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| **B.Sc.DataScience****Curriculum&Syllabus** |
| **ProgrammeEducationalObjectives(PEOs)** |
| **TheB.Sc.DataScienceprogramdescribeaccomplishmentsthatgraduatesareexpectedto****attainwithinfivetosevenyearsaftergraduation.** |
| **PEO1** | Our graduates will excel with professional skills, fundamental knowledge, and advanced futuristic technologies to become Data Scientists, Data Analyst, AI Research Scientists, or Entrepreneurs |
| **PEO2** | Our graduates will establish their knowledge by adopting Data Science Technologies to solve complex real-world problems with accurate, thoughtful solutions |
| **PEO3** | Our graduates will engage in lifelong learning to excel in their profession with social and ethical awareness and responsibility |

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| **ProgrammeSpecificOutcomes(PSOs)** |
| **AfterthesuccessfulcompletionofB.Sc.DataScienceprogramthestudentsareexpectedto** |
| **PSO1** | Ability to design, develop, implement and apply Analytical skills related to Research and Real-world problems |
| **PSO2** | Ability to apply tools and techniques to provide successful solutions in the multidisciplinary field |
| **PSO3** | Ability to critique the role of information and analytics for a innovative career, research activities and consultancy |

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| **ProgrammeOutcomes(POs)** |
| **OnsuccessfulcompletionoftheB.Sc.DataScience** |
| **PO1** | Applyanalyticalandcriticalthinkingtoidentify,formulate,analyze,andsolveComplex real-world problemsinordertoreachnuanced authenticated conclusions |
| **PO2** | Possess the ability to demonstrate advanced independent critical enquiry, analysis and reflection of modern statistical methodology and computing |
| **PO3** | Have a set of flexible and transferable skills for different types of employment, both within the Information Technology sector and beyond, in both global and local organizations  |
| **PO4** | Develop and implement data analysis strategies base on theoretical principles, ethical considerations, and deep, detailed and broad knowledge of the underlying data and its implications in the context from which the data was taken |
| **PO5** | Be critical and creative thinkers, with an aptitude and appreciation for continued self-directed learning in the evolving world of data science, artificial intelligence and social media  |
| **PO6** | Design and develop research-based solutions for complex problems with specified needswithappropriate ethical considerationforpublichealth,safety,culture,society, and the environment. |
| **PO7** | Establishtheabilitytolisten,read,proficientlycommunicateandarticulate nuanced data and information through traditional and digital channels to audiences with diverse perspectives |
| **PO8** | Articulate and evaluate appropriate legal and ethical standards pertaining to all forms of communications, network security and human rights. |
| **PO9** | Showcase an understanding of the interdisciplinary nature of data, information and community and its influence innovation and progress within the current local or global context |
| **PO10** | Be able to initiate and implement constructive change in their communities with their skills in data and information, including various professions and workplaces |

**BHARATHIARUNIVERSITY,COIMBATORE-641046**

**(Forthestudentsadmittedfromtheacademicyear2022-2023onwards)**

**SCHEME OF EXAMINATIONS – C**

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| **Part** | **StudyComponents** | **Course Title** | **Ins. hrs / week(Theory)** | **Examinations** | **Credits** |
| **Dur.Hrs** | **CIA** | **EndSem Exam** | **Total** |
|  | **SEMESTER–I** |
| I | Language-I | 6 | 3 | 50 | 50 | 100 | 4 |
| II | English-I | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core1:Computer FundamentalsandPythonProgramming | 4 | 3 | 50 | 50 | 100 | 4 |
| III | Core2: DatabaseManagement System withSQL | 4 | 3 | 50 | 50 | 100 | 4 |
| III | CoreLab1:PythonProgramming& SQL Lab | 4 | 3 | 50 | 50 | 100 | 4 |
| III | Allied Paper I:Descriptive Statistics | 4 | 3 | 50 | 50 | 100 | 4 |
| IV | EnvironmentalStudies # | 2 | 3 | - | 50 | 50 | 2 |
|  | **Total** | **30** |  | **300** | **350** | **650** | **26** |
|  | **SEMESTER–II** |
| I | Language-II | 6 | 3 | 50 | 50 | 100 | 4 |
| II | English-II& | 4 | 3 | 25 | 25 | 50 | 2 |
| III | Core3: Data Analytics | 5 | 3 | 50 | 50 | 100 | 4 |
| III | CoreLab2:AdvancedExcelLab | 4 | 3 | 50 | 50 | 100 | 3 |
| III | CoreLab3: Internet Basics Lab | 2 | 3 | 25 | 25 | 50 | 2 |
| III | Allied Paper II: Inferential Statistics | 5 | 3 | 50 | 50 | 100 | 4 |
|  | ValueEducation–HumanRights# |  2 | 3 | - | 50 | 50 | 2 |
|  | NaanMuthalvan - Skill CourseEffective Englishhttp://kb.naanmudhalvan.in/images/c/c7/Cambridge\_Course\_Details.pdf |  2 |  | 25 | 25 | 50 | 2 |
| **Total** |  | **30** |  | **275** | **325** | **600** | **23** |
|  | **SEMESTER–III** |
| III | Core5: DataEngineering | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core6: ArtificialIntelligence | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Core7: AppliedDataStructures | 4 | 3 | 30 | 45 | 75 | 3 |
| III | CoreLab5: ETLLab | 5 | 3 | 30 | 45 | 75 | 4 |
| III | Allied Paper III: DiscreteMathematics | 5 | 3 | 50 | 50 | 100 | 4 |
| IV | SkillbasedSubject-1:Miniproject usingPythonProgramming / Advanced Excel | 4 | 3 | 30 | 45 | 75 | 3 |
| IV | Tamil@/AdvancedTamil#(or)Non-Major Elective–I:YogaforHumanExcellence#/Women’s Rights # Constitution of India # | 2 | 3 | - | 50 | 50 | 2 |
|  | **Total** | **30** |  | **240** | **335** | **575** | **24** |
|  | **SEMESTER–IV** |
| III | Core8:RProgramming | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core9:Machine Learning Techniques | 6 | 3 | 50 | 50 | 100 | 4 |
| III | CoreLab6: RProgramming Lab | 4 | 3 | 25 | 25 | 50 | 2 |
| III | Allied Paper IV: DigitalMarketing | 6 | 3 | 30 | 45 | 75 | 3 |
| IV | SkillbasedSubject-2:Optimization Techniques | 3 | 3 | 25 | 25 | 50 | 2 |
| IV | Tamil@/ AdvancedTamil #(or)Non-majorelective-II:GeneralAwareness# | 2 | 3 | - | 50 | 50 | 2 |
|  | NaanMuthalvan – Skill CourseOffice Fundamentals - Labhttp://kb.naanmudhalvan.in/Bharathiar\_University\_(BU) | 3 |  | 25 | 25 | 50 | 2 |
|  | **Total** | **30** |  | **205** | **270** | **475** | **19** |
|  | **SEMESTER–V** |  |  |  |  |  |  |
| III | Core10:Data Visualization | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Core11: DeepLearning | 6 | 3 | 50 | 50 | 100 | 4 |
| III | CoreLab7: DataVisualizationLab | 6 | 3 | 50 | 50 | 100 | 4 |
| III | Elective–I: | 6 | 3 | 50 | 50 | 100 | 4 |
| IV | SkillbasedSubject-3: SocialMediaAnalytics | 6 | 3 | 30 | 45 | 75 | 3 |
|  | **Total** | **30** |  | **230** | **245** | **475** | **19** |
|  | **SEMESTER–VI** |  |  |  |  |  |  |
| III | Core12:NaturalLanguageProcessing | 6 | 3 | 50 | 50 | 100 | 4 |
| III | CoreLab8: Natural Language Processing Lab | 3 | 3 | 50 | 50 | 100 | 4 |
| III | Core 13: Project Work Lab %% | 6 | 3 | 60 | 90 | 150 | 6 |
| III | Elective–II: | 5 | 3 | 50 | 50 | 100 | 4 |
| III | Elective–III: | 5 | 3 | 50 | 50 | 100 | 4 |
| IV | SkillbasedSubject-4: CapstoneProject usingPythonorRProgramming,DataVisualization Tools. | 3 | 3 | 30 | 45 | 75 | 3 |
| V | ExtensionActivities@ | - | - | 50 | - | 50 | 2 |
|  | Naan Muthalvan - Skill CourseCyber Security **@**<http://kb.naanmudhalvan.in/images/7/71/Cybersecurity.pdf>(or) Machine Learning **#**<http://kb.naanmudhalvan.in/images/1/19/PBL_Google.pdf>(or) Android APP Development **$** <http://kb.naanmudhalvan.in/images/0/08/Android_App_Dev.pdf> | 2 | 2 | 25 | 25 | 50 | 2 |
|  | **Total** | **30** |  | **365** | **360** | **725** | **29** |
|  | **Grand Total** |  |  | **1615** | **1885** | **3500** | **140** |

* # No Continuous Internal Assessment (CIA). Only University Examinations.
* @ No University Examinations. Only Continuous Internal Assessment (CIA).
* **&** The English II- University semester examination will be conducted for 50 marks (As per existing pattern of Examination) and it will be converted for 25 marks.
* **#** Govt – Non-Autonomous Colleges, **$** Aided – Non-Autonomous Colleges, **@** Self - Financing **(**Non – Autonomous).
* NaanMudhalvan – skill courses- external 25 marks will be assessed by Industry

 and internal will be offered by respective course teacher.

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| **ListofElectivePapers(Collegescanchoose anyoneofthepaperas electives)** |
| **Elective–I** | **A** | MarketingAnalytics |
| **B** | DataSecurityand Compliance |
| **C** | ComputerVision |
| **Elective–II** | **A** | SupplyChainandLogistics Analytics |
| **B** | BusinessandFinancial Analytics |
| **C** | Recommender system |
| **Elective- III** | **A** | HRAnalytics |
| **B** | DataMining |
| **C** | Big Data and Cloud Computing |



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| **Course Code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Core 1** | **ComputerFundamentalsandPythonProgramming** | **4** | **-** | **-** | **4** |
| **Pre-requisite** |  | **SyllabusVersion** | **2022 – 23** |
| **Course Objectives:** |
| **The main objectives of this course are to:**1. **Understand about number systems, algorithms and OOP concepts.**
2. **Understand the basic Python programming constructs and data structures**
3. **Understand how to use files, modules and packages**
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
|  | ApplynumbersystemsandOOPsconceptsforalgorithmicproblemsolving | K2,K3 |
|  | DevelopsimplePythonprogramsininteractiveandscriptmodeusingcontrolstatements | K2,K3 |
|  | ConstructPythonprogramsusingfunctionsandstrings. | K3 |
|  | MakeuseofPythonlists,set,tuples,dictionariesto representcompounddata. | K3,K4 |
|  | Developpythonprogramstohandleexceptions,packagesand performfileprocessing | K3,K4 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **UNIT:1** | **COMPUTER FUNDAMENTALS, ALGORITHMIC PROBLEM SOLVING AND OOP CONCEPTS** | **11 Hours** |
|  | Introductiontonumbersystems-Algorithms,buildingblocksofalgorithms(statements, control flow, functions), pseudo code, flow chart, algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).**OOPconcepts**:OverviewofObjectorientedprogrammingapproach,Characteristicsof object oriented languages-Classes fundamentals: A Simple Class and Object, Accessing members of class, Initialization of class objects:(Constructor, Destructor). |
| **UNIT:2** | **BASICSOFPYTHONPROGRAMMING** | **6 Hours** |
|  | Introduction-Python interpreter- interactive and script mode; values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments. |
| **UNIT:3** | **CONTROLSTATEMENTSANDFUNCTIONSINPYTHON** | **7 Hours** |
|  | Conditional(if),alternative(if-else),chainedconditional(if-elif-else);Iteration:state,while,for, break, continue, pass;Functions:Introduction,inbuiltfunctions,userdefinedfunctions,passing parameters,return values, recursion. |
| **UNIT:4** | **DATASTRUCTURES:STRINGS,LISTS,SETS** | **9 Hours** |
|  | Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations,listmethods,mutability,aliasing,cloninglists,listandstrings,listandfunctions;listprocessing:listcomprehension,searchingandsorting,Sets:creatingsets,setoperations |
| **UNIT:5** | **DATASTRUCTURES:TUPLES,DICTIONARIES** | **12 Hours** |
|  | Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries. Filesandexception:text files,reading andwritingfiles,formatoperator,exception handling,modules,packages |
|  | **TotalLecture hours** | **45 hours** |
| **TextBook(s)** |
|  | Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018 |
|  | Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016John V Guttag, Introduction to Computation and ProgrammingUsingPython,RevisedandexpandedEdition,MITPress , 2013. |
|  | CharlesDierbach,IntroductiontoComputerScienceusingPython:AComputationalProblemSolvingFocus,WileyIndiaEdition,2013. |
| **ReferenceBooks** |
|  | RobertSedgewick,KevinWayne,RobertDondero,Introductionto ProgramminginPython: An Inter-disciplinaryApproach,Pearson India Education Services Pvt. Ltd., 2016. |
|  | TimothyA.Budd,ExploringPython,Mc-GrawHillEducation(India) PrivateLtd.,2015. |
|  | KennethA.Lambert,FundamentalsofPython:FirstPrograms, CENGAGELearning,2012. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
|  | [www.mhhe.com/kamthane/python](http://www.mhhe.com/kamthane/python) |
|  | Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016 [(http://](http://greenteapress.com/wp/think-python/)g[reenteapress.com/wp/think-python/](http://greenteapress.com/wp/think-python/)) |

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

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

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| **Course Code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Core 2** | **DatabaseManagementSystemwithSQL** | **4** | **-** | **-** | **4** |
| **Pre-requisite** |  | **SyllabusVersion** | **2022 – 23** |
| **Course Objectives:** |
| **The main objectives of this course are to:**1. **Understand the significance and fundamentals of database management systems.**
2. **Understand the Database design and query optimization techniques.**
3. **Understand the database security concepts**
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
|  | Describethefundamentalelementsofrelationaldatabase management systems | K1,K2 |
|  | Designrelationalschemausingdatabasedesignprinciples | K2,K3 |
|  | Explaintheconceptsoftransactionprocessing,basicdatabasestoragestructuresandaccesstechniques | K2,K3,K4 |
|  | Applyindexingtechniquestoaccessandgenerateuserreportsfora database. | K2,K3 |
|  | BuildingWebApplicationsusingPython&SQL. | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **UNIT:1** | **INTRODUCTION TO DATABASE ANDRELATIONAL MODEL** | **9 Hours** |
|  | Introduction:Databaseapplications,Purposeofdatabasesystems,Viewsofdata,Database Development Life cycle, Architecture of DBMS. Overview of query processing.RelationalDatabases:Relationalmodel,Databaseschema,Keys,FormalRelationalQuery Languages |
| **UNIT:2** | **DATABASEDESIGN** | **9 Hours** |
|  | LogicalDatabaseDesign:DifferentapproachesinLogicaldesign,ERModeling,ERnotations, StepsinERmodeling.Physicaldatabasedesign:ConvertingERModeltoRelationalDatabase Design,Normalization-FunctionalDependency,1NF,2NF,3NF(optional:multi-valueddependency and 4th Normal form). |
| **UNIT:3** | **QUERYOPTIMIZATION,TRANSACTIONPROCESSING****ANDCONCURRENCYCONTROL** | **9 Hours** |
|  | I SQL Standards – Data types – Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL.Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization. Transactions:Conceptandpurpose,ACIDpropertiesandtheirnecessity.Concurrency Control:lock-based protocols, 2-phase locking, Timestamp based protocols. Deadlock handling |
| **UNIT:4** | **STORAGEANDINDEXING** | **9 Hours** |
|  | Storage and File structure: File Organization, RAID. Indexing: Concepts, Clustered and Non-Clustered Indices, B-tree and B+-tree. Basics of Hashing (Static, Dynamic). |
| **UNIT:5** | **DATABASESECURITY** | **9Hours** |
|  | Data Classification-Threats and risks – Database access Control – Types of Privileges –Statistical Databases. - Distributed Databases-Architecture-Transaction Processing.Data Warehousing and Mining-Classification-Association rules-Clustering-Information Retrieval |
|  | **TotalLecture hours** | **45 hours** |
| **TextBook(s)** |
|  | AbrahamSilberschatz,HenryKorth,andS.Sudarshan,“DatabaseSystem Concepts”,SixthEdition,McGraw-Hill.2011 |
|  | R.ElmasriandS.Navathe,“FundamentalsofDatabaseSystems”,SixthEdition,PearsonEducation,2011 |
|  | RaghuRamakrishnan,JohannesGehrke,DatabaseManagementSystems,3nd Edition,McGrawHill,2003 |
| **ReferenceBooks** |
|  | ThomasM.ConnollyandCarolynE. Begg, “DatabaseSystems-APractical ApproachtoDesign,ImplementationandManagement”,Fifthedition,Pearson Education, 2010. |
|  | C.J.Date,A.Kannanand S.Swamynathan,“AnIntroductionto Database Systems”,EighthEdition,PearsonEducation,2006. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
|  | https://onlinecourses.nptel.ac.in/noc17\_cs33/course |
|  | [http://nptel.ac.in/courses/IIT- MADRAS /](http://nptel.ac.in/courses/IIT-%20MADRAS%20/) Intro\_to\_Database\_Systems\_Design |

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

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| **Course Code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 1** | **PythonProgramming& SQL Lab** | **-** | **-** | **4** | **4** |
| **Pre-requisite** | **None** | **SyllabusVersion** | **2022 – 23** |
| **Course Objectives:** |
| **The main objectives of this course are to:**1. **Apply the basic Python programming constructs and data structures.**
2. **Apply file concepts, create modules and packages**
3. **Analyze data using Python**
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
|  | Solve problems using various control statements, functions and strings inPython | K3 |
|  | Make use of Python lists , set, tuples, dictionaries to represent compound | K4 |
|  | Describethefundamentalelementsofrelationaldatabase management systems | K1,K2 |
|  | Designrelationalschemausingdatabasedesignprinciples | K2,K3 |
|  | Explaintheconceptsoftransactionprocessing,basicdatabasestoragestructuresandaccesstechniques | K2,K3,K4 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **PYTHON PROGRAMMING LAB** |
| **EXERCISE1** | **IntroductiontoPython** | **6** |
| Programs using expressions and input and output statements. Programs using operators, built infunctions and conditional statements |
| **EXERCISE2** | **Functions** | **6** |
| ProgramsusingFunctions-Programstofindsquareroot,GCD,sumanarrayofnumbers |
| **EXERCISE3** | **DataStructures:StringsAndLists** | **6** |
| Programsperformingallstringoperations-performoperationson lists- Sorting of elements (Selection and insertion sort) |
| **EXERCISE4** | **DataStructures:Tuples, Dictionaries, Sets** | **6** |
| Programsusingdictionariesandsets–Tuples |
| **EXERCISE5** | **Files,Modules,PackagesAndDataAnalysis** | **6** |
| **SQL LAB** |
| **LISTOFEXPERIMENTS 15** |
| 1. CreationofadatabaseandwritingSQLqueriestoretrieveinformationfromthe database.
2. Creatingrelationaldatabasetosetvarious constraints.
3. PerformingInsertion,Deletion,Modifying,Altering,UpdatingandViewingrecords based on conditions.
4. WorkingonTCL,DCLcommands
5. Creatingrelationshipbetweenthe databases.
 |
| **Total Marks : 45** |
| **TextBook(s)** |
| 1. TimothyA.Budd,ExploringPython,Mc-GrawHillEducation (India)PrivateLtd.,2015
 |
| 1. AshokNamdevKamthane,AmitAshokKamthane,ProgrammingandProblemSolvingwithPython,Mc-GrawHillEducation,2018
 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1. InfosysFoundationProgram:Module 2
 |
| 1. https://onlinecourses.nptel.ac.in/noc17\_cs33/course
 |
| 1. [http://www.db-book.com](http://www.db-book.com/)
 |
| 1. <http://nptel.ac.in/courses/IIT->
2. MADRAS/Intro\_to\_Database\_Systems\_Design
 |
| 1. <http://www.iitg.ernet.in/awekar/teaching/cs344fall11/>
 |
| 1. [www.w3schools.com/sql/](http://www.w3schools.com/sql/)
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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | M | M | M | L | L | L | L | L |
| CO2 | S | S | M | M | M | L | L | L | L | L |
| CO3 | S | S | M | M | M | L | L | L | L | L |
| CO4 | S | M | M | M | S | M | L | L | L | L |
| CO5 | S | M | M | M | M | M | L | L | L | L |

\*Strong;M-Medium;L-Low

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| **Course Code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Allied 1** | **DescriptiveStatistics** | **4** | **-** | **-** | **4** |
| **Pre-requisite** | **BasiclevelonMathematical Computation** | **Syllabus****Version** | **2022-23** |
| **Course Objectives:** |
| Themainobjectivesofthiscourseareto:1. Understandthesignificanceandcomputationalaspectsofstatisticalanalysis
2. Understandthepatterns of distribution of data
3. Understand the concepts of predictive analytics
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandthescopeandnecessityofStatisticsandthe representationof data | K1,K2 |
| 2 | Tabulateandrepresentthedataindiagramsand graphs | K2,K3 |
| 3 | Applytheformulaandcalculatedescriptivemeasuresofstatistics | K2,K3,K4 |
| 4 | Analyzethenatureofdataandinterpretthe measures | K2,K3,K4 |
| 5 | Analyzethedataandpredictthefuturevalues using regression  | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **UNIT:1** | **Status of Statistics and collection of data** | **12 hours** |
| Origin, scope, definition, limitations of Statistics. Data- Types- Primary and Secondary Data-Methods of data Collection |
| **UNIT:2** | **Classification, Tabulation and graphical representation** | **12 hours** |
| Classification of data, preparation of tables, Diagrammaticrepresentationofdata:OnedimensionalandTwodimensionaldiagrams–Graphical representation:Linediagram,Frequencypolygon,Frequencycurve,Histogram |
| **UNIT:3** | **MeasuresofCentralTendency and location** | **12 hours** |
| Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean-Properties with Merits and Demerits- Empirical Relation between means. Partition values: Quartiles, Deciles and Percentiles. |
| **UNIT:4** | **Measures of Dispersion** | **12 hours** |
| Absolute and Relative Measures Range, Mean deviation, Quartile deviation and Standard deviation – MeasuresofSkewness-Pearson’sandBowley’sCoefficientofSkewness, Coefficient of Skewness based on moments – Kurtosis and its significance |
| **UNIT:5** | **MeasuresofVariation, correlation and regression** | **12hours** |
| Measures of Variation : Standard, Mean and Quartile deviations-Co efficient of variation. SimpleCorrelation-KarlPearson‘sCo-efficientofcorrelation–Rankcorrelation-Regression lines. |
|  | **TotalLecture hours** | **60 hours** |

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| **Text Books:** |
| **1** | Agarwal,B.L.(2021).BasicStatistics,NewAgeInternational PrivateLimited,NewDelhi, India |
| **2** | Gupta, S.C., and Kappor, V. K. (2020). Fundamentals of MathematicalStatistics,12thEdition,SultanChand&Sons ,NewDelhi,India |
| **ReferenceBooks** |
| **1** |  Holcomb,Z.C.(2017).FundamentalsofDescriptiveStatistics, Routledge,NewYork,US. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** |  https://nptel.ac.in/courses/111/104/111104120/ |
| **2** | https:/[/www.iiserpune.a](http://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.p)c[.in/~bhasbapat/phy221\_files/curvefitting.p](http://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.p)df |

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

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



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| **Course Code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Core 3** | **Data Analytics** | **5** | **0** | **0** | **4** |
| **Pre- requisite** | **None** | **Syllabus version** | **2022-23** |
| **CourseObjectives** |
| The main goal of this course is to help students learn, understand, and practice big data analyticsandmachinelearningapproaches,whichincludethestudyofmoderncomputing big data technologies and scaling up machine learning techniques focusing on industryapplications. |
| **ExpectedCourseOutcomes** |
| 1 | Ability to select and implement machine learning techniques and computingenvironmentthataresuitablefortheapplication. | **K1,K2** |
| 2 | Abilitytoidentifythecharacteristicsofdatasetsandcomparethetrivialdataand unstructured data | **K2,K3** |
| 3 | Abilitytounderstandandapplyscalingupmachinelearningtechniquesandassociatedcomputingtechniquesand technologies | **K2,K3** |
| 4 | Abilitytorecognizeandimplementvariouswaysofselectingsuitablemodelparametersfordifferentmachinelearningtechniques. | **K1,K2** |
| 5 | Abilitytointegratemachinelearninglibrariesandmathematicaland statistical tools with modern technologies | **K2,K3** |
| **K1–RememberK2–UnderstandK3–applyK4-AnalyzeK5–evaluateK6-Create** |
| **UNITI** | **INTRODUCTIONTODATAANALYSIS** | **9** |
| Introduction to Big Data Platform – Challenges of conventional systems – Web data –EvolutionofAnalyticscalability,analyticprocessesandtools,Analysisvsreporting–Modern data analytic tools,  |
| **UNITII** | **DATAANALYSISTECHNIQUES** | **9** |
| Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks,Supportvectorandkernelmethods,Analysisoftimeseries:linear systemsanalysis, nonlinear dynamics – Rule Induction. |
| **UNITIII** | **LINEARMETHODSFORREGRESSIONAND CLASSIFICATION** | **9** |
| Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection ,  |
| **UNITIV** | **BASICANALYSISTECHNIQUES** | **9** |
| Basicanalysistechniques,Statisticalhypothesisgenerationandtesting,Chi-Squaretest,t-Test, Analysisofvariance,Correlationanalysis,Maximumlikelihoodtest,Practiceandanalysiswith R or Python |

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| **UNITV** | **MODELASSESSMENTANDSELECTION** | **9** |
| Bias,Variance,and model complexity,Bias-variance trade off, Optimism of the training error rate,EstimateofIn-samplepredictionerror,Effectivenumberofparameters |
| **TotalLectureHours** | **45Hours** |
| **TextBook(s)** |
|  |  |  |
| MichaelBerthold,DavidJ.Hand,IntelligentDataAnalysis,Springer,2007. |
| **ReferenceBook(s)** |
|  | AnandRajaramanandJeffreyDavidUllman,MiningofMassiveDatasets,Cambridge University Press, 2012 |
|  | JanHoller,VlasiosTsiatsis,CatherineMulligan,StefanAvesand,StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to aNewAgeofIntelligence”,1stEdition,AcademicPress,2014 |
|  | Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014. |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | S | M | M | L | L | L | L |
| CO2 | S | M | S | S | M | M | M | L | L | L |
| CO3 | S | M | M | M | S | M | L | L | M | L |
| CO4 | M | S | M | M | S | M | L | L | M | L |
| CO5 | M | S | M | M | S | M | L | L | M | L |
| \*S-Strong;M-Medium;L-Low |

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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 2** | **AdvancedExcel Lab** | **0** | **0** | **4** | **3** |
| **Pre- requisite** | **None** | **Syllabus version** | **2022-23** |
| **CourseObjectives** |
| Themainobjectivesofthiscourseareto:1. Constructformulas,includingtheuseofbuilt-infunctions,andrelative andabsolutereferences.
2. Converttextandvalidateandconsolidatedata.
3. Createpivottablesandcharts.
 |
| **ExpectedCourseOutcomes** |
| 1 | Developorganizeddataformatusingsortingandfilteringcomponents | K3,K4 |
| 2 | Designadvancedgraphicpresentationsonstoreddata | K3,K4 |
| 3 | Sort,search,andextractknowledgefromhistoricaldata | K3,K4,K5 |
| **K1–RememberK2– UnderstandK3–applyK4-AnalyzeK5– evaluateK6-Create** |
|  |
| **EXERCISE1** | **INTRODUCTIONTOSPREADSHEETS** | **9** |
| Introductiontospreadsheets,readingdata,manipulatingdata.Basicspreadsheetoperationsandfunctions |
| **EXERCISE2** | **DATACLEANINGANDWORKINGWITHCONDITIONS****USINGEXCEL** | **9** |
| **Working with Text:** Conditional expression (IF and nested IF), Logical Funcion**(**AND, OR, NOT), Concatenate functions in Excel-Left, Right, Upper and Lower, Data filtering capabilities of Excel, the constructionofPivotTablestoorganizedataandintroductiontochartsinExcel,UsingRanges,SelectingRanges,EnteringInformationIntoaRange,UsingAutoFill |
| **EXERCISE3** | **DATAMANIPULATIONUSINGEXCEL** | **9** |
| UsingFormulas,FormulaFunctions–Sum,Average,if,Count,max,min,Proper,Upper,Lower,UsingAutoSum,Vlookup,VlookUP withExactMatch, ApproximateMatch,NestedVlookUP, Hlookup, Match, Countif, Text, Trim |
| **EXERCISE4** | **DATAANALYSIS** | **9** |
| What-if-Analysis-GoalSeek,DataTable,ScenarioManager,FormattingCharts,3D Graphs, |
| **EXERCISE5** | **ADVANCED GRAPHING AND CHARTING** | **9** |
| FormattingandcustomizingPivottables,UsingadvancedoptionsofPivottables,Pivotcharts,Line,BarandPiecharts,,Scatterplots, Histograms |
| **TotalPracticalHours** | **45** |

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| **TextBook(s)** |
| **1** | MicrosoftExcel2019DataAnalysisandBusinessModeling,WayneWinston,2019 |
| **ReferenceBook(s)** |
| **2** | https:/[/www.coursera.o](http://www.coursera.org/learn/excel-data-analysis#syllabus)r[g/learn/excel-data-analysis#syllabus](http://www.coursera.org/learn/excel-data-analysis#syllabus) |
| **3** | https:/[/www.coursera.o](http://www.coursera.org/learn/analytics-excel#syllabus)r[g/learn/analytics-excel#syllabus](http://www.coursera.org/learn/analytics-excel#syllabus) |
| **4** | <https://kristujayanti.edu.in/pdf/2018/VAC-Data-Analysis-using-spreadsheet-Syllabus.pdf> |
| **5** | <https://online.rice.edu/courses/excel-data-analysis/> |
| **6** | <https://www.digitalvidya.com/certified-data-analytics-course/> |
| **7** | https:/[/www.zsem.hr/m](http://www.zsem.hr/media/2017/12/Syllabus_Big-Data-Analytics-using-Excel-)e[dia/2017/12/Syllabus\_Big-Data-Analytics-using-Excel-](http://www.zsem.hr/media/2017/12/Syllabus_Big-Data-Analytics-using-Excel-)Business-Intelligence-and-Power-BI-tools\_20172018.pdf |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | S | M | S | L | L | L | L |
| CO2 | S | M | M | M | M | S | L | L | L | L |
| CO3 | S | M | L | L | M | S | L | L | L | L |

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 3** | **Internet BasicsLab** | **-** | **-** | **2** | **2** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| **Course Objectives:** |
| 1. Introduce the fundamentals of Internet and the Web functions. 2. Impart knowledge and essential skills necessary to use the internet and its various components. 3. Find, evaluate, and use online information resources. 4. Use Google Apps for education effectively. |
| **ExpectedCourse Outcomes:** |
| 1 | Apply the predefined procedures to create Gmail account, check and receive messages | K3 |
| 2 | Apply the predefined procedures to perform various basic operations on internet | K3 |
| 3 | Utilize various google applications like docs, google classroom, google drive, google forms, google meet and slides | K3 |
| **K1**–Remember;**K2**–Understand;**K3**– Apply;**K4**–Analyze;**K5**–Evaluate;**K6**– Create |
| **PROGRAM - 1** | **2** |
| Create an email account in Gmail. Using the account created compose a mail to invite other college students for your college fest, enclose the invitation as attachment and send the mail to at least 50 recipients. Use CC and BCC options accordingly |  |
| **PROGRAM - 2** | **2** |
| Open your inbox in the Gmail account created, check the mail received from your peer from other college inviting you for his college fest, and download the invitation. Reply to the mail with a thank you note for the invite and forward the mail to other friends |  |
| **PROGRAM - 3** | **2** |
| Assume that you are studying in final year of your graduation and are eagerly looking for a job. Visit any job portal and upload your resume. |  |
| **PROGRAM - 4** | **2** |
| Create a meeting using Google calendar and share meeting id to the attendees. Transfer the ownership to the Manager once the meeting id is generated. |  |
| **PROGRAM - 5** | **2** |
| Create a label and upload bulk contacts using import option in Google Contacts |  |
| **PROGRAM - 6** | **4** |
| Create your own Google classroom and invite all your friends through email id. Post study material in Google classroom using Google drive. Create a separate folder for every subject and upload all unit wise E-Content Materials. |  |
| **PROGRAM - 7** | **2** |
| Create and share a folder in Google Drive using „share a link‟ option and set the permission to access that folder by your friends only. |  |
| **PROGRAM - 8** | **2** |
| Create one-page story in your mother tongue by using voice recognition facility of Google Docs |  |
| **PROGRAM - 9** | **2** |
| Create a registration form for your Department Seminar or Conference using Google Forms. |  |
| **PROGRAM - 10** | **2** |
| Create a question paper with multiple choice types of questions for a subject of your choice, using Google Forms. |  |
| **PROGRAM - 11** | **4** |
| Create a meet using Google Calendar and record the meet using Google Meet. Create a Google slides for a topic and share the same with your friends. |  |
| **PROGRAM - 12** | **4** |
| Create template for a seminar certificate using Google Slides. |  |
| **PROGRAM - 13** | **4** |
| Create a sheet to illustrate simple mathematical calculations using Google Sheets. Create student‟s internal mark statement and share the Google sheets via link. |  |
|  | **TotalLecture hours** | **30 hours** |
|  | **TextBook(s)** |  |
| 1 | Ian Lamont, Google Drive & Docs in 30 Minutes, 2nd Edition. |  |
|  | **ReferenceBooks** |  |
| 1 | Sherry Kinkoph Gunter, My Google Apps, 2014. |  |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | M  | M | L | L | L | L | L | L | L | M |
| CO2 | S  | M | L | L | L | L | L | L | L | L |
| CO3 | S | S | S | L | L | L | L | L | L | L |

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

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Allied 2** | **InferentialStatistics** | **5** | **-** | **-** | **4** |
| **Pre-requisite** | **Basicsofsamplingtechniques** | **Syllabus****Version** | **2022-23** |
| **Course Objectives:** |
| Themainobjectivesofthiscourseareto:1. Gainknowledgeonthemethodsoftestingstatisticalhypothesis.
2. Understandthemeaningand applicationsoftestsof significance
 |
| **ExpectedCourse Outcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Understandtestingofstatisticalhypothesis | K1,K2 |
| 2 | Understandtheconceptofpowerfultestsbased on ‘t’ and ‘F’ distributions | K2,K3 |
| 3 | Understandtheconceptofvariabilitytodrawinferences | K2, K3,K4 |
| 4 | Analyzethetest of goodness of fit | K2, K3,K4 |
| 5 | Understandandapply suitable test for analysis | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **Tests of Hypotheses** | **12 Hours** |
| Procedure of Testing hypothesis –two types of errors – critical region-Two - tailed and one- tailed tests, measuring the power of a hypothesis test |
| **Unit:2** |  **Estimation** | **12 Hours** |
| Properties of a good estimator, Tests of significance of attributes-tests for number of successes and proportion of successes |
| **Unit:3** | **Tests of significance for large samples** | **12 Hours** |
| Difference between small and large samples-two tailed test for difference between means of two samples, standard deviations |
| **Unit:4** | **Test of significance for small samples** | **12 Hours** |
| Assumption of normality-Student’s t-distribution-Properties of t-distribution-Application of t- distribution |
| **Unit:5** | **Sampling Distributions** | **12Hours** |
| Chi-square distribution, Fisher’s z distribution and F-test |
| **TotalLecture hours : 60 Hours** |

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| **TextBook(s)** |  |
| **1** | Gupta, S.C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics,12thEdition,SultanChand&Sons(Publisher),NewDelhi,India |  |
| **2** | Gupta S.P (2018), Statistical Methods, 45th revised edition, Sultan Chand & Sons, New Delhi |  |
| **ReferenceBooks** |  |
| **1** | Agarwal,B.L.(2006).BasicStatistics,NewAgeInternationalPrivateLimited,NewDelhi,India |  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://nptel.ac.in/courses/111/104/111104120/ |  |

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

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



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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core 5** | **DataEngineering** | **5** | **-** |  | **4** |
| **Pre-requisite** |  | **Syllabus****Version** | **2022-23** |
| **CourseObjectives:** |
| **Themainobjectivesofthiscourseareto:**1. **Identifybasicconcepts,terminology,theories,modelsandmethodsinthefieldofData Engineering**
2. **Applydatatransformationssuchasaggregationandfilteringforvisualization**
3. **Identifyopportunitiesforapplicationofdatavisualizationinvariousdomains.**
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Acquireknowledgeonvariousphasesofdataengineering | K1,K2 |
| 2 | Identifynecessityofdatapre-processingandapplythe appropriate procedure | K2,K3 |
| 3 | Demonstratedatawarehouseschemaandprocessofdata retrieval for real time applications. | K2,K3,K4 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**–Create |
| **UNIT:1** | **DATAENGINEERINGINTRODUCTION** | **12 Hours** |
| KDDProcess–Kindsofdatacanbemined–Kindofpatternscanbemined–Technologies used –Kinds of Applications targeted – Issues in data mining - Data Objects and Attribute Types-Datapreprocessingoverview –DataCleaning–Data Integration –DataReduction – Data Transformation and Discretization |
| **UNIT:2** | **DATAWAREHOUSING** | **12 Hours** |
| Datawarehouse–BasicConcepts–Modeling-DatacubeandOLAP–DatawarehouseDesignandUsage–Implementation-DataGeneralizationbyAttributeOriented Induction. |
| **UNIT:3** | **DATAMODELING** | **12 Hours** |
| Introductiontodata modeling-Relationaldata models-NoSQLdata models-DataPipelines-DataQuality-ProductiondataPipelines |
| **UNIT:4** | **DATAPROCESSING** | **12 Hours** |
| ETLbasics–ExtractionofData-ExtractionMethods-Transportationofdata-Transportation mechanisms-ETL Tools-Loading and Transformation. DataCapture-Datawarehouseperformance-basicquery-advancedquery-Schemamodelingtechniques-Analysisand Reporting-OLAP |
| **UNIT:5** | **DATAVISUALIZATION** | **12 Hours** |
| Datavisualization:Introduction,Typesofdatavisualization,Datafor visualization:Datatypes,Dataencodings,Retinalvariables,mapping variablestoencodings,Visualencodings. |
|  | **TotalLecture hours** | **60 hours** |
| **TextBook(s)** |
| 1 | Paul Crickard “Data Engineering with Python” work with massive datasets to design datamodels and automate data pipelines Using python,2020 |  |
| 2 | Jiawei Han, MichelineKamber, Jain Pei “Data Mining: Concepts and Techniques”, Third edition, Elsevier, Morgan Kaufmann Publishers, 2012. |  |
| **ReferenceBooks** |
| 1 | GlennJ.Myatt,MakingsenseofData:Apractical GuidetoExploratoryDataAnalysisandDataMining,JohnWiley Publishers, 2007. |  |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | M | S | S | M | S | M | M | L | M | M |
| CO2 | S | S | S | S | L | M | L | M | L | M |
| CO3 | S | S | M | M | L | M | S | M | M | M |

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

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core 6** | **ARTIFICIALINTELLIGENCE** | **5** | **-** | **-** | **4** |
| **Pre-requisite** | **SyllabusVersion** | **2022-23** |
| **Course Objectives:** |
| Themainobjectivesofthiscourseareto:1. Understandthe fundamentalsofartificialintelligenceandworkingofproblem-solvingagents.
2. UnderstandthelogicalagentsandknowledgerepresentationusingFirstOrder Logic.
3. Understandthe conceptofuncertaintyandbuildingprinciples ofdecision-making agents.
 |
| **ExpectedCourse Outcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Demonstratefundamentalsofartificialintelligence(AI)andproblemsolvingusingdifferentsearchmethods | K3 |
| 2 | Describeaboutadversarialsearchandconstraintsatisfactionproblemsolving. | K3 |
| 3 | Developknowledgeaboutlogicrepresentationsformakinginferences. | K2 |
| 4 | Demonstratethedecision-makingtechniquestohandleuncertainty. | K2 |
| 5 | ApplyAIprinciplestodevelopsolutionsandapplicationstosolveproblems. | K3 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit: 1** | **INTRODUCTIONANDPROBLEMSOLVING** | **9 Hours** |
| Definitions of AI - Intelligent Agents - Problem solving by searching: Problem-solving agents-Example problems – Search for solutions - Uninformed search strategies – Informed search strategies – Heuristic Function – Python AI search implementation. |
| **Unit: 2** | **ADVERSARIALSEARCHANDCSP** | **9 Hours** |
| Adversarial search: Games- Optimal decisions in games – Alpha-beta pruning – Imperfect real time decisions. Constraint Satisfaction Problems (CSP): Defining CSP problems-Constraint Propagation: Inference in CSPs - Backtracking search for CSPs. |
| **Unit: 3** | **LOGICSANDKNOWLEDGEREPRESENATION** | **9 Hours** |
| Logicalagents:Knowledge-basedagents–TheWumpusworld.Logic–Propositionallogic:A very simple logic-Propositional theorem proving.Firstorderlogic:Representation–Syntaxandsemanticsoffirstorderlogic –Usingfirstorder logic-PROLOG basics.Inferenceinfirstorderlogic:Propositionalversusfirstorderinference–Unificationandlifting–Forward chaining – Backward chaining – Resolution. |
| **Unit: 4** | **UNCERTAINITYANDDECISIONMAKING** | **9 Hours** |
| Making Simple Decisions-Combining beliefs and desires under Uncertainty-Utility Theory-Utility Functions-Multi-attribute utility functions- Quantifying uncertainty: Acting under uncertainty - Probabilitybasics – Bayes’ Rule and its use. Probabilistic reasoning: Representing knowledgeinuncertaindomain-ThesemanticsofBayesiannetworks-Decisionnetworks-The valueofinformation-Decisiontheoreticexpert systems. |

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| **Unit:5** | **AIAPPLICATIONS** | **9 Hours** |
| FutureofArtificialIntelligence-NaturalLanguageProcessing-SpeechRecognition – Robotics – Expert Systems - AI Application Case Studies. |  |
| **TotalLecture hours** | **45 hours** |
| **TextBook(s)** |  |
| **1** | StuartRussell,PeterNorvig,“ArtificialIntelligence–AModern Approach”,3rdEdition,PearsonEducation/PrenticeHallofIndia,2015. |
| **2** | ElaineRich,KevinKnight,Shivashankar.B.Nair,“Artificial Intelligence”, TataMcGrawHill,ThirdEdition,2009 |
| **ReferenceBooks** |
| **1** | NilsJ.Nilsson,“ArtificialIntelligence:AnewSynthesis”,HarcourtAsia Pvt.Ltd.,2000. |
| **2** | GeorgeF.Luger,“ArtificialIntelligence-StructuresandStrategiesFor ComplexProblemSolving”,PearsonEducation/PHI,2002 |
| **3** | DavidL.Poole,AlanK.Mackworth,“ArtificialIntelligence:Foundations ofComputationalAgents”,CambridgeUniversityPress, 2010. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | [http://aima.cs.berkeley.edu](http://aima.cs.berkeley.edu/) |
| **2** | <http://nptel.ac.in/courses/106106126/4> |
| **3** | https://medium.freecodecamp.org/an-introduction-to-q-learning-reinforcement-learning-14ac0b4493cc |

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

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

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| **Course code** | **TITLE OF THE PAPER** | **L** | **T** | **P** | **C** |
| **Core 7** | **AppliedDataStructures** | **4** | **0** | **0** | **3** |
| **Pre-requisite** | **None** | **Syllabus Version** | **2022-23****Onwards** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Mastertheimplementationoflinkeddatastructuressuchasstack,queues,linkedlists,trees etc.
2. Tochoosetheappropriatedatastructureforaspecific application
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | ConstructandanalyzeLinkedlistoperationswith illustrations | **K2,K3** |
| 2 | Constructandanalyzestackoperationswithillustrations | **K2,K3** |
| 3 | EnhancetheknowledgeofQueueand Hashing. | **K2,K3** |
| 4 | Demonstratetheconceptoftreesanditsapplications | **K2,K3** |
| 5 | DemonstratetheconceptofGraphanditsapplications | **K2,K3** |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
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| **Unit:1** | **LINKEDLIST** | **9 hours** |
| Arraylist-ReviewofPointers-Linkedlists–Types-Operations-Creation,Insertion,Deletion, Modification Doubly Linked List operations |
| **Unit:2** | **STACK** | **9 hours** |
| Stacks – Operations implemented using arrays and Linked list – Applications of Stack – Balancing Parenthesis – Infix to Postfix Conversion, Postfix Expression Evaluation |
| **Unit:3** | **QUEUESANDHASHING** | **9 hours** |
| Queues – Operations on Queues, Circular Queue – Operations, Double ended queue – Priority queue – Hashing- Collision resolution strategies |
| **Unit:4** | **TREES** | **9 hours** |
| General Trees Representation – Tree Traversals – Binary Trees- Expression trees – Binary Search Tree operations – B-Trees – B+Trees. |
| **Unit:5** | **GRAPHS** | **9 hours** |
| Graphs and their representation: BFS, DFS – Shortest Path Algorithms – Dijikstra’s Algorithm – Minimum Spanning Tree – Topological Sorting |
| **Total Hours : 45** |

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| **References:** |
| 1.EllisHorowitz,SartajSahniandSanguthevarRajasekaran,“FundamentalsofComputerAlgorithms”,SecondEdition,UniversitiesPress,Hyderabad,2008. |
| 2.MarkAllenWeiss,“DataStructuresandAlgorithmAnalysisinC”,Secondedition,PearsonEducationAsia,2007. |
| 3.JeanPaulTremblayandPaulG.Sorenson,Anintroductiontodatastructureswithapplications2ndedition,TataMcGraw-Hill,20014 |
| 4.GilbergandFerouzan,DataStructuresusingC,PearsonEducation 2004. |
| 5.RobertL.Kruse,ClovisL.Tondo,BruceP.Leung,‘DataStructuresandProgramDesign in C’,PHI,1996. |
| 6.AlfredV.Aho, JohnE.HopcroftandJeffryD.Ullman,DataStructures &Algorithms, PearsonEducation,NewDelhi,2009. |

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

S-Strong;M-Medium;L-Low

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Allied 3** | **Discrete Mathematics** | **5** | **-** |  | **4** |
| **Pre-requisite** | **Basic knowledge in Mathematics** | **Syllabus****Version** | **2022-23** |
| **CourseObjectives:** |
| 1. Introduce students to the techniques, algorithms, and reasoning processes involved in the study of discrete mathematical structures.
2. Introduce students to set theory, inductive reasoning, elementary and advanced counting techniques, equivalence relations, recurrence relations, graphs, and trees.
3. Introduce students to prove mathematical statements by means of inductive reasoning
 |
| **ExpectedCourseOutcomes:** |
| 1 | Understand discrete mathematical preliminaries and apply discrete mathematics in formal representation of various computing constructs | K2 |
| 2 | Demonstrate an understanding of relations ,functions, Combinatory and lattices | K2 |
| 3 | Apply the techniques of discrete structures and logical reasoning to solve a variety of problems and write an argument using logical notation | K3 |
| 4 | Analyze and construct mathematical arguments that relate to the study of discrete structures | K4 |
| 5 | Develop and model problems with the concepts and techniques of discrete mathematics. | K4 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**–Create |
| **UNIT:1** | **MATHEMATICAL LOGIC** | **15Hours** |
| Proposition – Logical Operators – Truth Tables – Laws of Logic – Equivalances – Rules of interface – validity Arguments – Consistency of Specifications – Propositonal Calculus – Quantifiers and universe of discourse. |
| **UNIT:2** | **PROOF TECHNIQUES & RELATIONS AND FUNCTIONS** | **15Hours** |
| **PROOF TECHNIQUES:** Introduction – Methods of proving theorems – Direct Proofs, Proof by Contraposition, Vacuous and trivial proofs, Proofs by contradiction – Mistakes in Proofs – Mathematical induction – Strong Mathematical induction – Strong mathematical induction and well ordering – Program Correctness. **RELATIONS AND FUNCTIONS:** Definition and properties of binary relations – Representing Relations – Closures of Relations – Composition of Relations – Equivalence Relations – Partitions and Covering of sets – Partial Orderings – n-array Relations and their applications. Functions – Injective, Surjective, Bijective functions, Composition, identity and inverse |
| **UNIT:3** | **COMBINATORICS** | **15Hours** |
| Basics of Counting – The Pigeonhole principle – Permutations and Combinations with and without repetition, Permutations with indistinguishable elements – distributions of objects – Generating permutations and combinations in lexicographic order |
| **UNIT:4** | **RECURRENCE RELATIONS** | **15Hours** |
| Some Recurrence Relation Models – Solution of linear homogeneous recurrence relations with constant coefficients – solution of linear non-homogeneous recurrence relations by the method of characteristic roots – Divide and conquer recurrence relations. |
| **UNIT:5** | **LATTICES** | **15Hours** |
| Lattices as partially ordered set – Properties of Lattices – Lattices as algebraic system – Sub lattices – Direct Product and Homomorphism – Some special lattices. |
|  | **TotalLecture hours** |  **75 hours** |
| **TextBook(s)** |
| 1 | Kenneth H. Rosen, “Discrete Mathematics and its applications”, McGraw Hill, 2011. |  |
| 2 | Judith L.Gersting, “Mathematical Structures for Computer Science”, W.H> Freeman and Company, 2014 |  |
| 3 | Tremblay J.P. and Manohar R., “Discrete and Combinatorial Mathamatics – An Introduction”, Addison Wesley, 2009. |  |
| **ReferenceBooks** |
| 1 | Doerr Alan and Levasseur K., “Applied Discrete Structures for Computer Science”, Galgotia Publications, 2002 |  |
|  | Benard Kolman, Robert C. Busby and Sharan Ross, “ Discrete Mathematical Structures”, Pearson Education, 2014 |  |
| **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| 1  | https://onlinecourses.swayam2.ac.in/aic20\_sp06/preview |  |
| 2 | https://onlinecourses.swayam2.ac.in/arp19\_ap79/preview |  |

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

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

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 5** | **ETL Laboratory** | **-** | **-** | **5** | **4** |
| **Pre-requisite** | **SyllabusVersion** | **2022-23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Togiveanunderstandingof coreconceptsandtechnologiesofdata science.
2. Togive anunderstandingofdatapre-processingtechniques
3. Toequip thestudents topreparethedatafor visualization
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Acquireknowledgeonvariousphasesofdataengineering | K1,K2 |
| 2 | Identifynecessityofdatapre-processingandapplytheappropriateprocedure | K2,K3 |
| 3 | Demonstratedatawarehouseschemaandprocessofdataretrieval for real time applications. | K2, K3,K4 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| 1 | DataMigration (Informatica) |
| 2 | IdentificationandRetrievalofdataset.(Kaggle/UCIRepository) |
| 3 | StatisticalDescriptionsofData(R/Python) |
| 4 | Pre-processingofdatasetsusingdataminingtools. |
| 5 | ExploratoryAnalytics |
| 6 | DataVisualization |
|  | **TotalPractical Hours:45** |
|  | **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | https:/[/www.uda](http://www.udacity.com/course/data-engineer-nanodegree--nd027)c[ity.com/course/data-engineer-nanodegree--nd027](http://www.udacity.com/course/data-engineer-nanodegree--nd027) |
| 2 | https:/[/www.datac](http://www.datacamp.com/courses/introduction-to-data-engineering)a[mp.com/courses/introduction-to-data-engineering](http://www.datacamp.com/courses/introduction-to-data-engineering) |
| 3 | https:/[/www.dataquest.io/path/data](http://www.dataquest.io/path/data-engineer/)-[engineer/](http://www.dataquest.io/path/data-engineer/) |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | S | S | S | M | L | L | M |
| CO2 | M | S | S | S | S | M | M | L | L | L |
| CO3 | M | S | S | M | M | M | L | L | M | M |

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

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| **CourseCode** | **MiniprojectIusingPython Programming / Advanced Excel** | **L** | **T** | **P** | **C** |
| **Supportive** | **SkillbasedSubject-1** | **-** | **-** | **4** | **3** |
| **Pre-requisite** | **Studentsshouldhaveagood****understandingofPython Programming Advanced Excel** | **SyllabusVersion** | **2022-23** |
| **Course Objectives:** |
| Themainobjectivesofthiscourseareto:1. Tounderstandandselectthetaskbasedontheircoreskills
2. Togettheknowledgeaboutanalyticalskillforsolvingtheselectedtask
3. Togetconfidencefor implementingthetaskandsolvingtherealtimeproblems.
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Illustratearealworldproblemandidentifythelistofprojectrequirements | K3 |
| 2 | Judgethefeaturesoftheprojectincludingforms,databases andreports | K5 |
| 3 | Design codetomeettheinputrequirementsandto achievetherequiredoutput | K6 |
| 4 | Composeaproject report incorporatingthe featuresoftheproject | K6 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Aimoftheprojectwork** |
| 1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied
2. Each student should carry out individually one project work and it may be a work using the softwarepackagesthattheyhavelearnedortheimplementationofconceptsfromthepapersstudied or implementation of any innovative idea focusing on application-oriented concepts
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

**VivaVoce**1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.
2. Outof75marks,45 marksforprojectreport and Viva Voce and30MarksforInternal Assessment.
 |
| **ProjectWorkFormat** |
| PROJECTWORKTITLEOFTHEDISSERTATIONBonafideWorkDonebySTUDENTNAME REG. NO.Dissertationsubmittedinpartialfulfillmentofthe requirementsfortheawardof<NameoftheDegree>ofBharathiarUniversity,Coimbatore-46.CollegeLogoSignatureoftheGuide SignatureoftheHOD |

Submitted for the Viva-Voce Examination held on

InternalExaminer

External Examiner

Month– Year

**Acknowledgement Contents**

**Synopsis**

1. **Introduction**
	1. OrganizationProfile
	2. SystemSpecification
		1. HardwareConfiguration
		2. SoftwareSpecification
2. **SystemStudy**
	1. ExistingSystem
		1. Drawbacks
	2. ProposedSystem
		1. Features
3. **SystemDesignandDevelopment**
	1. FileDesign
	2. InputDesign
	3. OutputDesign
	4. DatabaseDesign
	5. SystemDevelopment
		1. DescriptionofModules(Detailedexplanationabouttheproject work)

**4SoftwareTestingandImplementation Conclusion**

**Bibliography Appendices**

1. DataFlowDiagram
2. Table Structure
3. SampleCoding
4. SampleInput
5. SampleOutput

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

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



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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core8** | **R Programming** | **6** | **0** | **0** | **4** |
| **Pre- requisite** | **None** | **Syllabus****version** | **2022-23** |
| **CourseObjectives** |
| * Toexposethestudent sotthefundamental conceptsof RProgramming
 |
| **ExpectedCourseOutcomes** |
| 1 | UnderstandthebasicsinRprogrammingintermsofconstructs,controlstatements,stringfunctions | **K2** |
| 2 | UnderstandtheuseofRforBigDataanalytics | **K2** |
| 3 | ApplyR programmingfor Text processing | **K3** |
| 4 | Appreciateandapplythe Rprogrammingfromastatistical perspective | **K3** |
| **K1–Remember K2 –Understand K3–applyK4-AnalyzeK5–evaluateK6-Create** |
|  |
| **UNIT I** | **IntroducingtoR** | **9** |
| IntroducingtoR–RDataStructures–HelpFunctionsinR–Vectors–Scalars–Declarations–Recycling–CommonVectorOperations–Usingallandany–Vectorizedoperations –Filtering– Victoriesed if-then else– Vector Element names. |
| **UNITII** | **Matrices** | **9** |
| Creating matrices – Matrix Operations – Applying Functions to Matrix Rows and Columns – Addingand deleting rows and columns - Vector/Matrix Distinction – Avoiding Dimension Reduction – HigherDimensionalarrays–lists–Creatinglists–Generallistoperations–Accessinglistcomponentsandvalues–applyingfunctionsto lists–recursivelists. |
| **UNITIII** | **DataFrames** | **9** |
| CreatingDataFrames–Matrix-likeoperationsinframes–mergingDataframes–Applyingfunctions to Data Frames – Factors and Tables – Factors and levels – Common Functions used withfactors – Working with tables – Other factors and table related functions – Control statements –Arithmetic and Boolean operators and values – Default Values for arguments – Returning BooleanValues–Functionsareobjects– Recursion |
| **UNITIV** | **Classes** | **9** |
| S3Classes–S4Classes–Managingyourobjects–Input/output–accessingkeyboardandmonitor–readingandwritingfiles–accessingtheinternet– StringManipulation–Graphics–CreatingGraphs–CustomizingGraphs –SavingGraphstofiles –CreatingThree-Dimensionalplots. |
| **UNITV** | **Modelling in R**  | **9** |
|  Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear Models – Time Series and Auto-Correlation – Clustering.  |
| **TotalLectureHours** | **45Hours** |
| **TextBook(s)** |
| **1** | Norman Matloff,―TheArt ofR Programming: ATourof Statistical SoftwareDesign‖, NoStarchPress,2011. |
| **2** | Jared P.Lander, ―R for Everyone: AdvancedAnalytics andGraphics‖, Addison-WesleyData&AnalyticsSeries,2013. |

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| **ReferenceBook(s)** |
| **1** | Mark Gardner,―BeginningR– TheStatistical Programming Language‖,Wiley, 2013. |
| **2** | Robert Knell, ―IntroductoryR: ABeginner‘s Guideto Data Visualisation,Statistical Analysis and programmingin R‖,Amazon DigitalSouth Asia ServicesInc,2013. RichardCotton(2013).LearningR,O‘ReillyMedia. |
| **3** | GarretGrolemund(2014).Hands-onProgrammingwithR.O‘ReillyMedia, Inc. |
| **4** | RogerD.Peng(2018).R ProgrammingforDataScience. LeanPublishing. |
|  | **RelatedOnlineContents(MOOC,SWAYAM,NPTEL,Websitesetc)** |  |
| **1** | [**https://onlinecourses.swayam2.ac.in/aic20\_sp06/preview**](https://onlinecourses.swayam2.ac.in/aic20_sp06/preview) |  |
| **2** | [**https://onlinecourses.swayam2.ac.in/arp19\_ap79/preview**](https://onlinecourses.swayam2.ac.in/arp19_ap79/preview) |  |
| **CourseDesignedby :** |

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

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

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| **Course code** | **TITLEOFTHECOURSE** | **L** | **T** | **P** | **C** |
| **Core 9** | **MACHINELEARNING TECHNIQUES** | **6** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **Syllabus Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Understandthesignificanceandbasicconceptsofmachine learning.
2. Understanddifferentforms/methodsoflearninganditsalgorithmic perspective.
3. Understandthevariousapplicationsofmachinelearning.
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Understandthefundamentalsanddifferentformsofmachinelearning. | K2 |
| 2 | Demonstratevariousparametricandsemiparametricmachinelearning techniques. | K2 |
| 3 | Demonstratevariousnon-parametricmachinelearningtechniques. | K2 |
| 4 | Explainabouttheconceptsofcomputationallearningtheoryand dimensionality reduction | K2 |
| 5 | Developapplicationsusingappropriatemachinelearningapproaches for real life problems | K3 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **INTRODUCTIONANDSUPERVISEDLEARNING** | 12 hours |
| Introduction to Machine Learning – basic concepts in machine learning – Forms of Learning -Examples of machine learning applications - Supervised Learning: Learning a Class from Examples–Noise–Learning Multiple Classes– Perspectives and Issues in Machine Learning. |
| **Unit:2** | **PARAMETRICANDSEMI-PARAMETRICMETHODS** | 12 hours |
| ParametricClassification–Regression–TuningModelComplexity–ModelSelectionProcedures. Multivariate Methods: Data–Parameter Estimation–Estimation of Missing Values–Multivariate Normal Distribution–Multivariate Classification and Regression - Semi parametric method: Clustering –Expectation–Maximization Algorithm - Self Organizing Feature Map. |
| **Unit:3** | **NON-PARAMETRICMETHODS** | 12 hours |

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| NonparametricMethods:NonparametricDensityEstimationandClassification-Generalization to Multivariate Data–Condensed Nearest Neighbour–Smoothing Models. Decision Trees: Univariate Trees–Pruning–Rule Extraction–Learning Rules–Multivariate Trees. |
| **Unit:4** | **COMPUTATIONALLEARNING** | 12 hours |
| Computational Learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting, Dimensionality reduction: Principal component Analysis, feature selection and visualization. |
| **Unit:5** | **MLAPPLICATIONSANDCASESTUDY** |  |
| Automatedknowledgeacquisition,patternrecognition,programsynthesis,textand language processing, internet-based information systems, human computer interaction, semantic web, and bioinformatics. | 12 hours |
|  | **TotalLecture hours** | **60 hours** |
| **TextBook(s)** |  |
| **1** | EthemAlpaydin, -IntroductiontoMachineLearning3e (AdaptiveComputationand Machine Learning Series), Third Edition, MIT Press, 2014. |
| **2** | Bishop,C.(2006).PatternRecognitionandMachineLearning.Berlin:Springer-Verlag. |
| **3** | TomM.Mitchell,―MachineLearning,McGraw-HillEducation(India)Private Limited, 2013 |
| **4** | StephenMarsland,―MachineLearning:AnAlgorithmicPerspective,CRCPress, 2009. |
| **ReferenceBooks** |
| **1** | JasonBell,-MachineLearning–HandsonforDevelopersandTechnical professionals, First Edition, Wiley, 2014. |
| **2** | PeterFlach,-MachineLearning:TheArtandScienceofAlgorithmsthatMake Sense of Data, First Edition, Cambridge University Press, 2012. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://onlinecourses.nptel.ac.in/noc21\_cs24/preview |  |
| **2** | https:/[/www.coursera.o](http://www.coursera.org/learn/machine-learning)r[g/learn/machine-learning](http://www.coursera.org/learn/machine-learning) |  |

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

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 6** | **RProgrammingLab** | **-** | **-** | **4** | **2** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseisto:* ApplytheconceptsindescriptiveandinferentialstatisticstosolveproblemsusingR Studio
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandthebasicsinRprogrammingintermsofconstructs,controlstatements,stringfunctions | K2 |
| 2 | UnderstandtheuseofR forBigDataanalytics | K2 |
| 3 | ApplyRprogrammingforTextprocessing | K3 |
| 4 | AppreciateandapplytheRprogrammingfromastatisticalperspective | K3 |
| **K1**–Remember;**K2**–Understand;**K3**– Apply;**K4**–Analyze;**K5**–Evaluate;**K6**– Create |
| **Listof Programs** |
| **List of Programs** 1. R Expressions and Data Structures2. Manipulation of vectors and matrix3. Operators on Factors in R4. Data Frames in R5. Lists and Operators6. Working with looping statements.7. Graphs in R8. 3D plots in R |
|  | **TotalLecture hours** | **30 hours** |
|  | **TextBook(s)** |
| **1** | GarethM.James,DanielaWitten,TrevorHastie,RobertTibshirani,AnIntroductiontoStatisticalLearning:WithApplicationsinR,2017 |
| **2** | MarkGardner,―BeginningR–TheStatisticalProgrammingLanguage‖,Wiley,2013 |
| **3** | RogerD.Peng(2018).RProgrammingforDataScience.LeanPublishing |
|  | **ReferenceBooks** |
| **1** | GarretGrolemund(2014).Hands-onProgrammingwithR.O‘ReillyMedia, Inc. |

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| **2** | Robert Knell, ―Introductory R: A Beginner‘s Guide to Data Visualisation,StatisticalAnalysisandprogramminginR‖,Amazon Digital South Asia Services Inc, 2013. Richard Cotton(2013).LearningR, O‘ReillyMedia. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://onlinecourses.swayam2.ac.in/aic20\_sp06/preview |
| **2** | https://onlinecourses.swayam2.ac.in/arp19\_ap79/preview |

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| CO1 | M | S | S | M | M | S | L | L | L | L |
| CO2 | M | S | S | M | M | M | M | L | L | L |
| CO3 | S | M | S | M | M | S | M | L | L | L |
| CO4 | S | S | M | M | M | M | M | L | L | L |

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

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Allied Paper4** | **DIGITALMARKETING** | **6** | **-** | **-** | **3** |
| **Pre-requisite** | **None** | **SyllabusVersion** | **2022-23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Understandthemajordigitalmarketingchannels-onlineadvertising:Digital display, video, mobile, search engine, and social media
2. Learnanddevelop,evaluate,andexecuteacomprehensivedigitalmarketing strategy and plan
3. LearnhowtomeasuredigitalmarketingeffortsandcalculateROI
4. Explorethelatestdigitalad technologies
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | DefineandexplainvariousterminologiesassociatedwithDigitalMarketing. | K1,K2 |
| 2 | ApplytheknowledgeofDigitalmarketingconcepts. | K2,K3 |
| 3 | Constructanappropriatemarketingmodel. | K2,K3 |
| 4 | Analyzeroleandimportanceofdigital marketinginarapidlychangingbusinesslandscape. | K3 |
| 5 | Implementthekeyelementsofadigitalmarketingstrategy. | K2 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **INTRODUCTIONTODIGITALMARKETING** | **9 hours** |
| Digitalmarketing,Marketingv/sSales,comparisonbetweendigitalandtraditionalmarketing,BenefitsofDigitalmarketing,DigitalmarketingplatformsandStrategies,DefiningMarketing Goals, Latest Digital marketing trends, Case studies of Digital Campaigns |
| **Unit:2** | **SEARCHENGINEOPTIMIZATION(SEO)** | **12 hours** |
| Components of Search Engines, SEO Keyword Planning, Meta Tags and Meta Description, WebsiteContentOptimization,BackLinkStrategies,InternalandExternalLinks,Optimizing Site Structure Keywords in Blog and Articles, On Page SEO, Off Page SEO, Local SEO, MobileSEO,EcommerceSEO,optimizingwithGoogleAlgorithms,UsingWebMasterTool,MeasuringSEOEffectivenes |
| **Unit:3** | **SOCIALMEDIAMARKETING(SMM)** | **9 hours** |
| Introduction to social Media Marketing, Benefits of using SMM, Social Media Statistics, SocialMediaStrategy, FacebookMarketing, WordPress blogcreation,Twitter marketing,LinkedInMarketing,Googleplusmarketing,SocialMediaAnalyticalTools |
| **Unit:4** | **SEARCHENGINEMARKETING(SEM)** | **9 hours** |
| Houghtransformsandothersimpleobjectrecognitionmethods,shapecorrespondenceand shape matching,Principal component analysis,Shape priors for recognition.ImageUnderstanding-Patternrecognitionmethods-HMM,GMMandEM |
| **Unit:5** | **APPLICATION** | **6 hours** |
| GoogleAnalytics,Online ReputationManagement,E-MailMarketing, Affiliate Marketing, Social Media Analytics, Ad designing |
|  | **TotalLecture hours** | **45 hours** |
|  |  |  |
|  | **TextBook(s)** |  |
| **1** | RyanDeissandRussHennesberry,“DigitalMarketingforDummies",2017 |  |
| **2** | Puneetsinghbhatia, “Fundamentalsof DigitalMarketing”,2017 |  |
| **References*** IntroductiontoProgrammaticAdvertisingByDominikKosorin,2016
* Blogging:APracticalGuidetoPlanYourBlog:StartYourProfitableHome-Based Business with a Successful Blog by Jo and DaleReardon,2015
* EmailPersuasion:CaptivateandEngageYourAudience,BuildAuthorityand Generate More Sales With Email Marketing By IanBrodie,2013
* SocialMediaMarketingAll-In-OneforDummiesByJanZimmermanand Deborah Ng,2017
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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | M | S | S | M | S | M | M | S | M | M |
| CO2 | M | S | S | S | S | L | M | S | M | M |
| CO3 | S | S | M | M | S | L | S | M | M | S |
| CO4 | M | M | S | S | M | M | M | M | M | M |
| CO5 | M | M | M | M | M | M | M | L | L | L |

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **SkillbasedSubject-2** | **OptimizationTechniques** | **3** | - | - | **2** |
| **Pre-requisite** | **Nil** | **Syllabus****Version** | **2022-23** |
| **CourseObjectives:** |
| The main objective of this course is to make the students to gain knowledge about various concepts of Operations Research and to identify and develop operational research models from the verbal description of the real system and train them to apply the operations research tools that are needed to solve optimization problems. |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Defineandformulatelinearprogrammingproblemsandevaluatetheir applications | K1 |
| 2 | TounderstandconceptsandterminologyofLinearProgrammingfromformulationofmathematicalmodelstotheiroptimizationusingSimplex Method | K1 |
| 3 | TocomprehendtheconceptofaTransportationModelanddevelopthe initialsolutionandoptimalitycheckingofthesolution | K2 |
| 4 | Toapplythestrategiesofgametheoryandtomakebetterdecisionswhile solving business problems | K3 |
| 5 | Usecriticalpathanalysisandprogrammingevaluationand reviewtechniquesfor timelyproject schedulingand completion. | K3 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
|  |
| **Unit:1** | **INTRODUCTIONTOOPERATION****RESEARCH** | **11--hours** |
| IntroductiontoOperationsResearch–Meaning–Scope–Applications-Limitations.Linearprogramming-MathematicalFormulation-Applicationinmanagementdecision making - Graphical Method-Simplex Method. |
|  |
| **Unit:2** | **TRANSPORTATIONAND****ASSIGNMENTPROBLEMS** | **12--hours** |
| Transportation problems: Introduction- Finding Initial Basic Feasible solutions- moving towards optimality (non degenerate only) – Maximization in transportation problem-Unbalanced transportation problem. Assignment problem: Introduction –Hungarian Assignment method – Maximization in Assignment problem – Unbalanced Assignmentproblem. |
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| **Unit:3** | **GAMETHEORY** | **12--hours** |

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| Gametheory:ConceptofPureandMixedstrategies –solving2x 2matriceswith andwithoutsaddlepoint.Graphicalsolution-mx2and2xngames.Solvinggamesby Dominance Property. |
|  |
| **Unit:4** | **NETWORK ANALYSIS** | **11--hours** |
| CPM–Principles–Construction of network- Critical path –Forward pass–Backward pass computations–PERT–Timescaleanalysis-probabilityofcompletionofproject –typesoffloats. |
|  |
| **Unit:5** | **SEQUENCINGPROBLEMANDREPLACEMENT THEORY** | **12--hours** |
| TheoryofReplacement –Introduction-Replacementmodels–Replacementofitemsthatdeteriorates gradually(value ofmoneydoes not change with time) |
|  |
| **Unit:6** | **CONTEMPORARY ISSUES** | **02-hours** |
| Expertlectures,onlineseminars– webinars |
| **Note:Theoryandproblemshallbedistributedas20%and80%respectively.** |
|  | **TotalLecture hours** | **60--hours** |
| **TextBook(s)** |
| 1 | P.K.Gupta,ManMohan,KantiSwarup:“OperationsResearch”,SultanChand,2008. |
| 2 | J.K.Sharma:OperationsResearchTheory&Applications,MacmillanIndiaLimited, fifthedition.2013 |
| **ReferenceBooks** |
| 1 | KantiSwarup,P.K.GuptaandManMohan–OperationsResearch |
| 2 | SundaresanV,GanapathyK.S,GanesanK,ResourceManagementTechnique-LakshmiPublications,2003. |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| 1 | https://nptel.ac.in/courses/111/105/111105077/ |
| 2 | https://nptel.ac.in/content/syllabus\_pdf/111105077.pdf |

# MappingwithProgrammeOutcomes

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

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



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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core 10** | **DataVisualization** | **6** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **SyllabusVersion** |  | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Understandthefundamentalsofvisualizationconceptsandits importance.
2. Understandessentialdesignprinciplestodesignanddevelopeffectivevisualizations.
3. Understandplanningandvisualanalyticsthroughadvancedvisualization techniques.
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Understandfoundationalvisualizationconcepts | K2 |
| 2 | Demonstratevisualizationsprinciplestoenhancedatavisualization | K2 |
| 3 | Analyzeandapplyessentialdesignprinciplestodataexplorationandvisualization | K3 |
| 4 | Designappropriatecharts,tables,mapsanddashboards | K3 |
| 5 | Effectivelycreateandtellastorybasedonvisualized data | K3 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **VISUALIZATIONFUNDAMENTALS** | 9 hours |
| Introduction to data visualization-Need for data visualization and its definition-Tools for VisualizingData-Methodsofvisualizingdata-Overviewofmodernvisualizationtools -working with various data formats - Basic chart types. |
| **Unit: 2** | **DATAVISUALIZATIONFORHUMANPERCEPTION** | 9 hours |
| TheHumanBrainandDataVisualization-CognitivevsPerceptualDesignDistinction-IntroductionofEffectiveandIneffectiveVisuals-TypesofVisualizationsanditsexamples-PracticingGoodEthicsinDataVisualization-IneffectiveVisualsandimprovements-Visual Perception and Cognitive Principles-Strategic Use of Pre-Attentive Attributes -De-Cluttering. |
| **Unit: 3** | **DESIGNANDEXPLORATORYANALYSIS** | 9 hours |
| Introduction-ExploratoryandExplanatoryAnalysis-IdentifyingOutliers-ConstructingaControl Chart-Design For Purpose-Data, Relationships, and Design-Static Versus Interactive Visualizations-Multiple, Connected View, Language, Labelling, and Scales-Visual Lies and Cognitive Bias- Case Study. |
| **Unit:4** | **VISUALANALYTICSANDPLANNING** | 9 hours |
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| Basics of Visual Analytics -Charts- Colours, Shapes, and Sizes-Dual Line Charts-Bar Charts, Line Graphs, Pie Charts-Scatter Plots, Gantt Charts, Bubble Charts-Histograms, Bullet Charts, Heat Maps and Highlight Tables-Dates-Discrete vs. Continuous Dates-Basics of table calculations-Maps.IntroductiontoPlanningandPreproductionforVisualizations-ADesignChecklist-understandingStakeholders-Prioritizing,Optimizing,andDesigning |
| **Unit:5** | **DASHBOARDANDSTORYTELLING** |  |
| Dashboard Design Principles-Hierarchies, Actions, Filters, and Parameters-CreatingDashboards.TheStoryofthedata-TheArtofStorytelling(Past,Present, and Future)-Storytelling and the Human Brain-Bringing Data to Life-Emotion Modulators-Framing and Format-False Narratives and Data Storytelling-Preparation of the Story Points – Case Study | 9 hours |
|  | **TotalLecture hours** | **45 hours** |
|  | **TextBook(s)** |  |
| **1** | ColinWare andKaufmanM,,Visualthinkingfordesign‖,MorganKaufmannPublishers,2008 |  |
| **2** | Ben Fry, “ Visualizing data”, O’Reily,2007 |  |
|  | **ReferenceBooks** |  |
| **1** | Chakrabarti,S,―Miningtheweb:Discoveringknowledgefromhypertextdata―,MorganKaufmanPublishers,2003. |  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https:/[/www.coursera.o](http://www.coursera.org/learn/data-visualization-)r[g/learn/data-visualization-](http://www.coursera.org/learn/data-visualization-)tableau?specialization=data-visualization |  |
| **2** | Essential Design Principles for Tableau:https://www.coursera.org/learn/dataviz-design?specialization=data-visualization |  |
| **3** | Visual Analytics with Tableau :https://www.coursera.org/learn/dataviz-visual-analytics?specialization=data-visualization |  |
| **4** | Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz- dashboards?specialization=data-visualization |  |
| **5** | Data Visualization with Tableau Project: https://www.coursera.org/learn/dataviz-project |  |
| **6** | Data Visualization with Tableau Specialization: https://www.coursera.org/specializations/data-visualization |  |

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

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

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| **CourseCode** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core 11** | **DeepLearning** | **6** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Understandthefundamentalsofneuralnetworksanddeep networks
2. UnderstandthebasicsofTensorflow
3. UnderstandaboutthearchitecturesandapplicationsofDeepLearning
 |
| ExpectedCourseOutcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Understandthebasicsofneuralnetworksanddeepnetworks | K2,K3 |
| 2 | DevelopsmallapplicationsusingTensorflow | K2,K3 |
| 3 | UnderstandaboutthemajorarchitecturesofDeep Networks | K2 |
| 4 | AnalyzetheapplicationsofDeepLearning | K3,K4 |
|  |  |  |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **IntroductiontoLearning** | 12 hours |
| NeuralNetworks–TrainingNeuralnetworks-Activationfunctions-Lossfunctions-Hyperparameters |
| **Unit:2** | **FundamentalsofDeepNetworks** | 12 hours |
| DefiningDeepLearning-CommonarchitecturalprinciplesofDeepNetworks-BuildingblocksofDeep Networks |
| **Unit:3** | **Tensorflow** | 12 hours |
| Tensorflow–Variables–Operations–Placeholders–Sessions–SharingVariables–Graphs–Visualization |
| **Unit:4** | **MajorarchitecturesofDeepNetworks** | 12 hours |
| Unsupervisedpretrainednetworks**-**ConvolutionNeuralNetworks-Recurrentneuralnetworks-Recursiveneuralnetworks |
| **Unit:5** | **Applications** | 12 hours |
| LargescaleDeepLearning–ComputerVision-SpeechRecognition–NaturalLanguageProcessing(NLP)–OtherApplications |
|  | **TotalLecture hours** | **60 hours** |
|  | **TextBook(s)** |  |
| **1** | Josh Patterson & Adam Gibson, Deep Learning- A Practitioner’s approach, O'Reilly Media, 2019. |
| **2** | RajivChopra,DeepLearning-Apracticalapproach(UsingPython),SecondEdition,KhannaPublishing,2020. |
| **3** | CharlesDierbach,IntroductiontoComputerScienceusingPython:AComputationalProblemSolvingFocus, WileyIndiaEdition, 2013. |
|  | **ReferenceBooks** |
| **1** | IanGoodfellow,YoshuaBengio,AaronCourville,DeepLearning(AdaptivecomputationandMachineLearningseries),MITPress,2017. |
| **2** | NikhilBuduma,NicholasLocascio,FundamentalsofDeepLearning:DesigningNextGenerationMachineIntelligenceAlgorithms,O'ReillyMedia,2017. |
| **3** | LiDeng, DongYu,Deep Learning:MethodsandApplications,NowPublishers,2014 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://onlinecourses.swayam2.ac.in/aic20\_sp06/preview |
| **2** | https://onlinecourses.swayam2.ac.in/arp19\_ap79/preview |

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

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

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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 7** | **DataVisualizationLaboratory** | **0** | **0** | **6** | **4** |
| **Pre- requisite** | **None** | **Syllabus version** | **2022-23** |
| **CourseObjectives** |
| 1. Understandthefundamentalsofdatavisualizationconceptsandbasiccharttypes.
2. Applyessentialdesign principlestodesign anddevelopeffectivevisualizations.
 |
| **ExpectedCourseOutcomes** |
| 1 | Understandconceptsandbasicchartsusingdatavisualizationtoolsandtechniques. | **K2** |
| 2 | Analyzeandapplyessentialdesignprinciplestodataexplorationand visualization. | **K4** |
| 3 | Applyappropriatecharts,plots,tables,andmapsforcomplexdataanalysis. | **K3** |
| **K1–RememberK2– UnderstandK3–applyK4-AnalyzeK5– evaluateK6-Create** |
|  |
| **List of Experiments** | **60 hours** |
| 1. Create a basic visualization using Google Sheets.2. Demonstrate proper use of the design principles used: “pop-out” or “pre-attentive” attributes, Gestalt Principles, cognitive load and clutter, and static or interactive format.3. Analyze customer’s purchases and how much the company is profiting from each customer by create a scatter plot4. Create a table showing total sales by product category, broken down by Year and Month -sales spotlight.5. Create a dual layer map showing total profit by postal code, colorized by profit ratio, and sized by total sales.6 Provided any dataset, create a dashboard consisting of at least 2 KPIs.7. Create a story consisting of at least three story points and must explicitly answer the business question(s) in the project . |
| TotalPracticalHours | **60****Hours** |
| Text Book(s) |
| 1. ColinWareandKaufmanM,,Visualthinkingfordesign‖,MorganKaufmannPublishers,2008.
2. Chakrabarti,S,“Miningtheweb:Discoveringknowledgefromhypertextdata“,MorganKaufman Publishers, 2003.
3. BenFry,“Visualizingdata”,O‘Reily,2007.
 |
| **ONLINECOURSESANDVIDEOLECTURES:**1. https://www.coursera.org/learn/data-visualization-

tableau?specialization=data-visualization1. Essential Design Principles for Tableau:

https://www.coursera.org/learn/dataviz-design?specialization=data-visualization1. Visual Analytics with Tableau :https://www.coursera.org/learn/dataviz-visual-analytics?specialization=data-visualization
2. Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz- dashboards?specialization=data-visualization
3. Data Visualization with Tableau Project: <https://www.coursera.org/learn/dataviz-project>
4. Data Visualization with Tableau Specialization: https://www.coursera.org/specializations/data-visualization
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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | M | M | S | M | M | S | M | M | M |
| CO2 | S | S | S | S | M | S | S | M | M | M |
| CO3 | S | S | S | S | M | S | S | M | M | M |

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

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| **Course****code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **SkillbasedSubject-3:** | **SocialMediaAnalytics** | **6** | **-** | **-** | **3** |
| **Pre-requisite** | **None** | **SyllabusVersion** | **2022-23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:* Giveanoverviewofsocialnetworksanditsimportance.
* Understandthesocialnetworkconceptsandvariousmethodsof analysis.
* Exposeandtrainonvarioustoolsandtechniquesforanalyzingand visualizing social media networks.
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Analyzesocialnetworkdatausingvarioussoftwarepackages. | K1,K2 |
| 2 | Implementstatisticalmodelsofsocialnetworkstoanalyzenetworkformationandevolution. | K2,K3 |
| 3 | Implementthebasicconceptsandtheoriesofnetworkanalysisinthesocialsciences. | K2,K3 |
| 4 | Usestatisticalsoftwaretovisualizenetworksandanalyzetheirproperties. | K2 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **INTRODUCTIONTOSOCIALNETWORKSANDSNA** | 12 hours |
| Connected World – Networks: Actors, Relations and Attributes - Networks as Information Maps - Networks as Conduits – Leaders and Followers – Psychological foundationsofsocialnetworks–BasicbuildingBlocks–BriefhistoryofSocialNetworkAnalysis. |
| **Unit:2** | **NETWORK CONCEPTS** | 12 hours |
| Individual Members of the Network – Sociological Questions about Relationships – Whole SocialNetworks-Distributions–Multiplexity–RolesandPositions–NetworkSegmentation–GraphTheory–NotationsforSocialNetworkData |
| **Unit:3** | **SOCIALNETWORKANALYSIS FUNDAMENTALS** | 12 hours |
| Points,LinesandDensity–CentralityandCentralization–Components,CoresandCliques–Positions,RolesandClusters–DimensionsandDisplays. |
| **Unit:4** | **METHODSOFSOCIALNETWORKANALYSIS** | 12 hours |
| Graphs–Matrices–RelationshipMeasures–CentralityandPrestiges–Cliques–StructuralEquivalence–VisualDisplays–Bookmodels–NetworkPositionMeasures–LogitModels – Affiliation networks – Lattices- Levels of Analysis |
| **Unit:5** | **TOOLSANDTECHNOLOGIES** |
| TwitterAnalytics–FacebookAnalytics–Google+Analytics–Google+Ripples–R for Social Network Analysis – Pajek – Network Visualization Tools –AnalyzingSocialMediaNetworkswithNodeXL. | 12hours |
|  | **TotalLecture hours** | **60 hours** |

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| **TextBook(s)** |
| **1** | CharlesKadushin,“UnderstandingSocialNetworks:Theories,Concepts,and Findings”, Oxford University Press,USA,2011 |
| **2** | David Knoke, Song Yang, “Social Network Analysis”, 2ndEdition,SAGEPublications,2007 |
| **References**Christina Prell, “SocialNetwork Analysis: History, Theoryand Methodology”, 1st Edition, SAGE Publications Ltd, 2012. |

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

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



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| **Coursecode** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Core12** | **NaturalLanguageProcessing** | **6** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| **Course Objectives:** |
| Themainobjectivesofthiscourseareto:1. UnderstandthesignificanceofNLPtasks
2. Understandaboutsyntaxparsingandsemanticanalysis methods
3. Understandthe applicationdomainsofNLP
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | DemonstrateanunderstandingofNaturalLanguage Processing tasks in syntax, semantics, and pragmatics. | K1,K2 |
| 2 | DemonstrateanunderstandingofMorphologyandPartofSpeech Tagging. | K2,K3 |
| 3 | Showhowsyntaxparsingtechniquescanbe used. | K2,K3,K4 |
| 4 | Explaintheuseofsemanticanalysis methods. | K2,K3 |
| 5 | RelateafewapplicationsofNLP. | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **Introduction** | 12 hours |
| NaturalLanguage Processingtasksin syntax, semantics, and pragmatics–Issues-Applications- Theroleofmachinelearning-ProbabilityBasics–Informationtheory – Collocations-N-gram Language Models-Estimatingparametersandsmoothing- Evaluatinglanguagemodels. |
| **Unit:2** | **MorphologyandPartofSpeechTagging** | 12 hours |
| Linguistic essentials-Lexical syntax-Morphology andFinite StateTransducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models – Transformation based Models - Maximum Entropy Models. Conditional Random Fields |
| **Unit:3** | **SyntaxParsing** | 12 hours |
| SyntaxParsing-Grammarformalismsandtreebanks-ParsingwithContextFreeGrammars-FeaturesandUnification -StatisticalparsingandprobabilisticCFGs (PCFGs)-Lexicalized PCFGs. |
| **Unit:4** | **SemanticAnalysis** | 12 hours |
| RepresentingMeaning–SemanticAnalysis-Lexicalsemantics–Word-sensedisambiguation- Supervised– Dictionary based and Unsupervised Approaches-Compositionalsemantics-Semantic Role Labeling and Semantic Parsing– Discourse Analysis. |

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| **Unit:5** | **Applications** | 12 hours |
| Namedentityrecognitionandrelationextraction-IEusingsequencelabeling-Machine Translation(MT)-Basic issues in MT-Statistical translation-word alignment-phrase-basedtranslation– QuestionAnswering |
|  | **TotalLecture hours** | **60 hours** |
|  | **TextBook(s)** |  |
| **1** | DanielJurafskyandJamesH.Martin,“SpeechandLanguageProcessing”,SecondEdition,PrenticeHall,2008. |  |
|  | **ReferenceBooks** |  |
| **1** | Holcomb,Z.C.(2017).FundamentalsofDescriptiveStatistics,Routledge,NewYork,US. |  |
| **2** | StevenBird,EwanKleinandEdwardLoper,“NaturalLanguageProcessingwithPython”,O'ReillyMedia,FirstEdition,2009. |  |
| **3** | RolandR.Hausser,“FoundationsofComputationalLinguistics: Human- ComputerCommunicationinNaturalLanguage”,Paperback,MITPress,2011. |  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | NLTK–NaturalLanguageToolKit-<http://www.nltk.org/> |  |

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

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

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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core Lab 8** | **NaturalLanguageProcessingLab** | **0** | **0** | **3** | **4** |
| **Prerequisite** | **None** | **Syllabus Version** | **2022-23** |
| **CourseObjectives** |
| * Tointroducethefundamentalconceptsandtechniquesofnaturallanguage processing(NLP)
 |
|  |
| **ExpectedCourseOutcomes** |
| 1 | Understandthefundamentalconceptsandtechniquesofnaturallanguageprocessing(NLP) | **K2** |
| 2 | Understandingofthemodels andalgorithmsinthe fieldofNLP. | **K2** |
| 3 | Demonstratethe computational propertiesofnatural languagesandthecommonlyusedalgorithmsforprocessinglinguisticinformation. | **K2** |
| 4 | Understandingsemanticsandpragmaticsoflanguagesforprocessing | **K2** |
| **K1–Remember K2 –Understand K3–applyK4-AnalyzeK5–evaluateK6-Create** |
|  |
| **LISTOFPROGRAMS** |
| 1. Implementingword similarity
2. Implementingsimpleproblemsrelatedtoworddisambiguation
3. Simpledemonstrationofpartofspeechtagging.
4. Lexicalanalyzer.
5. SemanticAnalyzer.
6. SentimentAnalysis**.**
 |
| **TotalLectureHours** | **45Hours** |
| **TextBook(s)** |
| **1** | DanielJandJamesH.Martin,‖speechandlanguageprocessing‖anintroductiontonaturallanguageprocessing,computationallinguistcs&speechrecognition‖prenticehall,2009 |
| **ReferenceBook(s)** |
| **1** | LanHWrittenandElbef,MarkA.Hall,‖datamining:practicalmachinelearningtoolsandtechiniques‖,MorganKaufmann,2013 |
|  | **RelatedOnlineContents(MOOC,SWAYAM,NPTEL,Websitesetc)** |  |
| **1** | [**https://onlinecourses.swayam2.ac.in/aic20\_sp06/preview**](https://onlinecourses.swayam2.ac.in/aic20_sp06/preview) |  |
| **2** | [**https://onlinecourses.swayam2.ac.in/arp19\_ap79/preview**](https://onlinecourses.swayam2.ac.in/arp19_ap79/preview) |  |

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

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

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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Core 13** | **ProjectWorkLab** | **0** | **0** | **6** | **6** |
| **Pre-requisite** | Studentsshouldhavethestrongknowledgein anyoneof theprogramminglanguages in thiscourse. | **Syllabusversion** | **2022-23** |
| **CourseObjectives** |
| * Tounderstandand selectthetask basedontheircoreskills.
* Togettheknowledge aboutanalyticalskillforsolvingtheselectedtask.
* Togetconfidencefor implementingthetaskandsolvingthe realtimeproblems.
* Expresstechnicalandbehavioralideasandthoughtinoralsettings.
* Prepareandconductoralpresentations
 |
| **ExpectedCourseOutcomes** |
| Onthesuccessful completionofthecourse,student willbe ableto: |
| 1 | Formulate a real world problemanddevelopitsrequirementsdevelopa designsolutionforasetofrequirements | **K3** |
| 2 | Testandvalidatetheconformanceofthedevelopedprototypeagainsttheoriginalrequirementsof theproblem | **K5** |
| 3 | Workasaresponsiblememberandpossiblyaleaderofateamindevelopingsoftwaresolutions | **K3** |
| 4 | Expresstechnicalideas,strategiesandmethodologiesinwrittenform.Self-learn newtools,algorithmsandtechniquesthatcontributetothesoftwaresolutionof theproject | **K1- K4** |
| 5 | Generatealternativesolutions,comparethemandselecttheoptimumone | **K6** |
| **K1–Remember K2 –Understand K3–applyK4-AnalyzeK5–evaluateK6-Create** |
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| **Aimoftheproject work** |
| 1. Theaimof theprojectworkis toacquirepracticalknowledgeonthe implementationoftheprogrammingconcepts studied.
2. Each student should carry out individually one project work and it may be a work using thesoftwarepackages that theyhavelearned or theimplementation of concepts from thepapers studiedorimplementation of anyinnovative ideafocusing on application oriented concepts.
3. The project work should be compulsorily done in the college only under the supervision of thedepartmentstaff concerned.

**VivaVoce**1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) andExternalExaminers,afterdulyverifyingtheAnnexureReport availableinthe College,foratotal of200marks at thelast dayofthe practical session.
2. Outof200 marks,160marks forprojectreport and40marks forVivaVoce.
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| **ProjectWork Format** |
| **PROJECTWORK****TITLEOFTHEDISSERTATION**Bonafide Work Done bySTUDENT NAMEREG.NO.Dissertationsubmittedin partialfulfillmentofthe requirementsfor theawardof<NameoftheDegree>ofBharathiar University,Coimbatore-46.CollegeLogoSignatureof theGuide Signature of the HODSubmittedfortheViva-VoceExaminationheldon InternalExaminer External ExaminerMonth– Year |
| **CONTENTS****AcknowledgementContents****Synopsis**1. **Introduction**
	1. OrganizationProfile
	2. SystemSpecification
		1. HardwareConfiguration
		2. SoftwareSpecification
2. **SystemStudy**
	1. ExistingSystem
		1. Drawbacks
	2. ProposedSystem
		1. Features
 |

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| 1. **SystemDesign andDevelopment**
	1. FileDesign
	2. InputDesign
	3. OutputDesign
	4. DatabaseDesign
	5. SystemDevelopment
		1. DescriptionofModules(Detailedexplanation abouttheprojectwork)
2. **TestingandImplementation**
3. **ConclusionBibliographyAppendices**
4. DataFlowDiagram
5. TableStructure
6. SampleCoding
7. Sample Input
8. SampleOutput
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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **M** | **M** | **M** |
| **CO2** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **M** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **M** |
| **CO4** | **S** | **S** | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **M** |
| **CO5** | **S** | **S** | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **M** |

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **SkillbasedSubject-4:** | **CapstoneProjectusingPythonorR Programming,DataVisualization Tools**  | **-** | **-** | **3** | **3** |
| **Pre-requisite** | **Studentsshouldhavecompleted Project I & II Phase – IStrongcodingskillsinanyone programming paper** | **SyllabusVersion** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Tounderstandandselect thetaskbasedontheircoreskills
2. Togettheknowledgeaboutanalyticalskillforsolvingtheselected task.
3. Togetconfidenceforimplementingthetaskandsolvingtherealtime problems.
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Selectappropriateinput,output,formandtabledesign | K3 |
| 2 | Design codetomeettheinputrequirementsandto achievetherequiredoutput | K6 |
| 3 | Composeaproject report incorporatingthe featuresoftheproject | K6 |
| **K1**-Remember;**K2**-Understand;**K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Aimoftheprojectwork** |
| 1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied
2. Each student should carry out individually one project work and it may be a work using the softwarepackagesthattheyhavelearnedortheimplementationofconceptsfromthepapersstudied or implementation of any innovative idea focusing on application oriented concepts
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

**VivaVoce**1. Viva-VocewillbeconductedattheendofthesemesterbybothInternal(RespectiveGuides)and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.
2. Outof75marks,30 marksforprojectreport and45MarksforViva Voce
 |
| **ProjectWorkFormat** |
| PROJECTWORKTITLEOFTHEDISSERTATIONBonafideWorkDonebySTUDENTNAME REG. NO.Dissertationsubmittedinpartialfulfillmentofthe requirementsfortheawardof<NameoftheDegree>ofBharathiarUniversity,Coimbatore-46.CollegeLogoSignature of the Guide SignatureoftheHOD Submitted for the Viva-Voce Examination held on InternalExaminer ExternalExaminer |

Month– Year

**Acknowledgement Contents**

**Synopsis**

1. **Introduction**
	1. OrganizationProfile
	2. SystemSpecification
		1. HardwareConfiguration
		2. SoftwareSpecification
2. **SystemStudy**
	1. ExistingSystem
		1. Drawbacks
	2. ProposedSystem
		1. Features
3. **SystemDesignandDevelopment**
	1. FileDesign
	2. InputDesign
	3. Output Design
	4. DatabaseDesign
	5. SystemDevelopment
		1. DescriptionofModules(Detailedexplanationabouttheproject work)

**4SoftwareTestingandImplementation Conclusion**

**Bibliography Appendices**

1. DataFlowDiagram
2. Table Structure
3. SampleCoding
4. SampleInput
5. SampleOutput

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

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



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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **6** | **-** | **-** | **4** |
| **Elective I** | **MarketingAnalytics** |  |  |
| **Pre-requisite** | **OptimizationTechniques** | **Syllabus Version** | **2022-****23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Toprovideknowledgeonelementsofmarketanalysis
2. Tousemarketinganalyticstopredictoutcomes andsystematicallyallocateresources.
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| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | Gainasolidunderstandingofkeymarketingconceptsandskills | K2level |
| 2 | Identifyanddemonstratethedynamicnatureoftheenvironmentinwhichmarketingdecisionsaretakenandappreciatetheimplications for marketing analytics strategy determination and implementation. | K3level |
| 3 | Developthestudents'skillsinapplyingthe analyticperspectives,decisiontools,andconceptsofmarketingtodecisionsinvolving. segmentation, targeting and positioning. | K3level |
| 4 | Developanunderstandingoftheunderlyingconcepts,strategiesandthe issuesinvolvedintheexchangeofproductsandservices andcontrolthemarketingmixvariables inordertoachieveorganizationalgoals. | K2-K3level |
| 5 | DevelopstrongmarketingplansandapplytheconceptofSalesanalyticsinEcommercesalesand metrics | K3level |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **INTRODUCTION** | 12 hours |
| .MarketingAnalytics,Modelsandmetrics-MarketInsight–Marketdatasources,sizing,PESTLE trend analysis, and porter five forces analysis – Market segment identification and positioning |
|  |
| **Unit:2** | **COMPETITIVEANALYSISANDBUSINESSSTRATEGY:** | 12 hours |
| . Competitor identification, Intelligence gathering, analysis and strategy- Analytics based strategy selection, with strategic models and metrics, Forecasting, balanced scorecard, and critical success factors. |
|  |
| **Unit:3** | **PRODUCT,SERVICEANDPRICEANALYTICS:** | 12 hours |
| Conjointanalysismodel,decisiontreemodel,portfolioresourceallocation,Pricingtechniques,pricing assessment, pricing for business markets, price discrimination |
| **Unit:4** | **DISTRIBUTIONANDPROMOTION****ANALYTICS:** | 12 hours |
| Retail location selection, distribution channel evaluation, and multi-channel distribution, Promotion budget estimation and allocation, promotion metrics for traditional media and social media. |
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| **Unit:5** | **SALESANALYTICS** | 12 hours |
| ECommercesalesmode,salesmetrics,profitabilitymetricsandsupportmetrics. |
| Totalhours: 60 |
| **References:** |
| .1. Stephan Sorger, ―Marketing Analytics – Strategic Models and Metrics‖, Admiral Press, 2013. |
| 2.MarkJeffery,―DataDrivenMarketing:The15MetricsEveryoneinMarketing should know‖, |
| Wiley,2013. |
| 3. Paul W. Farris, Neil T. Bendle, Phillip E. Pfeifer, David J. Reibstein ―MarketingMetrics: The |
| DefinitiveGuidetoMeasuringMarketingPerformance‖,PearsonFTpress,2012. |

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

S-Strong;M-Medium;L-Low

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Elective I** | **DataSecurityandCompliance** | **6** | **0** | **0** | **4** |
| **Pre-requisite** | BasicInformationSystemexposure | **Syllabus Version** | **2022-23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Increaseinformationsecurityandprivacyawareness.
2. Manageinformationsystemsecurityriskfororganizations.
3. Knowthesecurityandprivacycompliance requirementsandstandards
 |
|  |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeableto: |
| 1 | UnderstandtheSecurityrequirements,components,andprocesses | **K2** |
| 2 | Understandthevariousneeds,risksandissuesrelatedtoInformationSecurity | **K2** |
| 3 | Toplaninformationsecurityrisk management | **K3** |
| 4 | UnderstandPhysical,OperationalandPersonnelSecurity | **K2** |
| 5 | Comprehendthe InformationSecurityandPrivacyCompliance Requirements | **K2** |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
|  |
| **Unit:1** | **Introduction** | **10hours** |
| History - What is Information Security? - CIA requirements- security model - Components of an information system - Securing the components - Balancing security and access - The SDLC -Security in SDLC |
| **Unit:2** | **Needs,InformationThreats,AttacksandIssues** | **10hours** |
| Needforsecurity-Businessneeds-Threats–Attacks– Legal-Ethicalandprofessional issues |
| **Unit:3** | **RiskManagement** | **10hours** |
| PlanningforSecurity,Riskmanagement:Identifyingandassessingrisk -Assessingandcontrolling risk. |
| **Unit:4** | **Physical,OperationalandPersonnelSecurity** | **10hours** |
| User-DefinedFunctions:Introduction–NeedandElementsofUser-DefinedFunctions-Definition-ReturnValuesandtheirtypes-FunctionCalls–Declarations– Categoryof |
| **Unit:5** | **Compliance–InformationSecurityManagementSystems** | **10hours** |
| Importance of ISMS – Purpose and Objectives, Process Approach, Processes involved in Establishing,Implementing,Operating,Monitoring,Reviewing,MaintainingandImprovingISMS.ScopeandExclusions.ISO27001,ISO/IEC27701,GDPR,DataProtectionBill-India |
| **Totalhours: 50** |
| **References:** |
| 1.MichaelEWhitmanandHerbertJ Mattord,“PrinciplesofInformationSecurity”,SixthEdition,CengageLearning,2017 |
| 2.AlanCalder,SteveWatkins,“IT Governance:AnInternationalGuidetoDataSecurityandISO27001/ISO27002”,KoganPage;6thedition, 2015 |
| 3. ISO/IEC27701 PIMS:<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3uDwE> |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO-10 |
| CO1 | M | L | M | M | L | S | L | M | M | L |
| CO2 | M | M | M | M | L | M | M | M | L | M |
| CO3 | M | M | M | M | M | S | L | L | L | M |
| CO4 | S | L | S | M | M | M | M | L | L | M |
| CO5 | S | M | S | M | M | S | L | L | L | M |

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

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| **Course Code** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Elective I** | **ComputerVision** | **6** | **-** | **-** | **4** |
| **Pre-requisite** | **Basiccomputerknowledge** | **Syllabus****Version** | **2022-23** |
| **CourseObjectives:** |
| Themainobjectivesofthiscourseareto:1. Identifybasicconcepts,terminology,theories,modelsandmethodsinthefieldof computer vision
2. Togive anunderstandingofimageprocessingforcomputervision
3. Focusonearlyprocessingofimagesandthedeterminationofstructure:edges,lines, shapes.
 |
| **ExpectedCourseOutcomes:** |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Acquireknowledgeon Imageretrievalandprocessing | K1,K2 |
| 2 | Design anddeployvariousimageformation models | K2,K3 |
| 3 | Applythetechniquesofmotionestimationandobjectrecognition. | K2,K3,K4 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **INTRODUCTION** | 10 hours |
| ImageProcessing-ComputerVision-LowLevel-MidLevel-HighLevel-Overviewofdiverse computer vision applications: Document Image Analysis, Biometrics,Object Recognition,Tracking,MedicalImageAnalysis, Content BasedImageRetrieval,Video dataProcessing,Mutimedia,VirtualRealityandAugmentedReality |
| **Unit:2** | **IMAGEFORMATIONMODELS** | 10 hours |
| Monocular Imaging System-Camera Model and Camera calibration-Binocular Imaging System,Multipleviewsgeometry,StructureDetermination,ShapefromShading-Construction of3Dmodelfromimages.ImageProcessingandFeatureExtraction-Imagerepresentation,Edgedetection |
| **Unit:3** | **MOTIONESTIMATION** | 10 hours |
| OpticalComputation,Structurefrommotion.ShapeRepresentationandSegmentation-Contourbasedrepresentation,Regionbasedrepresentation,Deformambalecurvesandsurfaces,multiresolutionanalysis |
| **Unit:4** | **OBJECTRECOGNITION** | 10 hours |
| Houghtransformsandothersimpleobjectrecognitionmethods,shapecorrespondenceand shape matching,Principal component analysis,Shape priors for recognition.Image Understanding-Pattern recognition methods-HMM,GMM and EM |
| **Unit:5** | **APPLICATIONS10hours** |
| Photo album-face detection-Face recognition-Eigen faces-Surveillance-foreground-background separation-particle filters-chamfer matching,tracking-occlusion-combining views from multiple cameras-locating roadway-road makings-identifying road signs-locating pedestrians |

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|  | **TotalLecture hours** | **50** |
|  | **TextBook(s)** |  |
| **1** | ComputerVision–Amodernapproach,byD.ForsythandJ.PoncePrentice Hall Robot Vision,by B.K.P.Horn.McGraw-Hill |  |
| **2** | IntroductoryTechniquesby3DComputerVision,byE.TruccoandA.Verri,Publisher:PrenticeHall |  |
| **3** | R.C.Gonzalez,R.E.Woods.DigitalImageProcessing.AddisonWesley Longman,Inc.,1992 |  |
| **4** | Richard Szeliski,Computer Vision:Algorithms and Applications.Springer,2010 |  |
|  | **ReferenceBooks** |  |
| **1** | R.H.Ballard,C.M.Brown,ComputerVision,PrenticeHall,Englewood Cliffs ,1982 |  |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://nptel.ac.in/courses/106/105/106105216/ |  |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | M | S | S | M | S | S | L | L | L | M |
| CO2 | M | S | S | S | S | S | M | L | M | L |
| CO3 | S | S | M | M | S | S | L | M | M | L |

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **ElectiveII** | **SupplyChainandLogistics Analytics** | **5** | **-** | **-** | **4** |
| **Pre-requisite** |  | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandoftheroleandimportanceofSupplychainmanagement. | K1,K2 |
| 2 | Understandtheconceptsofplanningsystems | K2 |
| 3 | UnderstandtheconceptsofLogisticsmanagement | K2, |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit: 1** | **Introduction** | 10 hours |
| BasicsofSupplyChainManagementSupplyChainManagement–AnOverviewSupplyChainAnalysisTypesofSupplyChainsAdvancedPlanning |
| **Unit: 2** | **ConceptsofAdvancedPlanningSystems** | 10 hours |
| StructureofAdvancedPlanningSystems,StrategicNetworkPlanning,DemandPlanning,Master Planning,DemandFulfilment,TransportPlanningCoordination,andIntegrationCollaborativePlanning |
| **Unit: 3** | **ImplementingSupplyChainProject** | 10 hours |
| ImplementingAdvancedPlanningSystems,TheDefinitionofaSupplyChainProject, TheImplementationProcess |
| **Unit: 4** | **LogisticsManagement** | 10 hours |
| DefinitionandEvolution-AchievementofcompetitiveadvantagethroughlogisticsFramework-RoleofLogisticsManagement-IntegratedLogisticsManagement-Model–Flowofprocess activities |
| **Unit: 5** | **LogisticsStrategy** | 10hours |
| Strategicroleoflogistics–Definition-roleoflogisticsmanagersinstrategicdecisions:Strategyoptions,LeanStrategy,AgileStrategies&Otherstrategies:Designing&Implementing logistical strategy. |
|  | **TotalLecture hours** | **50 hours** |
|  | **TextBook(s)** |  |

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| **1** | StadlerHartmutandKilgerChristoph(2005),“SupplyChainManagementandAdvancedPlanning:Concepts,Models,SoftwareandCaseStudies”,ThirdEdition, Springer, ISBN-3- 540-22065-8. |
| **2** | MárquezAdolfoCrespo (2010)“DynamicModellingforSupplyChain Management:DealingwithFront-end,Back-endandIntegrationIssues”,Springer |
| **3** | Simchi-Levi, David, Chen, Xin, Bramel, Julien (2014), “The Logic of Logistics Theory,Algorithms,andApplicationsforLogisticsManagement”,ThirdEdition,Springer,ISBN-978-1-4614-9149-1 |
| **4** | TangChristopherS,Teo Chung-PiawandWeiKwok-Kee(Eds)(2008), “SupplyChainAnalysis:AHandbookontheInteractionofInformation,Systemand Optimization”, Springer, ISBN-13: 978-0- 387-75239-6 |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | M | M | M | L | L | L | L |
| CO2 | S | S | S | M | M | M | L | L | L | L |
| CO3 | S | S | S | M | M | M | L | L | L | L |

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **ElectiveII** | **BusinessandFinancialAnalytics** | **5** | **-** | **-** | **4** |
| **Pre-requisite** | **BasicAnalyticalTools** | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. UnderstandthesignificanceandfundamentalsofBusinessanalytics
2. Understandthebasicmodelsof analytics.
3. UnderstandtheFinancialanalytics concepts
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandthebasicsonBusinessIntelligence. | K1,K2 |
| 2 | DescribetheessentialsonBusinessAnalyticsmodels | K2,K3 |
| 3 | UnderstandtheimportanceofBusinessAnalyticsforManagers | K2, K3,K4 |
| 4 | ExplaintheroleandimportanceofFinancialAnalytics. | K2,K3 |
| 5 | UnderstandtheroleofBusinessAnalystandDataScienceinbusiness | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit: 1** | **BusinessIntelligence(BI)** | 10 hours |
| Business Intelligence - Definitions - Evolution of Business Intelligence and Role of DSS, EIS, MIS and Digital dash boards-Differencebetween ERP and Business Intelligence-need forBI-BI forpast,PresentandFuture.BusinessIntelligenceApplications-technologysolutionsandbusinesssolutions-BusinessIntelligenceRolesandResponsibilities. |
| **Unit:2** | **EssentialsofBusinessAnalytics** | 10 hours |
| Introduction: Decision Making- Business Analytics Definition-Business Analytics meaning -categorizationofAnalyticalmethodsandmodels:Descriptive-Predictive-Prescriptive–Bigdata-BusinessAnalytics in practice: Financial, Human Resource, Marketing,Healthcare, SupplychainAnalytics.AnalyticsforgovernmentandNonprofits,sportsandwebAnalytics |
| **Unit: 3** | **BusinessAnalyticsforManagers** | 10 hours |
| Businessanalyticsmodel:OverviewofBusiness-drivenenvironment&technicallyorientedenvironment-typesofReportingandAnalyticalprocess-casestudy. |
| **Unit: 4** | **FinancialAnalytics** | 10hours |
| Introduction:Meaning-ImportanceofFinancialAnalyticsuses-Features-DocumentsusedinFinancialAnalytics:BalanceSheet,IncomeStatement,Cashflowstatement-Elementsof Financial Health: Liquidity, Leverage, Profitability. |

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| **Unit:5** | **Analysts:RoleandResponsibilities** | 10 hours |
| Information and Knowledge-Methodology-Data-Required Competencies for the Analyst- Data Scientistvs.DataEngineervs.BusinessAnalyst,CareerinBusinessAnalytics,,Applicationsfordatascience,DataScientistsRolesandResponsibility |
|  | **TotalLecture hours** | **50 hours** |
|  | **TextBook(s)** |  |
| **1** | AnIntroductiontoBusinessAnalytics,GerKoole,Lulu.com,2019 |
| **2** | BusinessAnalyticsforManagers-GEATH.N.LAURSENJESPERTHORLUND,P.No:1-16-UnitIII,P.No:93-136-UnitV |
| **3** | FundamentalsofBusinessAnalytics-RNPrasad,.SeemaAchavya,WileyIndiaPVTLtd,NewDelhi,P.No:87-100,P.No:115-125 |

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

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

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| **Course code** | **TITLEOF THE COURSE** | **L** | **T** | **P** | **C** |
| **Elective II** | **RecommenderSystems** | **5** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Understandaboutdifferenttypesofrecommender systems.
2. Understandtheevaluationmethodsforrecommender systems
3. Understandaboutsomeoftherecentdevelopmentsinthis field
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandthebasicsofRecommendersystems | K2 |
| 2 | Understandaboutthedifferenttypesofrecommendersystems | K2,K3 |
| 3 | AnalyzewaystoevaluateRecommenderSystemsandprovideexplanations | K3,K4 |
| 4 | UnderstandafewapplicationsofRecommenderSystems | K3 |
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| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **Collaborativerecommendation** | 10 hours |
| Introductiontobasicconceptsbehindrecommendersystems-Recentdevelopments**Collaborative recommendation**: User-based and item-based nearest neighbour recommendations–Ratings-Furthermodel-basedandpreprocessingbasedapproaches-Recent practical approaches and systems |
| **Unit:2** | **Content-basedandKnowledge-basedrecommendation** | 10 hours |
| **Content-basedrecommendation:**Contentrepresentationandcontentsimilarity-Similarity-based retrieval.**Knowledgebasedrecommendation:**Knowledgerepresentationandreasoning,Constraint based recommenders, Case based recommenders. |
| **Unit:3** | **Hybridrecommendationandexplanations** | 10 hours |
| **Hybridrecommendation:**Opportunitiesforhybridisation-monolithic,parallelizedand piplined hybridization designs**Explanationsinrecommendersystems**:Explanationsinconstraint-based,case-basedand collaborative filtering recommenders |
| **Unit:4** | EvaluatingRecommenderSystemandcasestudy | 10 hours |
| Generalpropertiesofevaluationresearch-Popularevaluationdesigns-Evaluationonhistorical datasets – Alternate evaluation designsCasestudy-Personalised gamerecommendationonthemobileinternet |

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| **Unit:5** | **Recentdevelopments** | 10 hours |
| **Onlineconsumerdecisionmaking**:Context,primacy/recencyandfurthereffects -Personality and social psychologyR**ecommendersystemsandthenextgenerationWeb:**Trust-awarerecommender systems-Folksonomies-Ontological filtering-Extracting semantics from the web |  |
|  | **TotalLecture hours** | **50 hours** |
|  | **TextBook(s)** |  |
| **1** | JannachandZanker,RecommenderSystems:AnIntroduction, Cambridge University Press, 2012. |  |
| **2** | Aggarwal,RecommenderSystems:TheTextbook,Springer Publications, 2016. |  |
|  | **ReferenceBooks** |  |
| **1** | RicciF.,RokachL.,ShapiraD.,KantorB.P.,RecommenderSystemsHandbook,Springer(2011),1sted. |  |
| **2** | ManouselisN.,DrachslerH.,VerbertK.,DuvalE.,RecommenderSystemsForLearning,Springer(2013),1sted. |  |
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| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https:/[/www.coursera.o](http://www.coursera.org/specializations/recommender-systems)r[g/specializations/recommender-systems](http://www.coursera.org/specializations/recommender-systems) |  |

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

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

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| **Coursecode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **ElectiveIII** | **HRAnalytics** | **5** | **-** | **-** | **4** |
| **Pre-requisite** | **None** | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. UnderstandthefundamentalsofHRanalytics
2. Understandtheprocessofrecruitmentanalysis
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | UnderstandoftheroleandimportanceofHRanalytics. | K1,K2 |
| 2 | Explainthestrategiestotrack,store,retrieve,analyseandinterpretHR data to support decision making. | K2,K3 |
| 3 | Applyappropriatesoftwaretorecord,maintain,retrieveandanalyse human resources information. | K2, K3,K4 |
| 4 | Applyquantitativeandqualitativeanalysistounderstandtrendsand indicators in human resource data. | K2,K3 |
| 5 | DemonstratehowtoconnectHRresultstobusinessresults. | K4,K5 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **IntroductiontoHRAnalytics** | 10 hours |
| Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics,EvolutionofHRAnalytics;HRMetricsandHRAnalytics;Intuitionversusanalytical thinking; HRMS/HRIS and data sources |
| **Unit:2** | **DiversityAnalysis** | 10 hours |
| Equality,diversityandinclusion,measuringdiversityandinclusion,Testingtheimpactofdiversity,Workforcesegmentationandsearchforcriticaljob roles. |
| **Unit:3** | **RecruitmentandSelectionAnalytics** | 10 hours |
| EvaluatingReliabilityandvalidityofselectionmodels,findingout selectionbias,Predictingthe performance and turnover. |
| **Unit:4** | **PerformanceAnalysis** | 10 hours |
| Predictingemployeeperformance,trainingrequirements,evaluatingtraininganddevelopment,Optimizingselectionandpromotiondecisions |
| **Unit:5** | **MonitoringimpactofInterventions:** | 10hours |
| Trackingimpactinterventions,Evaluatingstresslevelsandvalue-change.Formulatingevidence-basedpracticesandresponsibleinvestment.Evaluationmediationprocess,moderation,andinteractionanalysis |
|  | **TotalLecture hours** | **50 hours** |
|  | **TextBook(s)** |  |

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| **1** | EdwardsMartinR,EdwardsKirsten(2016),“PredictiveHRAnalytics:MasteringtheHRMetric”,KoganPagePublishers,ISBN-0749473924 |
| **2** | Fitz-enzJac(2010),“ThenewHRanalytics:predictingtheeconomicvalueofyourcompany’shumancapitalinvestments”,AMACOM, ISBN-13:978-0-8144-1643-3 |
| **3** | Fitz-enzJac,MattoxIIJohn(2014),“PredictiveAnalyticsforHumanResources”,Wiley,ISBN-1118940709 |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | M | L | L | L | L | L | L |
| CO2 | S | S | M | M | L | L | L | L | L | L |
| CO3 | S | M | M | M | L | M | L | L | M | L |
| CO4 | M | M | M | M | L | L | L | L | M | L |
| CO5 | M | M | M | M | L | L | L | L | M | L |

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

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| **Coursecode** | **TITLEOF THECOURSE** | **L** | **T** | **P** | **C** |
| **Elective III** | **DataMining** | **5** | **-** | **-** | **4** |
| **Pre-requisite** |  | **Syllabus****Version** | **2022-23** |
| Course Objectives: |
| Themainobjectivesofthiscourseareto:1. Understandthe fundamentalsofdataminingandsignificanceofdatapre-processing.
2. Applyappropriatedata miningtechnique onthelargedataset forknowledgediscovery.
3. Understandthe applicationofdataminingoncomplexdataobjects.
 |
| ExpectedCourse Outcomes: |
| Onthesuccessfulcompletionofthecourse,studentwillbeable: |
| 1 | Understanddataminingprimitivesanddatapre-processingmethods. | K2 |
| 2 | Applypredictionandassociationruleminingforreallifeminingapplications. | K3 |
| 3 | ApplyappropriateClassificationtechniquesforvariousproblemswithhighdimensionaldatausingmodern tools. | K3 |
| 4 | ApplyappropriateClusteringtechniquesforvariousproblemswithhighdimensionaldatausingmoderntools. | K3 |
| 5 | Synthesizevariousminingtechniquesandworkinteamsto developprojectoncomplex data objects. | K3 |
| **K1**-Remember;**K2** -Understand; **K3** -Apply;**K4**-Analyze;**K5**-Evaluate;**K6**– Create |
| **Unit:1** | **DATAMININGFUNDAMENTALS** | 10 hours |
| DataMininglifecycle-KDDProcess–Kindsofdatacanbemined–Kindofdatacanbemined – Technologiesused–Kinds ofApplications targeted–Issuesindatamining- DataObjects andAttributeTypes-DataPre-processingoverview. |
| **Unit:2** | **ASSOCIATIONANDCORRELATION** | 10 hours |
| MiningFrequentPatterns-AssociationsandCorrelations–MiningMethods–Apriori–FPGrowth - Miningvarious Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining. |
| **Unit:3** | **CLASSIFICATION** | 10 hours |
| Classification Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule BasedClassification–-SupportVectorMachine-LazyLearners–Otherclassificationmethods-ModelEvaluationandSelection. |
| **Unit:4** | **CLUSTERINGANDOUTLERANALYSIS** | 10 hours |
| ClusterAnalysis–PartitioningMethods-HierarchicalMethods–DensityBasedMethods–GridBasedMethods–EvaluationofClustering-OutlierAnalysis –Outlierdetection Methods. |
| **Unit:5** | **MININGCOMPLEXDATA** |  |
| TimeSeriesandSequenceMining–Mininggraphsandnetworks –WebMining–SpatialMining–TextMining–MultimediaMining–DataMining Applications. | 10 hours |
|  | **TotalLecture hours** | **50 hours** |
| **TextBook(s)** |  |
| **1** | JiaweiHan,MichelineKamber,JainPei“DataMining:ConceptsandTechniques”,Thirdedition,Elsevier,MorganKaufmannPublishers,2012. |
| **2** | AlexBersonandStephen J.Smith“DataWarehousing,DataMining&OLAP”,TataMcGraw–HillEdition,TenthReprint2007. |

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|  | **ReferenceBooks** |  |
| **1** | K.P.Soman,ShyamDiwakarandV.Ajay“InsightintoDataminingTheoryandPractice”,EasterEconomyEdition,PrenticeHallofIndia,2006. |
| **2** | Hand.D,MannilaH,Smyth.P,“PrinciplesofDataMining”,MITpress,USA,2001. |
| **3** | DunhamM,"DataMining: IntroductoryandAdvancedTopics”,PrenticeHall,NewDelhi,2002 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://nptel.ac.in/courses/106/105/106105174/ |
| **2** | https:/[/www.coursera.o](http://www.coursera.org/specializations/data-mining)r[g/specializations/data-mining](http://www.coursera.org/specializations/data-mining) |

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | P10 |
| CO1 | S | S | M | M | S | M | L | L | L | L |
| CO2 | S | S | S | M | S | S | L | L | L | L |
| CO3 | S | M | S | M | S | S | L | L | L | L |
| CO4 | M | M | M | M | S | S | L | L | L | L |
| CO5 | S | M | S | M | S | S | L | L | L | L |

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

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| **CourseCode** | **TITLE OF THE COURSE** | **L** | **T** | **P** | **C** |
| **Elective III** | **BigdataandCloud Computing** | **5** | **0** | **0** | **4** |
| **Pre- requisite** | **None** | **Syllabus version** | **2022-23** |
| **CourseObjectives** |
| * Toprovideanoverview ofanexcitinggrowingfieldofbigdataanalytics.
* TointroducethetoolsrequiredtomanageandanalyzebigdatalikeHadoop,MapReduce and other Hadoop Ecosystems.
* Introduction to cloud computing, cloud architecture, cloud service models, Service OrientedArchitectures,securityincloudcomputing,disastermanagementinclouds.
 |
| **ExpectedCourse Outcomes** |
| 1 | IdentifythecomponentsofHadoopDistributedFileSystemforbigdata processing | **K1, K2** |
| 2 | DevelopBigDataSolutionsusingHadoopEcoSystem | **K1, K4** |
| 3 | Identifythearchitectureandinfrastructureofcloudcomputing,including SaaS, PaaS, IaaS,Maas, public cloud, private cloud, hybrid cloud, etc | **K1, K3** |
| 4 | Providetheappropriatecloudcomputingsolutionsandrecommendations according to the applications used | **K1, K2** |
| 5 | Attempttogeneratenewideasandinnovationsincloudcomputing | **K1,K2** |
| **K1–RememberK2–UnderstandK3–applyK4-AnalyzeK5– evaluateK6-Create** |
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| **UNITI** | **IntroductiontoBigData** | **10****Hours** |
| Classification of digital data – Characteristics of data – Challenges – Five Vs- Typical Hadoop environment- Classification of analytics- Data science – Terminologies used in big data environments- Parallel Vs Distributed Environment-Big data applications, Problems when handling large data – General techniques for handling large data – Case study – Steps in big data – Distributing data storage and processing with Frameworks – Case study |
| **UNITII** | **INTRODUCTIONTOHADOOPECO SYSTEM** | **10****Hours** |
| Introduction to Hadoop Eco system- Hadoop core components- Hadoop distributions- HDFS-Common Hadoop Shell commands- Processing data with Hadoop- Name Node- Secondary Name Node,andDataNode-HadoopMapReduceparadigm-MapandReducetasks,Job, Tasktrackers- Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring &Maintenance. |
| **UNITIII** | **HADOOPECOSYSTEMCOMPONENTS** | **10****Hours** |
| Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, Hive : Hive Shell, Hive Services, Hive Metastore, HiveQL, Tables, Querying Data and User Defined Functions. Base: HBase Concepts, Clients, Example, Zookeeper - Building applications with Zookeeper, Oozie-Workflows of Oozie |

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| **Unit IV** | **Introduction to Cloud Computing** | **10 Hours** |
| Defining theCloud, The Emergenceof Cloud Computing, Cloud-Based Services, Grid Computing or Cloud Computing, Components of Cloud Computing, Virtualization, Cloud Computing Deployment Models (Types): Public, Private, Hybrid, Benefits of Using a Cloud Model, Legal IssuesinUsingCloudModels,CharacteristicsofCloudComputing,EvolutionofCloudComputing, Challenges for the Cloud computing, Grid Computing, Distributed Computing in Grid and Cloud. |
| **UNITV** | **CloudServiceModels** | **10 Hours** |
| Communication-as-a-Service (CaaS): Advantages of CaaS, Fully Integrated, Enterprise-Class Unified Communications, Infrastructure-as-a-Service (IaaS): Modern On-Demand Computing, Amazon’s Elastic Cloud, Amazon EC2 Service Characteristics, Monitoring-as-a-Service (MaaS), ProtectionAgainstInternalandExternalThreats,Platform-as-a-Service(PaaS):TheTraditionalOn-Premises Model, The New Cloud Model, Key Characteristics of PaaS, Software-as-a-Service (SaaS):SaaSImplementationIssues,KeyCharacteristicsofSaaS,BenefitsoftheSaaSModel,JerichoCloudCubeModel. |

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|  | **TotalLecture hours** | **50 hours** |
|  | **TextBook(s)** |  |
| **1** | SeemaAcharya,SubhashiniChellappan,“BigDataandAnalytics”Wiley,FirstEdition, 2015 |
| **2** | EMCEducationServices,“DataScienceandBigDataAnalytics:Discovering,Analyzing,VisualizingandPresentingData”,Wileypublishers,2015 |
| **3** | DavidS.Linthicum.,“CloudComputingandSOA Convergencein yourEnterprise,astepbystep guide”2009 |
| **4** | JohnW.Rittinghouse,JamesF.Ransome., “CloudComputing:ImplementationManagementandSecurity,2009 |
| **5** | DirkDeroosetal.,HadoopforDummies,DreamtechPress,2014 |
|  | **ReferenceBooks** |  |
| **1** | TomWhite,“HADOOP:ThedefinitiveGuide”,OReilly2012 |
| **2** | BorkoFurht,HandbookofCloudComputing,ArmandoEscalante(Editors),Springer,2010 |
| **3** | RajKumarBuyya,JamesBroberg,AndrezeiM.Goscinski,CloudComputing:Principlesandparadigms, 2011 |
| **RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]** |
| **1** | https://onlinecourses.nptel.ac.in/noc20\_cs92/preview |  |
| **2** | https://onlinecourses.nptel.ac.in/noc20\_cs20/preview |  |

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

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