**M.Sc.,**

**COMPUTER SCIENCE**

**SYLLABUS**

**FROM THE ACADEMIC YEAR**

**2023 - 2024**

**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION**

**CHENNAI – 600 005.**

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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** |
| **Programme** | **M.Sc., Computer Science**  |
| **Programme Code** |  |
| **Duration** | **PG - Two Years** |
| **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. |

**Credit Distribution for PG Programme**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Semester-II** | **Credit** | **Semester-III** | **Credit** | **Semester–IV** | **Credit** |
| 1.1. Core-I | 4 | 2.1. Core-IV | 4 | 3.1. Core-VII | 4 | 4.1. Core-X | 4 |
| 1.2 Core-II | 4 | 2.2 Core-V | 4 | 3.2 Core-VII | 4 | 4.2 Core-XI | 4 |
| 1.3 Core – III | 4 | 2.3 Core – VI | 4 | 3.3 Core – IX | 4 | 4.3 Core – XII | 4 |
| 1.4 Elective (Generic / Discipline Centric)- I | 3 | 2.4 Elective (Generic / Discipline Centric) – III | 3 | 3.4 Elective (Generic / Discipline Centric) – V | 3 | 4.4 Elective (Generic / Discipline Centric) – VI | 3 |
| 1.5 Elective (Generic / Discipline Centric)-II | 3 | 2.5 Elective (Generic / Discipline Centric)-IV | 3 | 3.5 Core Industry Module  | 3 | 4.5 Project with Viva-Voce | 3 |
| 1.6Ability Enhancement Course- Soft Skill -1 | 2 | 2.6 Ability Enhancement Course - Soft Skill -2 | 2 | 3.6 Ability Enhancement Course- Soft Skill -3 | 2 | 4.6 Ability Enhancement Course- Soft Skill -4 | 2 |
| Skill Enhancement Course SEC 1 | 2 | 2.7 Skill Enhancement Course SEC 2 | 2 | 3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3 | 2 | 4.7 Skill Enhancement Course - Professional Competency Skill | 2 |
|  |  |  |  | 3.8 Internship/ Industrial Activity | 2 | 4.8 Extension Activity | 1 |
|  | **22** |  | **22** |  | **24** |  | **23** |
|  | **Total Credit Points** | **91** |

**Component wise Credit Distribution**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  **Credits** | **Sem****I** | **Sem****II** | **Sem****III** | **Sem****IV** | **Total** |
| **PartA** | **18** | **18** | **18** | **18** | **72** |
| **Part B****(i)Discipline– Centric/GenericSkill** | **2** | **2** | **2** | **2** | **8** |
| **(ii)SoftSkill** | **2** | **2** | **2** | **2** | **10** |
| **(iii)SummerInternship/Industrial****Training** |  |  | **2** |  |
| **PartC** |  |  |  | **1** | **1** |
| **Total** | **22** | **22** | **24** | **23** | **91** |

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| **METHODS OF EVALUATION** |
| **Internal Evaluation** | Continuous Internal Assessment Test  | **25 Marks** |
| Assignments / Snap Test / Quiz |
| Seminars  |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | **75 Marks** |
| **Total** | **100 Marks** |
| **METHODS OF ASSESSMENT** |
| **Remembering (K1)** | * Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecoursecontent
* Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook.
 |
| **Understanding (K2)**  | * Understandingoffactsandideasbycomprehendingorganizing,comparing,translating,interpolatingandinterpretingintheirownwords.
* Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether
 |
| **Application (K3)** | * Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom.
* Studentsmust usetheir knowledgetodetermineaexactresponse.
 |
| **Analyze (K4)**  | * Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoitscomponentparts.
* Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclusionsorgeneralizations.
 |
| **Evaluate (K5)** | * Evaluationrequiresanindividualtomakejudgmentonsomething.
* Questionstobeaskedtojudgethevalueofanidea,acharacter,aworkofart,orasolutiontoaproblem.
* Studentsareengagedindecision-makingandproblem–solving.
* Evaluationquestionsdonothavesinglerightanswers.
 |
| **Create (K6)** | * Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking.
* Developingoriginalideasandproblemsolvingskills
 |

**PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING**

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| **PROGRAMME SPECIFIC OUTCOMES (PSO)** |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **PSO1** | **3** | **3** | **3** | **3** | **3** |
| **PSO2** | **3** | **3** | **3** | **3** | **3** |
| **PSO3** | **3** | **3** | **3** | **3** | **3** |
| **PSO4** | **3** | **3** | **3** | **3** | **3** |
| **PSO5** | **3** | **3** | **3** | **3** | **3** |

**Level of Correlation between PO’s and PSO’s**

*(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)*

Assign the value

**1 – Low**

**2 – Medium**

**3 – High**

**0 – No Correlation**

**M.Sc., Computer Science**

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| --- | --- | --- | --- | --- |
| **Course Code** | **Titleof theCourse** | **Credits** | **Hours** | **Maximum Marks** |
| **Theory** | **Practical** | **CIA** | **ESE** | **Total** |
| **FIRSTSEMESTER** |
| Core - I | PaperI:Analysis&Designof Algorithms | 5 | 7 |  | 25 | 75 | 100 |
| Core – II | PaperII:ObjectOriented Analysis and Design &C++ | 5 | 7 |  | 25 | 75 | 100 |
| Core – III | PaperIII:PythonProgramming | 4 | 6 |  | 25 | 75 | 100 |
| Elective - I | PaperIV: AdvancedSoftwareEngineering | 3 | 5 |  | 25 | 75 | 100 |
| Elective – II | Practical I:AlgorithmandOOPSLab | 3 | 5 | 5 | 40 | 60 | 100 |
| **Total** | 20 | 30 | 10 |  |  |  |
|  |
| **SECONDSEMESTER** |
| Core - IV | PaperV:DataMiningandWarehousing | 5 | 6 |  | 25 | 75 | 100 |
| Core – V | PaperVIAdvancedOperatingSystems | 5 | 6 |  | 25 | 75 | 100 |
| Core - VI | PaperVII AdvancedJava Programming | 4 | 6 |  | 25 | 75 | 100 |
| Elective – III | Paper VIII : Artificial Intelligence&MachineLearning | 3 | 4 |  | 25 | 75 | 100 |
| Elective –IV | Elective –IV | 3 | 4 |  | 25 | 75 | 100 |
| NME – I | Practical III :Data MiningLabusing R | 4 |  | 5 | 40 | 60 | 100 |
|  |  | 4 |  | 5 | 40 | 60 | 100 |
| **Total** | 22 | 30 | 10 |  |  |  |
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| **THIRD SEMESTER** |
| Core - VII | PaperIX:Digital ImageProcessing | 5 | 6 |  | 25 | 75 | 100 |
| Core – VIII | PaperX: CloudComputing | 5 | 6 |  | 25 | 75 | 100 |
| Core – IX | PaperXI:Network Security andCryptography | 5 | 6 |  | 25 | 75 | 100 |
| Core - X | PaperXII:DataScience& Analytics | 4 | 6 |  | 25 | 75 | 100 |
|  | Elective – V Practical :DigitalImage Processing Lab usingMATLAB / Practical :DigitalImage Processing Lab usingMATLAB | 3 | 3 |  | 25 | 75 | 100 |
| NME | PracticalVI:CloudComputing Lab | 2 | 3 | 4 | 40 | 60 | 100 |
| Internship Industrial Activity |  | 2 | - | 2 | 40 | 60 | 100 |
| **Total** | 26 | 30 | 10 |  |  |  |
| **FOURTHSEMESTER** |
| Core – XI | Python Programming LabPractical | 5 | 6 |  |  |  |  |
| Core – XII | Web Application development& hosting Practical | 5 | 6 |  |  |  |  |
|  | ProjectworkandViva-voce(200marks) | 7 | 10 |  | 40 | 60 | 100\* |
|  | Skill Enhancement Course - Professional Competency Skill | 2 | 4 |  |  |  |  |
|  | Extension Activity | 1 | - |  |  |  |  |
| **Total** | 23 | 30 |  |  |  | 100 |
| **Grand Total** | 91 |  |  |  |  |  |

**I – SEMESTER**

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| **Coursecode** |  | **ANALYSIS&DESIGNOF ALGORITHMS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicDataStructures& Algorithms |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. EnablethestudentstolearntheElementary DataStructuresandalgorithms.
2. Presentsanintroductiontothealgorithms,theiranalysisand design
3. DiscussvariousmethodslikeBasicTraversalAndSearchTechniques,divideandconquer method, Dynamic programming, backtracking
4. Understoodthevariousdesignandanalysisofthe algorithms.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Get knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique. | K1,K2 |
| 2 | GaingoodunderstandingofGreedymethodandits algorithm. | K2,K3 |
| 3 | Abletodescribeaboutgraphsusingdynamicprogrammingtechnique. | K3,K4 |
| 4 | Demonstratethe concept ofbacktracking&branchandboundtechnique. | K5,K6 |
| 5 | Explorethetraversaland searchingtechniqueandapplyitfortreesandgraphs. | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph. |
|  |
| **Unit:2** | **TRAVERSALANDSEARCHTECHNIQUES** | **15hours** |
| Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs -Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort. |
|  |
| **Unit:3** | **GREEDY METHOD** | **15hours** |
| TheGreedyMethod:-GeneralMethod–KnapsackProblem–MinimumCostSpanningTree– Single Source Shortest Path. |
|  |
| **Unit:4** | **DYNAMICPROGRAMMING** | **15hours** |
| DynamicProgramming-GeneralMethod–MultistageGraphs–AllPairShortestPath–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling. |
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**Version**

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| **Unit:5** | **BACKTRACKING** | **13hours** |
| Backtracking:-GeneralMethod–8-QueensProblem–SumOfSubsets–GraphColoring– Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson. |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars– webinars |
|  |
|  | **TotalLecturehours** | **75hours** |
|  |
| **Text Books** |
| 1 | EllisHorowitz,“ComputerAlgorithms”,GalgotiaPublications. |
| 2 | AlfredV.Aho,JohnE.Hopcroft,JeffreyD.Ullman,"DataStructuresandAlgorithms". |
| **ReferenceBooks** |
| 1 | Goodrich,“DataStructures&AlgorithmsinJava”,Wiley3rd edition. |
| 2 | Skiena,”TheAlgorithmDesignManual”,SecondEdition,Springer,2008 |
| 3 | AnanyLevith,”IntroductiontotheDesignandAnalysisofalgorithm”,PearsonEducation Asia, 2003. |
| 4 | RobertSedgewick,PhillipeFlajolet,”AnIntroductiontotheAnalysisofAlgorithms”, Addison-Wesley Publishing Company,1996. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/106/106/106106131/> |
| 2 | <https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm> |
| 3 | <https://www.javatpoint.com/daa-tutorial> |
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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | M | S | L | M | L | S | M |
| **CO2** | S | S | S | S | S | M | S | M | S | M |
| **CO3** | S | S | S | S | S | M | S | M | S | M |
| **CO4** | S | S | S | S | S | M | S | M | S | M |
| **CO5** | S | S | S | S | S | M | S | M | S | M |

\*S-Strong;M-Medium;L-Low

**I – SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **Coursecode** |  | **OBJECTORIENTEDANALYSISAND DESIGN & C++** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofC++and ObjectOriented Concepts |  |  |
| **CourseObjectives:** |
| Themainobjectivesofthis courseareto:1. Presenttheobjectmodel,classesandobjects,objectorientation,machineviewandmodel management view.
2. Enablesthestudentstolearnthebasicfunctions,principlesandconceptsofobjectoriented analysis and design.
3. EnablethestudentstounderstandC++languagewithrespecttoOOAD
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandtheconceptofObject-Orienteddevelopmentandmodelingtechniques | K1,K2 |
| 2 | Gainknowledgeaboutthevariousstepsperformedduringobjectdesign | K2,K3 |
| 3 | Abstractobject-basedviewsforgenericsoftwaresystems | K3 |
| 4 | LinkOOADwithC++ language | K4,K5 |
| 5 | Applythebasicconcept ofOOPsandfamiliarizetowriteC++ program | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **OBJECTMODEL** | **15hours** |
| The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.** |
|  |
| **Unit:2** | **CLASSESANDOBJECTS** | **15hours** |
| Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism. |
|  |
| **Unit:3** | **C++INTRODUCTION** | **15hours** |
| IntroductiontoC++-InputandoutputstatementsinC++-Declarations-controlstructures– Functions in C++. |
|  |
| **Unit:4** | **INHERITANCEANDOVERLOADING** | **13hours** |
| ClassesandObjects–ConstructorsandDestructors–operatorsoverloading–Type Conversion- Inheritance – Pointers and Arrays. |

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| **Unit:5** | **POLYMORPHISMANDFILES** | **15hours** |
| MemoryManagementOperators-Polymorphism–Virtualfunctions–Files–Exception Handling – String Handling -Templates. |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **75hours** |
|  |
| **Text Books** |
| 1 | “Object Oriented Analysis and Design with Applications”, Grady Booch, Second Edition, Pearson Education. |
| 2 | “Object-OrientedProgrammingwithANSI&TurboC++”,AshokN.Kamthane,First Indian Print -2003, Pearson Education. |
| **ReferenceBooks** |
| 1 | Balagurusamy“ObjectOrientedProgrammingwithC++”,TMH,SecondEdition,2003. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc19_cs48/preview> |
| 2 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/> |
| 3 | <https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | S | M | S | M | S | S |
| **CO2** | S | S | S | M | S | M | S | M | S | S |
| **CO3** | S | S | S | M | S | M | S | M | S | S |
| **CO4** | S | S | S | M | S | M | S | M | S | S |
| **CO5** | S | S | S | M | S | M | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**I – SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **Coursecode** |  | **PYTHONPROGRAMMING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofanyOOProgrammingLanguage |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. PresentsanintroductiontoPython,creationofwebapplications,networkapplicationsand working in the clouds
2. UsefunctionsforstructuringPython programs
3. UnderstanddifferentDataStructuresofPython
4. RepresentcompounddatausingPythonlists,tuplesanddictionaries
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandthebasicconceptsofPythonProgramming | K1,K2 |
| 2 | UnderstandFileoperations,Classesand Objects | K2,K3 |
| 3 | AcquireObject OrientedSkills inPython | K3,K4 |
| 4 | Developweb applicationsusingPython | K5 |
| 5 | DevelopClientServerNetworking applications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| **Python:**Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets– Comparison. |
|  |
| **Unit:2** | **CODESTRUCTURES** | **15hours** |
| **Code Structures:** if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions. |
|  |
| **Unit:3** | **MODULES,PACKAGESANDCLASSES** | **15hours** |
| **Modules, Packages, and Programs:** Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent withsuper–InselfDefense –GetandSetAttributeValueswithProperties –NameManglingfor Privacy – Method Types – Duck Typing – Special Methods –Composition. |
|  |
| **Unit:4** | **DATATYPESANDWEB** | **13hours** |
| **DataTypes:**TextStrings–BinaryData.**StoringandRetrievingData:**FileInput/Output– Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.**Web:**WebClients –Web Servers–WebServicesand Automation |
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| **Unit:5** | **SYSTEMSANDNETWORKS** | **15hours** |
| **Systems:**Files–Directories–ProgramsandProcesses–CalendarsandClocks.**Concurrency:** Queues– Processes–Threads–GreenThreadsandgevent–twisted–Redis.**Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – ZeroMQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds. |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **75hours** |
|  |
| **Text Books** |
| 1 | BillLubanovic,“IntroducingPython”,O’Reilly,FirstEdition-SecondRelease,2014. |
| 2 | MarkLutz,“LearningPython”, O’Reilly,FifthEdition, 2013. |
| **ReferenceBooks** |
| 1 | David M. Beazley,“Python Essential Edition,2009. | Reference”, | Developer’s Library, | Fourth |
| 2 | SheetalTaneja,Naveen Kumar, Approach”,PearsonPublications. | “Python | Programming-A | Modular |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websites etc.]** |
| 1 | <https://www.programiz.com/python-programming/> |
| 2 | <https://www.tutorialspoint.com/python/index.htm> |
| 3 | <https://onlinecourses.swayam2.ac.in/aic20_sp33/preview> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | M |
| **CO2** | S | S | S | S | S | S | S | M | S | M |
| **CO3** | S | S | S | S | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | S | M |
| **CO5** | S | S | S | S | S | S | S | M | S | M |

\*S-Strong;M-Medium;L-Low

**I – SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Coursecode** |  | **ADVANCEDSOFTWARE ENGINEERING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofSoftwareEngineering&SPM |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. IntroducetoSoftwareEngineering,Design,TestingandMaintenance.
2. EnablethestudentstolearntheconceptsofSoftwareEngineering.
3. LearnaboutSoftwareProjectManagement,SoftwareDesign&Testing.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandaboutSoftwareEngineeringprocess | K1,K2 |
| 2 | UnderstandaboutSoftwareprojectmanagementskills,designandquality management | K2,K3 |
| 3 | AnalyzeonSoftwareRequirementsandSpecification | K3,K4 |
| 4 | AnalyzeonSoftwareTesting, MaintenanceandSoftwareRe-Engineering | K4,K5 |
| 5 | Designandconductvarioustypesandlevelsofsoftwarequalityforasoftware project | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes. |
|  |
| **Unit:2** | **SOFTWAREREQUIREMENTS** | **15hours** |
| Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Resultmanagementsystem. SoftwareQuality Management –SoftwareQuality, Software Quality Management System, ISO 9000, SEI CMM. |
|  |
| **Unit:3** | **PROJECT MANAGEMENT** | **15hours** |
| Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead‟s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan. |
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| **Unit:4** | **SOFTWAREDESIGN** | **15hours** |

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| Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions. |
|  |
| **Unit:5** | **SOFTWARETESTING** | **13hours** |
| Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities. |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **75hours** |
|  |
| **Text Books** |
| 1 | AnIntegratedApproachtoSoftwareEngineering–PankajJalote,NarosaPublishingHouse, Delhi, 3rd Edition. |
| 2 | FundamentalsofSoftwareEngineering –RajibMall,PHIPublication,3rdEdition. |
| **ReferenceBooks** |
| 1 | SoftwareEngineering–K.K.AggarwalandYogeshSingh,NewAgeInternational Publishers, 3 rd edition. |
| 2 | APractitionersApproach-SoftwareEngineering,-R.S.Pressman,McGraw Hill. |
| 3 | Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli,PHIPublication. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.javatpoint.com/software-engineering-tutorial> |
| 2 | <https://onlinecourses.swayam2.ac.in/cec20_cs07/preview> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_cs69/preview> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | M | M |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**I – SEMESTER**

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| **Coursecode** |  | **PRACTICALI:ALGORITHMAND OOPS LAB** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicProgrammingofC++language |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Thiscoursecoversthebasicdatastructureslike Stack,Queue,Tree,List.
2. Thiscourseenablesthestudentstolearntheapplicationsofthedatastructuresusing various techniques
3. Italso enablethestudentstounderstandC++languagewithrespectto OOAD concepts
4. ApplicationofOOPSconcepts.
 |
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandtheconceptsofobjectorientedwithrespecttoC++ | K1,K2 |
| 2 | AbletounderstandandimplementOOPSconcepts | K3,K4 |
| 3 | ImplementationofdatastructureslikeStack, Queue,Tree,Listusing C++ | K4,K5 |
| 4 | ApplicationofthedatastructuresforSorting,Searchingusing different techniques. | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **75hours** |
| 1. Writeaprogram tosolvethetowerofHanoiusing recursion.
2. Writeaprogramtotraversethroughbinarysearch treeusingtraversals.
3. Writeaprogramto performvariousoperationson stackusinglinked list.
4. Writeaprogram toperformvarious operationincircular queue.
5. Writeaprogram tosortan arrayofan elementsusingquick sort.
6. Writeaprogramto solvenumberof elementsin ascending orderusing heap sort.
7. Writeaprogramtosolve theknapsackproblemusinggreedymethod
8. Writeaprogramto search foran elementin a tree using divide& conquerstrategy.
9. Writeaprogram toplacethe8 queenson an8X8matrixso thatno twoqueens Attack.
10. WriteaC++programto performVirtual Function
11. WriteaC++programtoperformParameterizedconstructor
12. WriteaC++programtoperform FriendFunction
13. WriteaC++programtoperform FunctionOverloading
14. WriteaC++program to performSingleInheritance
15. WriteaC++program toperform EmployeeDetailsusing files.
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| Expertlectures,onlineseminars –webinars |
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| **TotalLecturehours** | **75hours** |
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| **Text Books** |
| 1 | Goodrich,“DataStructures&AlgorithmsinJava”,Wiley3rd edition. |
| 2 | Skiena,”TheAlgorithmDesignManual”,SecondEdition,Springer,2008 |
| **ReferenceBooks** |
| 1 | AnanyLevith,”Introductiontothe DesignandAnalysisof algorithm”, Pearson Education Asia, 2003. |
| 2 | RobertSedgewick,PhillipeFlajolet,”AnIntroductiontotheAnalysisofAlgorithms”, Addison-Wesley Publishing Company,1996. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc19_cs48/preview> |
| 2 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/> |
| 3 | <https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm> |
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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**I – SEMESTER**

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| **Coursecode** |  | **PRACTICALII:PYTHON PROGRAMMING LAB** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicsofanyOOProgrammingLanguage |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Thiscoursepresentsanoverviewofelementarydataitems,lists,dictionaries,setsandtuples
2. Tounderstandand writesimplePythonprograms
3. ToUnderstandthe OOPSconceptsofPython
4. Todevelopweb applications usingPython
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | AbletowriteprogramsinPythonusingOOPS concepts | K1,K2 |
| 2 | TounderstandtheconceptsofFileoperationsandModulesinPython | K2,K3 |
| 3 | Implementationoflists,dictionaries,setsandtuplesas programs | K3,K4 |
| 4 | Todevelopweb applications usingPython | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **75hours** |
| ImplementthefollowinginPython:1. Programsusingelementarydataitems,lists,dictionariesandtuples
2. Programsusingconditionalbranches,
3. Programsusingloops.
4. Programsusingfunctions
5. Programsusingexceptionhandling
6. Programsusinginheritance
7. Programsusingpolymorphism
8. Programstoimplementfile operations.
9. Programsusingmodules.
10. Programsforcreatingdynamicandinteractivewebpagesusingforms.
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| **TotalLecturehours** | **75hours** |
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| **Text Books** |
| 1 | BillLubanovic,“Introducing Python”,O’Reilly,FirstEdition-SecondRelease,2014. |
| 2 | MarkLutz,“LearningPython”, O’Reilly,FifthEdition, 2013. |
| **ReferenceBooks** |

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| 1 | David M. Beazley,“Python Essential Edition,2009. | Reference”, | Developer’s Library, | Fourth |
| 2 | SheetalTaneja,Naveen Kumar, Approach”,PearsonPublications. | ”Python | Programming-A | Modular |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.programiz.com/python-programming/> |
| 2 | <https://www.tutorialspoint.com/python/index.htm> |
| 3 | <https://onlinecourses.swayam2.ac.in/aic20_sp33/preview> |
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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | M |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**II – SEMESTER**

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| **Coursecode** |  | **DATAMININGANDWAREHOUSING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofRDBMS&Algorithms |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
2. Developskillsofusingrecent dataminingsoftwareforsolvingpracticalproblems.
3. Developandapplycriticalthinking,problem-solving,anddecision-makingskills.
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandthebasicdataminingtechniquesandalgorithms | K1,K2 |
| 2 | UnderstandtheAssociationrules,ClusteringtechniquesandDatawarehousing contents | K2,K3 |
| 3 | Compareandevaluatedifferentdataminingtechniqueslikeclassification,prediction, Clustering and association rule mining | K4,K5 |
| 4 | DesigndatawarehousewithdimensionalmodelingandapplyOLAP operations | K5,K6 |
| 5 | Identifyappropriatedataminingalgorithmstosolverealworldproblems | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **BASICSANDTECHNIQUES** | **12hours** |
| Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms. |
|  |
| **Unit:2** | **ALGORITHMS** | **12hours** |
| Classification:Introduction –Statistical –basedalgorithms -distance–basedalgorithms-decision tree-basedalgorithms-neuralnetwork–basedalgorithms–rule-basedalgorithms–combiningtechniques. |
|  |
| **Unit:3** | **CLUSTERINGANDASSOCIATION** | **12hours** |
| Clustering:Introduction–SimilarityandDistanceMeasures–Outliers–HierarchicalAlgorithms-PartitionalAlgorithms.Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules. |
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| **Unit:4** | **DATAWAREHOUSINGANDMODELING** | **11hours** |
| Datawarehousing:introduction-characteristicsofadatawarehouse–datamarts–otheraspects |

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| ofdatamart.Online analyticalprocessing:introduction -OLTP&OLAPsystemsDatamodeling –star schema for multidimensional view –data modeling – multifactstar schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet. |
| **Unit:5** | **APPLICATIONSOFDATA WAREHOUSE** | **11** | **hours** |
| Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse.Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
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|  | **TotalLecturehours** | **60hours** |
| **Text Books** |
| 1 | MargaretH.Dunham,“DataMining:IntroductoryandAdvancedTopics”,Pearson education,2003. |
| 2 | C.S.R. Prabhu, “Data Warehousing Concepts,Techniques, Productsand Applications”, PHI, Second Edition. |
| **ReferenceBooks** |
| 1 | ArunK.Pujari,“DataMiningTechniques”,UniversitiesPress(India)Pvt. Ltd.,2003. |
| 2 | AlexBerson,StephenJ.Smith,“DataWarehousing,DataMiningandOLAP”,TMCH, 2001. |
| 3 | JiaweiHan&MichelineKamber, Academicpress. | “DataMiningConcepts | &Techniques”, | 2001, |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.javatpoint.com/data-warehouse> |
| 2 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/> |
| 3 | <https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | S | S | S | M | M | M | M |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**II – SEMESTER**

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| **Coursecode** |  | **ADVANCEDOPERATING SYSTEMS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofOS&its functioning |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Enablethestudentstolearnthedifferenttypesofoperatingsystemsandtheirfunctioning.
2. GainknowledgeonDistributedOperating Systems
3. Gaininsightintothecomponentsandmanagementaspectsofrealtimeandmobileoperating systems.
4. LearncasestudiesinLinuxOperating Systems
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandthedesignissuesassociatedwithoperating systems | K1,K2 |
| 2 | Mastervariousprocessmanagementconceptsincludingscheduling,deadlocks and distributed file systems | K3,K4 |
| 3 | PrepareRealTimeTaskScheduling | K4,K5 |
| 4 | AnalyzeOperatingSystemsforHandheld Systems | K5 |
| 5 | AnalyzeOperatingSystemslikeLINUXandiOS | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **BASICSOFOPERATINGSYSTEMS** | **12hours** |
| Basics of Operating Systems: What is an Operating System? – Main frame Systems –Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery. |
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| **Unit:2** | **DISTRIBUTEDOPERATINGSYSTEMS** | **12hours** |
| Distributed Operating Systems: Issues – Communication Primitives – Lamport‟s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda. |
|  |
| **Unit:3** | **REALTIMEOPERATINGSYSTEM** | **10hours** |
| Realtime Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling |
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| **Unit:4** | **HANDHELDSYSTEM** | **12hours** |
| OperatingSystemsforHandheldSystems:Requirements–TechnologyOverview–Handheld OperatingSystems–PalmOS-SymbianOperatingSystem-Android–Architectureofandroid– |

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| Securinghandheld systems |
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| **Unit:5** | **CASE STUDIES** | **12hours** |
| Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars–webinars |
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|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | AbrahamSilberschatz;PeterBaerGalvin;GregGagne,“OperatingSystemConcepts”, Seventh Edition, John Wiley & Sons, 2004. |
| 2 | MukeshSinghal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001. |
| **ReferenceBooks** |
| 1 | RajibMall,“Real-Time Systems:TheoryandPractice”,PearsonEducationIndia,2006. |
| 2 | Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010. |
| 3 | Daniel.P.Bovet&MarcoCesati,“UnderstandingtheLinuxkernel”,3rdedition,O‟Reilly,2005 |
| 4 | NeilSmyth,“iPhoneiOS4DevelopmentEssentials–Xcode”,FourthEdition,Payload media, 2011. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs04/preview> |
| 2 | <https://www.udacity.com/course/advanced-operating-systems--ud189> |
| 3 | <https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf> |
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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | S | S | S | M | M | M | M |
| **CO2** | S | M | S | S | S | S | S | M | S | M |
| **CO3** | S | M | S | S | S | S | S | M | S | M |
| **CO4** | S | M | S | S | S | S | S | M | S | M |
| **CO5** | S | M | S | S | S | S | S | M | S | M |

\*S-Strong;M-Medium;L-Low

**II – SEMESTER**

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| **Coursecode** |  | **ADVANCEDJAVAPROGRAMMING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofJava&itsUsage |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Enablethestudentstolearnthebasicfunctions,principlesandconceptsofadvancedjava programming.
2. Provideknowledgeon conceptsneededfordistributedApplication Architecture.
3. LearnJDBC,Servletpackages,JQuery,JavaServerPagesandJARfileformat
 |
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandtheadvanced conceptsofJava Programming | K1,K2 |
| 2 | UnderstandJDBCandRMIconcepts | K2,K3 |
| 3 | ApplyandanalyzeJavainDatabase | K3,K4 |
| 4 | Handle different event in java using the delegation event model, event listener and class | K5 |
| 5 | DesigninteractiveapplicationsusingJavaServlet, JSPandJDBC | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **BASICSOFJAVA** | **12hours** |
| JavaBasicsReview:Componentsandeventhandling–Threadingconcepts–Networkingfeatures – Media techniques |
|  |
| **Unit:2** | **REMOTEMETHOD INVOCATION** | **12hours** |
| Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons- Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces |
|  |
| **Unit:3** | **DATABASE** | **10hours** |
| JavainDatabases-JDBCprinciples–databaseaccess-Interacting-databasesearch–Creating multimedia databases – Database support in web applications |
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| **Unit:4** | **SERVLETS** | **12hours** |
| Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Readingdata from a client-Reading http request header-sending data to a client andwriting the http response header-working with cookiesJava Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions- Scriptlets-Directives-Declarations-A complete example |
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| **Unit:5** | **ADVANCEDTECHNIQUES** | **12hours** |
| JARfileformatcreation–Internationalization–SwingProgramming–Advancedjava |

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| techniques |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
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|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | JamieJaworski,“JavaUnleashed”,SAMSTechmediaPublications,1999. |
| 2 | Campione,Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999. |
| **ReferenceBooks** |
| 1 | JimKeogh,”TheCompleteReferenceJ2EE”,TataMcGrawHillPublishingCompanyLtd,2010. |
| 2 | DavidSawyerMcFarland,“JavaScriptAndJQuery-TheMissingManual”,Oreilly Publications, 3rd Edition,2011. |
| 3 | DeitelandDeitel, “JavaHowtoProgram”,ThirdEdition,PHI/PearsonEducationAsia. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.javatpoint.com/servlet-tutorial> |
| 2 | <https://www.tutorialspoint.com/java/index.htm> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_cs84/preview> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | M | M | M | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **ARTIFICIALINTELLIGENCE& MACHINE LEARNING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofAI&an Introductionabout ML |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. EnablethestudentstolearnthebasicfunctionsofAI,HeuristicSearchTechniques.
2. ProvideknowledgeonconceptsofRepresentationsandMappingsandPredicate Logic.
3. IntroduceMachineLearningwithrespectDataMining,BigDataand Cloud.
4. StudyaboutApplications&ImpactofML.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | DemonstrateAIproblemsandtechniques | K1,K2 |
| 2 | Understandmachinelearningconcepts | K2,K3 |
| 3 | ApplybasicprinciplesofAIinsolutionsthatrequireproblemsolving, inference, perception, knowledge representation, and learning | K3,K4 |
| 4 | Analyzetheimpact ofmachine learningon applications | K4,K5 |
| 5 | Analyzeanddesignarealworldproblemforimplementationandunderstand the dynamic behavior of a system | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search. |
|  |
| **Unit:2** | **SEARCHTECHNIQUES** | **12hours** |
| Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem. |
|  |
| **Unit:3** | **PREDICATELOGIC** | **12hours** |
| Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledgeusingrules:ProceduralVs Declarative knowledge- Logic programming-ForwardVsBackwardreasoning -Matching-Controlknowledge. |
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| **Unit:4** | **MACHINELEARNING** | **12hours** |

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| UnderstandingMachineLearning:WhatIsMachineLearning?-DefiningBigData-BigDatain ContextwithMachineLearning-TheImportanceoftheHybridCloud-LeveragingthePowerof Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning. |
|  |
| **Unit:5** | **APPLICATIONSOFMACHINE LEARNING** | **10hours** |
| LookingInsideMachineLearning:TheImpactofMachineLearningonApplications-Data Preparation-The Machine Learning Cycle. |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | ElaineRichandKevinKnight,"ArtificialIntelligence",TataMcGrawHillPublishers company Pvt Ltd, Second Edition, 1991. |
| 2 | GeorgeFLuger,"ArtificialIntelligence",4thEdition,PearsonEducation Publ,2002. |
| **ReferenceBooks** |
| 1 | MachineLearningForDummies®,IBMLimitedEdition byJudithHurwitz, Daniel Kirsch. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.ibm.com/downloads/cas/GB8ZMQZ3> |
| 2 | <https://www.javatpoint.com/artificial-intelligence-tutorial> |
| 3 | <https://nptel.ac.in/courses/106/105/106105077/> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | M | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **PRACTICALIII:DATAMINING USING R** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicsofDMAlgorithms&R Programming |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. ToenablethestudentstolearntheconceptsofDataMiningalgorithmsnamelyclassification, clustering, regression….
2. Tounderstand&writeprogramsusingtheDM algorithms
3. Toapplystatisticalinterpretationsforthesolutions
4. Abletousevisualizationstechniquesfor interpretations
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | AbletowriteprogramsusingRforAssociationrules,Clusteringtechniques | K1,K2 |
| 2 | Toimplement dataminingtechniques likeclassification, prediction | K2,K3 |
| 3 | Abletousedifferent visualizationstechniquesusingR | K4,K5 |
| 4 | Toapplydifferentdataminingalgorithmstosolverealworldapplications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **75hours** |
| 1. ImplementApriorialgorithmtoextractassociationruleof datamining.
2. Implementk-meansclusteringtechnique.
3. ImplementanyoneHierarchal Clustering.
4. ImplementClassificationalgorithm.
5. ImplementDecisionTree.
6. LinearRegression.
7. DataVisualization.
 |
| **TotalLecturehours** | **75hours** |
|  |
| **Text Books** |
| 1 | MargaretH.Dunham,“DataMining:IntroductoryandAdvancedTopics”,Pearson education,2003. |
| 2 | C.S.R. Prabhu, “Data Warehousing Concepts,Techniques, Productsand Applications”, PHI, Second Edition |
| **ReferenceBooks** |
| 1 | ArunK.Pujari,“DataMiningTechniques”,UniversitiesPress(India)Pvt. Ltd.,2003. |
| 2 | AlexBerson,StephenJ.Smith,“DataWarehousing,DataMiningandOLAP”,TMCH, 2001. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |

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| 1 | <https://www.javatpoint.com/data-warehouse> |
| 2 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/> |
| 3 | <https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | M |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **PRACTICALIV:ADVANCED JAVA LAB** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicsinJava Programming |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Toenablethestudents toimplementthesimpleprogramsusingJSP,JAR
2. ToprovideknowledgeonusingServlets, Applets
3. TointroduceJDBCandnavigationof records
4. Tounderstand RMI& its implementation
5. TointroducetoSocketprogramming
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandtotheimplementconceptsofJavausingHTMLforms,JSP&JAR | K1,K2 |
| 2 | MustbecapableofimplementingJDBCandRMI concepts | K3,K4 |
| 3 | AbletowriteAppletswithEventhandlingmechanism | K4,K5 |
| 4 | ToCreateinteractivewebbasedapplicationsusingservletsand jsp | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **75hours** |
| 1. DisplayawelcomemessageusingServlet.
2. DesignaPurchaseOrderformusingHtmlformandServlet.
3. Developaprogramforcalculatingthepercentage ofmarksofastudentusingJSP.
4. DesignaPurchaseOrderformusingHtmlform andJSP.
5. PrepareaEmployeepayslipusingJSP.
6. WriteaprogramusingJDBCforcreatingatable,Inserting,Deletingrecordsandlistouttherecords.
7. WriteaprogramusingJavaservlettohandleformdata.
8. WriteasimpleServletprogramtocreateatableofalltheheadersitreceivesalongwiththeirassociatedvalues.
9. Writeaprogramin JSPby using sessionobject.
10. WriteaprogramtobuildasimpleClientServerapplication usingRMI.
11. Createan appletforacalculatorapplication.
12. Programtosendatextmessagetoanothersystemandreceivethetextmessagefromthe system (use socket programming).
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| Expertlectures,onlineseminars –webinars |
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| **TotalLecturehours** | **75hours** |
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| **Text Books** |
| 1 | JamieJaworski,“JavaUnleashed”,SAMSTechmediaPublications,1999. |
| 2 | Campione,Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999. |
| **ReferenceBooks** |
| 1 | JimKeogh,”TheCompleteReferenceJ2EE”,TataMcGrawHillPublishingCompany Ltd,2010. |
| 2 | DavidSawyerMcFarland,“JavaScriptAndJQuery-TheMissingManual”,Oreilly Publications, 3rd Edition,2011. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.javatpoint.com/servlet-tutorial> |
| 2 | <https://www.tutorialspoint.com/java/index.htm> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_cs84/preview> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | M |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

**III SEMESTER**

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| **Coursecode** |  | **DIGITALIMAGEPROCESSING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofImageProcessing |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Learnbasicimageprocessingtechniquesforsolvingreal problems.
2. Gainknowledgeinimagetransformationand Imageenhancementtechniques.
3. LearnImagecompressionandSegmentation procedures.
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandthefundamentalsofDigitalImage Processing | K1,K2 |
| 2 | Understandthemathematicalfoundationsfordigitalimagerepresentation, image acquisition, image transformation, and image enhancement | K2,K3 |
| 3 | Apply, Design and Implement and get solutions for digital image processingproblems | K3,K4 |
| 4 | Applytheconceptsoffilteringandsegmentationfordigitalimageretrieval | K4,K5 |
| 5 | Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations. |
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| **Unit:2** | **IMAGEENHANCEMENT** | **12hours** |
| Image Enhancement in the spatial domain:- Background – some basic Gray levelTransformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods. |
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| **Unit:3** | **IMAGERESTORATION** | **12hours** |
| Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations. |
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| **Unit:4** | **IMAGECOMPRESSION** | **11hours** |
| ImageCompression:Fundamentals–Imagecompressionmodels–ElementsofInformation Theory – Error Free compression – Lossy compression – Image compression standards. |
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| **Unit:5** | **IMAGESEGMENTATION** | **11hours** |
| Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | RafaelC.Gonzalez,RichardE.Woods,“DigitalImageProcessing”,SecondEdition,PHI/Pearson Education. |
| 2 | B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003. |
| **ReferenceBooks** |
| 1 | NickEfford,“DigitalImageProcessingapracticalintroducingusingJava”,Pearson Education, 2004. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/117/105/117105135/> |
| 2 | <https://www.tutorialspoint.com/dip/index.htm> |
| 3 | <https://www.javatpoint.com/digital-image-processing-tutorial> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | S | S | M | S | M | M | S |
| **CO2** | S | S | S | S | S | M | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **CLOUDCOMPUTING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofCloud&itsApplications |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Gainknowledgeon cloudcomputing,cloudservices,architecturesandapplications.
2. Enablethestudentstolearnthebasicsofcloudcomputingwithrealtime usage
3. Howtostoreandshare,inandfromcloud?
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|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletion ofthecourse,studentwillbeableto: |
| 1 | Understandthe conceptsofCloudanditsservices | K1,K2 |
| 2 | CollaborateCloudforEvent&ProjectManagement | K3,K4 |
| 3 | Analyzeon cloudin –WordProcessing,SpreadSheets,Mail,Calendar, Database | K4,K5 |
| 4 | Analyzecloudinsocial networks | K5,K6 |
| 5 | Explorecloud storageand sharing | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services. |
|  |
| **Unit:2** | **CLOUDCOMPUTING** | **12hours** |
| CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloudcomputing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road. |
|  |
| **Unit:3** | **CLOUDSERVICES** | **12hours** |
| USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases. |
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| **Unit:4** | **OUTSIDETHECLOUD** | **12hours** |
| OUTSIDETHECLOUDEvaluatingwebmailservices,Evaluatinginstantmessaging, Evaluatingwebconferencetools,creatinggroupsonsocialnetworks,Evaluatingonline |

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| groupware,collaboratingviablogsandwikis. |
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| **Unit:5** | **STORINGAND SHARING** | **10hours** |
| STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | MichaelMiller,“Cloud Computing”,PearsonEducation,NewDelhi, 2009. |
| **ReferenceBooks** |
| 1 | Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGrawHill Education Private Limited, 2009. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/106/105/106105167/> |
| 2 | <https://www.tutorialspoint.com/cloud_computing/index.htm> |
| 3 | <https://www.javatpoint.com/cloud-computing-tutorial> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | S | M | S | M | S | M | M | M | S |
| **CO2** | M | S | M | S | S | S | M | M | M | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | M | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **NETWORKSECURITYAND CRYPTOGRAPHY** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofNetworks&itsSecurity |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.
2. Togainknowledgeonclassicalencryptiontechniquesandconceptsofmodulararithmeticand number theory.
3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandtheprocessofthecryptographicalgorithms | K1,K2 |
| 2 | Compareandapplydifferentencryptionanddecryptiontechniquestosolveproblems related to confidentiality and authentication | K2,K3 |
| 3 | Applyandanalyzeappropriatesecuritytechniquestosolvenetworksecurity problem | K3,K4 |
| 4 | Exploresuitablecryptographicalgorithms | K4,K5 |
| 5 | Analyzedifferentdigitalsignaturealgorithmstoachieveauthenticationand design secure applications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5. |
|  |
| **Unit:2** | **CRYPTOSYSTEM** | **12hours** |
| Public-keyCryptosystem:IntroductiontoNumberTheory-RSAAlgorithm–KeyManagement-Diffie-HellmanKeyexchange–EllipticCurveCryptographyMessageAuthenticationand Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol. |
|  |
| **Unit:3** | **NETWORK SECURITY** | **12hours** |
| NetworkSecurityPractice:AuthenticationApplications–Kerberos–X.509Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security. |
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| **Unit:4** | **WEB SECURITY** | **10hours** |
| WebSecurity-SecureSocketLayer–SecureElectronicTransaction.SystemSecurity-Intruders and Viruses – Firewalls– Password Security. |
|  |
| **Unit:5** | **CASE STUDY** | **12hours** |
| CaseStudy:ImplementationofCryptographicAlgorithms–RSA–DSA–ECC(C/JAVA Programming).Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography –Quantum Cryptography – Water Marking - DNA Cryptography |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars–webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | WilliamStallings,“CryptographyandNetworkSecurity”, PHI/PearsonEducation. |
| 2 | BruceSchneir,“AppliedCryptography”,CRC Press. |
| **ReferenceBooks** |
| 1 | A.Menezes, P Van Oorschot and S.Vanstone, “Hand Book ofApplied Cryptography”, CRC Press, 1997 |
| 2 | AnkitFadia,”NetworkSecurity”,MacMillan. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/106/105/106105031/> |
| 2 | <http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html> |
| 3 | <https://www.tutorialspoint.com/cryptography/index.htm> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | M | L | S | M | S | M | S |
| **CO2** | S | S | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **DATASCIENCE&ANALYTICS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofDataScience& itsApplications |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Introducethestudentstodatascience,bigdata&its ecosystem.
2. Learndata analytics &its life cycle.
3. ToexploretheprogramminglanguageR,withrespecttothedataminingalgorithms.
4. Relatetherelationshipbetweenartificialintelligence,machinelearning anddatascience.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandtheconceptofdatascience andits techniques | K1,K2 |
| 2 | Reviewdataanalytics | K2,K3 |
| 3 | ApplyanddetermineappropriateDataMiningtechniquesusingRtorealtime applications | K3,K4 |
| 4 | Analyzeon clusteringalgorithms | K4,K5 |
| 5 | AnalyzeonregressionmethodsinAI | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5** -Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| IntroductionofDataScience:datascienceandbigdata–facetsofdata-datascienceprocess- Ecosystem- The Data Science process – six steps- Machine Learning. |
|  |
| **Unit:2** | **BASICSOFDATA ANALYTICS** | **12hours** |
| DataAnalyticslifecycle-reviewofdataanalytics-AdvanceddataAnalytics-technologyand tools. |
|  |
| **Unit:3** | **DATAANALYTICSUSINGR** | **12hours** |
| Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis –Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation. |
|  |
| **Unit:4** | **CLUSTERING** | **12hours** |
| Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – DecisionTree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes’ Theorem – Naïve Bayes Classifier – Smoothing – Naïve Bayes in R. |

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| **Unit:5** | **ARTIFICIALINTELLIGENCE** | **10hours** |
| Artificialintelligence:MachineLearninganddeeplearningindatascience-Clustering, association rules. Linear regression-logistic regression-Additional regression methods. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016. Pdf |
| 2 | Datascienceinbigdata analytics-Wiley2015JohnWiley&Sons |
| **ReferenceBooks** |
| 1 | AsimpleintroductiontoDataScience-LarsNielson2015 |
| 2 | Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication |
| 3 | RProgrammingforData Science-RogerD.Peng 2015LeanPublication |
| 4 | DataScience&BigDataAnalytics:Discovering,Analyzing,VisualizingandPresenting Data |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/python_data_science/index.htm> |
| 2 | <https://www.javatpoint.com/data-science> |
| 3 | <https://nptel.ac.in/courses/106/106/106106179/> |
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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | M | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **PRACTICALV:DIGITALIMAGE PROCESSING Using MATLAB** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicProgrammingofImageProcessing& an intro to MATLAB |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques
2. Toenablethestudentstolearnthefundamentalsofimagecompressionandsegmentation
3. TounderstandImageRestoration&Filtering Techniques
4. Implementationofthe aboveusingMATLAB
 |
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Towriteprograms inMATLABforimageprocessingusingthe techniques | K1,K2 |
| 2 | ToabletoimplementImageEnhancements&Restorationtechniques | K2,K3 |
| 3 | CapableofusingCompressiontechniquesinan Image | K3,K4 |
| 4 | Mustbeable to manipulatethe imageand Segment it | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **60hours** |
| 1. ImplementImageenhancementTechnique.
2. HistogramEqualization
3. ImageRestoration.
4. ImplementImageFiltering.
5. EdgedetectionusingOperators(Roberts,PrewittsandSobelsoperators)
6. Implementimage compression.
7. ImageSubtraction
8. BoundaryExtractionusing morphology.
9. ImageSegmentation
 |
| **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | RafaelC.Gonzalez,RichardE.Woods,“Digital ImageProcessing”,Second Edition, |

|  |  |
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|  | PHI/PearsonEducation. |
| 2 | B.Chanda,D.DuttaMajumder,“DigitalImageProcessingandAnalysis”,PHI, 2003. |
| **ReferenceBooks** |
| 1 | NickEfford,“DigitalImageProcessingapracticalintroducingusingJava”,Pearson Education, 2004. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/117/105/117105135/> |
| 2 | <https://www.tutorialspoint.com/dip/index.htm> |
| 3 | <https://www.javatpoint.com/digital-image-processing-tutorial> |
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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **PRACTICALVI:CLOUD COMPUTING LAB** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 4 | 4 |
| **Pre-requisite** | BasicProgrammingusing Cloud |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Thiscoursecoversthebasicdatastructureslike Stack,Queue,Tree,List.
2. Thiscourseenablesthestudentstolearntheapplicationsofthedatastructuresusing various techniques
3. Italso enablethestudentstounderstandC++languagewithrespectto OOAD concepts
4. ApplicationofOOPSconcepts
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandtheconceptsofobjectorientedwithrespecttoC++ | K1,K2 |
| 2 | AbletounderstandandimplementOOPSconcepts | K3,K4 |
| 3 | ImplementationofdatastructureslikeStack, Queue,Tree,Listusing C++ | K4,K5 |
| 4 | ApplicationofthedatastructuresforSorting,Searchingusing different techniques. | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **60hours** |
| 1. WorkingwithGoogle Drivetomakespreadsheetandnotes.
2. LaunchaLinuxVirtualMachine.
3. Tohostastatic website
4. ExploringGooglecloudforthefollowinga)Storageb)Sharingofdatac)manageyour calendar, to-do lists, d) a document editing tool
5. WorkingandinstallationofGoogleApp Engine
6. WorkingandinstallationofMicrosoftAzure
7. ToConnectAmazon RedshiftwithS3bucket
8. To[Createand QueryaNoSQLTable](https://aws.amazon.com/getting-started/tutorials/create-nosql-table/?trk=gs_card&e=gs&p=gsrc)
 |
| Expertlectures,onlineseminars–webinars |
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| **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | MichaelMiller,“Cloud Computing”,PearsonEducation,NewDelhi, 2009. |
| **ReferenceBooks** |

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| 1 | Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGrawHill Education Private Limited, 2009. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://nptel.ac.in/courses/106/105/106105167/> |
| 2 | <https://www.tutorialspoint.com/cloud_computing/index.htm> |
| 3 | <https://www.javatpoint.com/cloud-computing-tutorial> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **PRACTICAL VII : WEB APPLICATIONDEVELOPMENTAND HOSTING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Core** |  |  | 2 | 2 |
| **Pre-requisite** | BasicProgrammingusingHTMLtags |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Abletodesign awebpageusingHTMLtags
2. Toenablethestudents touseFramesets,hyperlinksanddifferentformattingfeaturesofHTML tags
3. EnablethestudentstouseForms&other controlsinawebpage
4. TocreateinteractiveapplicationsusingPHP
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understand&implementthebasicHTMLtagstocreatestaticwebpages | K1,K2 |
| 2 | Capableofusinghyperlinks,frames,images, tables, inawebpage | K2,K3 |
| 3 | AbletowritedynamicwebapplicationsusingHTML forms | K4,K5 |
| 4 | MustbeabletowritedynamicwebapplicationsinPHP&HTMLtagsusing XAMPP. | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **LISTOF PROGRAMS** | **30hours** |
| 1. Developa websitefor yourcollegeusingadvanced tagsofHTML.
2. Write names of several countries in a paragraph and store it as an HTML document, world.html. Each country name must be a hot text. When you click India (for example), it must open india.html and it should provide a brief introduction about India.
3. Develop a HTML document to i)display Text with Bullets / Numbers - Using Lists ii) to display the Table Format Data
4. Develop a Complete Web Page using Frames and Framesets which gives the Information about a Hospital using HTML.
5. WriteaHTMLdocumenttoprintyourBio-Datainaneatformatusingseveralcomponents.
6. DevelopaHTMLdocumenttodisplayaRegistrationFormforaninter-collegiatefunction.
7. Using HTML form accept Customer details like Name, City, Pin code, Phone number and Email address and validate the data and display appropriate messages for violations using PHP

(Eg.NameisMandatoryfield;Pin codemust be6digits, etc.).1. Writeaprogramtoaccepttwonumbersn1andn2usingHTMLformanddisplaythePrime
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| numbersbetweenn1 andn2using PHP. |
| **TotalLecturehours** | **30hours** |
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| **Text Books** |
| 1 | IvanBayross,“WebEnabledCommercialApplicationsDevelopmentUsingHTML, JavaScript, DHTML and PHP”, BPB Publications, 4th Revised Edition, 2010. |
| **ReferenceBooks** |
| 2 | A.K.SainiandSumintTuli,“MasteringXML”,FirstEdition,NewDelhi, 2002. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/xml/index.htm> |
| 2 | <https://www.tutorialspoint.com/internet_technologies/websites_development.htm> |
| 3 | <https://www.youtube.com/watch?v=PlxWf493en4> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low

**ELECTIVE COURSES**

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| **Coursecode** |  | **MULTIMEDIAANDITS APPLICATIONS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofMultimedia |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Tointroducethestudents theconceptsofMultimedia,Images&Animation.
2. TointroduceMultimediaauthoring tools
3. Tounderstandtheroleof Multimediain Internet
4. ToknowaboutHighDefinitionTelevisionandDesktopComputing–Knowledgebased Multimedia systems
 |
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandthebasicconceptsofMultimedia | K1,K2 |
| 2 | DemonstrateMultimediaauthoringtools | K2,K3 |
| 3 | AnalyzetheconceptsofSound,Images,Video&Animation | K4 |
| 4 | ApplyandAnalyzetheroleofMultimediainInternetandrealtime applications | K4,K5 |
| 5 | AnalyzemultimediaapplicationsusingHDTV | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
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| **Unit:1** | **INTRODUCTION** | **12hours** |
| WhatisMultimedia?–IntroductiontomakingMultimedia–MacintoshandWindows Production platforms – Basic Software tools. |
|  |
| **Unit:2** | **MULTIMEDIATOOLS** | **12hours** |
| MakingInstantMultimedia–Multimediaauthoringtools–Multimediabuildingblocks–Text– Sound. |
|  |
| **Unit:3** | **ANIMATION** | **10hours** |
| Images–Animation–Video. |
|  |
| **Unit:4** | **INTERNET** | **12hours** |
| MultimediaandtheInternet–TheInternetandhowitworks–ToolsforWorldWideWeb– Designing for the World Wide Web. |
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| **Unit:5** | MULTIMEDIASYSTEMS | **12hours** |
| HighDefinitionTelevisionandDesktopComputing –Knowledgebased Multimedia systems. |

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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars - webinars |
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|  | **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | TayVaughan, “Multimediamakingitwork”,FifthEdition,TataMcGrawHill. |
| 2 | JohnF.KoegelBufford,“MultimediaSystems”,Pearson Education. |
| **ReferenceBooks** |
| 1 | JudithJeffloate,“MultimediainPractice(TechnologyandApplications)”,PHI,2003. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/multimedia/index.htm> |
| 2 | <https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm> |
| 3 | <https://nptel.ac.in/courses/117/105/117105083/> |
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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | M | S | M | M | M | S |
| **CO2** | S | S | S | S | M | S | M | S | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **EMBEDDEDSYSTEMS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofMicro Controller |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Presenttheintroductionto8051MicrocontrollerInstructionSet,conceptsonRTOS&Software tools.
2. Gaintheknowledge abouttheembeddedsoftwaredevelopment.
3. LearnaboutMicrocontrollerandsoftwaretoolsintheembeddedsystems.
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable to: |
| 1 | Understandtheconceptof8051microcontroller | K1,K2 |
| 2 | UnderstandtheInstructionSetandProgramming | K2,K3 |
| 3 | Analyzethe conceptsofRTOS | K3,K4 |
| 4 | AnalyzeanddesignvariousrealtimeembeddedsystemsusingRTOS | K5 |
| 5 | Debugthemalfunctioningsystemusingvariousdebuggingtechniques | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**– Create |
|  |
| **Unit:1** | **8051 MICROCONTROLLER** | **12Hours** |
| 8051Microcontroller:Introduction-8051Architecture-Input/OutputPins,PortsandCircuits- External Memory - Counters / Timers - Serial Data Input / Output –Interrupts |
|  |
| **Unit:2** | **PROGRAMMINGBASICS** | **12Hours** |
| Instruction Set and Programming Moving Data-Addressing Modes-Logical operations- Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts. |
|  |
| **Unit:3** | **CONCEPTSONRTOS** | **12Hours** |
| CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment. |
|  |
| **Unit:4** | **DESIGNUSING RTOS** | **10Hours** |
| Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL &QNX. |
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| **Unit:5** | **SOFTWARETOOLS** | **12Hours** |
| SOFTWARETOOLS:EmbeddedsoftwareDevelopmentTools:HostsandTargetMachines- |

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| Linker/Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro- using laboratory tools. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60Hours** |
|  |
| **Text Books** |
| 1 | DavidE.Simon,“AnEmbeddedSoftwareprimer”PearsonEducationAsia, 2003. |
| 2 | KennethJAyala,“The8051MicrocontrollerandArchitectureprogrammingand application”, Second Edition, Penram International. |
| **ReferenceBooks** |
| 1 | RajKamal,“Embedded Systems –Architecture,programminganddesign”,TataMcGraw– Hill, 2003. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs14/preview> |
| 2 | <https://www.javatpoint.com/embedded-system-tutorial> |
| 3 | <https://www.tutorialspoint.com/embedded_systems/index.htm> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | L | L | S | M | S | S | M | M | S |
| **CO2** | M | M | S | S | M | S | M | S | S | S |
| **CO3** | M | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **INTERNETOF THINGS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofSensors&its Applications |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. AboutInternetofThingswherevariouscommunicatingentitiesarecontrolledandmanaged for decision making in the application domain.
2. EnablestudentstolearntheArchitectureof IoTandIoTTechnologies
3. DevelopingIoTapplicationsandSecurityinIoT,BasicElectronicsforIoT,ArduinoIDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandaboutIoT,itsArchitectureandits Applications | K1,K2 |
| 2 | UnderstandbasicelectronicsusedinIoT&itsrole | K2,K3 |
| 3 | DevelopapplicationswithCusingArduinoIDE | K4 |
| 4 | Analyzeaboutsensorsandactuators | K5,K6 |
| 5 | DesignIoTinrealtimeapplicationsusingtoday’sinternet&wireless technologies | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT |
|  |
| **Unit:2** | **BASICELECTRONICSFORIoT** | **12hours** |
| Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – BinaryCalculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation. |
|  |
| **Unit:3** | **PROGRAMMINGUSINGARDUINO** | **12hours** |
| Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions. |
|  |
| **Unit:4** | **SENSORSANDACTUATORS** | **10hours** |
| SensorsandActuators:AnalogandDigitalSensors–Interfacingtemperaturesensor,ultrasound |

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| sensorandinfrared(IR)sensorwithArduino– Interfacing LEDandBuzzerwithArduino. |
|  |
| **Unit:5** | **SENSORDATAININTERNET** | **12hours** |
| Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak). |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **hours** |
|  |
| **Text Books** |
| 1 | ArshdeepBahga,VijayMadisetti,“InternetofThings:AHands-OnApproach”,2014. ISBN: 978-0996025515 |
| 2 | Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017. |
| **ReferenceBooks** |
| 1 | MichaelMargolis,“ArduinoCookbook”,O‟Reilly,2011 |
| 2 | MarcoSchwartz, “InternetofThingswithESP8266”,PacktPublishing, 2016. |
| 3 | DhivyaBala,“ESP8266:StepbyStepTutorialforESP8266IoT,ArduinoNODEMCU Dev. Kit”, 2018. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs66/preview> |
| 2 | <https://www.javatpoint.com/iot-internet-of-things> |
| 3 | <https://www.tutorialspoint.com/internet_of_things/index.htm> |

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| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | M | M | S | M | S | M | M | S | M |
| **CO2** | M | S | M | S | M | S | M | S | S | S |
| **CO3** | S | S | S | S | M | S | M | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **CRITICAL THINKING, DESIGN THINKINGANDPROBLEMSOLVING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofLogical&ReasoningSkills |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Learncriticalthinkinganditsrelated concepts
2. Learndesignthinkinganditsrelatedconcepts
3. DevelopThinkingpatterns,Problemsolving&Reasoning
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandtheconcepts ofCriticalthinkinganditsrelatedtechnology | K1,K2 |
| 2 | Focusontheexplicitdevelopmentofcriticalthinkingandproblemsolvingskills | K2,K3 |
| 3 | Applydesignthinkinginproblems | K3,K4 |
| 4 | Makeadecisionandtakeactionsbasedon analysis | K4,K5 |
| 5 | Analyze the concepts of Thinking patterns, Problem solving & Reasoning inreal time applications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **CRITICALTHINKING** | **12hours** |
| Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence –finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. Applied critical thinking: Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment. |
|  |
| **Unit:2** | **DESIGNTHINKING** | **12hours** |
| Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation. |
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| **Unit:3** | **CASESTUDY** | **12hours** |
| Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem. |
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| **Unit:4** | **PROBLEMSOLVING** | **10hours** |
| Problem solving: problem definition, problem solving methods, selectingand using information, dataprocessing,solutionmethods,solvingproblemsbysearching,recognizingpatterns,spatial |

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| reasoning,necessityandsufficiency, choosingandusingmodels,makingchoicesanddecisions. |
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| **Unit:5** | **REASONING** | **12hours** |
| Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. Advanced problem solving: Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  | **TotalLecturehours** | **60hours** |
|  |
| **Text Books** |
| 1 | JohnButterworthandGeoffThwaites,Thinkingskills:CriticalThinkingandProblem Solving, Cambridge University Press, 2013. |
| 2 | H.S.FoglerandS.E.LeBlanc,StrategiesforCreativeProblemSolving,2ndedition, Pearson, Upper Saddle River, NJ, 2008. |
| **ReferenceBooks** |
| 1 | A. Whimbey and J. Lochhead, Problem Solving & Comprehension, 6th edition, Lawrence Erlbaum, Mahwah, NJ, 1999. |
| 2 | M. Levine, Effective Problem Solving, 2nd edition, Prentice Hall, Upper Saddle River, NJ, 1994. |
| 3 | MichaelBaker,TheBasicofCriticalThinking,TheCriticalThinkingCopress, 2015. |
| 4 | DavidKelleyandTomKelley,CreativeConfidence,2013. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/critical_thinking/index.htm> |
| 2 | <https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm> |
| 3 | <https://nptel.ac.in/courses/109/104/109104109/> |
| **MappingwithProgrammingOutcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | S | S | S |
| **CO2** | S | S | M | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **MOBILECOMPUTING** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofMobile Communication |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. PresenttheoverviewofMobilecomputing,Applicationsand Architectures.
2. Describethefuturisticcomputing challenges.
3. Enablethestudentstolearntheconceptofmobile computing.
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandtheneedandrequirementsofmobile communication | K1,K2 |
| 2 | Focusonmobilecomputingapplicationsandtechniques | K2,K3 |
| 3 | Demonstratesatellitecommunicationinmobile computing | K4 |
| 4 | Analyzeaboutwirelesslocalloop architecture | K5,K6 |
| 5 | Analyzevariousmobilecommunicationtechnologies | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication. |
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| **Unit:2** | **MOBILECOMMUNICATION** | **12hours** |
| Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems. |
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| **Unit:3** | **MOBILECOMPUTING** | **12hours** |
| Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication. |
|  |
| **Unit:4** | **MOBILECOMMUNICATIONSYSTEM** | **11hours** |
| Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol. |
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| **Unit:5** | **COMMUNICATIONTECHNOLOGY** | **11hours** |



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| WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars–webinars |
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|  | **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | T.G.Palanivelu,R.Nakkeeran,“WirelessandMobileCommunication”,PHILimited, 2009. |
| 2 | JochenSchiller,“MobileCommunications”,SecondEdition,PearsonEducation, 2007. |
| **ReferenceBooks** |
| 1 | AsokeKTalukder,HasanAhmed,RoopaYavagal,“[MobileComputing](http://mheducation.co.in/html/9780070144576.html)”,TMH,2010. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/mobile_computing/index.htm> |
| 2 | <https://www.javatpoint.com/mobile-computing> |
| 3 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | M | L | L | M | S | M | M | M | M |
| **CO2** | S | S | S | M | M | S | M | S | S | S |
| **CO3** | S | S | S | S | M | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **BLOCKCHAIN TECHNOLOGY** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofBlockChain&Crypto Currency |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Understandthe fundamentalsofblockchainand cryptocurrency.
2. Understandtheinfluence androleofblock chaininvariousother fields.
3. Learnsecurityfeaturesandits significance.
4. Identifyproblems&challengesposedbyBlockChain.
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Demonstrateblockchain technologyandcrypto currency | K1,K2 |
| 2 | Understandtheminingmechanisminblockchain | K2 |
| 3 | Applyandidentifysecuritymeasures,andvarioustypesofservicesthatallow people to trade and transact with bitcoins | K3,K4 |
| 4 | ApplyandanalyzeBlockchaininhealthcareindustry | K4,K5 |
| 5 | Analyzesecurity,privacy,andefficiencyof agivenBlockchainsystem | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
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| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody. |
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| **Unit:2** | **NETWORKAND SECURITY** | **12hours** |
| Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain. |
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| **Unit:3** | **CRYPTOCURRENCY** | **12hours** |
| Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain |
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| **Unit:4** | **CRYPTOCURRENCYREGULATION** | **11hours** |
| CryptocurrencyRegulation-Stakeholders,RootsofBitcoin,Legalviews-exchangeof cryptocurrency-BlackMarket-GlobalEconomy.Cyrptoeconomics–assets,supplyand |



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| demand,inflationanddeflation – Regulation. |
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| **Unit:5** | **CHALLENGESINBLOCKCHAIN** | **11hours** |
| Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machinetomachinecommunication –Datamanagementinindustry4.0–futureprospects.Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data |
|  |
| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
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|  | **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016). |
| 2 | Antonopoulos,“MasteringBitcoin:UnlockingDigitalCryptocurrencies” |
| **ReferenceBooks** |
| 1 | SatoshiNakamoto,“Bitcoin:APeer-to-PeerElectronicCashSystem” |
| 2 | RodrigodaRosaRighi,AntonioMarcosAlberti,MadhusudanSingh,“Blockchain Technology for Industry 4.0” Springer 2020. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.javatpoint.com/blockchain-tutorial> |
| 2 | <https://www.tutorialspoint.com/blockchain/index.htm> |
| 3 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/> |

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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | S | S | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **WEB SERVICES** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofDistributedComputing |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Present the Web Services , Building real world Enterprise applications using Web ServiceswithTechnologiesXML, SOAP , WSDL , UDDI
2. Getoverview ofDistributedComputing,XML,andits technologies
3. UpdatewithQoSanditsfeatures
4. DevelopStandards andfutureofWeb Services
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Understandwebservices anditsrelated technologies | K1,K2 |
| 2 | UnderstandXMLconcepts | K2,K3 |
| 3 | AnalyzeonSOAPandUDDImodel | K4,K5 |
| 4 | Demonstratetheroad mapforthe standardsandfutureofweb services | K5 |
| 5 | AnalyzeQoSenabledapplicationsinwebservices | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | INTRODUCTION | **12hours** |
| Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms. |
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| **Unit:2** | **XMLFUNDAMENTALS** | **12hours** |
| XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML. |
|  |
| **Unit:3** | **SOAP MODEL** | **12hours** |
| SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure- interfacedefinitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registrySpecification- Core data structures-Accessing UDDI |
|  |
| **Unit:4** | **TECHNOLOGIESANDSTANDARDS** | **12hours** |
| Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management- workflows and workflow management systems Security: Basics-data handling and forwarding- data storage-errors-Web services security issues. |
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| **Unit:5** | **QUALITYOFSERVICE** | **10hours** |
| Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
|  |
|  | **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | Sandeep Chatterjee, James Webber, “Developing Enterprise Web Services: An Architects Guide”, Prentice Hall, Nov 2003. |
| 2 | Keith Ballinger, “NET Web services: Architecture and Implementation with .Net”, Pearson Education, First Edition, Feb 2003. |
| **ReferenceBooks** |
| 1 | RameshNagappan,“DevelopingJavaWebServices:Architectinganddevelopingsecure Web Services Using Java”, John Wiley and Sons, first Edition Feb 2003. |
| 2 | EricAMarksandMarkJWerrell,“ExecutiveGuidetoWebservices”,JohnWileyand sons, March 2003. |
| 3 | AnneThomasManes,“WebServices:AmanagersGuide”,AddisonWesley,June2003. |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/webservices/index.htm> |
| 2 | <https://www.javatpoint.com/web-services-tutorial> |
| 3 | <https://www.btechguru.com/training--programming--xml--web-services--web-services-part-1-video-lecture--11801--24--147.html> |
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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | M | S | M | M | M | S |
| **CO2** | S | S | S | M | M | S | M | S | M | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

\*S-Strong;M-Medium;L-Low

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| **Coursecode** |  | **ROBOTICPROCESSAUTOMATION FOR BUSINESS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | **Elective** | 4 |  |  | 4 |
| **Pre-requisite** | BasicsofRobots&its Applications |  |  |
| **CourseObjectives:** |
| Themain objectivesof thiscourseareto:1. Learntheconceptsof RPA,itsbenefits,typesandmodels.
2. Gaintheknowledgeinapplication ofRPAinBusiness Scenarios.
3. IdentifymeasuresandskillsrequiredforRPA
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Demonstratethebenefits andethicsofRPA | K1,K2 |
| 2 | UnderstandtheAutomationcycleandits techniques | K2 |
| 3 | DrawinferencesandinformationprocessingofRPA | K3,K4 |
| 4 | Implement&ApplyRPAinBusinessScenarios | K5 |
| 5 | AnalyzeonRobots&leveragingautomation | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
|  |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| IntroductiontoRPA -OverviewofRPA -BenefitsofRPAinabusinessenvironment -Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementingRPA -CentreofExcellence –Typesandtheirapplications -Buildingan RPAteam-ApproachforimplementingRPAinitiatives. |
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| **Unit:2** | **AUTOMATION** | **12hours** |
| RoleofaBusinessManagerinAutomationinitiatives-SkillsrequiredbyaBusinessManagerfor successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people. |
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| **Unit:3** | **AUTOMATIONIMPLEMENTATION** | **12hours** |
| Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows. |
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| **Unit:4** | **ROBOT** | **12hours** |



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| Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation. |
|  |
| **Unit:5** | **ROBOTSKILL** | **10hours** |
| Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill. |
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| **Unit:6** | **ContemporaryIssues** | **2 hours** |
| Expertlectures,onlineseminars –webinars |
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|  | **TotalLecturehours** | **60hours** |
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| **Text Books** |
| 1 | Alok Mani Tripathi” Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool” Packt Publishing Limited March 2018. |
| 2 | TomTaulli“TheRoboticProcessAutomationHandbook”Apress,February2020. |
| **ReferenceBooks** |
| 1 | SteveKaelble”RoboticProcessAutomation”JohnWiley&Sons,Ltd., 2018 |
|  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | <https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm> |
| 2 | <https://www.javatpoint.com/rpa> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_me74/preview> |
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| CourseDesigned By: |



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| **MappingwithProgrammingOutcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

\*S-Strong;M-Medium;L-Low