedded systems in C – C-looping structures – Register allocation – Function calls – Pointer aliasing – structure arrangement – bit fields – unaligned data and endianness – inline functions and inline assembly – portability issues.  |
|  | **UNIT-V:** **Embedded System Development :**Meeting real time constraints – Multi- State systems and function sequences. Embedded software development tools – Emulators and debuggers. Introduction to Internet of Things -Design issues – Design methodologies – Case studies using IoT– Complete design of example systems.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Andrew N Sloss, D. Symes, C. Wright, “ARM System Developers Guide”, Morgan Kauffman/ Elsevier,2006. 2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015 3. Microcontroller and Embedded Systems”, Pearson Education, Second edition, 2007  |
| Reference Books | 4. Michael J. Pont, “Embedded C”, Pearson Education, 2007. 5. Steve Heath, “Embedded System Design”, Elsevier, 2005. 6. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/105/106105193/ https://nptel.ac.in/courses/106/103/106103182/ https://nptel.ac.in/courses/106/105/106105159/ https://nptel.ac.in/courses/108/102/108102045/ https://nptel.ac.in/courses/108/105/108105057/  |

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| **CLO1:**Explain the embedded system concepts and architecture of embedded systems **CLO 2:**Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller. **CLO 3:**Demonstrate the open source RTOS and solve the design issues for the same and IOT. **CLO 4:** Select elements for an embedded systems tool and Embedded C programming. **CLO 5:**Design the interfacing for 8051 microcontroller.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Advanced Digital Image Processing** |
| Paper Number  |  |
| **Category** | Elective IV | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | II |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Able to know extract from Differential Equations and the understanding of Linear Algebra.  |
| **Objectives of the Course** | The main objectives of this course are to: * To understand representation of digital images in the spatial and frequency domains.
* To understand Image Compression, Segmentation and image compression standards.
* To provide an in-depth understanding of various concepts related to image Representation and Description.
* To get familiar with image enhancement concepts and image degradation/restoration process.
 |
| **Course Outline** | **UNIT-I :** **DIGITAL IMAGE FUNDAMENTALS** – Introduction -Resolution and Quantization- Image format-The Origins of digital image processing – fundamental steps in Digital Image Processing -elements of visual perception systems-Light and the electromagnetic Spectrum-Image Sensing and Acquisition- Image sampling and Quantization- Some basic Relationship between Pixels- Introduction to the Basic Mathematical Tools Used in Digital Image Processing  |
|  | **UNIT-II :** **INTENSITY TRANSFORMATION AND SPATIAL FILTERING:** Mathematics of Image formation**-** The Basic of Intensity Transformations and Spatial Filtering- Background-Some basic Intensity Transformation Function – Histogram Processing-Histogram Equations –Histogram Matching-Local Histogram Processing- Smoothing(Low Pass) Spatial Filter – Sharpening (High Pass) Spatial Filter – Highpass, Bandreject, and Bandpass Filters from Low pass Filters – Combining Spatial Enhancement Methods  |
| **UNIT-III :** **IMAGE RESTORATIONAND RECONTRUCTION:** Image Modeling**-** Spatial and Frequency Properties of Noise – Periodic Noise-A Model of the Image Degradation/Restoration Process. Noise Models. Restoration in the Presence of Noise Only-Spatial Filtering- The Weiner-Histogram filter-.Matrix formulation of image restoration- Constrained Least Squares Filtering- Geometric Mean Filter.  |
| **UNIT-IV :** **COLOR IMAGE PROCESSING:** Color Fundamentals **–** Color Models - Pseudo color Image Processing - Basics of Full –Color Image Processing-Color Transformations –Color Image Smoothing and Sharpening –Image Segmentation based on color - Using Color in Image Segmentation-Noise in Color Images - Color Image Compression  |
|  | **UNIT-V:** **COLOR IMAGE COMPRESSION & WATER MARKING:** Fundamentals-Huffman Coding – Golomb Coding – Arithmetic Coding – LZW Coding – Run length Coding – Symbol Based Coding-Bit Plane Coding – Black Transform Coding- Predictive Coding-Wavelet Coding – Digital Image Water marking.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | R.C. Gonzalez and R. E. Woods, Digital image processing, Addison-Wesley Publishing House, 4th edition, 2018.  |
| Reference Books | Chris Solomon and Toby Breckon, Fundamentals of Digital image processing, A Practical Approach with Examples in MATLAB, First edition, 2011 John wiley& Sons  |
| **Website and** **e-Learning Source** | https://www.imageprocessingplace.com/ https://www.fundipbook.com/  |

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| **CLO1:**Acquire knowledge of principles of digital image processing **CLO 2:**Solve problems pertaining to the field of image acquisition, preprocessing, Fourier domain processing. **CLO 3:**Perform basic image restoration, image segmentation and image compression. **CLO 4:** Provide the foundations for life-long learning and continual professional development in the areas of image applications. **CLO 5:**Interpret various image compression standards  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Natural Language Processing**  |
| Paper Number  |  |
| **Category** | Elective V | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | The students should be able to study language and the tools that are available to efficiently study and analyze large collections of text.  |
| **Objectives of the Course** | The main objectives of this course are to: * To recall the concepts of FSA and Language processing (K1 & K2)
* To understand the different types of Analysis in NLP(K2 & K3)
* To implement the techniques in applications like machine translators (K5 &K6)
* To implement the NLP for Multilingual problems (K4 & K6)
* To analyze and apply the language errors detection and correction methods (K3 &K4)
 |
| **Course Outline** | **UNIT-I :** Origins and challenges of NLP, Computational framework for natural language – Language Modeling: Grammar-based LM, Statistical LM - lexicon, algorithms and data structures for implementation of framework, different analysis of NLP - RTN, ATN-applications like machine translators . |
|  | **UNIT-II :** **Word level and syntactic analysis:** Regular Expression, Finite State Automata, Morphological parsing, Spelling errors detection and correction - Language Modeling - N-gram model, word classes, part of speech tagging-Hidden Markov modeling -Syntactic Analysis : Context free grammar -treebanks, syntactic parsing, Probabilistic parsing, Probabilistic lexicalized CFG's.  |
| **UNIT-III :** Semantics and pragmatics Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods  |
| **UNIT-IV :** **Natural language generation** Natural Language Generation (NLG): Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG. Machine Translation: Problems in Machine Translation, Machine Translation Approaches, Translation involving Indian Languages.  |
|  | **UNIT-V:** **Disclosure analysis and lexical resources:** Disclosure segmentation, Coreference phenomena, coreference resolution - Resources: Porter stemmer, Lemmatizer, Penn Treebank, World Net, Frame Net.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition by Daniel Jurafsky and James H. Martin, Pearson Education, Third Edition.  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106105158 ● https://nptel.ac.in/courses/106101007 ● https://www.ibm.com/cloud/learn/natural-language-processing ● https://www.analyticsvidhya.com/blog/2020/01/3-important-nlp-libraries-indian-languages-python/  |

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| **CLO1:** Understand language and the tools that are available to efficiently study and analyze large collections of text. **CLO 2:**Analyze and discuss the effects of electronic communication on our language **CLO 3:**Learn natural language processing with manual and automated approaches. **CLO 4:** Learn computational frameworks for natural language processing. .**CLO 5:**To implement the techniques in applications like machine translators  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Data Science**  |
| Paper Number  |  |
| **Category** | Elective V | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | III |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | This course provides the foundational view about data science functions and its subset techniques. Students should have basics understand in mathematical and statistical methods to simulate. Also to know how to handle fundamental programming structures and database processing.  |
| **Objectives of the Course** | The main objectives of this course are to: * Defines the basics Concept of Data Science and mathematical operations.
* Explain about various data analysis and data transformations in data science.
* Generalize the Learning function of Data science application using Tools and functional structures.
* Review an Idea of Exploratory Data Analysis with Probability and Statistics using Machine Learning Techniques and Social media analysis.
* Asses the concepts of data processing issues in the development of Data Applications, Evaluations, and Methods or other components that satisfy design requirements.
* Conceptualize the principles of Creative and dynamic thinking capability skills to build and design big data analysis and overcome the problems.
 |
| **Course Outline** | **UNIT-I :** **Introduction to Data Science:** Definition-Data Science Relate to Other Fields-Relationship between Data Science and Information Science -Skills for Data Science - Tools for Data Science - Issues of Ethics, Bias, and Privacy in Data Science. **Data Techniques:** Introduction - Data Types - Data Collections - Data Pre-processing - Data Analysis and Data Analytics - Descriptive Analysis - Diagnostic Analytics - Predictive Analytics - Prescriptive Analytics - Exploratory Analysis - Mechanistic Analysis - Visualizing Data.  |
|  | **UNIT-II :** **Statistical Learning:** Introduction - Supervised and Unsupervised Learning - Training and Test Loss - Tradeoffs in Statistical Learning -Estimating Risk - Modeling Data - Multivariate Normal Models. **Statistical Experiments and** **Significance Testing:** A/B Testing - Hypothesis Tests – Resampling - Statistical Significance and p-Values - t-Tests - Multiple Testing - Degrees of Freedom – ANOVA - Multi-Arm Bandit Algorithm - Power and Sample Size.  |
| **UNIT-III :** **Prediction:** Correlation- The Regression Line - The Method of Least Squares - Least Squares Regression - Visual Diagnostics - Numerical Diagnostics. **Inference for Regression:** A Regression Model - Inference for the True Slope - Prediction Intervals. **Classification:** Nearest Neighbors - Training and Testing - Rows of Tables - Implementing the Classifier - The Accuracy of the Classifier. **Comparing Two Samples:** Two Categorical Distributions - A/B Testing - Causality. **Updating Predictions:** A "More Likely Than Not" Binary Classifier - Making Decisions.  |
| **UNIT-IV :** **Tools for Data science: R Programming** - R Introduction - Getting Access to R - Getting Started with R- Graphics and Data Visualization- Statistics and Machine Learning. **MYSQL:** Introduction - Getting Started with MySQL - Creating and Inserting Records - Retrieving Records - Searching in MySQL - Accessing MySQL with Python - Accessing MySQL with R. **Introduction to Other Popular Databases:** NoSQL - MongoDB - Google BigQuery.  |
|  | **UNIT-V:** **Extracting Information from News:** Prologue – Framework - Algorithms - Crawlers and Scrapers - Text Pre-processing - The tm package - Term Frequency - Inverse Document Frequency (TF-IDF) – Wordclouds - Regular Expressions. **Extracting Data from Web Sources using APIs**: Using Twitter - Using Facebook - Text processing, plain and simple - A Multipurpose Function to Extract Text.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | 1. Data Science and Machine Learning "Mathematical and Statistical Methods", Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman,25th November 2020.  |
| **Reference Texts** | 1. Practical Statistics for Data Scientists "50+ Essential Concepts Using R and Python", Peter Bruce, Andrew Bruce, and Peter Gedeck, 2nd Edition Published by O’Reilly Media, Inc. 2. Computational and Inferential Thinking "The Foundations of Data Science" By Ani Adhikari and John DeNero. 3. A Hands-On Introduction to Data Science, CHIRAG SHAH, University of Washington. © Chirag Shah 2020.  |
| **Website and** **e-Learning Source** | https://onlinecourses.nptel.ac.in/noc21\_cs69/preview https://onlinecourses.nptel.ac.in/noc21\_ma35/preview https://onlinecourses.nptel.ac.in/noc21\_cs24/preview  |

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| **CLO1:**Understand to apply mathematics and science in AI and machine learning applications. **CLO 2:**Demonstrate the big data and statistical analysis using various data science tools. **CLO 3:**Recall the function of statistical learning methods and techniques to modeling the data in efficient manner. **CLO 4:** Compare and Contrast the various classifications of machine learning model and approaches. .**CLO 5:**Critique the data analyzing and extracting dimensional aspects in social networking applications.  |

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| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO****5** | **PSO****6** |
| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Distributed and Cloud Computing**  |
| Paper Number  |  |
| **Category** | Elective VI | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | The Prerequisites of Cloud computing is it builds upon prior knowledge that students have on computing and software systems and programming knowledge.  |
| **Objectives of the Course** | The main objectives of this course are to: * Classify and describe the architecture and taxonomy of Parallel and Distributed Systems Context.(K1)
* Cloud Virtualization, Abstractions and Enabling Technologies Characterize the distinctions between Infrastructure, Platform and Software as a Service (IaaS, PaaS, SaaS).(K2)
* Examine the design of task and data parallel distributed algorithms on Programming Patterns for "Big Data" Applications on Cloud.(K3,K4)
* Application Execution Models on Clouds.(K5)
* Illustrate the use of load balancing techniques for stateful and stateless applications.(K6)
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| **Course Outline** | **UNIT-I :** **Distributed Communication** Introduction to Distributed Systems – Characterization of Distributed Systems – Distributed Architectural Models –Remote Invocation – Request-Reply Protocols – Remote Procedure Call –Remote Method Invocation – Group Communication – Coordination in Group Communication– Ordered Multicast – Time Ordering – Physical Clock Synchronization – Logical Time and Logical Clocks.  |
|  | **UNIT-II :** **Distributed Resource Management** Global States– Distributed Mutual Exclusion – Election Algorithms – Distributed Deadlock – Distributed File System Architecture – HDFS – Map Reduce.  |
|  | **UNIT-III :** **Introduction to Cloud** Cloud Computing Overview – Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service , Broad network access , Location independent resource pooling , Rapid elasticity , Measured service. Architectural influences – High- performance Computing, Utility and Enterprise Grid Computing, Autonomic Computing, Service Consolidation, Horizontal scaling, Web services, High scalability Architecture. Cloud Benefits – Cloud Deployment Model: Public Clouds – Private Clouds – Community Clouds - Hybrid Clouds - Advantages of Cloud Computing.  |
|  | **UNIT-IV :** **Virtualization Techniques** Introduction to Virtual Machines, Emulation :Interpretation and Binary Translation, Process Virtual machines and System Virtual machines Virtualization : Virtualization and cloud computing - Need of virtualization – limitations – Types of Hardware Virtualization: Full Virtualization – Para Virtualization – Case Studies : Xen,VMware – Desktop Virtualization – Network Virtualization.  |
|  | **UNIT-V:** **Cloud Resources Management And Issues** Cloud architecture: Cloud delivery model, Cloud Storage Architectures, Software as a Service (SaaS): SaaS service providers – Google App Engine, Salesforce.com and googleplatfrom – Benefits – Operational benefits - Economic benefits – Evaluating SaaS – Platform as a Service (PaaS): PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com – Services and Benefits – Infrastructure-as-a -Service (IaaS): IaaS Service Providers – Amazon EC2 – GoGrid.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | George Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education Asia, 2012.  |
| **Reference Texts** | 1. Distributed Systems - Principles and Paradigms, Andrew S. Tanenbaum,Maarten Van Steen, Second Edition, Pearson Prentice Hall, 2006. 2. MukeshSinghal, Advanced Concepts In Operating Systems, McGraw Hill Series in Computer Science, 1994. 3. Cloud Computing A Practical Approach - Anthony T.Velte, Toby J. Velte, Robert Elsenpeter Tata-McGraw- Hill , New Delhi – 2010.  |
| **Website and** **e-Learning Source** | https://nptel.ac.in/courses/106/104/106104182/ https://onlinecourses.nptel.ac.in/noc21\_cs15/preview  |

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| **CLO1:**Introduction to distributed systems and cloud computing. **CLO 2:**Design, architectures and technology. Cloud applications, service quality and security. **CLO 3:**Algorithms for synchronization, coordination, data sharing, resource allocation, consistency, fault tolerance. **CLO 4:** Replication, consistency and concurrency control in transactional systems..**CLO 5:**Illustrate the use of load balancing techniques for stateful and stateless applications..  |

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| **CO1** | **3** | **3** | **2** | **2** | **3** | **3** |
| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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| Title of the Course | **Data Mining and Warehousing**  |
| Paper Number  |  |
| **Category** | Elective VI | Year |  | **Credits** | 3 | **Course Code** |  |
| **Semester** | IV |
| **Instructional Hours****per week** | **Lecture** | **Tutorial** | **Lab Practice**  | **Total** |
| 4 | 1 | -- | 5 |
| **Pre-requisite** | Able to know extract useful data from a sea of un-amassed data and the understanding of data analysis.  |
| **Objectives of the Course** | The main objectives of this course are to: Understand the basic data mining techniques and algorithms(K1) Understand the Association rules, Clustering techniques and Data warehousing contents(K1,K2) Illustrate the mining techniques like association, classification and clustering on transactional databases(K3) Illustrate the warehousing techniques like Online Analytical Processing(OLAP) and Multidimensional Data Analysis(K4) Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining(K5) Design data warehouse with dimensional modeling and apply OLAP operations(K6)  |
| **Course Outline** | **UNIT-I :** **Data Warehousing Data** Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.  |
|  | **UNIT-II :**

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| **Data Mining & Association Rule Mining** Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and  |
| Concept Hierarchy Generation. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – from Association Mining to Correlation Analysis – Constraint-Based Association Mining.  |

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|  | **UNIT-III :** **Classification & Prediction** Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor  |
|  | **UNIT-IV :** **Cluster Analysis** Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model Based Clustering Methods – Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.  |
|  | **UNIT-V:** **Applied Data Mining** Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.  |
| Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour) |
| Skills acquired from this course |  Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| **Recommended Text** | K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.  |
| **Reference Texts** | 1. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006 2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.  |
| **Website and** **e-Learning Source** | https://www.tutorialspoint.com/datawarehousing/index.htm https://www.mooc-list.com/tags/data-warehousing -MOOC https://onlinecourses.swayam2.ac.in/cec19\_cs01/preview-SWAYAM  |

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| **CLO1:**To introduce the concept of data Mining and warehousing as an important tool for enterprise data management and cutting edge technology for building competitive advantage **CLO 2:**Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing. **CLO 3:**To make students well versed in all data warehousing algorithms, methods of evaluation. **CLO 4:** Develop skills of using recent data mining software for solving practical problems .**CLO 5:**Develop and apply critical thinking, problem-solving, and decision- making skills. .  |

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| **CO2** | **3** | **2** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **2** | **3** | **2** | **2** | **1** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **2** | **3** | **3** | **3** | **3** |
| **Weightage ofcoursecontributed****toeachPSO** | **15** | **12** | **14** | **12** | **14** | **13** |

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