AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
(IOIT)
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

ACADEMIC COURSE

STRUCTURE & SYLLABUS

S. Y. BTECH
ARTIFICIAL INTELLIGENCE & DATA SCIENCE

B.TECH. 4 YEAR UG COURSE

(Applicable for the batches admitted from 2022-2023)

AISSMS INSTITUTE OF
INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune- 411-001, Maharashtra State, India
Email: principal@aissmsioit.org,
Website: **http://www.aissmsioit.org**

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BOS-ARTIFICIAL INTELLIGENCE
& DATA SCIENCES
AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Artificial Intelligence and Data Science - Second Year (Semester –III)

Sr. No.	Course Code	Course Name	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	IOHSM301	Democracy, Election and Governance @@	2	--	--	2	--	--	25	--	25	50
2	ADBSC302	Discrete Mathematics and Statistics	3	--	--	3	40#	60*	---	--	--	100
3	ADPCC303	Software Engineering	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC304	Data Structure	3	--	--	3	40#	60**	--	--	--	100
5	ADPCC305	Object Oriented Programing	3	--	--	3	40#	60*	--	--	--	100
6	ADOEC306	MOOC-Programming in JAVA	3	--	--	3	40$	60$$	---	--	--	100
7	ADPCC307	Object Oriented Programming Laboratory@@	--	--	4	2	--	--	25	50	--	75
8	ADPCC308	Data Structure Laboratory@@	--	--	4	2	--	--	25	50	--	75
9	IOHSM3AC	Audit course 3-Vedic Mathematics	1	--	--	1	--	--	25	--	--	25
Total			**18**	**--**	**08**	**22**	**200**	**300**	**100**	**100**	**25**	**725**
10	ADMNR301	Python Programming for Data Science	3	--	--	3	--	75*	--	--	--	75
11	ADMNR302	Python Programming for Data Science Laboratory	-	--	2	1	---	--	25	--	--	25
Grand Total			**21**	**--**	**10**	**26**	**200**	**375**	**125**	**100**	**25**	**825**

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation**
Insem1-Subjective
Insem-2- "**GATE based** MCQ" and "**numerical based** subjective"

Based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

@@ **Separate passing** in each of the head is mandatory to earn the specified credits.

MOOC : Programming in Java
https://nptel.ac.in/courses/106105191

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AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Artificial Intelligence and Data Science - Second Year (Semester –IV)

Sr. No.	Course Code	Course Name	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM401	Project Management@@	2	--	--	2	--		25	--	25	50
2	ADPCC402	Artificial Intelligence	3	--	--	3	40#	60*	--	--	--	100
3	ADPCC403	Database Management Systems	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC404	Exploratory Data Analysis	3	--	--	3	40#	60**	--	--	--	100
5	ADPCC405	Operating Systems	3	--	--	3	40#	60*	--	--	--	100
6	ADVSE406	Data Analytics with Python @@	1	--	4	3	--	--	50	50	--	100
7	ADPCC407	Database Management Systems Laboratory@@	--	--	4	2	--	--	25	50	---	75
8	ADPCC408	Artificial Intelligence and Data Analysis Laboratory@@	--	--	4	2	--	--	25	50	--	75
9	IOHSM4AC	Audit course - 4 Sustainable Development goals	1	--	- -	1	--	--	25	--	--	25
10	IOLLC4L1	Lifelong Learning Skills-I	--	--	--	1	--	--	25	--	--	25
11	IOLLC4L2	Lifelong Learning Skills-II	--	--	--	1	--	--	25	--	--	25
Total			16	--	12	24	160	240	200	150	25	775
12	ADMNR401	Artificial Intelligence	3	--	--	3	--	75*	--	--	--	75
13	ADMNR402	Artificial Intelligence Laboratory	--	--	2	1	--	--	25	--	--	25
Grand Total			19	--	14	28	160	315	225	150	25	875

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation**

Insem1-Subjective
Insem-2- "**GATE based** MCQ" and "**numerical based** subjective"
Based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

@@ **Separate passing** in each of the head is mandatory to earn the specified credits.

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Second Year Artificial Intelligence & Data Science (2022 Course) Democracy,Election and Governance			
Course Code	IOHSM301	**Credit**	02
Contact Hours	02 Hrs/ weeks((L)	**Type of Course**	Lecture/Tutorial
Examination Scheme	TW: 25 marks OR: 25 marks	**Total Marks**	50

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	25
2.	Oral	External	25

Course Objectives	
1	To introduce the students meaning of democracy and the role of the governance.
2	To help the understand the various approaches to the study of democracy and governance

Course Outcomes : Students will be able to	
301.1	Explain the meaning of democracy and the role of the governance in life.
301.2	Apply the various approaches to the democracy and governance

Topics covered:

UNIT-I: DEMOCRACY-FOUNDATIONANDDIMENSIONS (5 hrs.)

a. Constitution of India
b. Evolution of Democracy-Different Models
c. Dimensions of Democracy-Social, Economic, and Political

UNIT-II: DECENTRALIZATION (5 hrs.)

a. Indian tradition of decentralization
b. History of panchayat Raj institution in the lost independence period
c. 73rdand74thamendments
d. Challenges of caste, gender, class, democracy and ethnicity

UNIT-III: GOVERNANCE (5 hrs.)

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

Text books

1. Banerjee- Dube, I. (2014). A history of modern India. Cambridge University Press.
2. Basu, D. D. (1982). Introduction to the Constitution of India. Prentice Hall of India.
3. Bhargava, R. (2008). Political theory: An introduction. Pearson Education India.
4. Bhargava,R.,Vanaik,A.(2010)UnderstandingContemporaryIndia:CriticalPerspective. New Delhi: Orient Blackswan.
5. Chandhoke.N.,Proyadardhi.P,(ed)(2009),'ContemporaryIndia:Economy,Society,Politi cs', Pearson India Education Services Pvt. Ltd, ISBN 978-81- 317-1929-9.

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BOS–ARTIFICIAL INTELLIGENCE
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AISSMS IOIT (AUTONOMOUS),
PUNE–1.

6. Chandra, B. (1999). Essays on contemporary India. Har-Anand Publications.
7. Chaterjee, P. (1997). State and Politics in India.
8. Dasgupta.S.,(ed)(2011),'PoliticalSociology',DorlingKindersley(India)Pvt.Ltd .,Licens ees of Pearson Education in south Asia. ISBN: 978-317-6027- 7.
9. Deshpande,S.(2003).ContemporaryIndia:ASociologicalView,NewDelhi:Viki ngPublic ation.
10. Guha,R.(2007).India After Gandhi: The History of the

    World's Largest.Democracy, HarperCollins Publishers, New York.
11. Guha, R. (2013). Gandhi before India. Penguin UK.
12. Jayal. N.G. (2001). Democracy in India. New Delhi: Oxford University Press.
13. Kohli,A.(1990).Democracyanddiscontent:India'sgrowingcrisisofgovernability .Cambri dge University Press.
14. Kohli,A.,Breman,J.,&Hawthorn,G.P.(Eds.).(2001).ThesuccessofIndia'sde mocracy (Vol. 6). Cambridge University Press.
15. Kothari,R.(1989).Stateagainstdemocracy:Insearchofhumanegovernance.ApexPr.
16. Kothari, R. (1970). Politics in India. New Delhi: Orient Blackswan.
17. Kothari, R. (1995). Caste in Indian politics. Orient Blackswan.
18. Sarkar,S.(2001).Indiandemocracy:thehistoricalinheritance.theSuccessofIndia' sDemoc racy, 23-46.

मराठी संदर्भ ग्रंथ:

१. राही श्रुती गणेश., आवटे श्रीरंजन, (२०१९), *'आपलं आयकार्ड'*, सुहास पळशीकर द युनिक अकॅडमी पब्लिकेशनप्रा.लि.,.

२. व्होरा राजेंद्र., पळशीकर, सुहास.(२०१४). *भारतीय लोकशाही अर्थ आणि व्यवहार.* पुणे : डायमंड प्रकाशन.

३. सुमंत, यशवंत.(२०१८). *प्रा. यशवंत सुमंत यांची तीन भाषणे.* पुणे : युनिक अँकॅडमी पब्लिकेशन्स प्रा.लि

४. भोळे. भा.ल. (२०१५). *भारतीय गणराज्याचे शासन आणि राजकारण.* नागपूर: पिंपळापुरे बुक प्रकाशन

५. कसबे. रावसाहेब. (२०१०)डॉ. आंबेडकर आणि भारतीय राज्यघटना. पुणे: सुगावा प्रकाशन

Note: The assessment for the subject shall be based on presentation and reportsubmission.

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PUNE–1.

Second Year Artificial Intelligence & Data Science (2022 Course) Discrete Mathematics and Statistics			
Course Code:	ADBSC302	**Credit:**	03
Contact Hours:	03 Hrs/ weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Basic Knowledge of Mathematics.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40#
2.	End Semester Evaluation	External	60*

Course Objectives	
1	To build knowledge of relations and functions.
2	To introduce the basic concepts of probability and random variables
3	To categorize types of probability distribution.
4	To learn statistical methods in various engineering applications.
5	To illustrate the knowledge of testing of hypothesis for small and large samples.
6	To explain the correlation.

Course Outcomes : Students will be able to	
302.1	Identify relations and operations on functions.
302.2	Apply the fundamentals of probability and random variables.
302.3	Analyze the behavior of various discrete and continuous probability distributions.
302.4	Implement sampling distribution.
302.5	Apply the concept of testing of hypothesis for small and large samples in real life problems.
302.6	Classify correlation.

Topics covered:

UNIT-I: RELATIONS & FUNCTIONS (06 Hrs)

Product Sets and Partitions, Relations, Properties of Relations, Equivalence Relations, Binary Relations, Operations on Relations, Representation of Relations, Closure of Relations and Warshalls Algorithm, Introduction of Function, Classification of Functions, Operation on Functions, Composite Functions, Inverse Function.

UNIT-II: PROBABILITY & RANDOM VARIABLES (06 Hrs)

Sample Space, Events, The Concept of Probability, he Axioms of Probability, Conditional Probability, Theorems on Conditional Probability, Independent Events, Bayes' Theorem, Random Variables, Discrete Random Variables, Continuous Random Variables, Joint Probability Distributions, Independent Random Variables, Distribution Function for Random Variable, Distribution Function for Discrete and Continuous Random Variable, Probability Density Functions, Cumulative Distribution Functions and Expected Values.

UNIT- III: PROBABILITY DISTRIBUTION (06 Hrs)

The Binomial Probability Distribution, Properties of Binomial Probability Distribution, Hypergeometric and Negative Binomial Distributions, The Poisson Probability

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Distribution, Normal Distribution, Properties of Normal Distribution, Continuous Uniform Distribution, Applications of Normal Distribution, Gamma and Exponential Distributions, Chi-Squared Distribution, Beta Distribution, Lognormal Distribution.
UNIT- IV: SAMPLING AND ESTIMATION THEORY (06 Hrs) Population and Sample, Statistical Inference, Sampling with and without Replacement, Random Samples, Population Parameters, Sample Statistics, Sampling Distributions, Sample Mean, Sampling Distribution of Means, Sample Variances, Sampling Distribution of Variances, Unbiased Estimates and Efficient Estimates, Point Estimate and Interval Estimates, Confidence Interval Estimates of Population Parameters, Confidence Intervals for Variance of a Normal Distribution, Maximum Likelihood Estimates.
UNIT- V: TESTS OF HYPOTHESIS AND SIGNIFICANCE (06 Hrs) Statistical Hypothesis, Null and Alternate Hypothesis, Test of Hypothesis and Significance, Type I and Type II Errors, Level of Significance, Tests Involving the Normal Distribution, One-Tailed and Two-Tailed Tests, P Value. Special Tests of Significance for Large Samples and Small Samples (F, chi- square, z, t- test).
UNIT- VI: CORRELATION (06 Hrs) Correlation, The Linear Correlation Coefficient, Generalized Correlation Coefficient, Rank Correlation, Probability Interpretation of Correlation, Sampling Theory of Correlation, Correlation and Dependence.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) **Unit I:** Relations, Generating Functions. **Unit II:** Axiomatic Definition of Probability, Properties of Probability Function, Conditional Probability, Bayes' Theorem, Independence of Events; **Unit III:** Random Variables and their Distributions, Distribution Function, Probability Mass Function, Probability Density Function and their Properties, Distribution of Functions of a Random Variable, Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Discrete Uniform, Poisson, Continuous Uniform, Exponential, Gamma, Beta, Sampling Distributions: Central, Chi-Square, Central T, And Central F Distributions

Text Books:

1. "Discrete mathematical structures", B Kolman RC Busby, S Ross PHI Pvt. Ltd
2. "Probability and Statistics", Murray R. Spiegel, John Schiller and R. Alu Srinivasan, Tata McGraw-Hill Edition.
3. "Probability and Statistics for Engineering and the Sciences", Jay Devore, Eighth Edition

Reference Books:

1. "Discrete structures", Liu, Tata McGraw -Hill.
2. "Discrete Mathematical structures", Y N Singh, Wiley- India
3. "Introduction to Probability and Statistics for Engineers and Scientists", Sheldon M. Ross, Academic Press.
4. "Probability and Statistics for Engineers and Scientists", Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Ninth Edition
5. "Applied Statistics and Probability for Engineers", D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons

EBooks:

1. Discrete Mathematics (openmathbooks.org)
2. mth202.pdf (iitk.ac.in)
3. cs103x-notes.pdf (stanford.edu)

MOOC:

Introduction to Probability Theory and Stochastic Processes:
https://nptel.ac.in/courses/111102518

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AISSMS IOIT (AUTONOMOUS), PUNE–1.

Second Year Artificial Intelligence & Data Science (2022 Course) Software Engineering			
Course Code:	ADPCC303	**Credit:**	03
Contact Hours:	03 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Basic knowledge of software.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40#
2.	End Semester Evaluation	External	60*

Course Objectives	
1	To discuss fundamental of Software Engineering.
2	To get familiar with analyzing Software requirement.
3	To explain Software Engineering Practices.
4	To interpret software analysis model.
5	To make use of practices and techniques for software testing & managing software maintenance processes.
6	To explain the significance of open source software in the technology industry.

Course Outcomes : Students will be able to	
303.1	Identify key element of software engineering.
303.2	Construct Software requirement specification for the required software.
303.3	Rephrase Software engineering practices.
303.4	Build software analysis model
303.5	Explain software testing & maintenance practices to ensure long-term sustainability and usability.
303.6	Differentiate between open source and proprietary software, highlighting its key distinctions..

Topics covered:

UNIT I: INTRODUCTION TO SOFTWARE PROCESS MODELS (06 Hrs)

Introduction to Software Engineering , Nature of Software, Software Myths, Software Engineering a Layered Technology, Software Process Models, Generic Process Model, Process Framework, Software Development Life Cycle(SDLC),Waterfall Model, Iterative development Model, Incremental Process model, Evolutionary Process Model, Prototyping Model, Spiral Model, Concurrent Model, Agile Model/Development: SCRUM and KANBAN/Jira, Other Agile Process Models.

UNIT II: REQUIREMENTS ANALYSIS (06 Hrs)

Requirement Engineering, Software Engineering tasks, Requirement Engineering Process, Feasibility Study, Requirement elicitation and analysis, Requirement validation, Requirements management, Software Requirement Specification (SRS), KANO Model: Prioritizing

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BOS ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Requirements, Planning Practices, Communication practices, Modeling Practices, Design Practices.
UNIT-III: SOFTWARE ENGINEERING SPECIFICATION (06 Hrs) Software Requirement Specifications (SRS): Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model. Requirement Models: Use Case, Activity, Class, Data Flow, State Diagrams.
UNIT- IV: SOFTWARE ANALYSIS MODELING AND DESIGN (06 Hrs) Data Modeling Types & Techniques, **Building Analysis Model:** requirement analysis, Analysis Modeling Approaches, Data Modeling Concepts, Scenario based modeling, Flow oriented Modeling, Class based modeling, Behavioral modeling, **Software Design:** Quality Guidelines & Attributes, Software Design Concepts, Coupling &Cohesion, User Interface Design Model, Architectural Design model, Project Planning: Process, Project Scope Management, Work Breakdown Structure (WBS),Project Scheduling Process, Principles & Techniques, Project management Spectrum: 4P's, W5HH Principle: Boehm's Principle, Project Cost Estimation, COCOMO Model, Software Configuration Management.
UNIT- V-SOFTWARE TESTING AND MAINTAINANCE (06 Hrs) Introduction & Principles of Software Testing, White Box Testing, Black Box Testing, Testing Levels: Unit Testing, Integration Testing, System testing, User Acceptance Testing, Verification & Validation, Quality Management: Quality Concepts, Quality assurance and Quality control. **Software Maintenance:** Need of software maintenance, key aspects of software maintenance, software maintenance types: corrective, adaptive, perfective, Preventive, etc., advantages & disadvantages of software maintenance, debugging techniques and tools, defect cycle, benefits of Defect Lifecycle, and bug management, refactoring, code refactoring techniques, benefits of refactoring, reverse engineering.
UNIT-VI- OPEN SOURCE SOFTWARE (06 Hrs) Introduction to open source software, historical context of open source software, Free Software Foundation: four essential freedoms to its users, Pros & Cons of open source software, differentiating between open source and proprietary software, understanding open source governance models, software licenses: proprietary, copyleft, permissive, public domain, etc., types of open source licenses: MIT License, GNU General Public License, GNU LGPL (Lesser General Public License), Mozilla Public License (MPL),Apache License 2.0, BSD License 2.0,etc,. Open Source Software Examples: Linux, Mozilla Firefox, Apache HTTP Server, etc.

Text Books:

1. Pressman, Roger S., and Maxim, Bruce R. Software Engineering: A Practitioner's Approach. United Kingdom, McGraw-Hill Education, 2020.
2. Sommerville, Ian. Software Engineering. India, Pearson India Education Services, 2017.
3. Rao, M. N. Fundamentals of Open Source Software. India, PHI Learning, 2014.
4. Takang, Armstrong A., and Grubb, Penny A.. Software Maintenance: Concepts and Practice. Germany, International Thomson Computer Press, 1996.

Reference Books:

1. Rajib Mall, "Fundamentals of Softawre Engineering", PHI, ISBN-13:978-120348981.
2. Pankaj Jalote. " Software Engineering, A Precise Approach", Wiley India. 2010.

EBooks:

1. https://www.jobilize.com/web-assets/ebook/foundations-of-software-engineering-by-prof-kevinamaratunga-mit.pdf
2. https://my.uopeople.edu/pluginfile.php/57436/mod_book/chapter/46513/CS4403.Conger. New Software.Engineering.Ch01.Ch09.pdf

CHAIRMAN
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AISSMS IOIT (AUTONOMOUS), PUNE–1.

Second Year Artificial Intelligence & Data Science (2022 Course) Data Structure			
Course Code:	ADPCC304	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60**	**Total Marks:**	100

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60**

Course Objectives	
1	To understand the basics of data structures and algorithms.
2	To discover linear data structures – lists, stacks, and queues.
3	To learn different non- linear data structure and their implementation.
4	To identify various searching and sorting methods.
5	To study some advanced data structures such as hash and dictionary.
6	To analyze file management systems.

Course Outcomes : Students will be able to	
304.1	Outline concepts of data structure and algorithm.
304.2	Implement Linear data structures.
304.3	Understand non- linear data structure and principle.
304.4	Identify the various searching and sorting algorithms.
304.5	Analyze hash tables and dictionaries.
304.6	Apply various data structures in file organization.

Topics covered:

UNIT-I: DATA STRUCTURES AND ALGORITHM **(06 Hrs)**

Basics of Data Structures, Data Structures Classification, Abstract Data Types (ADT), Operations on Array merging of two arrays, storage representation and their address calculation. Concept of algorithm, Algorithm design tools Pseudo-code and flowchart. Complexity of algorithm Space and Time complexity, Asymptotic notations Big-O, Theta and Omega.

UNIT-II: LINEAR DATA STRUCTURE **(06 Hrs)**

Linked List: Concept, Types, Design, Operations, Implementation, complexity, and Application.

Stack: Concept, Design, Operations, Implementation, complexity, and Application.

Queue: Concept, Types, Design, Operations, Implementation, complexity, and Application.

Recursion: Concept, Variants of Recursion-Direct, Indirect, Tail and Tree, Use Of Stack in Backtracking.

UNIT-III :SEARCHING AND SORTING METHODS **(06 Hrs)**

Searching: Sequential Search, Binary Search

CHAIRMAN
BOS- ARTIFICIAL INTELLIGENCE
& DATA SCIENCES
AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Sorting: Insertion sort, Bubble Sort, Merge sort, Quick sort and Heap sort, Shell sort, sort order, Radix sort, Index passes.
UNIT- IV: NON LINEAR DATA STRUCTURE **(06 Hrs)** Graph: Basic concepts, storage representation, Adjacency matrix, adjacency list. Traversals: Prims and Kruskal algorithms, Dikjstra's single source shortest path. Tree: Basic concepts, Representations, Traversals, Binary tree, Binary search tree, B+ Trees, Threaded Binary search tree- concepts, threading, insertion and deletion of nodes, AVL Trees.
UNIT-V:DICTIONARIES AND HASHING **(06 Hrs)** Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hash: Hash Table, Hash Function, Collision Resolution Techniques in Hashing-Chaining, Open Addressing-Linear, Quadratic Probing and Double Hashing. Hash table overflow-open addressing and chaining.
UNIT- VI: FILE ORGANIZATION **(06 Hrs)** Files: concept, need, primitive operations. Sequential file organization- concept and primitive operations, Direct Access File: Concepts and Primitive operations, Indexed sequential file organization-concept, types of indices, structure of index sequential file.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) Recursion, Arrays, stacks, queues, linked lists, binary heaps, graphs. **Unit1:** Asymptotic worst case time and space complexity, Algorithm design techniques: greedy, dynamic programming, and divide-and-conquer. **Unit 2:** Recursion. Arrays, stacks, queues, linked lists. **Unit 3:** Searching, sorting. **Unit 4:** Trees, binary search trees, shortest paths. **Unit 5:** Hashing.

Text Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy" 5th edition, Careermonk Publications, ISBN-13 . 978-8193245279 :
2. Robert Sedgewick and Kevin Wayne, "Algorithms" Addison-Wesley Professional; 4th edition (March 24, 2011), ISBN-13. 978-0321573513 :
3. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books:

1. Adam Drozdek, "Data Structures and Algorithms in C++", Course Technology Ptr; 4th edition (27 August 2012), ISBN-13 978-1133608424 :
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", MIT Press, 1990 (first edition), ISBN: 978-0-262-04630-5.

EBooks:

1. https://www.cse.iitb.ac.in/~ranade/cs213/
2. Data Structures and Algorithms (iitpkd.ac.in)

CHAIRMAN
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AISSMS IOIT (AUTONOMOUS), PUNE–1.

Second Year Artificial Intelligence & Data Science (2022 Course) Object Oriented Programming			
Course Code:	ADPCC305	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60*

Course Objectives	
1	To introduce the object-oriented programming paradigm & fundamentals of object oriented design.
2	To explain the concept of class, objects, its memory requirements.
3	To elaborate on inheritance and pointers
4	To introduce the concept of polymorphism.
5	To empower the students for file and exception handling.

Course Outcomes : Students will be able to	
305.1	Explain the need, benefits and fundamentals of OOP and basics of C++ programming.
305.2	Describe the concept of class, objects and memory requirements and also demonstrate the use of different types of constructors and destructors.
305.3	Choose suitable inheritance while proposing solution for the given problem and also handle pointers and memory management effectively.
305.4	Explain the concept and types of polymorphism and also Infer knowledge on various types of overloading.
305.5	Demonstrate file handling in C++.
305.6	Explain and demonstrate exception handling techniques and templates.

Topics covered:

UNIT-I: Fundamentals of Object Oriented Programming **(06 Hrs)**

Introduction to object-oriented programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, C++ as object oriented programming language.

C++ programming Basics: character Set, Tokens, Keyword, Identifiers variable, Constant Data type, Operators, Expression, Typecasting, Control Structure, Arrays, Function, function prototype, accessing function and utility function String, Structure, Enumerations, Array of String, Array of Structure, Array of Function.

UNIT-II: Class & Object **(06 Hrs)**

Class, Object, class and data abstraction, Access specifies, separating interface from implementation.

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PUNE–1.

Objects and Memory requirements, Static members: variable and functions, inline function, friend function, Constructors and destructor, Types of constructor.

UNIT- III: Inheritance and Pointers **(06 Hrs)**

Inheritance- Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class.

Pointers: declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.

UNIT- IV: Polymorphism **(06 Hrs)**

Polymorphism- Introduction to Polymorphism, Types of Polymorphism, Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable.

Function overloading,

Run Time Polymorphism- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.

UNIT- V: Files and Streams **(06 Hrs)**

Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.

UNIT- VI: Exception Handling and Templates **(06 Hrs)**

Exception Handling- Fundamentals, other error handling techniques, simple exception handling- Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance.

Templates- The Power of Templates, Function template, overloading Function templates, and class template, class template and Non type parameters, template and friends Generic Functions, The type name and export keywords.

Text Books:

1. E. Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Herbert Schildt, "C++-The complete reference", Eighth Edition, McGraw Hill Professional, 2011, ISBN: 978-00-72226805

Reference Books:

1. Robert Lafore, —Object-Oriented Programming in C++‖, fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089)
2. Matt Weisfeld, —The Object-Oriented Thought Process‖, Third Edition Pearson ISBN13:075-2063330166
3. Cox Brad, Andrew J. Novobilski, —Object –Oriented Programming: An Evolutionary Approach‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

EBooks:

https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf

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Second Year Artificial Intelligence & Data Science (2022 Course) Programming in Python			
Course Code	ADOEC306	**Credit**	03
Contact Hours	03 Hrs/weeks((L)	**Type of Course**	MOOC
Examination Scheme	ISE:40Marks ESE: 60 Marks	**Total Marks**	100

Pre-requisites:

1. Basic computer principles.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
3.	In Semester Evaluation	Internal	40$
4.	End Semester Evaluation	External	60$$

Course Objectives	
1	To understand problem solving, problem solving aspects, programming and to know about various program design tools.
2	To learn basics, features of Python programming
3	To acquaint with data types, input output statements, decision making, looping and functions in Python
4	To illustrate the working of Tuple and Dictionary.
5	To build a knowledge of python functions and modules.
6	To acquaint with the use and benefits of files handling in Python

Course Outcomes : Students will be able to	
306.1	Inculcate and apply various skills in problem solving.
306.2	Choose most appropriate programming constructs and features to solve the problems in diversified domains
306.3	Demonstrate significant experience with the Python program development environment.
306.4	Apply the operations of tuple and dictionaries.
306.5	Identify function and module in python programming.
306.6	Demonstrate object oriented and File handling programming construct

Topics covered:

UNIT-I: PROBLEM SOLVING METHODS **(06 Hrs)**

Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

UNIT-II: INTRODUCTION TO PYTHON **(06 Hrs)**

Introduction to Python: Structure of a Python Program, Elements of Python, Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings and Operators. Conditional Statements and Looping: Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.

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UNIT- III: STRINGS AND LIST MANIPULATION	**(06 Hrs)**
String Manipulation: Understanding string, Accessing Strings, Basic Operations, String slices, Function and Methods. List: Introduction to list, Accessing list, list operations, Working with lists, Function and Methods.	
UNIT- IV: TUPLES AND DICTIONARY	**(06 Hrs)**
Tuples: Introduction to tuple, Accessing tuples, Operations, Working, Functions and Methods. Dictionary: Introduction to dictionaries, Accessing values in dictionaries, Working with dictionaries, Properties, Functions.	
UNIT- V: FUNCTIONS AND MODULES	**(06 Hrs)**
Python Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Organizing python codes using functions. Python Modules: Organizing python projects into modules, Importing own module as well as external modules, Understanding Packages, modules and external packages.	
UNIT- VI: FILE AND EXCEPTION HANDLING	**(06 Hrs)**
Input-Output: Printing on screen , Reading data from keyboard , Opening and closing file , Reading and writing files , Functions. Exception Handling: Introduction to Exception, Exception Handling, Except clause, Try ? finally clause, User Defined Exceptions.	
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)	

Text Books:

1. "Python Programming: Using Problem Solving Approach", Reema Thareja, Oxford University, 2017
2. "Core Python Programming", Dr.R. Nageswara Rao, Dreamtech Press, 2021

Reference Books:

1. "Think Python, 2e: How to Think Like a Computer Scientist", B. Downey, O'Reilly, 2015.
2. "Learn Python 3 The Hard Way", Z. Shaw,Addison-Wesley, 2017.
3. "Problem Solving and Python Programming", Arockia Mary P, Shanlax Publications, 2021.

MOOC Course URL:

1. https://onlinecourses.swayam2.ac.in/cec24_cs01/preview

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Second Year Artificial Intelligence & Data Science (2022 Course) Object Oriented Programming Laboratory			
Course Code:	ADPCC307	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR:50	**Total:**	75

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To understand basic concepts of Object Oriented Programming.
2	To learn Inheritance, Polymorphism and Exception Handling features of Object Oriented Programming.

Course Outcomes : Students will be able to	
307.1	Apply the basic concepts of Object Oriented Programming in application development.
307.2	Solve different real life problems using inheritance and Polymorphism.
307.3	Design and develop real world applications using file handling and exception handling concepts.

List of Experiment

	Group A
1	Write a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
2	Write a C++ program to implement Friend function.
3	Create a class Student having data member student_name, Student_Roll, Student_Address, Student_banch. Construct default constructor, Parameterized constructor, and Copy Constructor.
4	Design a program to implement Array of pointers, pointer to functions, pointer to objects.
5	Write a C++ Program on. In a bank, different customer has saving account. Some customers may have taken loan from the bank. So the bank always maintains information about bank depositors and borrower. Customers having data member name, phone_no, depositor having data member account_no, balance and borrower having data member loan_no, alon_amount using multilevel inheritance
6	Program to perform the addition and subtraction of two complex numbers using the binary (+) and (-) operator
7	Write a Menu driven program to perform mathematical operation using Function Overloading.

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	Group B (Any 4)
8	Write a C++ program to implement Pure Virtual Functions.
9	Program to calculate the total marks of student using the concept of virtual base class.
10	Write a program to handle divide by zero exception.
11	Create an inventory system for shop and perform different file handling operations.
12	Develop a program to implement class and function template for stack and queue.
13	Design a program to demonstrate the concepts of catching and throwing of an exception.
	Group C (Any 1)
12	**Mini Project:** Credit Calculator
13	**Mini Project:** Purchase Requisition
14	**Mini Project:** Student Report Management System

Text Books:

1. E. Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Herbert Schildt, "C++-The complete reference", Eighth Edition, McGraw Hill Professional, 2011, ISBN: 978-00-72226805

Reference Books:

1. Robert Lafore, —Object-Oriented Programming in C++‖, fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089)
2. Matt Weisfeld, —The Object-Oriented Thought Process‖, Third Edition Pearson ISBN13:075-2063330166
3. Cox Brad, Andrew J. Novobilski, —Object –Oriented Programming: An Evolutionary Approach‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

EBooks:

1. https://faculty.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf

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Second Year Artificial Intelligence & Data Science (2022 Course) Data Structures Laboratory			
Course Code:	ADPCC308	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR:50	**Total:**	75

Pre-requisites: Problem Solving and Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	25
2	End Semester Evaluation	External	75

Course Objectives	
1	To understand basics of CUDA programming model and its use in data structure.
2	To understand the principles of hashing-based sorting algorithms, including Radix Sort, Dijkstra's Shortest Path using CUDA.
3	To develop an ability to work with programming languages such as CUDA, C++, or Python.
4	To implement and use different data structures such as arrays, linked lists, trees, stacks, queues.
5	To learn to design and implement efficient algorithms and data structures for specific problems and applications.
6	To Develop an ability to implement and use different algorithms such as sorting, searching algorithms.

Course Outcomes : Students will be able to	
308.1	Learn different programming languages, tools, and environments.
308.2	Explain the basics of parallel computing and GPU architecture.
308.3	Apply the principles of hashing-based sorting algorithms, including Radix Sort, Dijkstra's Shortest Path using CUDA.
308.4	Analyze the performance of GPU-based sorting algorithms and comparing them to their CPU-based counterparts.
308.5	Apply and use different data structures such as arrays, linked lists, trees, stacks, queues for specific problems and applications.
308.6	Analyze algorithms and calculate their time and space complexity.

List of Experiment

Sr. No.	Name of the program
1.	Study of CUDA and CUDA in Data Structure Algorithm.
2.	Study of Hashing-based Sorting Algorithm using CUDA.
3.	Study of Radix Sort Algorithm using CUDA.
4.	Study of Dijkstra's Shortest Path Algorithm using CUDA.

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5.	Write a C++ programs to implement list ADT to perform following operations a. Insert an element into a list. b. Delete an element from list c. Search for a key element in list count number of nodes in list
6.	Write a C++ program that uses functions to perform the following operations onsingly linked list a. Creation b. Insertion. c. Deletion. d. Traversal.
7.	Write Python programs for the following: a. Uses Stack operations to convert infix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression.
8.	Write a C++ programs to implement recursive and non-recursive a. Linear search b. Binary search
9.	Write Python programs for implementing the following searching techniques. a. Sequential search b. Binary search
10.	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort b. Insertion sort **OR** Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Quick sort b. Merge sort
11.	Write a Python program to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre order, post-orderand in-order. c. Count the number of nodes in the binary search tree.
12.	Write a C++ program to perform the following operations: a. Insert an element into a AVL tree. b. Delete an element from a AVL tree.Search for a key element in an AVL tree.
13.	Write a C++ program to implement all the functions of a dictionary (ADT).
14.	Department maintains a student information. The file contains roll number, name, division and address. Write a C++ program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.
15.	Content Beyond Syllabus: 1. Minimum Spanning Tree (https://ds2-iiith.vlabs.ac.in/exp/min-spanning-trees/index.html) 2.Topological Sort (https://ds2-iiith.vlabs.ac.in/exp/topo-sort/index.html)

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Text Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy" 5th edition, Careermonk Publications, ISBN-13 . 978-8193245279 :
2. Robert Sedgewick and Kevin Wayne, "Algorithms" Addison-Wesley Professional; 4th edition (March 24, 2011), ISBN-13. 978-0321573513 :
3. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books:

1. Adam Drozdek, "Data Structures and Algorithms in C++", Course Technology Ptr; 4th edition (27 August 2012), ISBN-13 978-1133608424 :
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", MIT Press, 1990 (first edition), ISBN: 978-0-262-04630-5.

EBooks:

1. https://www.cse.iitb.ac.in/~ranade/cs213/
2. Data Structures and Algorithms (iitpkd.ac.in)

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Audit Course-3 IOHSM3AC (2022 Course) Course Title: Vedic Mathematics			
Contact Hours:	1Hrs./week(L)	Type of Course:	Lecture
Examination Scheme	In Sem Exam:	End Sem Exam	Practical:
Course Credit	01		

Sr. No.	Course assessment methods/tools	External/Internal	Marks
1.	Assignment	Internal	25
		Total	25

Pre-requisites: Vedic Sutras, Vedic Sub Sutras

Course Objectives	
1	To develop the understanding of techniques /sutras to solve mathematical arithmetic's in easy and faster way and uses these techniques to various competitive exams.
2	To improve speed and efficiency to solve even the most complex Mathematical problems.
3	To remove the phobia about mathematics in the minds of students
4	To help students to have better command over mathematical concepts and boost up their self confidance level toewards the subject.

Course Outcomes : Students will be able to	
3AC.1	Apply Vedic Mathematics techniques to perform quickly and accurately mathematical calculations like multiplication ,division ,squares,LCM,HCF
3AC.2	Apply Vedic Mathematics techniques to solve Linear Equations, Quadratic Equations, and Factorizations of a cubic Polynomial.
3AC.3	Apply Vedic mathematics techniques to perform calculations in coordinate Geometry, Differentiation, Integration and Trigonometry without relying on calculators or written methods.

Module I:- Basic Level **(04Hrs)**

Introduction of Vedic Mathematics, Multiplication, Square, Cube, Divisibility Test , Highest Common Factor of Polynomials, Multiplication of Polynomials, Division of Polynomials,

Module II: Intermediate Level **(04Hrs)**

Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial, Magic squares, Dates and Calendar.

Module III: Advance Level **(04Hrs)**

Determinant, Coordinate Geometry, Differentiation, Integration, Trigonometry.

Textbooks

1. Advanced Vedic Mathematics, Rajesh Kumar Thakur.
2. Vedic Mathematics Made Easy , DhavalBathia
3. VEDIC MATHEMATICS ForStudents: LEVEL – 1 OF 5 SERIES, by Nava Vision

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Reference Books

1. Sri BharatikrishnaTirthaji,"Vedic Mathematics",Published by MotilalBanarsidass, 1965.ISBN 81-208-0163-6.
2. Williams K.R. "Discover Vedic Mathematics" Vedic Mathematics Research Group, 1984.ISBN 1-869932-01-3.
3. Wiliams K.R. and M.Gaskell "The Cosmic Calculator". MotilalBanarsidass ,2002.ISBN 81-208-1871-7.

Nicholas A.P., Williams,J. Pickles."Vertically and Crosswise". Inspiration books, 1984.ISBN 1-902517-03-2

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Semester IV

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Second Year Artificial Intelligence & Data Science (2022 Course) Project Management			
Course Code:	ADHSM401	**Credit:**	2
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	TW: 25 OR: 25	**Total Marks:**	50

Pre-requisites: Software Engineering

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Oral	External	25

Course Objectives	
1	To understand the process of software Project Management.
2	To identify the estimation of project and task scheduling
3	To recognize the risks involved.
4	To understand software configuration management process

Course Outcomes : Students will be able to	
401.1	Explain the process of software Project Management.
401.2	Illustrate project estimation and scheduling the task.
401.3	Interpret the risk involved in project.
401.4	Apply software configuration management process and reengineering.

Topics covered:

UNIT-I: Project Management : Process, Metrics **(06 Hrs)**

Project Management Concepts: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size & function oriented metrics (FP & LOC), Metrics for Project and Software Quality

UNIT-II: Project Estimation & Scheduling **(06 Hrs)**

Project Estimation: Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO I, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation

Project Scheduling: Basic Concepts, Defining a Task Set for the Software Project, Defining Task Network, and Scheduling with time-line charts, Tracking the schedule, tracking progress for an object oriented projects, scheduling for webapp projects.

UNIT- III: Project Risk Management **(06 Hrs)**

Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, RMMM plan

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UNIT- IV: Configuration Management, Maintenance & Reengineering (06 Hrs) **Software Configuration Management :** The SCM repository, SCM process, Configuration management for WebApps, **Maintenance & Reengineering:** Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering

Text Books:

1. Roger S. Pressman, "Software Engineering – A Practitioner"s Approach", McGraw-Hill, ISBN 0-07-337597-7.
2. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI, ISBN-13:978-8120348981.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.

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Second Year Artificial Intelligence & Data Science (2022 Course) Artificial Intelligence			
Course Code:	ADBSC402	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE =60*	**Total Marks:**	100

Pre-requisites: Data Structures.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60*

Course Objectives	
1	To understand the concepts of Artificial Intelligence and its applications
2	To learn the concepts of searching for AI problems
3	To understand Adversarial Search & Constraint Satisfaction Problems
4	To learn about Agents and Knowledge Representation
5	To use the concepts of Planning & Acting in the real world
6	To choose the Best Hypothesis from various observations

Course Outcomes : Students will be able to	
402.1	Explain the concepts of Artificial Intelligence and its applications
402.2	Apply various searching algorithms to solve real life problems
402.3	Illustrate Constraint Satisfaction Problems & Adversarial Search
402.4	Represent real world knowledge using first order or propositional logic
402.5	Apply the concepts of Planning & Acting in the real world
402.6	Evaluate the Best Hypothesis from various observations

Topics covered:

UNIT-I: Introduction & Problem-Solving **(06 Hrs)**

Introduction, Foundation, History and Application of AI, Intelligent Agents, Define Problems as a State Space Search, Solving Problems, Problem-Solving Agents, Searching for Solutions, **Strategies:** Greedy Strategy, Divide and Conquer Strategy; **Uninformed Search Strategies:** Breadth-First Search, Depth-First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, **Informed Search Strategies:** Greedy best-first search, A*, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT-II: Adversarial Search & Constraint Satisfaction Problems **(06 Hrs)**

Adversarial Search: Games, Optimal Decisions in Games, Optimal Strategies, Minimax Algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Stochastic Games, Partially Observable Games, **Constraint Satisfaction Problems (CSP):** Constraint Propagation: Inference in CSPs; Backtracking Search for CSPs: Variable and Value Ordering, Intelligent Backtracking; Local Search for CSPs.

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PUNE-1.

UNIT-III: First-Order Logic & Knowledge Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.	**(06 Hrs)**
UNIT-IV: Knowledge Representation Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.	**(06 Hrs)**
UNIT-V: Planning & Acting Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches, Time, Schedules and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning.	**(06 Hrs)**
UNIT-VI: Learning from Observations Information, Inductive Logic Programming.	**(06 Hrs)**
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)	

Text Books:

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley

EBooks:

https://courses.csail.mit.edu/6.034f/ai3/rest.pdf

MOOC Course:

1. Introduction to Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc22_cs56/preview - Course (nptel.ac.in)

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Second Year Artificial Intelligence & Data Science (2022 Course) Database Management Systems			
Course Code:	ADPCC403	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Basic Knowledge of Mathematics.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60*

Course Objectives	
1	To learn the concepts of Database Management System using ER model
2	To explore Database queries
3	To disseminate database design techniques and practice.
4	To emphasize the importance of transaction processing and concurrency control.
5	To build a knowledge to differentiate types of advance database
6	To learn knowledge of emerging database

Course Outcomes : Students will be able to	
403.1	Implement Database Management System using ER model.
403.2	Structuring database queries.
403.3	Elaborate database design techniques.
403.4	Understand transaction processing and concurrency control.
403.5	Identify types of advance database.
403.6	Categorizing emerging database.

Topics covered:

UNIT-I: INTRODUCTION TO DBMS AND DATA MODEL **(06 Hrs)**

Introduction and Purpose of Database System

Database Design: Entity, Attributes, Relationships, Constraints, Keys, Design Process.

Data models: Entity Relationship (ER), ER model, Mapping ER Model to Relational Mode, ER Diagram, Design issues. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations, ER to Table Conversion.

UNIT-II: RELATIONAL ALGEBRA **(06 Hrs)**

Relational Algebra: Select, Project, Union, Set difference, Joins, **SQL**-Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, Views, Indexes.

SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL

UNIT-III: PL/SQL AND DATABASE DESIGN **(06 Hrs)**

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PUNE–1.

PL SQL: Concept of Stored Procedures, Functions, Cursors, Triggers.
Relational Model: Basic concepts, Attributes and Domains, CODD's Rules.
Functional Dependency, Purpose of Normalization, Data Redundancy and Update Anomalies, Functional Dependency Single Valued Dependencies. Single Valued Normalization: 1NF, 2NF, 3NF, BCNF. Decomposition: lossless join decomposition and dependency preservation, Multi valued Normalization (4NF), Join Dependencies and the Fifth Normal Form.

UNIT- IV: DATABASE PROCESSING AND TRANSACTION (06 Hrs)

Introduction to Query processing and query optimization, Basic concept of a Transaction, Transaction Management, ACID Properties of Transactions, Concept of Schedule, Serial and Concurrent Schedule, **Serializability**: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, **Concurrency Control**: Need, Locking based Protocol, Deadlocks-Prevention, Detection Techniques, **Recovery methods** : Shadow Paging and Log Based Recovery, Checkpoint.

UNIT- V: ADVANCE CONCEPTS OF DATABASES (06 Hrs)

NOSQL- MongoDB CRUD Operations, SQL Vs NoSQL Databases, Database Architectures: Centralized and ClientServer Architectures. Introduction to Parallel Databases, Architecture of Parallel Databases. Introduction to Distributed Databases, Distributed Transactions. 2PC, 3PC protocols.

UNIT- VI: EMERGING DATABASE (06 Hrs)

Introduction to Big data, Handling large datasets using Map-Reduce and Hadoop. Introduction to Hbase data model and hbase region. Introduction to emerging database technologies- Cloud Databases, Mobile Databases, SQLite Database, XML Databases.

Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):*

Unit 1 - Data models.
Unit 2 - Relational Algebra
Unit 3 - Relational Model, 1NF, 2NF, 3NF, BCNF
Unit 4 - Serializability, Concurrency Control
Unit 5 - Transactions. 2PC, 3PC protocols
Unit 6 - Big data, Hadoop, Emerging database technologies

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
3. "MongoDB: The Definitive Guide" by Kristina Chodorow, O"Reilly Publications
4. Pramod J. Sadalage Martin Fowler," NoSQLDistilled",Addison Wesley, ISBN- 10:0321826620
5. "Principles of Distributed Database Systems", by M. Tamer Özsu, Patrick Valduriez, Springe

Reference Books:

1. S. K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
2. Data Mining: Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, Elsevier

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3. Big Data: Understanding How Data Powers Big Business, Bill Schmarzo, Wiley 3. Hadoop: The Definitive Guide, Fourth Edition, Tom White, O"Reilly
4. H Base: The Definitive Guide, Fourth Edition, Lars George, O"Reilly Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++‖, Pearson Education

EBooks:

1. DBMS Full Form: Database Management System - javaTpoint
2. Introduction to Database Management Systems (DBMS) | Udemy
3. Introduction to Database Systems - Course (nptel.ac.in)

MOOC Course:

Introduction to Database Systems: https://onlinecourses.nptel.ac.in/noc20_cs03/preview

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Second Year Artificial Intelligence & Data Science (2022 Course) Exploratory Data Analysis			
Course Code:	ADPCC404	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60**	**Total Marks:**	100

Pre-requisites:

1. Programming and Problem Solving
2. Discrete mathematics and statistics

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60**

Course Objectives	
1	To introduce the concept of exploratory data analysis.
2	To explain data transformation and its techniques.
3	To describe different data visualization methods.
4	To explore data analysis.
5	To explain multivariate data analysis.
6	To describe time series data analysis.

Course Outcomes : Students will be able to	
404.1	Understand fundamentals of exploratory data analysis.
404.2	Apply different data transformation techniques.
404.3	Implement data visualization methods.
404.4	Perform univariate data exploration and analysis.
404.5	Apply multivariate data exploration and analysis.
404.6	Implement time series data analysis on real world problems.

Topics covered:

UNIT-I: INTRODUCTION TO EXPLORATORY DATA ANALYSIS (06 Hrs)

Introduction, Understanding data science, The significance of Exploratory Data Analysis, Steps in Exploratory Data Analysis, Data, Properties of data, Types of data: numerical data and categorical data, Measurement scales, Software tools available for Exploratory Data Analysis.

UNIT-II: DATA TRANSFORMATION (06 Hrs)

Introduction, Benefits of data transformation, Distribution function, Descriptive statistics, Calculating Percentiles, Quartiles, Merging database, Transformation techniques, Handling missing data, Outliers, Outlier detection methods: Z-scores, Modified Z-score, IQR, Permutation and random sampling, dummy variables, Data transformation Challenges.

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UNIT- III: DATA VISUALIZATION	**(06 Hrs)**
Introduction, Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization. Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box- plot Box and Whisker Plots, Line Charts, Maps, Candlestick Charts, Treemaps and Sunburst Charts ,Sparkline's and Facets.	
UNIT- IV: UNIVARIATE ANALYSIS	**(06 Hrs)**
Introduction, Univariate non-graphical EDA -Categorical data, Characteristics of quantitative data, Central tendency, spread, Skewness and kurtosis, Univariate graphical EDA –Histograms, Stem-and-leaf plots, Boxplots, Quantile-normal plots, Bivariate analysis.	
UNIT- V: MULTIVARIATE ANALYSIS	**(06 Hrs)**
Introduction, Multivariate non-graphical EDA- Cross-tabulation, Correlation for categorical data, Univariate statistics by category, Correlation and covariance, Covariance and correlation matrices, Multivariate graphical EDA-Univariate graphs by category, Scatterplots Multivariate analysis Techniques.	
UNIT- VI: TIME SERIES ANALYSIS	**(06 Hrs)**
Introduction, Univariate time series, Characteristics of time series data, Visualizing time series, Grouping time series data, Resampling time series data, Case studies of time series data.	
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):*	
Unit III: Data Visualization	
Unit V: Multivariate EDA	

Text Books:

1.Data analytics Anil Maheshwari.
2.Hands-On Exploratory Data Analysis with Python, Suresh Kumar Mukhiya
3.Probability and Statistics", Murray R. Spiegel, John Schillerand R. Alu Srinivasan, Tata McGraw-Hill Edition.
4.Data Analytics" ravindra gogineni
5."Exploratory Data Analysis" John Turky

Reference Books:

1.Experimental Design and Analysis Howard J. Seltman July 11, 2018
2.DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition

EBooks:

1. STAT GR5702 Exploratory Data Analysis and Visualization (EDAV) Syllabus Spring 2018.pdf(columbia.edu)
2. Exploratory Data Analysis with Pandas and Python 3.x | Udemy
3. Data Analytics with Python - Course (nptel.ac.in)
4. Agglomerative Hierarchical Clustering - Clustering Methodology for Symbolic Data - WileyOnline Library

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Second Year Artificial Intelligence & Data Science (2022 Course) Operating Systems			
Course Code:	ADPCC405	**Credit:**	3
Contact Hours:	3 Hrs/ weeks((L)	**Type of Course:**	**Lecture**
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Programming and Problem Solving

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	External	60*

Course Objectives	
1	To understand main Structure of Operating System and it's working.
2	To learn the operations performed by Operating System and various scheduling procedures of Operating System.
3	To understand the concept of Deadlocks and Concurrency.
4	To learn the different memory management techniques
5	To understand I/O management and File systems.
6	To learn with the basics of Linux system.

Course Outcomes : Students will be able to	
405.1	Illustrate concept and Structures of Operating systems.
405.2	Apply scheduling algorithms to solve a given problem.
405.3	Illustrate deadlock prevention, avoidance and recovery.
405.4	Describe memory management technique.
405.5	Illustrate I/O and file management policies.
405.6	Explain Linux and process management.

Topics Covered:

UNIT-I: OPERATING SYSTEMS OVERVIEW AND STRUCTURE **(06 Hrs)**

Introduction, operating system operations, operating systems generations, Types of Management- process management, memory management, storage management, protection and security, Structures- Operating system services and systems calls, system programs, operating system structure, Types of OS- Batch, time sharing, multiprogramming,distributed, network and real-time systems.

UNIT-II: PROCESS MANAGEMENT **(06 Hrs)**

Process concept, Process Control Block(PCB), Process Operations, Processes Scheduling - first come first serve, Round-robin, shortest job first, priority based scheduling and Multilevel feedback queue scheduling. Threads - Multithreading models, Thread implementations – user level and kernel level threads and Thread Scheduling.

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PUNE–1.

UNIT- III: CONCURRENCY AND DEADLOCK	**(06 Hrs)**
Principles of Concurrency, Mutual Exclusion: Hardware approaches, Software approach, Operating System/Programming Language support: Semaphores, Mutex, and Monitors. Classical Problems of Synchronization- Readers-Writers problem, Producer Consumer problem, Dining Philosopher problem, Deadlock - Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Deadlock Recovery.	
UNIT- IV: MEMORY MANAGEMENT	**(06 Hrs)**
Memory Management requirements, Memory Partitioning - Fixed, Dynamic Partitioning, Buddy Systems. Placement Strategies- First Fit, Best Fit, and Worst Fit, Fragmentation, Swapping, Paging, Segmentation, Address translation, Virtual Memory - Concepts, VM with Paging, Page Table Structure and VM with Segmentation.	
UNIT- V: I/O AND FILE SYSTEM	**(06 Hrs)**
Input/output Devices - Types, Organization of the I/O Function- Technique, DMA, OS design issues for I/O management, I/O Buffering, Disk Scheduling - FCFS, SCAN, C-SCAN, and SSTF. File systems – Concept, File system interface, File system structure, Access methods and protection.	
UNIT- VI: CASE STUDY: LINUX	**(06 Hrs)**
LINUX Overview of Linux, - Goals, Interfaces to Linux, The Shell, Linux Utility Programs and Kernel Structure. GitHub/Gitlab - Version Control.	
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)	
Unit 1 - System calls. Unit 2 - processes and threads, inter-process communication. Unit 3 - concurrency, and synchronization, Deadlock. Unit 4 - Memory management and virtual memory. Unit 5 - I/O scheduling, File Systems.	

Text Books:

1. Tanenbaum, Andrew S., and Bos, Herbert. Modern Operating Systems. United Kingdom, Pearson, 2015.
2. Silberschatz, Abraham, et al. Operating System Concepts. United States, Wiley, 2018.

Reference Books:

1. "Operating System in depth: Design and Programming", Thomas W. Doeppner, WILEY, ISBN: 978-0-471-68723-8

EBooks:

1. https://www.coursera.org/lecture/introduction-to-hardware-and-operating-systems/an-introduction-to-operating-systems-eQ46T
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://www.cse.iitb.ac.in/~mythili/os/

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Second Year Artificial Intelligence & Data Science (2022Course) Database Management Systems Laboratory			
Course Code:	ADPCC407	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR: 50	**Total Marks:**	75

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To understand basics of Database manipulation skills and implement a database schema for a given problem-domain.
2	To implement and use different PL/SQL Programming.
3	To explain designing of database, creating relational database, analysis of table design.
4	To study the concepts and techniques relating to MongoDB and its implementations.
5	To learn to design database connectivity for implementation of project.

Course Outcomes : Students will be able to	
407.1	Identify SQL DML/DDL/TCL commands using database languages.
407.2	Demonstrate different PL/SQL Programming including stored procedures, stored functions, cursors, packages.
407.3	Describe the database using queries to retrieve records.
407.4	Analyze solutions for database applications using Mongo DB Queries using aggregation and indexing.
407.5	Develop solutions using database concepts for real time requirements.

Sr. No	Name of the program [Group A] DBMS
1.	**SQL Queries: (DML)** • Data manipulation language (DML) of base tables and views. • DML commands: INSERT , UPDATE , DELETE , SELECT • Write at least10 SQL queries for suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts DML commands.

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PUNE-1.

2.	**SQL Queries: (DDL)** • Design and Develop SQL Data definition languages (DDL) commands of base tables and views. • DDL commands: CREATE , ALTER , DROP , RENAME , TRUNCATE • Write at least10 SQL queries for suitable database application using SQL DDL statements. Note: Instructor will design the queries which demonstrate the use of concepts DDL commands.
3.	**Perform the following: (TCL)** a. Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
4.	For a given set of relation schemes, create tables and perform the following Simple Queries with Aggregate functions (group by and having clause), Queries involving- Functions (String, date and Math)
5.	For a given set of relation schemes, create tables and perform the following a. Views- Creating ,updating and deleting view b. Join Queries- Inner Join, Outer Join c. Sub queries- With IN clause, With EXISTS clause.
6.	**PL/SQL Programming** i. Creating stored procedures ,Error handling and Exception ii. Triggers and auditing triggers
7.	**Cursors(All types)** Write a PL/SQL block that will display the name, dept no, salary of fist highest paid employees.
8.	Write a Mongo DB query to display the fields restaurant_id, name, borough and cuisine for all the documents in the collection restaurant. ' OR Design and Develop Mongo DB Queries using aggregation and indexing with suitable example using Mongo DB.
	[Group B] Mini Project

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PUNE-1.

9.	**Database Connectivity :** Create a program to implement MySQL database connectivity with any front end language that allows To enter the employee details into a database. OR To create an application program that process a query which returns the grade result of a student after processing the marks table. 1.Develop an application with following details • Front End: Python/Java/PHP/Perl/Ruby/.NET/ or any other language • Backend : MongoDB/ MySQL/ Oracle / or any standard SQL / NoSQL database 2. Test and validate application using Manual/Automation testing. 3.Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle: • Title of the Project, Abstract, Introduction • Software Requirement Specification (SRS) • Conceptual Design using ER features, Relational Model in appropriate Normalize form. • Graphical User Interface, Source Code • Testing document • Conclusion.

Text Books:

6. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
7. Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
8. "MongoDB: The Definitive Guide" by Kristina Chodorow, O"Reilly Publications
9. Pramod J. Sadalage Martin Fowler," NoSQLDistilled",Addison Wesley, ISBN- 10:0321826620
10. "Principles of Distributed Database Systems", by M. Tamer Özsu, Patrick Valduriez, Springe

Reference Books:

5. S. K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
6. Data Mining: Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, Elsevier
7. Big Data: Understanding How Data Powers Big Business, Bill Schmarzo, Wiley 3. Hadoop: The Definitive Guide, Fourth Edition, Tom White, O"Reilly
8. H Base: The Definitive Guide, Fourth Edition, Lars George, O"Reilly Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++I, Pearson Education

EBooks:

4. DBMS Full Form: Database Management System - javaTpoint
5. Introduction to Database Management Systems (DBMS) | Udemy
6. Introduction to Database Systems - Course (nptel.ac.in)

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Second Year Artificial Intelligence & Data Science (2022 Course) Artificial Intelligence and Data Analysis Laboratory			
Course Code	ADPCC408	**Credit**	02
Contact Hours	4 Hrs/weeks((P)	**Type of Course**	Practical
Examination Scheme	TW:25 PR: 50	**Total Marks**	75

Pre-requisites:

- Data Structures.
- Basics of Data Mining Algorithms.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To learn the concepts of searching for AI problems
2	To learn about scheduling algorithms
3	To use the concepts of tree
4	To learn different data transformation techniques.
5	To summarize principles of Data Science for the analysis of real time problems
6	To develop approach for implementation of the key technologies in Data Analytics

Course Outcomes: Students will be able to	
408.1	Apply various searching algorithms to solve real life problems
408.2	Implement concepts of scheduling algorithms.
408.3	Illustrate working of tree execution.
408.4	Use different transformation techniques.
408.5	Use and evaluate data analytics algorithms
408.6	Utilize data visualization techniques

LIST OF ASSIGNMENTS
(Artificial Intelligence) **Group A (Any 4)**
1. Implementation of Depth First Search for Water Jug problem
2. Implementation of Breadth First Search for Tic- Tac – Toe problem
3. Solve 9- puzzle problem using Best First Search.
4. Write a PROLOG/Python program to solve N-Queens problem.
5. Implementation of Traveling Salesman problem.
Group B (Any 3)
6. Employee scheduling algorithm using python.
7. Min max algorithm in game theory program using python.
8. Implementation of Greedy Search algorithm for Dijkastra's minimum spanning tree algorithm

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PUNE-1.

9. Implementation of alpha beta tree search for any game search problem
Group C (Any 1)
10. Implement interval scheduling algorithm using python
11. Airline scheduling algorithm.

LIST OF ASSIGNMENTS
(Data Analysis Laboratory) **Group A (Any 4)**
1. Load the panda's data frame and perform basic operations on dataset.
2. Perform the following operations using Python on any open source dataset (e.g., data.csv) 1. Import all the required Python Libraries. 2. Locate open source data from the web (e.g., https://www.kaggle.com). Provide a cleardescription of the data and its source 3. Load the Dataset into pandas data frame. 4. Data Preprocessing: check for missing values in the data using pandas isnull(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame. 5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set.If variables are not in the correct data type, apply proper type conversions. 6. Turn categorical variables into quantitative variables in Python.
3. Perform the following operations using Python on any open source dataset 1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniquesto deal with them. 3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution. 4. Reason and document your approach properly.
4. Perform the following operations on any open-source dataset (e.g., data.csv) 1. Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. 2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor' of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.
5. Perform the following operations on any open-source dataset Scan the dataset and give the inference as: 1. List down the features and their types (e.g., numeric, nominal) available in the

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

dataset. 2. Create a histogram for each feature in the dataset to illustrate the feature distributions. 3. Create a boxplot for each feature in the dataset. 4. Compare distributions and identify outliers.
6. Design a python program to explore the concepts of sampling & sampling distributions. Generate random samples from a given population analyze their characteristics & demonstrate how the sample mean evolves as more samples are taken. Investigate properties of sampling distributions (Mean & S.D).
Group B (Any 2)
1. Perform outlier detection using z-score and modified z-score on open source dataset.
2. Perform Univariate and bivariate data analysis on open source dataset.
3. Perform Time Series Analysis and apply the various visualization techniques.
4. Implement color detection using Pandas and Autoviz,Sweetviz
Group C (Any 1)
1. Mini project I: Perform EDA on Wine Quality Dataset.
2. Mini project II: Perform EDA on Market Analysis dataset.
3. Mini project III: Perform EDA on Student performance dataset.

Text Books:

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley
4. Experimental Design and Analysis Howard J. Seltman July 11, 2018
5. Symbolic Data Analysis: Conceptual Statistics and Data Mining
6. DT Editorial Services, "Big Data, Black Book", DT Editorial Services,ISBN: 9789351197577, 2016 Edition

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PUNE-1.

Second Year Artificial Intelligence & Data Science (2022 Course) Lifelong Learning Skills-I			
Course Code:	IOLLC4L1	Credit: 1	TW:25

All the students are required to acquire 1 credit, which will have grades as below:

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Sports	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
2.	NSS/NCC	Camp	Attended	B		
		Camp + 5 Activities	Attended	B+		
		Camp + 10 Activities	Attended	A		
		Camp + 15 Activities	Attended	A+		
		Camp + 20 Activities	Attended	O		
3.	Cultural	Inter collegiate	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
4.	Community Engagement	Certified by NGO/Authorities with report and geo-tagged photograph	1 Activity	B		
			2 Activities	B+		
			3 Activities	A		
			4 Activities	A+		
			5 Activities	O		

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

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Second Year Artificial Intelligence & Data Science (2022 Course) Lifelong Learning Skills-II			
Course Code :	IOLLC4L2	Credit: 1	1

All the students are required to acquire 1 credit, which will have grades as below:

Sr. No	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Conference	National	Participation	B	Prize winner	A
		International	Participation	B+	Prize winner	A+
		International (Scopus indexing)	Participation	A+	Prize winner	O
2.	Journal Publication	Non-refereed but recognized and reputed journal/ periodical, having ISSN number.		B		
		Refereed Journal - As listed by UGC		A		
		Refereed Journals- As listed by Scopus		A+		
		Refereed Journals - As listed by SCI/ SCIE		O		
3.	Hackathon		Participation	A+	Prize winner	O
4.	Professional Body	National	Membership	P	3rd Prize	A
			Activities/participation	B	2nd Prize	A+
			5 participations	B+	1st Prize	O
5.	Internship	1 week	Completed	C		
		2 week	Completed	B		
		3 week	Completed	B+	Sponsored Project	A+
		4 week	Completed	A	Job through internship	O
6.	Entrepreneurship	Awareness camp	Attended	A	Product Developed	A+
					Own Startup	O
7.	Project/Technical events	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

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PUNE–1.

Audit Course 4 IOHSM4AC (2022 Course)			
Course Title: Sustainable Development Goals **COURSE CODE: IOHSM4AC**			
Contact Hours:	**1 Hrs./week**	Type of Course:	**Lecture**
Examination Scheme	**Home Assignment / MCQ 25 Marks**	Course Credit	1

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	MCQ Exam	Internal	25
		Total	25

Prerequisites – Basic Concepts of Environmental Studies

Course Objectives	
1	To discuss the sustainable development goals.
2	To explain fframework of Seventeen Sustainable Development Goals.
3	To discuss structure and order of Sustainable Development Goals.
4	To study cases of Sustainable Development Goals.

Course Outcomes: At the end of course students will be able to	
4AC.1	Explain sustainable development goals.
4AC.2	Describe fframework of Seventeen Sustainable Development Goals.
4AC.3	Discuss structure and order of Sustainable Development Goals.
4AC.4	Report case studies of Sustainable Development Goals.

Syllabus
Course: Sustainable Development Goals

Total Hours: 12Hrs. (SESSIONS)

Sustainable Development Goals
Unit 1: Introduction to SDGs **(03 Hrs)** Sustainability, Sustainable development, Role of UN and the Need for SDGs, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs, Distinction between Development and Sustainable Development
Unit 2: Sustainable Development Goals **(03Hrs)** Framework and Structuring of Seventeen SDGs SDG 1: No Poverty SDG 2: Zero Hunger SDG 3: Good Health and Well-being SDG 4: Quality Education SDG 5: Gender Equality

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BOS–ARTIFICIAL INTELLIGENCE
& DATA SCIENCES
AISSMS IOIT (AUTONOMOUS),
PUNE–1.

SDG 6: Clean Water and Sanitation
SDG 7: Affordable and Clean Energy
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 10: Reduced Inequality
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action
SDG 14: Life Below Water
SDG 15: Life on Land
SDG 16: Peace and Justice Strong Institutions
SDG 17: Partnerships to achieve the Goal

Unit 3: SDG Structure and Order **(03Hrs)**

Interrelationships and Connections between Seventeen SDGs, SDG Structure and Order at Levels of People, Ecological and Spiritual , SDGs and Socio Ecological Systems: Economy; Society; Biosphere

Unit 4: Sustainable Development Goals- Case Studies **(03Hrs)**

Case Studies from around the World, Case studies from India

BOOKS

1. Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
2. Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York
3. OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
4. Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

Relevant websites, movies, and documentaries

https://www.un.org/sustainabledevelopment/

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PUNE–1.

Python Programming for Data Science (2022 Course)			
Course Code:	**ADMNR 301**	Course Title:	**Python Programming for Data Science**
Contact Hours:	**3 Hrs./week (L)**	Type of Course:	**Lecture**
Examination Scheme		**Paper (End Sem)**	**75 Marks**

Pre-requisites: Problem Solving & Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester	External	75

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.

Course Outcomes : Students will be able to	
301.1	Explain concept of Python programming.
301.2	Implement program using Data Structures.
301.3	Make use of loop structures to implement programs.
301.4	Apply concept of functions to implement programs.

Topics covered:

UNIT-I: PYTHON FOUNDATIONS **(06 Hrs)**

Introduction to Python, Why Python is best for Data Science, Variables and Data Types, Basic Operators and expressions, Indentation, Flow/Decision Control statements: Selection/Conditionals, Branching (if-else), Looping/Iterative statements

Self-Study: https://docs.python.org/3/tutorial/controlflow.html

UNIT-II: DATA STRUCTURES AND STRING MANIPULATION **(06 Hrs)**

String, Data Manipulation with .sort(), .pop(), and len(), Slicing Techniques, Append(), extend(), Strings and their Methods, Built-in functions in String: lower(), upper(), title(), capitalized(), swapcase(), maketrans(), split(), String Comparison: casefold() and lower().

Self-Study: https://www.javatpoint.com/python-strings

UNIT- III: ADVANCED PROGRAMMING CONSTRUCTS **(06 Hrs)**

For and While Loops, Break, Continue, pass, else statements, Advanced Functions and Error Handling, File Handling in Python: reading, Writing, Closing, Regular Expressions.

Self-Study: https://www.geeksforgeeks.org/file-handling-python/

UNIT- IV: FUNCTIONAL PROGRAMMING AND COMPREHENSIONS **(06 Hrs)**

Introduction to Functions and Modules ,Need for functions, Lambda Functions and their Applications, Map, Filter, and Reduce Functions, List Comprehensions, Introduction to Modules and Packages, Types of Arguments: Positional, Default, Keyword, Variable length arguments.

Self-Study: https://realpython.com/python-functional-programming/

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AISSMS IOIT (AUTONOMOUS),
PUNE–1.

https://medium.com/@sylvia.shubhangsingh/list-comprehension-map-filter-and-reduce-functional-programming-making-our-life-easy-6b05b397ad8

UNIT- V: DATA ANALYSIS WITH NUMPY AND PANDAS **(06 Hrs)**

Introduction to Numpy: Arrays and Matrices, Basic Operations in Numpy, Introduction to Pandas: DataFrames and Series, Data Cleaning and Manipulation in Pandas, Libraries used in Data Analysis, Data Analysis Techniques using Numpy and Pandas.

Self-Study: https://youtu.be/GPVsHOlRBBI

Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):*

1.

2.

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science
https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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PUNE–1.

Python Programming for Data Science Laboratory (2022 Course)			
Univ. Course No. College Course Code:	**ADMNR302**	Course Title:	**Python Programming for Data Science Lab**
		Credit:	**1**
Contact Hours:	**2 Hrs/week (L)**	Type of Course:	**Practical**
Examination Scheme		**Term Work 25 Marks**	

Pre-requisites:
Problem Solving & Programming
Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	External	25

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.
Course Outcomes : Students will be able to	
302.1	Explain concept of Python programming.
302.2	Implement program using Data Structures.
302.3	Make use of loop structures to implement programs.
302.4	Apply concept of functions to implement programs.
302.5	Apply knowledge of data analysis.

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PUNE-1.

Group A (At least Seven)	
1	Installation of Python, Setting Python environment and execute a simple "Hello World!" script.
2	Perform basic arithmetic operations and handle user input.
3	Implement Contact book: Use dictionaries to store and retrieve contact details, allowing users to add, view, and search for contacts.
4	Perform String operations like reversing, counting vowels, word replacement, etc.
5	Design a basic quiz game where users answer questions; use loops and conditionals to manage user experience.
6	Implement Simple log parser: Read a file and extract specific data from it, using string methods and possibly regular expressions.
7	Design Expense tracker: Allow users to input daily expenses, categorize them, and analyze (e.g., highest expense, total spent, etc.) using lambda and filter functions.
8	Design Module explorer: Introduce of different Python modules, import and explore basic functionalities.
Group B(At least Four)	
9	Implement array and matrix operations in Numpy, including creation, manipulation and basic linear algebra.
10	Mini calculator project: Implement basic arithmetic operations through functions and provide a user interface for input and operation selection.
11	Implement Pandas data analysis project: Use a sample dataset, clean, process, and analyze the data, extracting meaningful insights using Pandas functionalities.
12	Implement on Missing Data in Pandas: Use functions for detecting, removing, and replacing null values in Pandas.
13	Implement Pandas data analysis project: Use Slicing, Indexing, Manipulating and Cleaning in Pandas
Group C(Compulsory)	
14	Implement Project for Predicting Weather
15	Implement Project for Predicting price of pre-owned cars
16	Implement Project to Classifying personal income.
17	**Content Beyond the Syllabus:** Computer Science and Engineering-Python Programming Lab: List of Experiments: 1. Arithmetic Operations - https://python-iitk.vlabs.ac.in/exp/arithmetic-operations/ 2. Strings - https://python-iitk.vlabs.ac.in/exp/strings/

List of Experiments:

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science
https://nptel.ac.in/courses/106106212

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PUNE-1.

Artificial Intelligence (2022 Course)			
Univ. Course No. College Course Code:	ADBSC402	**Course Title:**	Artificial Intelligence
Contact Hours:	03 Hours/Week	**Type of Course:**	Theory
Examination Scheme		**End Sem.**	75*

Pre-requisites:

1. Advanced Data Structures

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Sem	External	75

Course Objectives	
1	To understand the concepts of Artificial Intelligence and its applications
2	To learn the concepts of searching for AI problems
3	To understand Adversarial Search & Constraint Satisfaction Problems
4	To learn about Agents and Knowledge Representation
5	To use the concepts of Planning & Acting in the real world

Course Outcomes: Students will be able to	
402.1	Explain the concepts of Artificial Intelligence and its applications
402.2	Apply various searching algorithms to solve real life problems
402.3	Illustrate Constraint Satisfaction Problems & Adversarial Search
402.4	Represent real world knowledge using first order or propositional logic
402.5	Apply the concepts of Planning & Acting in the real world

Topics covered:

UNIT-I: Introduction & Problem-solving [06 Hrs]

Introduction, Foundation, History and Application of AI, Intelligent Agents, Define Problems as a State Space Search, Solving Problems, Problem-Solving Agents, Searching for Solutions, **Strategies:** Greedy Strategy, Divide and Conquer Strategy; **Uninformed Search Strategies:** Breadth-First Search, Depth-First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, **Informed Search Strategies:** Greedy best-first search, A*, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT-II: Adversarial Search & Constraint Satisfaction Problems [06 Hrs]

Adversarial Search: Games, Optimal Decisions in Games, Optimal Strategies, Minimax Algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Stochastic Games, Partially Observable Games, **Constraint Satisfaction Problems (CSP):** Constraint Propagation: Inference in CSPs; Backtracking Search for CSPs: Variable and Value Ordering, Intelligent Backtracking; Local Search for CSPs.

UNIT-III: First-Order Logic & Knowledge [06 Hrs]

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of

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AISSMS IOIT (AUTONOMOUS),
PUNE–1.

First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.
UNIT-IV: Knowledge Representation [06 Hrs] Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
UNIT-V: Planning & Acting [06 Hrs] Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches, Time, Schedules and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning.
Syllabus contents required for competitive exams (GATE) **Unit-I** 1. Breadth-First Search 2. Depth-First Search 3. Greedy Strategy 4. Divide & Conquer Strategy

Text Books:

1.S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books:

1.Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley

NPTEL: Fundamentals of Artificial Intelligence
https://nptel.ac.in/courses/112103280

References:

1. NIT, Trichy
2. NIT, Durgapur

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AISSMS IOIT (AUTONOMOUS),
PUNE–1.

Second Year Artificial Intelligence and Data Science 2022Course Artificial Intelligence Laboratory			
Course Code:	ADPCC408	**Credit**	1
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	TW - 25	Total Marks	25

Pre-requisites:

- Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester Examination	TW	25

Course Objectives	
1	To learn basics of object oriented programming.
2	To know constructor inheritance & overloading.
3	To review different type of file operation.
4	To illustrate exception handling & template.

Course Outcomes: Students will be able to	
408.1	Identify features of object oriented programming.
408.2	Identify constructor inheritance & overloading.
408.3	Categorize type of file operation
408.4	Implement exception handling & template.

List of Experiment:

	Group A (At least four)
1	Implementation of Depth First Search for Water Jug problem.
2	Implementation of Breadth First Search for Tic- Tac – Toe problem
3	Solve 9- puzzle problem using Bread First Search.
4	Write a program to solve N-Queens problem using Greedy approach.
5	Implementation of Traveling Salesman problem.
6	Min max algorithm in game theory program using python.
7	Implement A star (A*) Algorithm for any game search problem.
8	Implement a solution for a Constraint Satisfaction Problem using Branch and Bound for n-queens problem.
	Group B
7	Implement Alpha-Beta Tree search for any game search problem.
8	Implement Greedy search algorithm for Single-Source Shortest Path Problem
9	Employee Scheduling algorithm using python
10	Implement Greedy search algorithm for Minimum Spanning Tree

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PUNE–1.

11	Implement Greedy search algorithm for Dijkstra's Minimal Spanning Tree Algorithm
	Group C(Compulsory)
12	Implement interval scheduling algorithm using python or C++
13	Implement decision Tree
14	Implement Airline scheduling algorithm.

Text Books:

1. E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011,
ISBN: 978-00-72226805

Reference Books:

1. Data Structures and Algorithm Analysis in C++ Hardcover, by Mark A. Weiss, Jun 2013, Publisher: PHI; 4 editions, ISBN-10: 013284737X ISBN-13: 978-0132847377.
2. Algorithms in C++: Fundamentals, Data Structures, Sorting, Searching, Parts 1-4, 3rd Edition (Paperback), Pearson India, ISBN-10 8131713059, 2009, ISBN-13 9788131713051.

References:

1.https://nptel.ac.in/content/syllabus_pdf/106105166.pdf
2.https://ece.unm.edu/featured-students/spotlight-images/ece1d-intro-to-io

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PUNE-1.

Second Year Artificial Intelligence & Data Science (2022Course) Data Analytics with Python			
Course Code	ADVSE406	**Credit**	03
Contact Hours	1 Hrs/week((L) 4 Hrs/ week(PR)	**Type of Course**	Lecture/Practical
Examination Scheme	PR: 50 marks TW: 50 marks	**Total Marks**	100

Pre-requisites:

- Programming and Problem Solving.
- Discrete Mathematics.
- Machine Learning

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical	External	50
2.	Term work	Internal	50

Course Objectives	
1	To explain the fundamental concepts of data analytics, descriptive statistics, data cleaning and visualization.
2	To utilize the regression analysis, clustering algorithms in python.

Course Outcomes : Students will be able to	
406.1	Demonstrate the ability to select appropriate sampling methods and apply the concepts of descriptive statistics, data cleaning and visualize data effectively using Matplotlib
406.2	Apply custom functions or scripts to enhance the functionality of regression and clustering tasks.

Topics covered:

UNIT-I: DATA ANALYTICS AND SAMPLING **(06 Hrs)**

Introduction to Data Analytics and Data preprocessing, Cleaning, Central Tendency and Dispersion, Probability, Sampling and sampling distributions, Hypothesis testing & its types with its application, Two sample testing and introduction to ANOVA, Two way ANOVA.

Self-Study: https://www.simplilearn.com/types-of-sampling-techniques-article

UNIT-II: REGRESSION AND CLUSTERING **(06 Hrs)**

Estimation, Prediction of Regression Model, Linear regression and Multiple regression, Concepts of MLE and Logistic regression, ROC and Regression Analysis Model Building, C Test and Introduction to cluster analysis, Clustering analysis, Classification and Regression Trees (CART).

Self-Study: https://www.egnyte.com/guides/life-sciences/data-sampling

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PUNE–1.

List of Experiment:

Group A any 7	
1.	Implement Numpy, Pandas data analysis: Use a sample dataset, clean, process, and analyze the data, extracting meaningful insights using Pandas functionalities.
2	Demonstrate the central limit theorem by plotting the distribution of sample means & comparing it to the population distribution.
3	Develop a python program that analyzes a dataset containing information about a company's sales, expenses & profit. Implement data cleaning, descriptive statistics & data visualization.
4	Design a Python program that simulates the rolling of a fair six-sided die. Implement a function to generate a histogram of the outcomes based on a specified number of rolls.
5	Design a python program that simulates a basic probabilistic scenario, such as rolling dice or drawing cards from a deck. Introduce fundamental concepts of probability, including sample space, events & probability calculations.
6	Design a python program to explore the concepts of sampling & sampling distributions. Generate random samples from a given population analyze their characteristics & demonstrate how the sample mean evolves as more samples are taken. Investigate properties of sampling distributions (Mean & S.D).
7	**Sampling Distribution:** Write a program to generate multiple samples(at least 30) from the population & calculate the mean for each sample.
8	**Random Sampling:** Implement a random sampling process to extract a representative sample from the chosen dataset.
9	Develop a python program for hypothesis testing, focusing on comparing means of two samples. Implement a statistical test such as t-test or z-test, to analyze whether there is significant difference between the means.
10	Create a python program that performs a two sample hypothesis test & introduce the basics of ANOVA. Allow users to input data for multiple groups, choose a significance level & conduct a two sample t-test for comparing means or ANOVA for comparing means or ANOVA for comparing means across more than two groups.
Group B any 4	
11	Develop a python program for linear regression analysis. Enable users to input a dataset. Specify independent & dependent variable & perform linear regression to model the relationship between them.
12	Create a python program for multiple regression analysis .Allow users to input a datasets with multiple independent variables, specify a dependent variable & perform multiple regression to model the complex relationship.
13	Develop a python program to introduce the concepts of maximum likelihood estimation & logistic regression. Enable users to input a dataset with binary outcomes, Implement MLE to estimate the logistic regression parameters & showcase how to make predictions based on the logistic regression model.
14	Build a python program that allows users to input data for a binary outcome, perform logistic regression, evaluate the models performance using ROC analysis & visualize the ROC curve.
15	Build a python program to enable users to input categorical data for chi-squared test, assess the association between variables & interpret the results.
16.	Design a python program for clustering analysis. Allow users to input a dataset & choose a clustering algorithm. Implement the selected algorithm, visualize the clusters & provide insights into grouping patterns within the data.

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AISSMS IOIT (AUTONOMOUS),
PUNE-1.

17	**Stock Price Forecasting:** Develop a program to perform linear regression on historical stock prices use relevant features like previous day closing price, trading volume &market indices. Access the models ability to predict future stock prices.
Group C Any 1	
18	Write a python program to allow users to input a dataset with both categorical & numerical features & build decision trees for classification or regression tasks. Showcase the process of tree construction feature importance & the interpretability of decision tree models.
19.	Utilize housing price prediction dataset, split it into training & testing sets, train the model &evaluate its accuracy.
20.	**Student Performance Analysis:** Implement linear regression to analyze the relationship between study hours & exam scores in a dataset of students. Visualize the regression line & access how well study hours predict academic performance. (https://www.kaggle.com/datasets/spscientist/students-performance-in-exams)
21.	Implement Logistic regression to analyze rainfall . (https://www.kaggle.com/code/chandrimad31/rainfall-prediction-7-popular-models)
22	**Content Beyond the Syllabus:** . Computer Science and Engineering-Problem Solving Lab-Experiments:1.Advanced Arithmetic - https://ps-iiith.vlabs.ac.in/exp/advanced-arithmatic/ 2. Permutation - https://ps-iiith.vlabs.ac.in/exp/permutation/

Text Books:

4. Nelli, Fabio. Python data analytics: Data analysis and science using PANDAs, Matplotlib and the Python Programming Language. Apress, 2015.
5. Rogel-Salazar, Jesus. Data science and analytics with Python. CRC Press, 2018.
6. TH, Phuong Vo, et al. Python: Data Analytics and Visualization. Packt Publishing Ltd, 2017.
7. Mukhopadhyay, Sayan. Advanced data analytics using Python: with machine learning, deep learning and nlp examples. Apress, 2018.

Reference Books:

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
2. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
3. Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".
4. Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
5. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
6. Jay L. Devore (2011). Probability and Statistics for Engineering and the Sciences. "Cengage Learning".
7. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). "Wiley-Interscience Publication".
8. Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. "
9. Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. "John Wiley & Sons, Inc".

MOOC Course:

https://archive.nptel.ac.in/courses/106/107/106107220/

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PUNE–1.