

Syllabus of BCA

101-Artificial Intelligence and Machine Learning / 102-Data Science

INDUCTION PROGRAM: One Week (30 Hrs)

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Department/Branch & Innovations

Mandatory Visits/Workshop/Expert Lectures:

1. It is mandatory to arrange one industrial visit every semester for the students of each branch.
2. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/industry/entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

Semester-I

101CC101/ 102CC101	Mathematics Foundation to Computer Science	3L:0T:0P	3 Credits
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Course Objectives

- CO1: Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics.
- CO2: This course enables the students to use mathematical models and techniques to analyze and understand problems in computer science.
- CO3: This course demonstrates how the mathematical principles give succinct abstraction of computer science problems and help them to efficiently analyze.

Course Content:

UNIT-I:	Set, Relation, Counting and Recurrence Relation: Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set Closures of Relations. Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem. Recurrence relations, modelling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method. (12 Hrs.)
UNIT-II:	Elementary Graph Theory And Matrix Algebra: Basic terminologies of graphs, connected and disconnected graphs, subgraph, paths and cycles, complete graphs, digraphs Types of matrices, algebra of matrices—addition, subtraction, and multiplication of matrices, determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix. (11 Hrs.)
UNIT-III	Logic and Methods of Proofs: Propositions, logical operations (basic connectives), compound statements, construction of truth table, quantifiers, conditional statements, tautology, contradiction, contingency, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF). Methods of proofs: Rules of inference for propositional logic, modus ponens, modus tollens, syllogism, proof by contradiction, Mathematical Induction. (11 Hrs.)
UNIT-IV	Numerical Methods: Concept and importance of errors in numerical methods. Solution of algebraic and transcendental equations: Bisection method and Newton-Raphson methods. Numerical Interpolation: Newton's Forward and Newton's Backward interpolation formula and Lagrange's formula. Numerical Integration : Trapezoidal rule and Simpson's 1/3 rule (11 Hrs.)

Text Books

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023.
3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
4. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India, 1979.
5. Vasishtha A. R. and Vasishtha A.K., Matrices, Krishna Prakashan, 2022.
6. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
7. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL, 2022.
8. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall, 2003.
9. S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)

Reference Books

1. Grimaldi Ralph P. and Ramana B. V. Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education, 2007.
2. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019.
3. West Douglas B., Introduction to Graph Theory, Second Edition, Pearson Education, 2015

Web-Resources

1. <https://nptel.ac.in/courses/106103205>
2. <https://nptel.ac.in/courses/111101115>
3. <https://nptel.ac.in/courses/111107127>
4. <https://www.math.iitb.ac.in/~siva/si50716/SI507lecturenotes.pdf>

101SEC101/ 102SEC101	Problem Solving Using C	3L:0T:0P	3 Credits
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Course Objectives

- CO1 : Understand basic terminology of computers, problem solving, programming Languages and their evolution (Understand)
- CO2 : Design the solution from specification of a problem and write pseudo code of the algorithm using basic building block so structured programming constructs(Sequence, Selection and Repetition statement). (Create)
- CO3 : Translate an algorithm in to a C computer program (Create)
- CO4 : Testing and analyzing programs using debugging tools. (Analyze)

Course Content:

UNIT-I	Algorithm, flowcharting, Types of programming languages. History of C language, Advantages, Structure of C program, Character set, Identifiers, Keywords, Constants and Variables, Symbolic constants, Qualifiers, Type conversion. Operators , Operator Precedence and Expressions (12 Hrs.)
UNIT-II	Formatted I/O : scanf(), printf(), Unformatted I/O : getch(), getchar(), gets(), putchar(), puts(). Control structures: Branching: if, if-else, Conditional operator(? :), nested if, else-if Ladder. Looping: while, do-while, for statements, comma operator, nested loops, goto, break, continue. (11 Hrs.)
UNIT-III	Arrays - Declaration and initialization of one and two dimensional array Functions - Definition of function, Types of Functions, function prototype, categories of function, actual argument, formal argument, function calling: call by value, call by reference, function parameters, local and global variable, functions with array, function recursion. String functions - String functions :strlen(), strcpy(), strcmp() &strcat(), Recursion and Application of it. (11 Hrs.)
UNIT-IV	Structure - Definition, declaration, initialization, array of structure, nested structure, union. Pointers - Declaration, initialization, pointers arithmetic (11 Hrs.)

Text Books

1. [Venkatesh](#), Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company, 2024.
2. Brian W. Kernighan, Dennis M. Ritchie, C Programming Language, 2nd Edition Prentice Hall; 2 edition (April 1, 1988)
3. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
4. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Reference Books

1. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson, 2015.
2. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson, 2015.

101LabSEC101/ 102LabSEC101	Problem Solving Using C	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Converting degrees Celsius to Fahrenheit and vice versa?
2. Display three input numbers in sorted (non-decreasing) order?
3. Given a positive integer value n ($n \geq 0$) display number, square and cube of numbers from 1 to n in a tabular format?
4. Given an input positive integer number, display odd numbers from in the range $[1, n]$?
5. Display first mathematical tables, each table upto 10 rows? Generalize this to display first n ($n > 0$) mathematical tables up to m ($m > 0$) rows?
6. Display following patterns of n rows ($n > 0$), For the below examples $n=5$? For each pattern write a separate algorithm/program?
- 7.

\$	\$	12345	12345
\$\$	\$\$	1234	1234
\$\$\$	\$\$\$	123	123
\$\$\$\$	\$\$\$\$	12	12
\$\$\$\$\$	\$\$\$\$\$	1	1

- 8 Display the following patterns of n rows ($n > 0$), for the below examples $n=5$?

Hollow square pattern:	Triangle Patterns with numbers:	Square with diagonals:	Diamond Pattern
##### # # # # # # #####	1 121 12321 1234321 123454321	* *	* *** ***** *** *

8. Display the first n ($n > 0$) terms of the Fibonacci sequence?
9. Display the Factorial of number?
10. Design Program for Sum of Array elements .
11. Compute character grade from the marks ($0 \leq \text{marks} \leq 100$) of a subject. Grading Scheme: 80-100 : A, 60 - 79: B, 50 - 59: C, 40-49: D, 0-39: F? Solve this using both else-if ladder and switch-case?*****

12. Compute body mass index, $BMI = \text{weight in KGs} / (\text{Height in Meters} * \text{Height in Meters})$,

Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges: BMI Values Underweight: less than 18.5, Normal: ≥ 18.5 and < 25

Overweight: ≥ 25 and < 30

Obese: ≥ 30

13. Design a modularized algorithm / program to compute a maximum of 4 numbers?
14. Design algorithm / program to perform matrix operations addition, subtraction and transpose?
15. Recursive solutions for the problems: Factorial of a number.
16. Design program for union .
17. Design Program for Student using structure
18. Design Programs to show use of Pointer and its Arithmetic Operations
19. Design Programs for different User defined functions
20. Design Programs for different library string functions and math functions.

101CC102/ 102CC102	Computer Architecture	3L:0T:0P	3 Credits
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Course Objectives

CO1: To Understand the basics of Digital Electronics and Binary Number System

CO2: To Learn the implementation of Combinational Circuit.

CO3: To Learn the implementation of Sequential Circuit.

CO4: To Understand the Organization of basic computers.

Course Content:

UNIT-I	Number Systems: Decimal, Binary, Octal, Hexadecimal, Number System Conversions, Binary Arithmetic, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, Error detecting and correcting codes, ASCII, EBCDIC, Excess-3 Code, The Gray Code. Digital Principles: Logic Gates (AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR) (12 Hrs.)
UNIT-II	Combinational Circuits: Half and full Adder Subtractor, Decoders, Multiplexer, Demultiplexer Sequential Circuits: Flip-Flops- CLK SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop. Register: 4 bit shift register (SISO) Binary Counter- 4-bit synchronous and Asynchronous binary counter. (11 Hrs.)
UNIT-III	Computer Basics: Definition of Computer, Applications, Characteristics of Computer, block diagram of computer. Memory: Primary Memory: RAM , ROM , PROM , EPROM, EEPROM and Cache memory Input Devices: Keyboard, Mouse, Joystick, Scanner, Mic, Display Devices (LED & Touch Screen). Output Devices: Speaker, Plotter, Printer, Types of Printer. Secondary storage: Hard disk, SSD, PD (11 Hrs.)
UNIT-IV	Basic Computer Organization and Design: Design of Basic Computer, Central Processing Unit: Computer Registers, General Register Organization, Stack Organization, Instruction Codes, Computer Instructions, Instruction Formats, Addressing Modes. (11 Hrs.)

Text Books:

1. Donald P Leach, Albert Paul Malvino, Goutam Saha-“Digital Principles & Applications”, Tata McGrawHill Education Private Limited, 2011 Edition.
2. M. Morris Mano - “Computer System Architecture ”, Pearson / Phi, Third Edition.

Reference Books:

- 1 William Stallings - “ Computer Organization and Architecture ” , Pearson / PHI, Sixth Edition,
- 2 Andrew S. Tanenbaum - “Structured Computer Organization”, PHI / Pearson 4th Edition,
- 3 M.V. Subramanyam, “Switching Theory and Logic Design”, Laxmi Publications(P)Ltd.

101LabCC102/ 102LabCC102	Computer Architecture	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments:

1. Verify logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates.
2. To study and verify NAND as a Universal Gate
3. Design and test of an S-R flip-flop using NAND / NOR gate.
4. Verification of Truth Tables of J-K Flip-Flop using NAND / NOR gate
5. Realize Decoder and Encoder circuit using Basic Gates.
6. Design and implement the 4 :1 MUX using gates.
7. Design and verify operation of half adder and full adder.
8. Design and verify operation of half subtractor.
9. Design and implement a 4 bit shift register using Flip flops.
10. Design and implement a 4 bit synchronous counter.

Hardware

1. Familiarize the computer system layout : marking positions of SMPS, mother board, FDD, HDD, CD, DVD and add on cards.
2. Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit)
3. Identify and Troubleshoot the problems of RAM, SMPS and mother-board
4. Configure BIOS settings-disable and enable US Band LAN
5. Adding additional RAM to the system. (expanding RAM size).
6. To Study mother board layout of a system.
7. Demonstrate the assembly of a PC
8. Demonstration of various ports : CPU, VGA port, PS / 2 (keyboard, mouse), USB, LAN, Speaker, Audio.
9. Install and configure windows OS
- 10.To study the installation of Printer and troubleshooting.

101AEC101/ 102AEC101	General English - I	1L:1T:0P	2 Credits
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Course Objective:

- CO1: To provide learning environment to practice listening, speaking, reading and writing skills.
CO2: To assist the students to carry on the tasks and activities through guided instructions and materials.
CO3: To effectively integrate English language learning with employability skills and training.
CO4: To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Course Content:

UNIT-I	Vocabulary Building The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations. (4 Hrs.)
UNIT-II	Basic Writing Skills Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely (4 Hrs.)
UNIT-III	Identifying Common Errors in Writing Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies Nature and Style of sensible Writing Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Module V : Writing Practices, Comprehension, Précis Writing, Essay Writing. (4 Hrs.)
UNIT-IV	Oral Communication (This Module involves interactive practice sessions in Language Lab) Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations. (3 Hrs.)

Text / Reference Books:

1. AICTE's Prescribed Text book: Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2023.
2. Effective Communication Skills. KulBhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan. 2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Alternative NPTEL / SWAYAM Course:

S.No.	NPTEL/SWAYAM Course Name	Instructor	Host Institute
1	English language for competitive exams	Prof. Aysha Iqbal	IITMADRAS
2	Technical English forengineers	Prof. Aysha Iqbal	IITM

Course Outcomes: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills

101MDE101/ 102MDE101	Indian Knowledge System	2L:0T:0P	2 Credits
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IKS : Indian Knowledge Systems and Traditions

Course Objectives

- To sensitize the students about context in which they are embedded i.e. Indian culture and civilization including its Knowledge System and Tradition.
- To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
- To help to study the enriched scientific Indian heritage.
- To introduce the contribution from Ancient Indian system & tradition to modern science & Technology

Detailed contents:

Module1: Introduction to IKS

(Any eight of total sessions assigned for Literary activity)
Introductory lecture on the **any eight** topics below:

1. Indian Knowledge System
2. Indian Culture & Civilization
3. Ancient Indian Chemistry
4. Ancient Indian Metallurgy
5. Ancient Indian Mathematics
6. Ancient Indian Astronomy
7. Indian Astronomical Instruments
8. Indian Knowledge System (Upveda : Ayurveda)
9. Indian Knowledge System (Upveda : Gandharveda)
10. Indian Knowledge System (Vedangas: Shiksha, Kalpa, Vyakrana)
11. Indian Knowledge System (Vedangas : Jyotisha, Nirukta, Chandas)
12. Indian Architecture I : Sthapatya -Veda
13. Indian Architecture II : Temples
14. Indian Architecture III : Town & Planning
15. Indian Philosophical System.

(15 Hrs.)

Module 2 : Introduction to Creative Practices

(Twenty Lectures with at least Five different topics of total session under Creative activity)

Introductory lecture on the topics below:

1. Dhatuvada : art of metallurgy
2. Akarajnana : art of mineralogy

3. Vastuvidya : art of engineering
4. Yantramatrika: art of mechanics
5. Takshana : art of carpentry
6. Chalitakayoga : art of practicing as a builder of shrines
7. Raupyaratna pariksha : art of testing silver and jewels
8. Maniragajnana : art of tinging jewels
9. Sucivayakarma : art of needle works and weaving
10. Vadya vidya : art of playing on musical instruments
11. Geet vidya: art of singing
12. Nritya vidya : art of dancing
13. Natya vidya : art of the atricals
14. Alekhya vidya : art of painting
15. Viseshakacchedya vidya: art of painting the face and body with color
16. Udakavadya : art of playing on musicin water
17. Manasika vyakriya : art of composing verse
18. Bhushanayojana : art of applying or setting ornaments
19. Citrasakapupa bhakshya vikara kriya : art of preparing varieties of delicious food
20. Dasanavasanangaraga : art of applying preparations for cleansing the teeth, cloths and painting the body
21. Utsadana : art of healing or cleaning a person with perfumes
22. Vastragopana : art of concealment of cloths
23. Balakakridanaka : art of using children's toys
24. Tandulakusumabali vikara : art of preparing offerings from rice and flowers
25. Pushpastarana : art of making a covering of flowers for a bed. **(15 Hrs.)**

References:

1. Text book on IKS by Prof. B Mahadevan, IIM Bengaluru
2. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay,1995.
3. The Cultural Heritage of India. Vol. I. Kolkata: Ramakrishna Mission Publication,1972.
4. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.
5. Dr. R. C. Majumdar, H. C. Ray Chaudhuri and Kalinkar Datta : An Advanced History of India (Second Edition) published by Macmillan & Co., Limited, London, 1953.
6. Rao, N. 1970. The Four Values in Indian Philosophy and Culture. Mysore : University of Mysore.
7. Avari, B. 2016. India: The Ancient Past: A History of the Indian Subcontinentfromc. 7000 B C Eto C E 1200. London : Routledge.

101VAC101/ 102VAC101	Environmental Science and Sustainability	2L:0T:0P	2 Credits
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Course description:

This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forth coming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers. The course content is divided into four comprehensive units.

Course Objective(s):

- CO1 This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forth coming sustainability challenges.
- CO2 This course will equip students to make decisions that consider environmental consequences.
- CO3 This course will enable future business graduates to become environmentally sensitive and responsible managers.

Course Content:

UNIT-I	Understanding Environment, Natural Resources, and Sustainability Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, them an-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education. (7 Hrs.)
UNIT-II	Ecosystems, Biodiversity, and Sustainable Practices Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation. (8 Hrs.)
UNIT-III	Environmental Pollution, Waste Management, and Sustainable Development Varioustypesofenvironmentalpollution,includingair,water,noise,soil, andmarinepollution,andtheirimpactsonbusinessesandcommunities.Causesofpolluti on,suchasglobalclimatechange,ozonelayerdepletion,thegreenhouseeffect,andacidra in,withaparticularfocusonpollutionepisodesinIndia.Importanceofadoptingcleanerte chnologies;Solidwastemanagement; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts. (7 Hrs.)
UNIT-	Social Issues, Legislation, and Practical Applications

IV	Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental justice, environmental refugees, and the resettlement and rehabilitation of affected populations; Ecological economics, human population growth, and demographic changes in India. (8 Hrs.)
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Text Books(Latest Editions):

- Poonia, M. P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.
- Bharucha, E. Textbook of Environmental Studies (3rded.) Orient Black swan Private Ltd.
- Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd.
- Rajagopalan, R. Environmental studies : from crisis ocure (4thed.). Oxford University Press.
- Miller, G. T. & Spool man S. Living in the Environment. (20thed.). Cengage.
- Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press.
- Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books.
- Pritwani, K. Sustainability of business in the context of environmental management. CRC Press.
- Wright, R. T. & Boorse, D. F. Environmental Science: Toward A Sustainable Future(13thed,). Pearson.

Web:

1. <https://www.ourplanet.com>
2. <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>
3. www.myfootprint.org
4. <https://www.globalchange.umich.edu/globalchange1/current/lectures/king/eco>
system
5. [/ecosystem.html](#)

Course Outcome(s):

6. Explore the basic environmental concepts and issues relevant to the business and management field.
7. Recognize the interdependence between environmental processes and socio-economic dynamics.
8. Determine the role of business decisions, policies, and actions in minimizing environmental degradation.
9. Identify possible solutions to curb environmental problems caused by managerial actions.
10. Develop skills to address immediate environmental concerns through changes in business operations, policies, and decisions.

SEMESTER-II

101CC103/ 102CC103	Object Oriented Programming using C++	3L:0T:0P	3 Credits
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Course Objectives:

- CO1. To provide students with understanding of code organization and functional hierarchical decomposition with using data types.
- CO2. Programming is about writing the instructions which a computer follows to enable it to store knowledge, process knowledge, and communicate knowledge with the outside world.

Course Content:

UNIT-I	C++ Basics History of C++ , Features of C++, Tokens, Keywords, Identifiers, Variables, Scope of variables, Constants, Basic Data types, User defined, derived data types, type conversion, Basic Operators, Scope resolution operators, type casting , Structure of C++ program, Control Structures, I/O Statements, (12 Hrs.)
UNIT-II	Classes and Objects: Classes and Objects Introduction, Defining a Class, array within class, array of objects Functions: Function Prototyping, call by reference, return by reference, Inline Function, Default Argument, Function Overloading, friend and virtual function Constructor & Destructor: Introduction, Parameterized Constructor, Multiple constructors in class, constructors with default arguments, Copy constructors, Destructors. (11 Hrs.)
UNIT-III	Inheritance: Definition, Types of Inheritance: Single, Multiple, Hierarchical, Multilevel, Hybrid, Visibility Modes Pointers & Polymorphism: pointers, pointers to object, this pointer, pointers to derived classes, virtual functions. Operator Overloading: Operator function, Unary and Binary operator overloading (11 Hrs.)
UNIT-IV	Exception handling: Introduction, basics, throwing mechanism, catching mechanism. Working with Files: Introduction, classes for file stream operations, Opening and closing files, File modes, File pointers and their manipulations, sequential I/O operations, Updating a File: Random Access, Error handling during File handling. (11 Hrs.)

Text books:

1. Object oriented programming with C++: E.Balagurusamy
2. Learn To Program With C++ , by John Smiley , 1st Edition
3. The C++ Programming Language, by Bjarne Stroustrup, 4th Edition

Reference Books:

1. The Object-Oriented Thought Process, 5th Edition by Matt Weisfeld
2. An Introduction to Object-Oriented Programming: Timothy Budd
3. The C++ programming language: Bjarne Stroustrup
4. Programming principles and Practice using C++: Bjarne Stroustrup

Weblink to Equivalent MOOC on SWAYAM if relevant:

- https://onlinecourses.nptel.ac.in/noc20_cs59/preview
- https://onlinecourses.nptel.ac.in/noc19_cs48/preview
- <https://www.classcentral.com/course/swayam-programming-in-c-6704>
- <https://www.naukri.com/learning/articles/oops-concepts-in-c-plus-plus/>

Weblink to Equivalent Virtual Lab if relevant:

1. <http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/exp1/index.php>

101CC104/ 102CC104	Data Structures	3L:0T:0P	3 Credits
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Course Objectives

CO1: Understand the fundamental concepts of Data Structures and their applications.

CO2: Develop problem-solving skills using Data Structures.

CO3: Implement Data Structures using C programming language.

Prerequisite:

1. **Programming Fundamentals:** Understanding the basic syntax and semantics of C programming language.
2. **Problem-Solving Skills :** Ability to break down a problem into smaller steps and devise a step-by-step solution and familiarity with simple algorithms.

Course Content:

UNIT-I	Introduction and Overview: Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Trade off. Arrays: Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear Arrays: Traversing, Inserting, Deleting, Searching, Sorting and Merging. Searching : Linear Search and Binary Search, Comparison of Methods. Sorting : Bubble Sort, Selection Sort, and Insertion Sort. Two-Dimensional Arrays, Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays. (12 Hrs.)
UNIT-II	Linked Lists: Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials. Hashing and Collision: Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining. (11 Hrs.)
UNIT-III	Stacks: Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression. Recursion: Definition, Recursive Notation, Runtime Stack, Applications of Recursion Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi. Queues: Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List, Applications of Queues. (11 Hrs.)
UNIT-IV	Graphs: Definition, Terminology, Representation, Traversal.

	Trees: Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Tree, Inserting, Deleting and Searching in Binary Search Tree, Height Balanced Trees. (11 Hrs.)
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Text Books

1. R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company, 2023(AICTE Recommended Textbook)
2. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill,2011.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications,2022.

Reference Books

1. Reema Thareja, “Data Structures Using C”, Second Edition, Oxford University Press,2014.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press, 2007.

Web Resources

1. Geeks for Geeks-Data Structures Tutorial
2. Khan Academy-Algorithms Course

101LabCC104/ 102LabCC104	Data Structures	0L:0T:4P	2 Credits
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Lab Programs:

1. Write a program for insertion and deletion operations in an array.
2. Write a program to search for an element in an array using Linear Search and Binary Search.
3. Write a program to sort an array using Bubble Sort, Selection Sort and Insertion Sort.
4. Write a program to merge two arrays.
5. Write a program to add and subtract two matrices.
6. Write a program to multiply two matrices.
7. Write a program to insert an element in to a Singly Linked List:
 - (a) At the beginning
 - (b) At the end
 - (c) At a specified position
8. Write a program to delete an element from a Singly Linked List:
 - (a) At the beginning
 - (b) At the end
 - (c) A specified element
9. Write a program to implement stack operations using an array.
10. Write a program to implement stack operations using a linked list.
11. Write a program to add two polynomials using a linked lists.
12. Write a program to evaluate a postfix expression using a stack.
13. Write a program to perform the following using recursion:
 - (a) Find the factorial of a number
 - (b) Find the GCD of two numbers
 - (c) Solve Towers of Hanoi problem
14. Write a program to implement simple queue operations using an array.
15. Write a program to implement circular queue operations using a linked list.

101CC105/ 102CC105	Operating Systems	3L:0T:0P	3 Credits
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Course Outcomes:

- CO1 : Understand the general concept of operating systems
- CO2 : Know about types of system software and their functions
- CO3 : Understand different types and structures of operating systems
- CO4 : Understand different functions of operating systems
- CO5 : Know about open-source operating systems

Course Content:

UNIT-I	Operating Systems Overview: Definition, Evaluation of O.S, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems. Operating Systems Structures: Operating system services and systems calls, system programs, operating system structure, operating systems generations. (12 Hrs.)
UNIT-II	Process Management: Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads. Process Scheduling: Definition, Scheduling objectives, Scheduling algorithms, CPU scheduling Preemptive and Non-preemptive Scheduling algorithms (FCFS, SJF and RR) , Performance evaluation of the scheduling Algorithms (11 Hrs.)
UNIT-III	Process Synchronization: Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors. Deadlocks: System model, dead lock characterization, dead lock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks. (11 Hrs.)
UNIT-IV	Memory Management : Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation. Virtual Memory : Demand paging, Page Replacement algorithms, Allocation of frames, thrashing. I/O Management : Principles of I/O Hardware : Disk structure, Disk scheduling algorithms. (11 Hrs.)

Text Books:

- Ekta Walia, Operating Systems Concepts, Khanna Publishing House, 2022 (AICTE Recommended Textbook)
- Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition O R Later edition, Wiley India Private Limited, New Delhi.
- Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.

Reference Books:

1. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
2. SumitabhaDas, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Course Outcomes(COs):

At the end of the course, students will be able to:

CO1 : Explain the fundamentals of the operating system.

CO2 : Comprehend multithreaded programming, CPU scheduling, process management, process synchronization, memory, deadlocks, and storage management.

CO3 : Compare the performance of CPU scheduling algorithms

CO4 : Identify the features of I/O and File handling methods.

101SEC103/ 102SEC103	Web Technologies	1L:0T:0P	1 Credits
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Course Objectives

- CO1. Knowledge about actual working of WWW.
- CO2. Ability to create web page by integrating multimedia.
- CO3. Get familiar to plan a responsive website.
- CO4. Knowledge to Publish site with Search Engine Optimization.
- CO5. Acquire the professional knowledge of Web Programming required for Industry

Course Content:

UNIT-I	Introduction to Web Publishing, Anatomy of Website, Wire framing your website, web hosting, Basics of HTML & CSS, Creating Web Pages, organizing information with lists, working with Links (8 Hrs.)
UNIT-II	Formatting Text with HTML and CSS, Using CSS to Style a Site, Using images on web pages, Building tables Using CSS to position elements on the page, Designing Forms, Structuring page with HTML 5 (7 Hrs.)
UNIT-III	Integrating Multimedia: Video and Sound, Advance CSS: Page layout in CSS, Using Responsive Web Design Introducing JavaScript, JQuery, Use of JavaScript, working with Frames & Linked Windows, Designing for the Mobile Web, Designing for user experience. (8 Hrs.)
UNIT-IV	Live on the Web, Publishing the site, Taking advantage of Server, Search Engine & Search Engine Optimization (7 Hrs.)

Course Outcomes:

- 1. Knowledge about actual working of WWW.
- 2. Ability to create web page by integrating multimedia.
- 3. Get familiar to plan a responsive website.
- 4. Knowledge to Publish site with Search Engine Optimization.
- 5. Acquire the professional knowledge of Web Programming required for Industry

101LabSEC103/ 102LabSEC103	Web Technologies	0L:0T:2P	1 Credits
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Practical list of Programs:

1. Create your class time table using table tag.
2. Design a Webpage for your college containing description of courses, department, faculties, library etc. using list tags, href tags, and anchor tags.
3. Create web page using Frame with rows and columns where we will have header frame, left frame, right frame, and status bar frame. On clicking in the left frame, information should be displayed in right frame.
4. Create Your Resume using HTML, use text, link, size, color and lists.
5. Create a Web Page of a supermarket using (internal CSS)
6. Use In line CSS to format your resume that you have created.
7. Use External CSS to format your time table created.
8. Use all the CS (inline, internal and external) to format college web page that you have created.
9. Write a HTML Program to create your college website using for mobile device.
10. Write an HTML/Java Script page to create log in page with validations.
11. Develop a Simple calculator for addition, subtraction, multiplication and division operation using JavaScript.
12. Use Regular Expressions for validations in Login Page using JavaScript.
13. Write a Program to retrieve date from a textfile and displaying it using AJAX.
14. Create XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-Id.

101SEC102/ 102SEC102	Object Oriented Programming using Java	3L:0T:0P	3 Credits
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Course Objectives

- CO1: To introduce the object oriented programming system concepts
- CO2: To introduce syntax and semantics of Java programming language
- CO3: To develop modular programs using Java
- CO4: To setup JDK environment to create, debug and run Java programs

Prerequisite: Knowledge of Problem Solving Techniques using C programming language

Course Content:

UNIT-I	Fundamentals of Object Oriented Programming: Basic Concepts of Object Oriented Programming (OOP), Benefits and Applications of OOP. Java Evolution: Java Features, Difference between Java, C and C++, Java and Internet, Java Environment. Overview of Java Language: Introduction to Simple Java Program, Use of Comments and Math function, Application of two classes, Java Program Structure, Java Tokens and statements, Implementing Java program And JVM, Command Line Arguments (12 Hrs.)
UNIT-II	Constants, Variables and Data Types: Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Type casting. Operators & Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity. Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jumpin loops, Labelled loops. (11 Hrs.)
UNIT-III	Classes, Objects and Methods: Defining Class, Methods Declaration, Constructors, Methods Overloading, Overriding Methods, Inheritance Arrays, Strings and Vectors: 1D arrays, Creating an Array, 2D arrays, Strings, Vectors, Wrapper Classes, Enumerated Types Inheritance: Defining, extending classes, and Implementing Interfaces. Multiple inheritance and polymorphism (11 Hrs.)
UNIT-IV	Packages: Basics of packages, System packages, Creating and accessing packages, Creating user defined packages, Adding class to a package. Exception Handling: Using the main keywords of exception handling: try, catch, throw, throws and finally; Nested try, Multiple catch statements, Creating user defined exceptions Applet Programming: Applet Basics, Applet Life Cycle, Applet Implementation and Applications. (11 Hrs.)

Text Books

1. Balaguruswamy E.(2023).Programming with JAVA: APrimer.7th edition. India : McGraw Hill Education
2. Schildt, H.(2022).Java:The Complete Reference.12th edition. McGraw-Hill Education.

Reference Books

3. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited, 2012.
4. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited,2015.
5. Y. Daniel Liang, Introduction to Java Programming,7th Edition, Pearson, 2008.
6. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

Web Resources

1. <https://www.w3schools.com/java/>.
2. <http://www.java2s.com/>.
3. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

101LabSEC102/ 102LabSEC102	Object Oriented Programming using Java	0L:0T:4P	2 Credits
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List of Practical:

1. Write a program to read two numbers from user and print their product.
2. Write a program to print the square of a number passed through command line arguments.
3. Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student.
4. Write a java program to find the largest number out of n natural numbers.
5. Write a java program to find the Fibonacci series & Factorial of a number using recursive and non-recursive functions.
6. Write a java program to multiply two given matrices.
7. Write a Java program for sorting a given list of names in ascending order.
8. Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome.
9. Write a java program to read n number of values in an array and display it in reverse order.
10. Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from Add Subclass to use the member data of the superclass. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.
11. Create a JAVA class called Student with the following details as variables within it.
12. USN, NAME, BRANCH, PHONE, PERCENTAGE
13. Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings.
14. Write a Java program that displays the number of characters, lines and words in a text.
15. Write a Java program to create a class called Shape with methods called getPerimeter() and getArea().
16. Create a sub class called Circle that overrides the getPerimeter() and getArea()

101VAC102/ 101VAC102	Indian Constitution	2L:0T:0P	2 Credits
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Course Content:

UNIT-I	• The Constitution - Introduction • The History of the Making of the Indian Constitution • Preamble and the Basic Structure, and its interpretation • Fundamental Rights and Duties and their interpretation • State Policy Principles. (8 Hrs.)
UNIT-II	• Union Government • Structure of the Indian Union • President–Role and Power • Prime Minister and Council of Ministers • Lok-Sabha and Rajya-Sabha. (7 Hrs.)
UNIT-III	• State Government • Governor–Role and Power • Chief Minister and Council of Ministers • State Secretariat. . (8 Hrs.)
UNIT-IV	• Administration • District Administration • Municipal Corporation • Zila Panchayat • Role and Functioning • Chief Election Commissioner • State Election Commission. (7 Hrs.)

Suggested Learning Resources:

1. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008
2. The Constitution of India by B. L. Fadia Sahitya Bhawan ; New edition(2017)
3. Introduction to the Constitution of India by D D Basu Lexis Nexis; Twenty-Third, 2018 edition

Suggested Software / Learning Websites:

- a. <https://www.constitution.org/cons/india/const.html>
- b. <http://www.legislative.gov.in/constitution-of-india>
- c. <https://www.sci.gov.in/constitution>
- d. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

Cases

- Rustom Cavasjee Cooper v. Union of India, (1970)1SCC 248
- State of Rajasthan v. Mohan Lal Vyas, AIR 1971 SC 2068 (confirmation of a private monopoly, not a violation of fundamental right)
- Mithilesh Garg v. Union of India, (1992)1 SCC 168 : AIR 1992 SC221(Right to carry on business, not breached when it is liberalised)

- Chintamanrao v. The State of Madhya Pradesh, AIR 1951 SC 118 (scope of reasonable restrictions in relation to trade and occupation)
- Cooverjee B. Bharucha v. Excise Commissioner, Ajmer, AIR 1954 SC220(the reasonableness of the restriction imposed may depend upon the nature of the business and prevailing conditions including public health and morality)
- T. B. Ibrahim v. Regional Transport Authority. Tanjore, AIR1953SC79
- Harman Singh v. RTA, Calcutta, AIR 1954SC190
- DwarkaPrasad LaxmiNarain v. State of U.P., AIR 1954SC224
- State of Bombay v. R. M. D. Chamarbaugwala, AIR 1957SC699
- Parbhani Transport Coop. Society Ltd. v. Regional Transport Authority, Aurangabad, AIR1960 SC801
- State of Bombay v. R. M. D. Chamarbaugwala, (1957)S.C.R.874,
- G. K. Krishnan vs State of TamilNadu, 1975 SCC (1)375
- Automobile Transport (Rajasthan) Ltd. Vs State of Rajasthan, AIR1962SC1406

Course Outcome(s):

Upon completion of this course, students will be able to:

1. Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.
2. Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).
3. State Government Mechanisms : Examine the powers of the Governor, Chief Minister, and the State Secretariat.
4. Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.
5. Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections.
6. Application of Knowledge: Apply constitutional principles to contemporary political issues and evaluate governance effectiveness.

SEMESTER III

101CC201/ 102CC201	Probability and Statistics	3L:0T:0P	3 Credits
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Course Objectives

- CO1: This course aims to make the students trained to handle randomness scientifically using theory of probability.
- CO2: This course intends to make the students able to represent the statistical data in a systematic way and analyze it to draw meaningful information from them.
- CO3: Through plentiful examples and exercises, this course provides the students scope to apply probabilistic and statistical techniques to deal with the real-life problems.

Course Content:

UNIT-I	Concepts of probability: Experiment and sample space, events and operations with events, probability of an event, basic probability rules, applications of probability rules, conditional probability. Random Variables: Discrete and continuous random variable, probability distribution of a random variable, probability mass function, probability density function, expectation and variance of a random variable. Standard Probability Distributions: Binomial probability distribution, Poisson probability distribution, Normal probability distribution. (12 Hrs)
UNIT-II	Sampling Distribution: Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample proportion. Statistical Inference: Estimation and Hypothesis Testing (only concept). Hypothesis Testing for a Single Population: Concept of a hypothesis testing, tests involving a population mean and population proportion (z test and t test). (11 Hrs)
UNIT-III	Basic concepts of Statistics, qualitative and quantitative data, classification of data, construction of frequency distribution, diagrammatic representation of data. Measures of Central Tendency: Arithmetic mean, median and mode—their properties Measures of Dispersion: Range, mean deviation, quartile deviation, variance and standard deviation. (11 Hrs)
UNIT-IV	Correlation: Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient. Regression: Linear regression-fitting by least square method and interpretation. Regression Table: P-value, R-squared (11 Hrs)

Text Books

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, 2010 (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill, 2010.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier, 2021.

4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education, 2005

Reference Books

1. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013
2. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley, 2016.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, 2024.

Web Resources

1. <https://nptel.ac.in/courses/111106112>
2. <https://nptel.ac.in/courses/111105041>

101CC202/ 102CC202	Database Management System	3L:0T:0P	3 Credits
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Course Objectives

- CO1: Understanding Core Concepts of DBMS
- CO2: Proficiency in Database Design and SQL
- CO3: Application of Advanced Database Techniques

Prerequisite: Basic knowledge of Set Theory.

Course Content:

UNIT-I	Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators Data Models: Introduction to Data Models, Data Model Classification (Hierarchical, Network, Relational, Object-oriented), Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, and Weak Entity Sets, Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Key Constraints, Introduction to the Relational Model and Relational Schema Design. (12 Hrs.)
UNIT-II	Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization. Database Storage and Indexing: Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection (11 Hrs.)
UNIT-III	Structured Query Language (SQL): SQL Basics: DDL and DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses (Group By, Having, Order by, top/limit), Joins in SQL, (Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join). (11 Hrs.)
UNIT-IV	Transaction Management: Introduction, ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Serializability and Recoverability, Introduction to Lock Management, Lock-Based Concurrency Control, Performance of Locking, Dealing with Deadlocks, Transaction Support in SQL, Introduction to Crash Recovery, Strict 2PL, ARIES algorithm. (11 Hrs.)

Text Books

1. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill, 2018
2. Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall, 2015
3. Brad Dayley, "NoSQL with MongoDB in 24 Hrs.", 1st edition, Sams Publishing, 2024

Reference Books

1. Korth, Silbertz, Sudarshan,” Database System Concepts”, Seventh Edition, McGraw - Hill.(2019)
2. R.P. Mahapatra, Govind Verma, “Database Management Systems”, Khanna Publishing House, 2025.

Web Resources

1. <https://oracle-base.com/articles>
2. https://forums.oracle.com/ords/apexd/domain/dev-community/category/sql_and_pl_sql
3. <https://asktom.oracle.com/ords/f?p=100:1:0>

101LabCC202/ 102LabCC202	Database Management System	0L:0T:4P	2 Credits
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List Of Practical's

1. Draw an ER Diagram of Registrar Office
2. Draw an ER Diagram of Hospital Management System
3. Reduce The ER diagram in question no 1 into tables
4. Reduce the ER diagram of question no 2 into tables
5. Consider the following Schema (DDL Commands)
 - Supplier(SID, Sname, branch, city, phone)
 - Part(PID, Pname, color, price)
 - Supplies(SID, PID, qty, date_supplied)
 - I. Create the above tables
 - II. Add a new attribute state in supplier table
 - III. Remove attribute city from supplier table
 - IV. Modify the data type of phone attribute
 - V. Change the name of attribute city to address
 - VI. Change a table's name, supplier to sup
 - VII. Use truncate to delete the contents of supplies table
 - VIII. Remove the part table from database
6. DML Commands
 - i. Insert at least 10 records in tables supplier, part and supplies
 - ii. Show the contents in tables supplier, part and supplies
 - iii. Find the name and city of all suppliers
 - iv. Find the name and phoneno of all suppliers who stay in 'Delhi'
 - v. Find all distinct branches of suppliers
 - vi. Delete the record of the supplier whose SID is 204001
 - vii. Delete all records of supplier table
 - viii. Delete all records of suppliers whose city starts with capital A.
 - ix. Find the supplier names which have 'lk' in any position
 - x. Find the supplier name where 'R' is in the second position
 - xi. Find the name of supplier whose name starts with 'V' and ends with 'A'
 - xii. Change the city of all suppliers to 'BOMBAY'
 - xiii. Change the city of supplier 'Vandana' to 'Goa'
7. Queries with Constraints
 - I. Create the supplier table with Primary Key Constraint
 - II. Create supplies table with Foreign key Constraint
 - III. Create a part table with UNIQUE Constraint
 - IV. Create supplier Table with Check Constraints
 - V. Create Supplier table with Default Constraint
9. Aggregate Functions:
 1. Find the minimum, maximum, average and sum of costs of parts
 2. Count the total number of parts present

3. Retrieve the average cost of all parts supplied by 'Mike'

10. Queries on GROUP BY, HAVING AND ORDER BY Clauses

1. Display total price of parts of each color
2. Find the branch and the number of suppliers in that branch for branches which have morethan 2 suppliers
3. Find all parts sorted by pname in ascending order and cost in descending order
4. Find the branch and the number of suppliers in that branch

11. Queries on Operators

1. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200and less than or equal to 600.
2. Find the sname , SID and branch of suppliers who are in 'local' branch or 'global' branch
3. Find the pname, phoneno and cost of parts for which cost is between 200 and 600
4. Find the pname and color of parts , which has the word 'NET' anywhere in its pname.
5. Find the PID and pname of parts with pname either 'NUT' or 'BOLT'
6. List the suppliers who supplied parts on '1st may2000', '12 JAN 2021' ,'17 dec 2000','10 Jan 2021'
7. Find all the distinct costs of parts

12. Join Operators

1. Perform Inner join on two tables
2. Perform Natural Join on two tables
3. Perform Left Outer Join on tables
4. Perform Right Outer join on tables
5. Perform Full Outer Join on tables

13. Set Theory Operators

1. Show the use of UNION operator with union compatibility
2. Show the use of intersect operator with union compatibility
3. Show the use of minus operator with union compatibility
4. Find the cartesian product of two tables

101SEC201/ 102SEC201	Python Programming	2L:0T:0P	2 Credits
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Course Objectives:

CO1: Develop modular Python programs.

CO2: Apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem.

CO3: Understand basic Data visualization and File handling in Python.

Prerequisites:

Understanding of Problem-solving techniques using a programming language and basic datastructures.

Course Content:

UNIT-I	Introduction: History and Application areas of Python; Structure of Python Program; Identifiers and Keywords; Operators and Precedence; Basic Data Types and type conversion; Statements and expressions; Input/Output statements. Strings: Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings. Control Flow Statements: Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit. (12 Hrs.)
UNIT-II	Functions: Built-In Functions, Function Definition and call; Scope and Lifetime of Variables, Default Parameters, Command Line Arguments; Lambda Functions; Assert statement; Importing User defined module; Mutable and Immutable objects: Lists, Tuples and Dictionaries; Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as arguments to functions. Using Math and Numpy module for list of integers and arrays. (11 Hrs.)
UNIT-III	Files: Types of Files; Creating, Reading and writing on Text and Binary Files; The Pickle Module, Reading and Writing CSV Files. Reading and writing of csv and JSON files. Exception Handling: Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions. Data visualization: Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosine curves. (11 Hrs.)
UNIT-IV	Object-Oriented Programming, Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism. (11 Hrs.)

Text Books:

1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021.
2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.
3. Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.

Reference Books:

1. Think Python, by Allen Downey, 2nd edition, 2015, O'Reilly.

https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view

2. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
3. Introduction to Computation and Programming using Python, by John Guttag, 2nd edition, 2016, PHI India.

Web Resources:

1. <https://www.learnpython.org/>
2. <https://www.w3schools.com/python/default.asp>

101LabSEC201/ 101LabSEC201	Python Programming	0L:0T:4P	2 Credits
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Practical List:

1. Write a program to find whether a number is a prime number.
2. Write a program to print m raise to power n, where m and n are read from the user.
3. Write a program having a parameterized function that returns True or False depending on whether the parameter passed is even or odd.
4. Write a program to print the summation of the following series up to n terms: 1-2+3-4+5-6+7.....n
5. Write a menu driven program to perform the following operations on strings using string built-in functions.
 - a. Find the frequency of a character in a string.
 - b. Replace a character by another character in a string.
 - c. Remove the first occurrence of a character from a string.
 - d. Remove all occurrences of a character from a string.
6. Write a program that accepts two strings and returns the indices of all the occurrences of the second string in the first string as a list. If the second string is not present in the first string, then it should return -1
7. Using Numpy module write menu driven program to do following
 - a. Create an array filled with 1's.
 - b. Find maximum and minimum values from an array
 - c. Dot product of 2 arrays.
 - d. Reshape a 1-D array to 2-D array.
8. Write a function that takes a sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count.
9. Consider a tuple t1=(1,2,5,7,9,2,4,6,8,10). Write a program to perform following operations:
 - a. Print contents of t1 in 2 separate lines such that half values come on one line and other half in the next line.
 - b. Print all even values of t1 as another tuple t2.
 - c. Concatenate a tuple t2=(11,13,15) with t1.
 - d. Return maximum and minimum value from t1..
10. Write a function that reads a file file1 and copies only alternative lines to another file file2. Alternative lines copied should be the odd numbered lines.
11. Write a Python program to handle a Zero Division Error exception when dividing a number by zero.
12. Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
13. Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.
14. Take as input in the months and profits made by a company ABC over a year. Represent this data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total profit.

101CC203/ 102CC203	Software Engineering	3L:0T:0P	3 Credits
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Course Objectives

- CO1: To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.
- CO2: To Develop proficiency in project management methodologies and strategic decision-making for successful software project execution.
- CO3: To Master the art of software design, development, and testing to produce robust and efficient software solutions.

Prerequisites: Basic understanding of Software, Applications, Programming fundamentals.

Course Content:

UNIT-I	The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process. Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process. (12 Hrs.)
UNIT-II	Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management. Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques. (11 Hrs.)
UNIT-III	Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance. (11 Hrs.)
UNIT-IV	Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability. Release Management: Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring.

	Product sustenance: Maintenance, updates, End of life, migration strategies. (11 Hrs.)
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Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTER Recommended Textbook)
2. Software Engineering, Ian Somerville, 9th edition, Pearson education.
3. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

Reference Books

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
2. Software Engineering: Principles and Practice Hans van Vliet

101DSE201	Feature Engineering	1L:0T:0P	1 Credits
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Course Content:

UNIT-I	Introduction to Feature Engineering Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio. Basic Feature Preprocessing : Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation. (8 Hrs.)
UNIT-II	Feature Engineering Techniques Techniques for Numerical Data : Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques : One Hot Encoding, Label Encoding. Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction : Introduction and application of Principal Components Analysis. (7 Hrs.)

Text Books

1. M. C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024.
2. Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning : Principles and techniques for data scientists. O'Reilly Media, Inc.
3. Kalita, J. K. , Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science : Theory and Practice. Elsevier. ISBN-13: 9780323917780.

Reference Books:

1. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
2. N.Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
3. M. C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024.
4. Ng, Andrew. (2018). Machine learning yearning (Draft, MITLicensed). GitHub.ISBN-10:199957950X, ISBN-13: 978-1999579500.
5. Han, Jiawei, Kamber, Micheline, & Pei, Jian.(2011). Datamining: Concepts and techniques(3rded.). Morgan Kaufmann Publishers. ISBN978-0123814791.
6. Tan, Pang-Ning, Steinbach, Michael, Karpadne, Anuj, & Kumar, Vipin.(2021). Introduction to datamining(2nd ed.). Pearson. ISBN978-9354491047.
7. Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'ReillyMedia, Inc.
8. Galli, Soledad. (2020). Python feature engineering cookbook : Over 70 recipes for creating, engineering, and transforming features to build machine learning models. Packt Publishing, Limited.
9. Nielsen, Aileen. (2019). Practicaltime seriesanalysis : Prediction with statistics and machine learning. O'Reilly Media.
10. Rajiv Chopra, Deep Learning, Khanna Publishing House, 2024.
11. Jeeva Jose, Machine Learning, Khanna Publishing House, 2024.

12. Chollet, François. (2017). Deep learning with Python. Manning Publications. ISBN9781617294433.

Course Outcomes

- CO1: Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time).
- CO2: Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization.
- CO3: Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation.
- CO4: Utilize categorical data techniques, such as one-hot encoding and label encoding, and understand features election methods, including filter and wrapper methods.
- CO5: Perform feature transformation using techniques like Principal Component Analysis(PCA) and understand its application in machine learning.

101LabDSE201	Feature Engineering	0L:0T:4P	2 Credits
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LAB Experiments

The lab experiments can be implemented in Python using relevant libraries such as numpy, pandas, sklearn, nltk, matplotlib, and seaborn. Kaggle datasets, public repositories (e.g., UCI, Machine Learning etc.), or generated data sets can be used for conducting the experiments. Experiments may be conducted on numerical, image, or time-series datasets.

Suggested list of Experiments (not limited to):

1. Handle missing values in column(s) of a dataset. For example, fill missing values with the mean / median / mode of the columns such as 'Age', 'Height', 'Weight', 'Grade' for a dataset.
2. Clean a dataset by identifying and removing invalid data entries. For example, a dataset having columns 'Name', 'Gender' and 'Age' where 'Name' contains 'invalid data'.
3. Scale numerical features using Min-Max normalization for a dataset with columns like 'Height', 'Weight'.
4. Perform exploratory data analysis and visualize data distributions using histograms and boxplots.
5. Compute and visualize the correlation matrix of a dataset with 2 or more columns.
6. Create polynomial and interaction features from numerical data in a dataset with two columns.
7. Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.
8. Perform one-hot encoding on categorical features in a dataset with column 'Category' containing categorical values. The distinct values in the Category feature are [Good, Better, Best] and Gender [Male, Female].
9. Preprocess text data(tokenization) for a data set with a column 'Text'.
10. Preprocess text data(stemming) for a data set with a column 'Text'.
11. Preprocess text data(lemmatization) for a dataset with a column 'Text'.
12. Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.
13. Apply TF-IDF transformation to text data for a column 'Text'.
14. Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.
15. Perform image augmentation resizing for a set of images.
16. Perform image augmentation normalization for a set of images.
17. Perform image augmentation rotation for a set of images.
18. Perform image augmentation translation for a set of images.
19. Decompose a time series into trend, seasonal, and residual components for a data set with a column 'Time Series'.
20. Perform Principal Component Analysis (PCA) on a data set and visualize the first two principal components.

Course Outcomes

- CO1: Demonstrate proficiency in handling and preprocessing missing data, including filling missing values and cleaning invalid data entries.
- CO2: Apply feature scaling techniques, such as Min-Max normalization, and perform exploratory data analysis through data visualization methods like histograms and boxplots.
- CO3: Implement feature engineering techniques, including binning, polynomial feature creation, and logarithmic transformations on numerical data.
- CO4: Perform text data preprocessing tasks, such as tokenization, stemming, lemmatization,

and apply TF-IDF and Bag-of-Words transformations.
CO5: Apply image and time series data augmentation and decomposition techniques to enhance and analyze image and time series data.

102DSE201	Basics of Data Analytics using Spreadsheet	1L:0T:0P	1 Credits
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Course Objectives:

CO1: Understand the basics of data analytics and its applications.

CO2: Develop proficiency in using spreadsheet software for data manipulation and analysis.

CO3: Build and use spreadsheet models for decision making & Communicate data insights effectively

Prerequisite: Knowledge on basics of mathematical & Statistical concepts such as arithmetic, percentages, averages, and basic algebra.

Course Content:

UNIT-I	Introduction to Data Analytics Understanding data and its types (structured, unstructured, semi-structured)- What is Data Analytics-Types of data Analytics - Importance of Data Analytics - Applications of Data Analytics. (8 Hrs.)
UNIT-II	Data, Ethics, and Industry : Case Studies Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation-Handling Missing Data and Outliers - Ethical considerations in data analytics. - Real-world Applications of Data Analytics - Industry - specific applications (finance, marketing, operations) - Case Study (7 Hrs.)

Text Books

1. "Beginner's Guide for Data Analysis using R Programming " by Jeeva Jose, Khanna Publishing House, 2024.
2. "Data Analytics" by V. K. Jain, Khanna Book Publishing Company, 2024.
3. "Excel Data Analysis For Dummies " by Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition, 2016
4. "Data Analysis Using Microsoft Excel " by Michael R. Middleton, Thomson, Brooks / Cole, 3rd edition, 2004

Reference Books

1. "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018
2. "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cengage learning asia pet. 2015
3. "Mastering Excel " by Web Tech Solutions, Khanna Publishing House, 2024.

102LabDSE201	Basics of Data Analytics using Spreadsheet	0L:0T:4P	2 Credits
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Lab Program List

Introduction to Excel and Basic Functions

1. Getting started with Excel : Workbook, Worksheet, Cells, and Ranges
2. Data entry and basic formatting techniques
3. Using basic arithmetic functions : SUM, AVERAGE, MIN, MAX, ROUND
4. Introduction to cell referencing : relative, absolute, and mixed

Data Importing and Pre-processing

1. Importing data from various sources (CSV, textfiles, webdata)
2. Data cleaning : removing duplicates, handling missing data, and standardizing formats
3. Data transformation : text-to-columns, data validation techniques
4. Using the "Find & Replace" and "Text Functions" (LEFT, RIGHT, MID, CONCATENATE)

Descriptive Statistics Using Excel

1. Calculating measures of central tendency : mean, median, mode
2. Computing measures of dispersion : range, variance, standard deviation
3. Creating and interpreting frequency distributions and histograms
4. Using Excel's "Data Analysis Toolpak" for basic statistical analysis

Advanced Spreadsheet Functions

1. Using logical functions : IF, AND, OR, IF ERROR
2. Lookup and reference functions : VLOOKUP, HLOOKUP, INDEX, MATCH
3. Data aggregation techniques : SUMIFS, COUNTIFS, AVERAGE IFS
4. Text functions for datamanipulation : TRIM, CLEAN, TEXT, RIGHT, LRFT, MID

Data Visualization Techniques

1. Creating various chart types : bar, line, pie, scatter
2. Advanced charting techniques : combocharts, dual-axis charts
3. Data visualization best practices : choosing the right chart, formatting, and styling
4. Creating and customizing Pivot Tables and Pivot Charts

Dashboard Creation

1. Introduction to dashboards : concepts and components
2. Using Pivot Tables and Pivot Charts for dashboard elements
3. Applying conditional formatting for dynamic visual cues
4. Creating interactive dashboards with slicers and timeline

101LabVAC201/ 102LabVAC201	Yoga and Physical fitness/Sports/ NCC /NSS/ Disaster Management	0L:0T:4P	2 Credits
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Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

YOGA

Yoga course is designed to provide students with a comprehensive understanding of physical fitness, wellness, and nutrition. This course explores the meaning and importance of yoga in the modern era, the role of sports in maintaining physical fitness, and the various components of physical wellness. Students will also learn about the significance of nutrition and weight management, equipping them with the knowledge to promote a healthy and balanced lifestyle. Through this course, students will gain insights into the holistic approach to health and well-being.

Course Objective(s):

- Understand yoga's significance and its practical applications for holistic well-being.
- Explore subtle energy systems and their role in enhancing health through yogic practices.
- Examine various paths of yoga to foster self-realization and spiritual growth.
- Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.
- Apply yogic principles to manage psycho-somatic ailments and promote resilience.

Course Content:

Unit-I

(8 Hrs.)

- Yoga: Meaning and definition
- Importance of yoga in 21st century
- Introduction to Yogic Anatomy and Physiology
- Yoga & sports, Yoga for healthy lifestyle
- Types of Yoga: - Hatha yoga, laya yoga, mantra yoga, bhakti yoga, karma yoga, jnana yoga, raj yoga
- Study of Chakras, Koshas, Pranas, Nadis, Gunas, Vayus and its application in Yogic practices.
- Ashtang Yoga: - Yama, niyama, asana, pranayama, Pratyahar, dharna, dhyana, Samadhi : Benefits, Utilities & their psychological impact on body and mind. According to yoga concept of normality in modern psychology, concept of personality & its development, yogic management of psycho-somatic ailments: frustration, anxiety, depression

Unit- 2

(7 Hrs.)

- Sports for Physical Fitness: Meaning and definition
- Physical Activity – Concept, Benefits of Participation in Physical Activities
- Components and Significance of Physical Fitness -Health, Skill and Cosmetic Fitness
- Types of Physical Activities – Walking, Jogging, Running, Calisthenics, Rope Skipping, Cycling, Swimming, Circuit Training, Weight training, Adventure Sports
- Principles of Physical Fitness, Warming Up, Conditioning, Cooling Down, Methods to Develop and Measure Health and Skill related components of Physical Fitness

- Measurement of Health Related Physical Fitness (HRPF)

Unit -3

(8 Hrs.)

- Physical Wellness: Concept, Components
- Types of wellness: psychological, social, emotional, and spiritual.
- Significance with reference to Positive Lifestyle 2.2
- Concepts of Quality of Life and Body Image
- Factors affecting Wellness
- Wellness Programmes

Unit-4: Nutrition and Weight Management

(7 Hrs.)

- Concept of Nutrients, Nutrition, Balanced Diet, Dietary Aids and Gimmicks
- Energy and Activity- Calorie Intake, Energy Balance Equation
- Obesity - Concept, Causes, Obesity Related Health Problems
- Weight Management through Behavioural Modifications

Text Books / References:

- Anand O P. Yog Dawra Kaya Kalp. Sewasth Sahitya Perkashan. Kanpur.
- Brown, J.E. Nutrition Now Thomson-Wadsworth.
- Corbin et.al.Fitness & Wellness-Concepts. McGraw Hill. Publishers. New York.U.S.A
- Corbin, C. B., G. J. Welk, W. R Corbin, K. A. Welk, Concepts of Physical Fitness: Active Lifestyle for Wellness. McGraw Hill, New York, USA.
- Hoeger, W W K and S.A. Hoeger. Principles and Labs for Fitness and Wellness, Thomson Wadsworth, California, USA.
- Hoeger, W.W. & S. Hoeger Fitness and Wellness. 7th Ed. Thomson Wadsworth, Boston, USA.
- Kamlesh, M. L. & Singh, M. K.) Physical Education (Naveen Publications).
- Kansal, D.K. Text book of Applied Measurement, Evaluation & Sports Selection. Sports & Spiritual Science Publications, New Delhi.
- Kumari, Sheela, S., Rana, Amita, and Kaushik, Seema,, Fitness, Aerobics and Gym Operations, Khel Sahitya, New Delhi
- Lumpkin, A. Introduction to Physical Education, Exercise Science and Sports Studies, McGraw Hill, New York, U.S.A.
- Sarin N) Yoga Dawara Rogon Ka Upchhar.Khel Sahitya Kendra
- Savard, M. and C. Svec The Body Shape Solution to Weight Loss and Wellness: The Apples & Pears Approach to Losing Weight, Living Longer, and Feeling Healthier. Atria Books, Sydney, Australia.
- Siedentop, D. Introduction to Physical Education, Fitness and Sport, McGraw Hill Companies Inc., New York, USA.
- Sri Swami Ramas. Breathing. Sadhana Mandir Trust.Rishikesh.
- Swami Ram Yoga & Married Life Sadhana Mandir Trust. Rishikesh

Course Outcome(s):

- i. Gain a comprehensive understanding of yoga and its modern applications for holistic well-being.

- ii. Demonstrate proficiency in yogic anatomy and physiology, enhancing yoga practice and promoting physical and energetic balance.
- iii. Master the Eight Limbs of Yoga and comprehend their psychological impact, fostering personal growth and self-realization.
- iv. Integrate yoga principles into sports and physical fitness activities to enhance performance and prevent injuries.
- v. Develop skills in wellness management and nutrition

Sports Management

Sports Management course is designed to provide undergraduate students with a broad, foundational understanding of the dynamic field of sports management. This course will familiarize students with the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations. Students will gain insights into the roles of marketing and sponsorship in the sports industry, as well as develop proficiency in financial management techniques specific to sports organizations. Additionally, the course will explore the application of analytics and technology in sports, enhancing the strategic decision-making and fan engagement capabilities.

Course Objective(s):

- i. Understand the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations.
- ii. Analyse the role of marketing and sponsorship in the sports industry, with a focus on branding, target audience segmentation, and event management.
- iii. Develop proficiency in financial management techniques specific to the sports industry, including revenue generation, cost management, and investment strategies.
- iv. Explore the application of analytics and technology in sports, including performance evaluation, strategic decision-making, and fan engagement.
- v. Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

Course Content:

Unit 1: Introduction to Sports Management

(8 Hrs.)

- Definition and scope of sports management
- Significance of sports management in society and its evolution over time
- Organizational structure of sports: amateur, professional, and non-profit entities
- Roles and responsibilities of key personnel: managers, coaches, and agents
- Governance bodies in sports: FIFA, IOC, and NCAA
- Legal issues: contracts, negotiations, intellectual property rights
- Ethical considerations: fair play and doping

Unit 2: Sports Marketing and Sponsorship**(7 Hrs.)**

- Unique aspects of sports marketing
- Fan engagement strategies
- Target audience identification and segmentation
- Branding strategies for sports teams and athletes
- Sponsorship and endorsement deals
- Negotiating and managing partnerships
- Event management: planning, organizing, and promoting sports events

Unit 3: Financial Management in Sports**(8 Hrs.)**

- Revenue generation in sports: ticket sales, broadcasting rights, merchandise sales
- Financial models: budgeting and forecasting
- Cost management: player salaries, facility expenses, operational costs
- Investment opportunities in sports
- Risk management techniques specific to sports organizations

Unit 4: Sports Analytics and Technology**(7 Hrs.)**

- Introduction to sports analytics
- Evaluating player performance
- Devising game strategies
- Fan engagement through technology
- Analytical techniques: statistical analysis, data visualization, predictive modeling
- Key performance indicators (KPIs) in sports
- Applications of analytics: talent scouting, injury prevention, performance optimization.

Text Books :

1. Pedersen, P. M., Thibault, L., & Pedersen, P. M. (2019). Contemporary Sport Management. Human Kinetics.
2. Hoyer, R., Smith, A. C. T., Nicholson, M., et al. (2021). Sports Management: Principles and Applications. Routledge.
3. Chelladurai, P., & Kerwin, S. (2017). Introduction to Sport Management: Theory and Practice. Human Kinetics.
4. Hoyer, R., Cuskelly, G., & Nicholson, M. (2019). Sports Governance: A Guide for Sport Organizations. Routledge.
5. Conrad, M. (2018). The Business of Sports: A Primer for Journalists. Routledge.
6. Shank, M. D. (2019). Sports Marketing: A Strategic Perspective. Pearson.
7. Collett, P., & Fenton, W. (2019). The Sponsorship Handbook: Essential Tools, Tips and Techniques for Sponsors and Sponsorship Seekers. Kogan Page.
8. Fullerton, S. Jr., & Funk, D. C. (2019). Sports Marketing: A Practical Approach. Routledge.
9. Conrad, M. (2019). Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
10. McCarty, L. A., & McPherson, G. (2019). Sports Event Management: The Caribbean Experience. Routledge.

11. Brown, M. T., Rascher, D., & Leeds, M. A. (2017). *Financial Management in the Sport Industry*. Routledge.
12. Winfree, J. A., & Rosentraub, M. S. (2017). *Sports Finance and Management: Real Estate, Entertainment, and the Remaking of the Business*. Taylor & Francis.
13. Foster, G., O'Reilly, N., & Cuskelly, G. (2018). *Sports Business Management: Decision Making Around the Globe*. Routledge.
14. Brown, M. T., & Shick, D. M. (2019). *Financial Management in the Sport Industry*. Routledge.
15. Conrad, M. (2018). *The Business of Sports: A Primer for Journalists*. Routledge.
16. Alamar, B. C. (2013). *Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers*. Columbia University Press.
17. Miller, T. W. (2019). *Sports Analytics and Data Science: Winning the Game with Methods and Models*. FT Press.
18. Marchi, M., Albert, J., & Baumer, B. (2014). *Analyzing Baseball Data with R*. Chapman and Hall/CRC.
19. Schumaker, R. P., Hwang, R. S. Y., & Chen, H. (2016). *Sports Data Mining*. Routledge.
20. Alamar, B. C. (2013). *Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers*. Columbia University Press.

References:

Course Outcome(s):

- i. Demonstrate a comprehensive understanding of sports management principles, including organizational structures, legal issues, and ethical considerations.
- ii. Evaluate marketing strategies and sponsorship opportunities in the sports industry, devising effective branding and promotional campaigns.
- iii. Apply financial management techniques to analyze revenue streams, control costs, and make informed investment decisions in sports organizations.
- iv. Utilize sports analytics tools and technology to enhance performance evaluation, strategic planning, and fan engagement initiatives.
- v. Synthesize course concepts through practical applications, demonstrating the ability to address real-world challenges in sports management scenarios.

National Cadet Corps (NCC)

This course develops essential skills in discipline, leadership, and tactical operations through structured curriculum and practical exercises. It emphasizes the role of drills in fostering discipline, leadership, and teamwork, and includes comprehensive weapon handling training with a focus on safety protocols. The course teaches map reading, understanding topographical features, and navigating diverse terrains. Practical units cover the history and objectives of the National Cadet Corps (NCC), various maneuvers, parade formations, saluting protocols, and field and battlecraft techniques. By the end, learners will master discipline, leadership, weapon handling, and tactical decision-making, effectively utilizing terrain features for strategic

advantages.

Course Objective(s):

1. Understand the foundational role of drill in fostering discipline and leadership within a group, enabling effective command towards achieving common goals.
2. Appreciate the importance of grace and dignity in executing foot drill movements, recognizing their significance in enhancing performance and teamwork.
3. Comprehend the criticality of weapon handling and detailed safety measures, emphasizing the importance of accident prevention through strict adherence to safety protocols.
4. Develop an awareness of diverse terrain types and their strategic significance in battle craft, enabling informed decision-making and effective utilization of terrain features for tactical advantage.

Course Content (Practical):

Unit 1:

Overview of NCC, its history, aims, objectives, and organizational structure, Incentives and duties associated with NCC cadetship; Maneuvers: Foot drill, Word of Command, Attention, and stand at ease, and Advanced maneuvers like turning and sizing; Parade formations: Parade line, open line, and closed line; Saluting protocols, parade conclusion, and dismissal procedures. Marching styles: style march, double time march, and slow march **(8 Hrs.)**

Unit 2:

Weapon Training, Handling firearms, Introduction and characteristics of the .22 rifle; Handling Firearm techniques, emphasizing safety protocols and Best practices. **(7 Hrs.)**

Unit 3:

Map Reading (MR): Topographical forms and technical terms, including relief, contours, and gradients, crucial for understanding terrain features; Cardinal points, magnetic variation and grid convergence **(8 Hrs.)**

Unit 4:

Field Craft & Battle Craft (FC & BC): Fundamental principles and techniques essential for effective field and battle craft operations; Methods of judging distance, including estimation, pacing, and visual cues **(7 Hrs.)**

References:

- DGNCC Cadet's Hand Book - Common Subjects -All Wings
- Tiwari, R. (2019). NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
- Chhetri, R.S. (2010). Grooming Tomorrows Leaders, The National Cadet Corps.
- [Directorate General National Cadet Corps](#) (2003). National Cadet Corps, Youth inAction.
- Vanshpal, Ravi (2024). The NCC Days, Notion Press.

Course Outcome(s):

1. Mastery of Discipline and Leadership through Drill Learners would demonstrate the ability to effectively command a group, foster discipline, and work collaboratively towards achieving shared objectives.
2. Mastery of Grace and Dignity in Foot Drill Performance Learners would demonstrate an understanding of how these qualities enhance performance and foster teamwork within a group setting.
3. Proficient Weapon Handling and Safety Adherence Learners would showcase a thorough understanding of the criticality of safety measures, emphasizing accident prevention through strict adherence to safety protocols.
4. Enhanced Tactical Awareness and Strategic Decision-Making Learners would gain the ability to make informed decisions and effectively utilize terrain features to gain tactical advantage during operations.

National Service Scheme (NSS)

This course provides students with an in-depth understanding of the National Service Scheme (NSS), including its history, philosophy, aims, objectives, and organizational structure. It equips students with knowledge about various NSS programmes and activities, emphasizing their relevance and importance. The course also develops skills in community mobilization, teaching students effective techniques for engaging and mobilizing community stakeholders. Additionally, it cultivates an appreciation for volunteerism and shramdan (voluntary labor), highlighting their role in community development initiatives. By the end of the course, students will have a comprehensive understanding of NSS, enhanced leadership and team-building skills, and a strong sense of social awareness and patriotism.

Course Objective(s):

1. To provide students with an understanding of the history, philosophy, and basic concepts of the National Service Scheme (NSS).
2. To familiarize students with the aims, objectives, and organizational structure of NSS.
3. To equip students with knowledge about NSS programmes, activities, and their relevance.
4. To develop an understanding of community mobilization techniques and their importance in NSS activities.
5. To cultivate an appreciation for volunteerism, shramdan (voluntary labor), and their role in community development initiatives.

Course Content:**Unit 1: Introduction and Basic Concepts of NSS****(8 Hrs.)**

National Service Scheme (NSS) - history, philosophy, and fundamental concepts, aims and objectives, providing clarity on the organization's overarching goals. Symbols of NSS - Emblem, flag, motto, song, and badge; Organizational structure of NSS

Unit 2: NSS Programmes and Activities**(7 Hrs.)**

Diverse programmes and activities conducted under the aegis of the National Service Scheme (NSS); Significance of commemorating important days recognized by the United Nations, Centre, State Government, and University; Examination of the methodology for adopting villages/slums and conducting surveys; Financial patterns of the NSS scheme

Unit 3: Community Mobilization

(8 Hrs.)

Dynamics of community mobilization within the framework of the National Service Scheme (NSS); Functioning of community stakeholders; The conceptual lens of community development

Unit 4: Volunteerism and Shramdan in the Indian Context: Roles and Motivations within the NSS Framework

(7 Hrs.)

Ethos of volunteerism and shramdan (voluntary labor) within the cultural context of India and the framework of the National Service Scheme (NSS); Motivations and constraints shaping volunteer engagement; Role of NSS volunteers in initiatives such as the Swachh Bharat Abhiyan and Digital India

References:

1. Ministry of Youth Affairs and Sports, Government of India. (2022). National Service Scheme (NSS) Manual.
2. Agarwalla, S. (2021). NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. (2024). Stories Of NSS (English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. (2022). NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. (2024). The motivation and engagement of student volunteers in volunteerism at the University of Gondar. *Discover Global Society*, 2(1), 1-16.
6. Saha, A. K. (2002). Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, 6(3), 209-214.
7. Mills, S. (2013). “An instruction in good citizenship”: scouting and the historical geographies of citizenship education. *Transactions of the Institute of British Geographers*, 38(1), 120–134. <http://www.jstor.org/stable/24582445>
8. Mishra, S. K., Sachdev, S., Marwaha, N., & Avasthi, A. (2016). Study of knowledge and attitude among college-going students toward voluntary blood donation from north India. *Journal of blood medicine*, 19-26.
9. Mukherji, B. (2007). Community Development in India. Orient Longmans.
10. History Background of NSS and its Philosophy, Aims and Objectives
11. <https://www.osmania.ac.in/NSS%20URL/9.%20%20Historical%20Background%20of%20NSS%20and%20its%20Philosophy,%20Aim.pdf>
12. In Defence of Nationalism <https://www.mkgandhi.org/indiadreams/chap03.htm>
13. Unlocking Youth Potential for Nation Building: Strengthening NYKS and NSS
14. <https://www.undp.org/india/projects/strengthening-nyks-and-nss>

Course Outcome(s):

1. Students will demonstrate an understanding of the history, philosophy, and objectives of the National Service Scheme (NSS), thereby fostering increased social awareness and patriotism among them.
2. Students will be able to organize and conduct various NSS programmes and activities effectively and through it understand the importance of leadership and team building.
3. Students will develop skills in community mobilization and partnership building.
4. Students will appreciate the importance of volunteerism and shramdan in societal development and thus, be able to understand role of community participation.

DISASTER MANAGEMENT

5. In our rapidly evolving 21st-century world, challenges emerge in diverse forms, transcending borders and intertwining economic, societal, and environmental realms. These challenges profoundly affect vulnerable communities, magnifying their susceptibility to climate-related shocks and disasters. As we navigate through these complexities, it becomes increasingly evident that aligning strategies with global Sustainable Development Goals (SDGs) across various geographical scales is paramount. This alignment incorporates perspectives of environmental sustainability, climate adaptation, and disaster resilience. In light of these considerations, this course aims to equip students with the knowledge and skills necessary to address and mitigate the impacts of disasters in a holistic manner.

Course Objective(s):

- to provide understanding of the concepts related to disaster
- to highlight the importance and role of disaster management
- to enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

Course Content:**Unit 1: Concepts and Terminologies****(8 Hrs.)**

Understanding key concepts of Hazards, disasters; Disaster types and causes (Geophysical, Hydrological, Meteorological, Biological and Atmospheric; Human-made); Global trends in disasters - Impacts (Physical, Social, Economic, Political, Environmental and Psychosocial); Defining Vulnerability (Physical Vulnerability; Economic Vulnerability; Social Vulnerability)

Unit 2: Key concepts of Disaster Management Cycle**(7 Hrs.)**

Components of disaster management cycle (Phases: Response and recovery, Risk assessment, Mitigation and prevention, Preparedness planning, Prediction and warning); Disaster risk reduction (DRR), Community based disaster risk reduction

Unit 3: Initiatives at national and international level**(8 Hrs.)**

Disaster Risk Management in India and at international level: Related policies, plans, programmes and legislation; International strategy for disaster reduction and other initiatives

Unit 4: Emergency Management

(7 Hrs.)

Explosion and accidents (Industrial, Nuclear, Transport and Mining) - Spill (Oil and Hazardous material); Threats (Bomb and terrorist attacks) - Stampede and conflicts

Training and Demonstration Workshops (at least two workshops) be organized in association with the NIDM, NDRF, NCDC, Param Military, Fire Brigade, CISF, local administration etc.

Readings

1. Sharma, S.C. (2022), Disaster Management, Khanna Book Publishing.
2. Clements, B. W., (2009): Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) (2009): Disaster Management and Human HealthRisk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability andMitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N. (1991) Disaster Management: A Disaster Management Handbook. Asian Development Bank, Manila.
8. Govt. of India (2008) Vulnerability Atlas of India. BMTPC, New Delhi.
9. Govt. of India (2011) Disaster Management in India. Ministry of Home Affairs, New Delhi.
10. Matthews , J.A., (2002) Natural Hazards and Environmental Change, Bill McGuire, IanMason.

E-Resources

<http://www.ndma.gov.in/en/> <http://nidm.gov.in/>
<https://www.unisdr.org/> <http://www.emdat.be>
<https://www.weather.gov/safety/>
<https://www.preventionweb.net/risk/vulnerability>

Course Outcomes:

Upon successful completion of this course, students will be able to:

- i. Articulate the critical role of disaster management in reducing risks and enhancing resilience
- ii. Identify and describe key institutional frameworks and processes in disaster management.
- iii. Conduct risk assessments and develop disaster management plans for specific scenarios

SEMESTER-IV

101CC 204/ 102CC 204	Entrepreneurship and Startup Ecosystem	1L:1T:0P	2 Credits
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Course Objective(s):

- To understand Entrepreneurship and its types
- To understand that not all ideas can be turned into viable business models and guestimatebusiness potential of an idea
- To understand different type of finances available and financing methods
- To be able to draft business plans on an identified idea
- To understand the nuances of operating a startup – low budget marketing, stabilizing operations, build a team from scratch and scaling the business
- To know what is a Family Business and how is it different from Entrepreneurship

Course Content:

Unit 1: Introduction to Entrepreneurship & Family Business (4 Hrs.)

- Definition and Concept of entrepreneurship
- Entrepreneur Characteristics
- Classification of Entrepreneurs
- Role of Entrepreneurship in Economic Development –Start-ups
- Knowing the characteristics of Family business with discussion on few Indian cases ofFamily Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.

Unit 2: Evaluating Business opportunity (4 Hrs.)

- Sources of business ideas and opportunity recognition
- Guesstimating the market potential of a business idea
- Feasibility analysis of the idea
- Industry, competition and environment analysis

Unit 3: Building Blocks of starting ventures (4 Hrs.)

- Low cost Marketing using digital technologies
- Team building from scratch
- Venture Funding
- Establishing the value-chain and managing operations
- Legal aspects like IPR and compliances

Unit 4: Start-up Ecosystem

(4 Hrs.)

- Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc.
- Know various govt. schemes like Start-up India, Digital India, MSME etc.
- Sources of Venture Funding available in India
- Source of Technology, Intellectual Property management

Text Books (Latest Edition):

1. *Startup India Leaning Program* by Start Up India available at www.startupindia.gov.in
2. *Entrepreneurship*, Rajeev Roy, Oxford University Press
3. *Entrepreneurship: Successfully Launching New Ventures* by R. Duane Ireland Bruce R. Barringer, Pearson Publishing
4. *Family Business Management* by Rajiv Agarwal, Sage Publishing
5. Anish Tiwari (2003), "Mapping the Startup Ecosystem in India", *Economic & Political Weekly*
6. Ramachandran, K, *Indian Family Businesses: Their survival beyond three generations*, ISB Working Paper Series

References

Course Outcome(s):

At the end of the course, the student would be able to -

- Understand basic building blocks of creating a venture
- Be able to identify a business opportunity and translate it into a viable business model
- Identify the elements of the Indian entrepreneurship ecosystem and take relevant benefits from the constituents
- Know the legacy of family businesses and key differentiations from entrepreneurship

101CC205/ 102CC205	Computer Networks	3L:0T:0P	3 Credits
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Course Objectives:

- CO1: Understand the fundamental concepts of Computer Networks and their applications.
CO2: Develop problem-solving skills related to network design, implementation, and troubleshooting.
CO3: Implement network protocols and configure network devices.

Prerequisites:

1. Basic Networking Knowledge: Familiarity with basic networking concepts such as IP addressing and network topologies.
2. Programming Skills: Ability to write basic network programs and scripts in languages such as Python or C.
3. Operating Systems: Understanding of OS concepts related to networking, such as process management and memory allocation

Course Content:

UNIT-I	Introduction to Computer Networks Overview of Computer Networks: Definition and Objectives, Applications and Examples Network Components and Architecture Network Models: OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models Network Topologies: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology Data Transmission: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency Networking Devices: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device. (12 Hrs.)
UNIT-II	Data Link Layer and Networking Protocols Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms. Ethernet: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods Network Protocols: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation. (11 Hrs.)
UNIT-III	Network Layer and Transport Layer Network Layer: IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT) Transport Layer: TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption (11 Hrs.)
UNIT-IV	Application Layer and Emerging Technologies Application Layer Protocols: HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and

	Resolution Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP(VoIP) and Streaming. Emerging Technologies: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking Network Management: SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques. (11 Hrs.)
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Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.

Reference Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
3. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023.
4. Mastering PC Hardware & Networking, Khanna Publishing House, 2024.

Web Resources:

1. Cisco Networking Academy - Online Courses and Resources
2. NetworkLessons.com - Tutorials on Various Networking Topics

101LabCC205/ 102LabCC205	Computer Networks	0L:0T:4P	2 Credits
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Lab Programs:

1. Configure Basic Network Settings:
 - a) IP Address Configuration
 - b) Subnet Mask and Gateway Settings
2. Implement Network Protocols:
 - a) Write a simple Python script to perform DNS resolution.
 - b) Implement a basic HTTP client-server application.
3. Network Simulation:
 - a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.
 - b) Configure routers and switches in a simulated environment.
4. Performance Measurement:
 - a) Measure network performance using tools like `ping`, `traceroute`, and `iperf`.
 - b) Analyze network traffic using Wireshark.
5. Set Up a Simple Web Server:
 - a) Deploy a basic web server and configure HTTP/HTTPS access.
6. Network Security Lab:
 - a) Implement basic firewall rules and VPN configurations.
 - b) Perform vulnerability scanning and analyze results.
7. Network Troubleshooting:
 - a) Diagnose and resolve common network issues.
 - b) Use troubleshooting commands and techniques to fix connectivity problems.

101CC206/ 102CC206	Design and Analysis of Algorithm	3L:0T:0P	3 Credits
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Course Objectives

- CO1: This course envisions to impart to students the understanding of basic algorithm designing paradigms.
- CO2: This course introduces the basic knowledge on how to analyse an algorithm.
- CO3: This course expects to enable a student to synthesize efficient algorithms in common design situations and real-life problems.

Prerequisite: Knowledge of Data Structures

Course Content:

UNIT-I	What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity. Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms. Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication. Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem (12 Hrs.)
UNIT-II	The Divide & Conquer Design Technique: The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication. Lower bound for comparison-based sorting. The Greedy Design Technique: The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem. (11 Hrs.)
UNIT-III	The Dynamic Programming Design Technique: The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem. Algorithms on Graphs: Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting. (11Hrs.)
UNIT-IV	Limitations of Algorithmic Power: Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem. Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems. (11 Hrs.)

Text Books

1. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
2. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.
4. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012

Reference Books

1. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
2. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.

Web Resources

1. <https://nptel.ac.in/courses/106101060>
2. <https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf>

101CC207/ 102CC207	Artificial Intelligence	3L:0T:0P	3 Credits
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Prerequisites:

Basic understanding of computer science concepts, including data structures and algorithms. Proficiency in minimum one programming language, such as Python.

Course Content:

UNIT-I	Introduction to AI What is AI? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World. Problem-solving: Problem-solving agents. (12 Hrs)
UNIT-II	Advanced Search Techniques Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. (11 Hrs.)
UNIT-III	Logical Reasoning and Uncertainty Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. Introduction to Planning: Blocks World problem, Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy logic. (11 Hrs.)
UNIT-IV	Domains and Applications of AI Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks, and their Applications. Expert Systems: The architecture and role of expert systems. (11 Hrs.)

Text Books:

1. M.C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).
2. Nilsson Nils J, *Artificial Intelligence: A new Synthesis*, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
3. Dan W Patterson, *Introduction to Artificial Intelligence & Expert Systems*, PHI Learning 2010.
4. Rajiv Chopra, *Data Science with Artificial Intelligence, Machine Learning and Deep Learning*, Khanna Book Publishing Company, 2024.

Reference Books:

1. M.C. Trivedi, *Introduction to AI and Machine Learning*, Khanna Book Publishing Company, 2024.
2. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd

edition, Prentice Hall

3. Van Hirtum, A. & Kolski, C. (2020). *Constraint Satisfaction Problems: Algorithms and Applications*. Springer
4. Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.

Course Outcomes:

- CO1: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents.
- CO2: Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications.
- CO3: Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning.
- CO4: Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets.
- CO5: Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI

Artificial Intelligence Lab

Prerequisites: Basic understanding of algorithms and data structures (e.g., trees, graphs, lists). Proficiency in Python programming, including libraries like NLTK for NLP tasks.

101LabCC207/ 102LabCC207	Artificial Intelligence	0L:0T:4P	2 Credits
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LAB Experiments

The lab experiments may be implemented in Python. Libraries like NLTK, Tensorflow and Keras may be used for Machine learning experiments.

Suggested list of Experiments (not limited to):

1. Demonstrate basic problem-solving using Breadth-First Search on a simple grid.
2. Implement Depth-First Search (DFS) on a small graph.
3. Solve the Water Jug Problem using Breadth First Search (BFS).
4. Implement a Hill Climbing search to find the peak in a numeric dataset.
5. Apply the A* Search algorithm to find the shortest path in a 4x4 grid.
6. Implement the Minimax search algorithm for 2-player games. You may use a game tree with 3 plies.
7. Solve the 4 – Queens Problem as a CSP backtracking problem.
8. Use constraint propagation to solve a Magic Square puzzle.
9. Apply optimization techniques to find the maximum value in a list.
10. Represent and evaluate propositional logic expressions.
11. Implement a basic rule-based expert system for weather classification.
12. Implement a basic AI agent with simple decision-making rules.
13. Implement a basic Rule-Based Chatbot.
14. Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content.
 - a) Tokenizing
 - b) Filtering Stop Words
 - c) Stemming
15. Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content.
 - a) Part of Speech tagging
 - b) Chunking
 - c) Named Entity Recognition (NER)

Course outcomes:

CO1: Apply Uninformed Search Algorithms and Implement Heuristic Search techniques
CO2: Analyze and Solve Constraint Satisfaction Problems
CO3: Develop Rule-Based Systems
CO4: Implement and Evaluate Optimization Techniques
CO5: Apply and illustrate the NLP concepts

101DSE202	Introduction to ML	1L:0T:0P	1 Credits
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Prerequisites: Basic knowledge of statistics and probability. Familiarity with fundamental programming concepts and proficiency in Python.

Course Content:

UNIT-I	Introduction to Machine Learning Introduction: Definition, History and Application of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi Supervised, and Reinforcement Learning. Labeled and Unlabeled Dataset. Supervised Learning Tasks: Regression vs. Classification, Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC. (8 Hrs.)
UNIT-II	Supervised Learning and Unsupervised Learning Regression: Linear and non-linear Regression, Logistic Regression. <i>Classification</i> : Naïve Bayes, K Nearest Neighbors, Decision Trees. Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data. <i>Clustering</i> : K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. <i>ML Applications</i> : Ethical Considerations in Machine Learning, Case study and Real-world Applications. (7 Hrs.)

Text Books:

1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2. JeevaJose(2023), Introduction to Machine Learning, Khanna Publishing House.
3. Mitchell T.(1997). Machine Learning, First Edition, McGraw-Hill.
4. Kalita, J. K., Bhattacharyya, D. K. , & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780

Reference Books:

1. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN:9781107422223, 2012.
2. Duda, R. O., Hart, P. E., Stork, D. (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.
4. Chollet, F. (2018). Deep Learning with Python. Manning Publications.
5. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
7. Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media.

Course Outcomes

- CO1: Define and explain machine learning concepts, types, and basic metrics.
- CO2: Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression).
- CO3: Apply unsupervised learning methods (e.g., K Means, Hierarchical Clustering, Association Rules).
- CO4: Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks).
- CO5: Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.

101LabDSE202	Introduction to ML	0L:0T:4P	2 Credits
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Prerequisites: Understanding of machine learning algorithms and concepts (e.g., classification, clustering, regression). Proficiency in Python programming, with experience using libraries such as NumPy, pandas, Scikit-Learn, NLTK, Matplotlib, and Seaborn.

LAB Experiments

The lab experiments may be implemented in Python using relevant ML libraries, and data sets from Kaggle, public repositories, or generated datasets.

Suggested list of Experiments (not limited to):

1. Implement linear regression on a dataset and visualize the regression line.
2. Implement logistic regression on a binary classification data set and plot the decision boundary.
3. Implement and evaluate the performance of Decision tree ID3/ Cart classifier for any given dataset.
4. Implement and evaluate the performance of the Naïve Bayes Classifier on a given dataset.
5. Build and evaluator and om forest classifier using a numerical dataset.
6. Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary.
7. Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.
8. Implement hierarchical clustering on a dataset.
9. Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.
10. Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.
11. Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow / Keras) and visualize their decision boundaries. Also evaluate its performance.
12. Demonstrate the concept of boosting using the Ada Boost algorithm.

Course Outcomes

- CO1: Implement and evaluate supervised learning techniques, including K-Nearest Neighbors, linear regression, and logistic regression, and measure model performance using accuracy, precision, recall, and F1 score.
- CO2: Apply and visualize clustering algorithms such as K-Means, hierarchical clustering, and DBSCAN on datasets. This practical application helps you understand their real-world use.
- CO3: Perform dimensionality reduction using Principal Component Analysis (PCA) and interpret the results.
- CO4: Develop and assess classification models using random forests, support vector machines, and neural networks.
- CO5: Demonstrate ensemble learning concepts through bagging with random forests and boosting with the AdaBoost algorithm.

102DSE202	Data Visualization	1L:0T:0P	1 Credits
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Course Objectives

- CO1: Understand the fundamentals of data visualization and its importance.
CO2: Learn about visual perception and its impact on data interpretation.
CO3: Explore the ethical considerations and challenges in data visualization.
CO4: Study different types of visualizations and their appropriate uses.
CO5: Utilize Power BI to create and customize various types of visualizations.

Prerequisite:

Familiarity with using a computer, including file management and basic software navigation.
Basic knowledge of data structures, such as tables and databases. Basic understanding of data analysis concepts and familiarity with data types.

Course Content:

UNIT-I	Introduction to Data Visualization Definition and importance of data visualization-Role of data visualization in decision making-Types of data (numerical, categorical, temporal, geographical)-Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization Visualization tools: Overview of Visualization Tools (e.g., Excel, Tableau, PowerBI, Python) - Comparing and contrasting features and Use Cases among these tools. (8 Hrs)
UNIT-II	Principles of Data Story telling : Narrative and Context-Best Practices for Dashboard Layout and Interactivity Designing Effective Visualizations Principles of Good Visualization Design - Understanding and Using Color in Visualizations -Importance of Data Modelling in Visualization. (9 Hrs.)

TextBooks

1. "Story telling with Data : A Data Visualization Guide for Business Professionals " Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.
2. "The Visual Display of Quantitative Information " by Edward Tufte, Graphics Press USA ; 2nd edition, 2001.

Reference Books

1. "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.
2. "Analyzing Data with Power BI and Power Pivot for Excel ", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.
3. "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

Web Resources

1. <https://learn.microsoft.com/en-us/power-bi/>
2. <https://www.storytellingwithdata.com/>
3. https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20Data%20Visualization_Spring%202024.pdf

102DSE202	Data Visualization LAB	0L:0T:4P	2 Credits
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Lab Programs for Data Visualization Using Power BI

Introduction to Power BI Interface and Basics

1. Installation and interface overview
2. Exploring the Power BI workspace : Ribbon, panes, and canvas.
3. Importing data from Excel and CSV files.
4. Introduction to multiple data sources
5. Basic report creation : Adding visuals and saving a report.

Data Transformation and Preparation

1. Using Power Query Editor
2. Cleaning data : Removing duplicates, handling missing values.
3. Transforming data : Splitting columns, changing datatypes, renaming columns.
4. Merging and appending queries.
5. Creating custom columns and calculated columns

Data Modeling

1. Creating relationships between tables
2. Identifying and resolving data inconsistencies
3. Creating calculated columns and measures

Creating Basic Visualizations

1. Creating various chart types (bar, column, line, pie, area, etc.,)
2. Formatting and customizing visualizations

Publishing and Sharing Reports

1. Publishing a report to Power BI Service.
2. Sharing reports and dashboards with team members.
3. Setting up data refresh schedules and managing permissions.

101SEC202/ 102SEC202	Design Thinking and Innovation	1L:1T:0P	2 Credits
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Course Objectives:

Operating under turbulent and uncertain business environment, ‘innovation’ has become the key driver of organizational success for all companies. Managers are expected to be leading this change by navigating companies into rapid evolution of new products/services and business models.

The primary focus of DTI is to help learners develop creative thinking skills and apply design based approaches/tools for identifying and implementing innovation opportunities into implementable projects. Following a learning-by-doing approach, the objectives of the course are

—

1. Introduce students to design-based thinking approach to solve problems
2. Observe and assimilate unstructured information to well framed solvable problems
3. Introduce student to templates of ideation
4. Understand the importance of prototyping in the innovation journey
5. Implementing innovation projects

Course Content:

Unit 1: Basics of Design Thinking (8 Hrs.)

1. Understand the concept of innovation and its significance in business
2. Understanding creative thinking process and problem solving approaches
3. Know Design Thinking approach and its objective
4. Design Thinking and customer centricity – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product.
5. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc.
6. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement

Unit 2: Learning to Empathize and Define the Problem (7 Hrs.)

1. Know the importance of empathy in innovation process – how can students develop empathy using design tools
2. Observing and assimilating information
3. Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences.
4. What are wicked problems
5. Identifying wicked problems around us and the potential impact of their solutions

Unit 3 : Ideate, Prototype and Implement (8 Hrs.)

1. Know the various templates of ideation like brainstorming, systems thinking
2. Concept of brainstorming – how to reach consensus on wicked problems
3. Mapping customer experience for ideation
4. Know the methods of prototyping, purpose of rapid prototyping.
5. Implementation

Unit 4 : Feedback, Re-Design & Re-Create

(7 Hrs.)

1. Feedback loop, focus on User Experience, address ergonomic challenges, user focused design
2. Final concept testing,
3. Final Presentation – Solving Problems through innovative design concepts & creative solution

Text Books (Latest Edition):

1. E Balaguruswamy (2023), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
2. Tim Brown, (2008), “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, *Harvard Business Review*
3. 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing

Reference Book

1. Design Thinking by Nigel Cross, Bloomsbury

Course Outcome(s):

By the end of the course, students will be able to –

- Propose real-time innovative product designs and Choose appropriate frameworks, strategies, techniques during prototype development.
- Know wicked problems and how to frame them in a consensus manner that is agreeable to all stakeholders using appropriate frameworks, strategies, techniques during prototype development.
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI



THREE-YEAR UNDERGRADUATE PROGRAMME

Bachelor in Computer Application (BCA)

102 - Data Science

Semester - V and VI

FACULTY: SCIENCE AND TECHNOLOGY

(Courses effective from Academic Year 2026-27) Under NEP 2020

SYLLABUS

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Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology (Science Group)
Board of Studies in Computer Science
(including Computer Application, Information Technology, BCA etc.)

Sr. No.	Name	Designation	Address
01	Dr. Swati Sherekar	Chairman	PGTD in Computer Science and Engineering, SGBAU, Amravati
02	Dr. Dineshkumar N. Satange	Member (Faculty Member)	Smt. Narsamma Arts, Commerce and Science College, Kiran Nagar, Amravati. 444606
03	Dr. Mohd. Atique Mohd. Junaid	Member	HoD, PGTD in Computer Science and Engineering, SGBAU, Amravati
04	Dr. Avinash Baburao Kadam	Member	Shri Shivaji Science and Arts College, Chikhali Dist. Buldana
05	Dr. Ajay Purushottam Chendke	Member	Degree College of Physical Education (HVPM), Amravati
06	Dr. Chandrashekhar H. Sawarkar	Member	Smt. Narsamma Arts, Commerce and Science College, Kiran Nagar, Amravati. 444606
07	Dr. Arvind A. Tayade	Member	G.S. Science Arts and Commerce College, Khamgaon Dist. Buldana
08	Prof. Sudeshkumar Chaudhari	Member	RDIK, Mahavidyalaya, Badnera Rly. Amravati.
09	Dr. Narendra M. Jathe	Member	Smt. Narsamma Arts, Commerce and Science College, Kiran Nagar, Amravati. 444606
10	Dr. HomrajPatelpaik	Member	Lokmanya Tilak Mahavidyalaya Wani, Dist. Yavatmal
11	Prof. Sureshkumar Mapari	Member	Rajasthan Aryan Arts, Shri Mithulal Kacholia Commerce and Shri SatyanarayanjiRamkrishnaji Rathi Science College, Washim

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science and Technology
Teaching, Learning and Examination Scheme
(Three Years- Six Semesters Bachelor in Computer Application (BCA)Stream: Data Science
(Four Years- Eight Semesters Bachelor in Computer Application (Honours) [(BCA)-Honours] &
(Four Years- Eight Semesters Bachelor in Computer Application (Honours with Research) [(BCA)-(Honours with Research)]

THIRD YEAR: SEMESTER – V

The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Mode of Examination, Evaluation & Assessment	Examination Theory/Practical				Examination Theory/ Practical/ Tutorial (Total)	
							External		Internal			
							Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Skill Enhancement courses (SEC)	Tutorial-3	102SEC301	Quantitative Techniques	2	2	Internal	60	18	40	12	100	40
	Lab/ Practical-5	102LabSEC302	*Internship/capstone Project	4	8	External & Internal	60	18	40	12	100	40
	Lab/ Practical-6	102LabSEC303	Major Project [evaluation in sixth semester]	0	4	--	--	--	--	--	--	--
Discipline Specific Elective (DSE)	Theory-3	102DSE301	Introduction to Data Science	3	3	External & Internal	60	18	40	12	100	40
	Lab/ Practical-3	102LabDSE301	Laboratory on Introduction to Data Science	2	4	External & Internal	60	18	40	12	100	40
	Theory-4	102DSE302	Time Series Analysis	3	3	External & Internal	60	18	40	12	100	40
	Lab/ Practical-4	102LabDSE302	Laboratory on Time Series Analysis	2	4	External & Internal	60	18	40	12	100	40
	Theory-5	102DSE303	Machine Learning	3	3	External & Internal	60	18	40	12	100	40
	Lab/ Practical-5	102LabDSE303	Laboratory on Machine Learning	2	4	External & Internal	60	18	40	12	100	40
Total:				21	35							

Special Note: External Examination (Theory and Practical) shall be conducted by University and Internal Examination (Theory and Tutorial) shall be conducted by college

***Internship/capstone Project: Students may engage with either Internship or capstone Project.**

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science and Technology
Teaching, Learning and Examination Scheme
(Three Years- Six Semesters Bachelor in Computer Application (BCA)Stream: Data Science
(Four Years- Eight Semesters Bachelor in Computer Application (Honours) [(BCA)-Honours] &
(Four Years- Eight Semesters Bachelor in Computer Application (Honours with Research) [(BCA)-(Honours with Research)]

THIRD YEAR: SEMESTER –VI

The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Mode of Examination, Evaluation & Assessment	Examination Theory/Practical				Examination Theory/ Practical/ Tutorial (Total)	
							External		Internal			
							Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Core Courses (CC)	Theory-13	102CC301	Generative AI	2	2	External & Internal	60	18	40	12	100	40
	Lab/ Practical-7	102LabCC301	Laboratory on Generative AI	2	4	External & Internal	60	18	40	12	100	40
Ability Enhancement Courses (AEC)	Tutorial-4	102TuAEC301	Soft Skills	1	1	Internal	--	--	50	20	50	20
Skill Enhancement courses (SEC)	Lab/ Practical-7	102LabSEC304	Major Project [Initiated in 5th Semester]	4	4	External & Internal	60	18	40	12	100	40
Discipline Specific Elective (DSE)	Theory-6	102DSE304	Big Data Analytics	3	3	External & Internal	60	18	40	12	100	40
	Lab/ Practical-6	102LabDSE304	Laboratory on Big Data Analytics	2	4	External & Internal	60	18	40	12	100	40
	Theory-7	102DSE305	Exploratory Data Analysis	3	3	External & Internal	60	18	40	12	100	40
	Lab/ Practical-7	102LabDSE305	Laboratory on Exploratory Data Analysis	2	4	External & Internal	60	18	40	12	100	40
Total:				19	25							

Special Note: External Examination (Theory and Practical) shall be conducted by University and Internal Examination (Theory and Tutorial) shall be conducted by college

Skill Enhancement Course: Quantitative Techniques

102SEC301	Quantitative Techniques	0L:2T:0P	2 Credits
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Course Objectives:

CO1: Develop students' quantitative aptitude and numerical problem-solving skills using fundamental mathematical concepts.

CO2: Enhance logical, analytical, and reasoning abilities required for solving competitive examination and placement aptitude questions.

CO3: Strengthen students' understanding of arithmetic, algebraic, and statistical concepts for practical applications.

CO4: Improve critical thinking, decision-making, and logical interpretation through verbal and non-verbal reasoning.

CO5: Prepare students for campus recruitment tests, competitive examinations, and real-life problem-solving by developing speed, accuracy, and analytical skills.

Course Content:

Unit	Content	Teaching Hours.
1	Numbers System: Simplification, Divisibility, HCF and LCM, Decimal Fractions, Square roots and Cube Roots. Mean, median, mode. Probability, Permutation and Combination. Odd man out and series: Number series, letter series, coding and decoding. Problems on blood Relationships and classification.	7 hrs.
2	Work, time and efficiency, Age Problems, Problems on Clock and Calendar. Time and Distance: Problems of Train, Boats and Streams, Pipes and Cistern. Calculating surface area and volume. Money and Interest: Simple Interest, Compound Interest.	8 hrs.
3	Averages, Percentage, Sitting arrangement, Direction Sense. Profit and Loss, Ratio and Proportion, Partnership, Allegation / mixture. Understanding the structure of arguments; Evaluating and distinguishing deductive and inductive reasoning; Verbal analogies: Word analogy Applied analogy; Verbal classification; Reasoning Logical Diagrams: Simple diagrammatic relationship, multi diagrammatic relationship; Venn diagram; Analytical Reasoning.	7 hrs.
4	Data Interpretation: Tabulation, Bar Graphs, Pie Charts, Line Graphs. Data Interpretation Sources, acquisition and interpretation of data; Quantitative and qualitative data; Graphical representation and mapping of data.	8 hrs

Course Outcomes:

CO1:**Understanding of Quantitative Methods:** Students learn to use quantitative methods for objective measurements and statistical analysis of data.

CO2:**Statistical Knowledge:** The course prepares students for future courses with quantitative components, enhancing their analytical skills.

CO3:**Decision-Making Skills:** Students develop decision making skills based on data analysis, which is crucial for informed business decisions.

CO4:**Analytical Ability:** The course enhances analytical ability to solve real- world problems using statistical methodologies.

CO5:**Data Interpretation:** Students gain the ability to interpret data and make informed decisions based on statistical results.

These outcomes are essential for students aiming to excel in their careers in the IT and software sectors, where data analysis and decision-making are critical.

Text Books

1. R.S.Aggarwal,QuantitativeAptitude,S.Chand&Company,NewDelhi, 2012
2. GovindPrasadSinghandRakeshKumar,TextBookofQuickest Mathematics(for all Competitive Examinations), Kiran Prakashan, 2012.
- 3.R.S.Aggarwal, ObjectiveArithmetic, S.Chand&Company,NewDelhi, 2005.
- 4.Dr.Lal,Jain,Dr.K.C.Vashistha,“U.G.C.-NET/JRF/SETTeaching&Research Aptitude”, Upkar Prakashan, 2010.

Reference Books

1. Arun Sharma, How to Prepare for Quantitative Aptitude for CAT, McGraw Hill Education, 11th Edition,2024.
2. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, McGraw Hill Education,Latest Edition.

Assessment Rubric: Internal for Tutorial

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – V (102-Data Science)			
Theory	Course Code:101SEC301	Course Title:Quantitative Techniques	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Skill Enhancement Course: Internship/Capstone Project

102LabSEC302	Internship/Capstone Project	0L:0T:8P	4 Credits
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1. Internship:

Course Objectives:	1. Gain practical exposure to industry, research organizations, startups, or professional work environments related to Computer Science/ Computer Application. 2. Apply theoretical knowledge acquired during the academic program to real-world computing problems and industry practices. 3. Enhance professional skills such as communication, teamwork, leadership, project management, and workplace ethics. 4. Strengthen problem-solving, analytical thinking, innovation, and decision-making abilities through experiential learning. 5. Understand organizational structure, work culture, professional responsibilities, and industry standards.
Course Outcomes:	On completion of the Internship students will be able to - 1. Demonstrate the ability to apply Computer Science/ Computer Application concepts, tools, and technologies in real workplace or project environments. 2. Analyze industry-specific problems and develop appropriate technical solutions using modern computing techniques. 3. Communicate effectively with team members, supervisors, clients, and stakeholders through reports, presentations, and discussions. 4. Demonstrate teamwork, leadership qualities, project management skills, and collaborative learning abilities. 5. Prepare internship reports documenting objectives, methodology, activities performed, outcomes achieved, and lessons learned. 6. Evaluate industry practices and identify opportunities for innovation, entrepreneurship, higher studies, research, and career development.
Contents Internship in Computer Application (During vacations/break period of Semester V and Semester VI) for duration of 8 hours/Week mandatory to all the students, to be completed during vacations of Semester V and/or VI. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester V credit grade report. General Guidelines 1. The examinee shall be required to produce hard copy and soft copy of completion of internship certificate duly signed by competent authority to Faculty Mentors.	

2. Student can take internship work in the form of Online/Onsite mode.
3. Research internship under Faculty member (Internal and External), IISC, IIT's, NIT's, research project or innovative project and other Research organizations also be considered.

Guidelines for Internship for Under Graduate Students:

For understanding key principles of Guidelines for Internship for Under Graduate Students published by UGC on 2023. Please refer https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

Internship Work Evaluation:

1. The parent HEI will examine/evaluate the student's performance following its evaluation method.
2. The interns will be evaluated by research internship supervisor based on their efforts and research output.
3. The interns will be evaluated through seminar presentation or viva-voce at the HEI, (marks will be given by a group of experts from HEI including the supervisor).
4. Students will be allotted to faculty mentors/supervisor
5. Student need to submit at least one/two progress report, attendance, and regular supporting documents to faculty mentors/supervisor

Assessment Rubric/Internal evaluation for the Internship

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – V (102-Data Science)			
Internship	Course Code: 101LabSEC302	Internship in Computer Application	Max Marks: 40
Sr. No.	Exercise		Marks
1	Activity logbook and evaluation report of Internship Supervisor		10
2	Format of presentation and the quality of the intern’s report		10
3	Regular Attendance		20
Total:			40

Assessment Rubric/External evaluation for the Internship

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – V (102-Data Science)			
Internship	Course Code: 101LabSEC302	Internship in Computer Application	Max Marks: 60
Sr. No.	Exercise		Marks
1	Acquisition of skill sets by the intern		10
2	Originality and any innovative contribution		10
3	Significance of research outcomes		15
4	Seminar/Viva-Voce /Presentation (PPT) (Visual clarity, and confidence, Findings etc.)		25
Total:			60

2. Capstone Project:

Course Objectives:	1. Promote integration and synthesis within the program of study. 2. Promote meaningful connections between the program of study and career experiences. 3. Improve learner's career preparation and pre professional developments. 4. Demonstrate professional identity as learner's transition from academic to professional World. 5. Use a real-world professional scenario- built out with employer engagement where ever possible. 6. Align skills to be assessed to a job. 7. Explicitly and intentionally developed important learner's skills, competencies and perspectives that are tacitly developed in the curriculum and required in the workplace. 8. Give learner's the freedom to showcase their learning though a demonstrable artifact or output e.g. Technical Product, System, Service that resolves a real-world problem.
Course Outcomes:	On successful completion of the capstone project, students will be able to: 1. Write Capstone project scope document 2. Prepare a capstone project execution plan 3. Manage the capstone project from start to finish meeting stated milestones and timelines

- | | |
|--|---|
| | 4. Test and validate the findings
5. Demonstrate interpersonal skills, teamwork, and effective use of appropriate technology required for the capstone project |
|--|---|

Capstone Project in Computer Application (During vacations/break period of Semester V and Semester VI) for duration of 8 hours/Week mandatory to all the students, to be completed during vacations of Semester V and/or VI. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester V credit grade report.

General Guidelines:

Responsibilities of the Head of the Department

The Head of the Department shall coordinate in Executing the Specialization Pathway Capstone projects, their responsibilities can be summarized as follows:

1. To ensure that the Capstone project scope document is relevant to the specialization pathway opted by the students in Fifth semester
2. To assign Cohort owner to the students
3. To maintain a centralized capstone project hub repository to facilitate capstone project management and keeping track of all capstone projects and design changes

Responsibilities of the Cohort owner

Students will be supervised by Cohort owner; their responsibilities can be summarized as follows:

1. To guide the students in writing the Capstone project scope document
2. To guide the students in preparing capstone project execution plan
3. To interact with the students once in a week to review the progress of the capstone project work, these sessions shall reinforce/review the concepts, findings and focus on addressing issues relevant to weekly meetings
4. To guide the students in managing the capstone project from start to finish, meeting the stated milestones and timelines
5. To guide the students in preparing the capstone project report
6. Develop appropriate Rubrics and evaluate the capstone project work as per assessment criteria
7. To oversee the capstone project work until the submission of the final report, and Semester End Examination
8. Maintain all the documents related to the capstone project work

Responsibilities of the Students

Students are also required to exercise self-discipline, self-management, job co-ordination, teamwork, and trustworthiness to ensure the success of the capstone project. The expected responsibilities are:

1. To write the Capstone project scope document
2. To prepare a capstone project execution plan
3. To adhere to the weekly meeting schedule with the cohort owner for the purpose of updating their progress and seeking advice on capstone project matters (Attendance is compulsory as per regulation) and submit weekly report

4. To Manage the capstone project from start to finish meeting stated milestones and timelines
5. To report immediately to the cohort owner any difficulties encountered that would interrupt the work
6. To submit all reports on time

Group Member Roles and Contributions

The Capstone project groups often function more effectively when group members have designated roles. Each capstone project group shall consist of not more than **four students**. The Three core roles and responsibilities are:

1. **Capstone project Lead:** One student in the group shall act as a capstone project lead, who is responsible for keeping the group on task, distributing the workload, meeting deadlines, and ensuring smooth group communication and coordination as well as accountability with the cohort owner and capstone project requirements
2. **Documenter Lead:** One student in the group shall act as a documenter lead, who is responsible for recording group discussions and decisions, documenting various aspects of the capstone project's progress, and ensuring well-formed reports and capstone project documents are produced.
3. **Development Lead:** Two students in the group shall act as a Development lead, who are responsible for overseeing the collaborative aspects of the capstone project, troubleshooting major technical problems.

The entire capstone project team should be engaged in discussions, documentation, and development of the capstone project. All members are expected to contribute towards the capstone project.

Groups will have to rotate the roles among members for different stages of the capstone project. This will allow members to gain experience through being responsible in different areas of capstone project management.

Guidelines for Internship for Under Graduate Students:

For understanding key principles of Guidelines for Internship for Under Graduate Students published by UGC on 2023. Please refer https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

Internship Work Evaluation:

6. The parent HEI will examine/evaluate the student's performance following its evaluation method.
7. The interns will be evaluated by research internship supervisor based on their efforts and research output.
8. The interns will be evaluated through seminar presentation or viva-voce at the HEI, (marks will be given by a group of experts from HEI including the supervisor).
9. Students will be allotted to faculty mentors/supervisor
10. Student need to submit at least one/two progress report, attendance, and regular supporting documents to faculty mentors/supervisor

Assessment Rubric/Internal evaluation for the Capstone Project

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – V (102-Data Science)			
Capstone Project	Course Code: 101LabSEC302	Capstone Project in Computer Application	Max Marks: 40
Sr. No.	Exercise		Marks
1	Writing the Capstone project scope document		5
2	Capstone project Planning (Work Breakdown Structure, Time-line Schedule, Cost Breakdown Structure, Risk Analysis)		10
3	Capstone project Details (Description of Technology Used, Details of Hardware devices, Details of software products, Programming languages, Descriptions of the components in the system, Component diagrams and required design if any, Construction or Fabrication details, any other information needed to execute the capstone project		10
4	Testing and validation: Details of laboratory experiments/programming/modelling/simulations/analysis/fabrication/construction etc.,		10
5	Results and inference		5
Total:			40

Assessment Rubric/External evaluation for the Internship

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – V (102-Data Science)			
Capstone Project	Course Code: 101LabSEC302	Capstone Project in Computer Application	Max Marks: 60
Sr. No.	Exercise		Marks
1	Capstone project Report -Format and Technical writing skill		15
2	Demonstration the Capstone project work		15
3	Power point presentation on outcomes of the Capstone project work		30
Total:			60

Skill Enhancement Course: Major Project [Evaluation in sixth semester]

101/102SEC303	Major Project [Evaluation in sixth semester]	0L:0T:4P	0 Credits
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Major Project in Computer Application

Course Objectives:

1. To understand the research project development process.
2. To motivate students to undertake research projects and pursue innovations.
3. To cultivate a research and innovation mindset in students.
4. To create awareness about Design Thinking and innovative research idea generation.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Develop new research ideas and innovations.
2. Create innovative solutions for identified problems.
3. Use research tools effectively.
4. Develop feasible solutions aligned with Sustainable Development Goals (SDGs).

Guidelines:

1. The Project must be research or Application based and focus on innovation and problem-solving.
2. The research work needs to be carried out collaboratively and the topic shall be in area of Computer Science or an interdisciplinary in nature.
3. Single or at the most group of Four student will engage in Research Project.
4. Student or group of students responsible for regularly reporting the progress of their research project to their guide (Project In-charge).
5. The synopsis must be submitted within the timeframe provided by the guide (Project In-charge)/Department.
6. Students must submit the Title and Synopsis (5-8 pages) in the prescribed format provided by guide (Project In-charge)/Department.
7. Plagiarism is strictly prohibited. Projects found to contain plagiarism will be rejected.
8. The single or at the most group of four students will conduct the project.
9. Students must submit One copy of their final project report for examination to the department.
10. All students must adhere to the given schedule for submissions and presentations.
11. Students should ensure that their research work is aligned with ethical research practices.
12. The project report and synopsis should strictly follow the provided format for consistency.

13. Students are encouraged to seek funding or support from relevant bodies and publish their research where applicable.

Formats of the Proposal/Synopsis and Report

Synopsis Format:

1. Title Page
2. Certificate
3. Acknowledgement
4. Index/Table of Contents
5. Abstract
6. Introduction
7. Motivation
8. Aims and Objectives
9. Literature Review
10. Methodology
11. Proposed System/Model
12. Applications
13. References

Research Project Report Format:

1. Title Page
2. Certificate
3. Acknowledgement
4. Index/Table of Contents
5. Abstract
6. Introduction
7. Literature Review
8. Methodology
9. Proposed System/Model
10. Implementation
11. Results and Discussion
12. Conclusion and Future Scope
13. References

Discipline Specific Elective Course: Introduction to Data Science

102DSE301	Introduction to Data Science	3L:0T:0P	3 Credits
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Course Objectives

CO1: To introduce the fundamental concepts, history, and architecture of Data Science (Remember).

CO2: To develop comprehension of the Data Science life cycle and its practical applications (Understand).

CO3: To train students in the systematic Data Science process including data retrieval, cleansing, integration, transformation, and modeling (Apply).

CO4: To provide knowledge of different types of data (structured, unstructured, multimedia, etc.) and their handling in Data Science (Analyze).

CO5: To impart practical skills in Python libraries such as NumPy, Pandas, SciPy, and Matplotlib for data analysis (Apply).

CO6: To enable students to visualize data effectively using modern tools and techniques, and to apply statistical methods like correlation and regression for decision-making (Evaluate).

Course Content:

UNIT-I	Introduction to Data Science, Definition and Description of Data Science, history and development of Data Science, terminologies related with Data Science, basic framework and architecture, Need for Data Science, benefits and uses of data science, Data Science Life Cycle, overview of different Data Science techniques. (12 Hrs.)
UNIT-II	Data Science Processes: Six steps of data science processes define research goals, data retrieval, cleansing data, and correct errors, integrating – combine data from different sources, transforming data, exploratory data analysis, Data modelling, model and variable selection, model execution, model diagnostic and model comparison, presentation and automation. (11 Hrs.)
UNIT-III	Facets of Data: Structured data, unstructured data, natural language, machine generated data, network data, audio, images and video streaming data. Data science process: overview of data science process, defining the goal, retrieving data, data preparation, data exploration, build the models. Python in Data Science: Introduction to Numpy, Pandas, SciPy, Matplotlib. NumPy Basics: Arrays and Vectorized Computation, Getting Started with Pandas, Data Loading, Storage, and File Formats. (11 Hrs.)
UNIT-IV	Data Visualization: Definition, importance of data visualization in data science, Exploratory Data analysis, visualization tools,

	Chart Types: Tabular data, dot and line plots, scatter plots, bar plots, Histograms and pie charts, Visualization with Seaborn. Correlation: correlation coefficient for quantitative data, computational formula for correlation coefficient, Regression line, least squares regression line, Standard error of estimate, interpretation of R^2, multiple regression equations, regression towards the mean.
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(11 Hrs.)

Course Outcomes:

1. Students will be able to explain the definition, scope, and importance of Data Science in modern applications (Understand).
2. Students will demonstrate the ability to apply the Data Science process for solving real-world problems (Apply).
3. Students will gain proficiency in handling diverse data types including text, images, audio, and video (Analyze).
4. Students will acquire hands-on experience in Python-based data analysis using NumPy, Pandas, SciPy, and Matplotlib (Apply).
5. Students will be able to perform exploratory data analysis and present insights through effective visualization techniques (Create).
6. Students will apply statistical tools such as correlation, regression, and model evaluation to interpret and validate data-driven results (Evaluate).

Text Books

1. Data Smart: Using Data Science to Transform Information into Insight 1st Edition by John W. Foreman. (2015) Wiley Publication.
2. Data Science from Scratch: First Principles with Python 1st Edition by Joel Grus.

Reference Books

1. Data Science for Dummies by Lillian Pierson (2015)
2. Introducing Data Science Big Data, Machine Learning, And More, Using Python Tools, Davy Cielen, Arno D. B. Meysman, Mohamed Ali.
3. Python Data Science HandBook, Jake VanderPlas
4. Steven S. Skiena, "The Data Science Design Manual", Published by Springer Nature. Steven S. Ski
5. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from the Frontline", O'Reilly.

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – V (102-Data Science)			
Theory	Course Code:102DSE301	Course Title: Introduction to Data Science	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Discipline Specific Elective Course: Laboratory on Introduction to Data Science

102LabDSE301	Laboratory on Introduction to Data Science	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Stats models and Pandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
 - a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
 - b. Bivariate analysis: Linear and logistic regression modelling
 - c. Multiple Regression analysis
 - d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
 - a. Normal curves
 - b. Density and contour plots
 - c. Correlation and scatter plots
 - d. Histograms
 - e. Three-dimensional plotting
7. Visualizing Geographic Data with Basemap

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)			
Practical	Course Code: 102LabDSE301	Laboratory onIntroduction to Data Science	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1.	Attendance/Regularity in practical's / Students' overall performance		10
2.	Record book Preparation (Preferably handwritten)		10
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce		10
4.	Internal Viva Voce		10

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)				
Practical	Course Code:102LabDSE301	Laboratory onIntroduction to Data Science	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15

Discipline Specific Elective Course: Timeline Series Analysis

102DSE302	Time Series Analysis	3L:0T:0P	3 Credits
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Course Objectives

- CO1: Understand the fundamental concepts and importance of Time Series Analysis.
- CO2: Learn techniques for analyzing and forecasting time-dependent data.
- CO3: Study statistical methods and models used in time series forecasting.
- CO4 : Develop practical skills using software tools and programming for time series data analysis.
- CO5 : Explore real-world applications of time series analysis in business, economics, and Technology.

Course Content:

UNIT-I	Fundamentals of Time Series Analysis: Introduction to Time Series: Introduction to Time Series Data, Components of Time Series: Trend, Seasonal Variation, Cyclical Variation, Irregular Variation. Types and Characteristics of Time Series: Stationary and Non-Stationary Series, Time Series Patterns, Applications of Time Series Analysis. Data Collection and Visualization: Sources of Time Series Data, Time Series Plotting, Data Visualization Techniques Basic Statistical Concepts: Mean and Variance, Correlation and Autocorrelation Moving Averages (12 Hrs.)
UNIT-II	Time Series Decomposition and Smoothing: Time Series Decomposition: Additive Model, Multiplicative Model, Trend Estimation Methods. Smoothing Techniques: Simple Moving Average, Weighted Moving Average, Exponential Smoothing. Trend Analysis: Linear Trend Models, Polynomial Trend Models, Least Squares Method. Seasonal Analysis: Seasonal Indices, Seasonal Adjustment Methods, Forecasting with Seasonal Data (11 Hrs.)
UNIT-III	Forecasting Models and Techniques: Forecasting Fundamentals: Principles of Forecasting, Forecast Accuracy Measures, Forecast Errors. Regression Models: Linear Regression for Time Series, Multiple Regression Basics. ARIMA Models: Introduction to AR, MA, and ARIMA Models, Identification of ARIMA Parameters, Model Fitting and Prediction. Advanced Forecasting Techniques: Holt's Linear Trend Method, Holt-Winters Method, Introduction to Machine Learning for Forecasting. (11 Hrs.)
UNIT-IV	Applications and Advanced Concepts: Applications of Time Series Analysis: Business and Sales Forecasting, Stock Market Prediction, Weather Forecasting, Demand Forecasting. Time Series in Data Science: Big Data and Time Series, IoT and Sensor Data Analysis, Real-Time

	Analytics. Visualization and Reporting:Dashboard Creation, Graphical Representation of Forecast Data, Interpretation of Results. Emerging Trends and Ethics: AI in Time Series Analysis, Deep Learning for Forecasting, Ethical Issues in Predictive Analytics, Future Scope of Time Series Analysis
	(11 Hrs.)

Reference Books

1. Time Series Analysis and Its Applications – Springer.
2. Introduction to Time Series and Forecasting – Springer.
3. Forecasting: Principles and Practice – OTexts.
4. Applied Time Series Analysis – Academic Press.
5. Practical Time Series Forecasting with R – Axelrod Schnall Publishers.
6. Hands-On Time Series Analysis with Python – Packt Publishing.

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – V (102-Data Science)			
Theory	Course Code:102DSE302	Course Title:Time Series Analysis	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Discipline Specific Elective Course: Laboratory on Time Series Analysis

102LabDSE302	Laboratory on Time Series Analysis	3L:0T:0P	3 Credits
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Suggestive Laboratory Experiments

1. Installation and setup of Python and Jupyter Notebook.
2. Basic operations using NumPy arrays and Pandas DataFrames.
3. Data cleaning and preprocessing on sample datasets.
4. Exploratory Data Analysis (EDA) using statistical methods.
5. Data visualization using Matplotlib and Seaborn libraries.
6. Implementation of linear regression on sample datasets.
7. Classification using K-Nearest Neighbor (KNN) algorithm.
8. Clustering using K-Means algorithm.
9. Sentiment analysis or prediction using simple machine learning models.
10. Mini project on data analysis and visualization using real-world datasets.

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)			
Practical	Course Code:102LabDSE302	Laboratory on Time Series Analysis	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1.	Attendance/Regularity in practical's / Students' overall performance		10
2.	Record book Preparation (Preferably handwritten)		10
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce		10
4.	Internal Viva Voce		10

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)				
Practical	Course Code:102LabDSE302	Laboratory on Time Series Analysis	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15

Discipline Specific Elective Course: Machine Learning

102DSE303	Machine Learning	3L:0T:0P	3 Credits
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Course Objectives

- CO1: To introduce the fundamental concepts, history, and types of machine learning (Remember).
 CO2: To develop comprehension of supervised learning algorithms, regression models, and classification techniques (Understand).
 CO3: To train students in implementing supervised and unsupervised learning algorithms using real-world datasets (Apply).
 CO4: To provide knowledge of ensemble learning methods (bagging, boosting, stacking) and their advantages/limitations (Analyze).
 CO5: To enable students to assess model performance using metrics, cross-validation, and bias-variance trade-off (Evaluate).
 CO6: To encourage students to design machine learning solutions for industry-specific applications such as banking, healthcare, retail, and e-commerce (Create).

Course Content:

UNIT-I	Introduction to Machine Learning: applications of ML, Learning from Data, History of Machine Learning, Steps in the design of learning system, Challenges in machine learning, Applications of machine learning, Machine learning model. Types of machine learning: supervised, unsupervised, semi-supervised and reinforcement learning (12 Hrs.)
UNIT-II	Supervised Learning Algorithms: working of supervised machine learning algorithm, Linear models for Regression: Simple Linear Regression, Multiple Linear Regression, Assumptions of Linear Regression, Least Squares Estimation, Gradient estimation. Naive Bayes algorithm, decision tree, Support Vector Machines, KNN, Random Forest algorithm. Non-Linear Regression Models: Polynomial Regression, lasso & Ridge Regression, Exponential Regression, Logarithmic Regression, evaluation metrics Logistic Regression: Definition and comparison with linear regression, Sigmoid Function, Model Estimation, Interpretation of Coefficients, Model Evaluation, Applications. (11 Hrs.)
UNIT-III	Unsupervised Learning Algorithms: Working of unsupervised machine learning algorithm, clustering (K-Means), Neural Networks, Principal Component Analysis. Reinforcement Learning Algorithms: Working of Reinforcement Machine Learning Algorithm, Finite Markov Decision Processes, Dynamic Programming, Monte Carlo Methods, Ensemble Learning: Introduction to Ensemble Learning, Rationale Behind Ensembles, Methods of Combining Models- Bagging (Bootstrap

	Aggregating), Boosting, Stacking Bagging Algorithms: Random Forests, Extra Trees (Extremely Randomized Trees) Boosting Algorithms: AdaBoost (Adaptive Boosting): Gradient Boosting, XGBoost (Extreme Gradient Boosting) Practical Applications of Ensemble Methods, Advantages and Limitations of Ensemble Methods. (11 Hrs.)
UNIT-IV	Overfitting, Underfitting, Bias and Variance, Imbalanced dataset and its handling, Hyper-parameter tuning, Ensemble methods: Bagging and Boosting, Ensemble voting. Machine Learning Use-cases Machine learning in business, Use cases of machine learning implementation in various industry domains: Banking, Finance, Retail, Healthcare, Manufacturing, Ecommerce, Human Resource. (11 Hrs.)

Course Outcomes:

- Students will be able to explain the applications, challenges, and types of machine learning models (Understand).
- Students will demonstrate the ability to implement supervised learning algorithms like regression, decision trees, SVM, and Naive Bayes (Apply).
- Students will gain proficiency in unsupervised learning, clustering, PCA, and reinforcement learning methods (Analyze).
- Students will acquire hands-on experience in ensemble learning techniques such as Random Forests, AdaBoost, Gradient Boosting, and XGBoost (Apply).
- Students will critically assess model performance, handle imbalanced datasets, and apply cross-validation for robust results (Evaluate).
- Students will design and deploy machine learning solutions tailored to real-world industry domains, demonstrating innovation and problem-solving skills (Create).

Text Books

- Machine Learning by Tom M. Mitchell. 2014 Reprint. McGraw-Hill Science
- Machine Learning by Saikat Dutt Subramanian Chandramouli Amit Kumar Das. Pearson

Reference Books

- Understanding Machine Learning: From Theory to Algorithms by Shai Shalev Shwartz (2015).
- Marsland, S. (n.d.). Machine learning: An algorithmic perspective. Taylor & Francis.
- E. Alpaydin, Introduction to Machine Learning (4 ed.), Phi, 2020. ISBN 978- 8120350786
- Shai Shalev Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" .

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – V (102-Data Science)			
Theory	Course Code: 101DSE303	Course Title: Natural Language Processing	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Discipline Specific Elective Course: Laboratory on Machine Learning

102LabDSE303	Laboratory on Machine Learning	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Prediction using simple linear regression
2. Classification using Logistics regression
3. Classification using linear discriminant analysis
4. Classification using support vector machine.
5. Classification using Guassian Naïve Bayes
6. Classification using decision Tree
7. Classification using Random Forest.
8. Classification using K nearest neighbour.
9. Write a program to Retrieve Data for a machine Learning project.
10. Write a program to Conduct Exploratory Data Analysis using Python
11. Write a program to Clean the Data
12. Write a program for Data Modeling
13. Write a program to implement multiple linear regression.
14. Write a program to implement multiple logistic regression.
15. Write a program for graphical representation of data.
16. Create a program to import, load and view dataset
17. Create a program to display the summary and statistics of the dataset
18. Implement linear regression to perform prediction
19. Implement Bayesian logistic regression and SVM for classification
20. Implement K-means clustering, mixtures of Gaussians and Hierarchical clustering algorithm to categorize data.
21. Create a program to perform PCA
22. Implement Ensemble learning models to perform classification

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)			
Practical	Course Code:102LabDSE303	Laboratory on Machine Learning	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1.	Attendance/Regularity in practical's / Students' overall performance		10
2.	Record book Preparation (Preferably handwritten)		10
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce		10
4.	Internal Viva Voce		10

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – V (102-Data Science)				
Practical	Course Code:102LabDSE303	Laboratory on Machine Learning	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15

Core Courses (CC) Course:Generative AI

102CC301	Generative AI	2L:0T:0P	2 Credits
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Course Objectives

CO1: Explain the basic concepts and applications of Generative AI.

CO2: Use prompt engineering techniques to generate quality AI outputs.

CO3: Apply Generative AI tools to solve real-world problems in content creation, programming, and business applications.

CO4: Demonstrate awareness of ethical, legal, and responsible use of Generative AI.

Course Content:

UNIT-I	Introduction to Artificial Intelligence: AI, Machine Learning, Deep Learning, and Generative AI, Evolution of Generative AI, Types of Generative AI, Applications of Generative AI, Popular Generative AI Tools (ChatGPT, Gemini, Copilot, Claude), Benefits, Limitations, and Challenges of Generative AI (7 Hours)
UNIT-II	Large Language Models and Prompt Engineering: Introduction to Large Language Models (LLMs), Basic Working of LLMs (Conceptual Overview), Tokens and Context Window, PromptEngineering, Types of Prompts: Zero-shot, One-shot, Few-shot, Prompt Writing Best Practices, AI Hallucination and Prompt Improvement (8 Hours)
UNIT-III	Generative AI Applications: I for Text Generation, AI for Image Generation, AI for Code Generation, AI for Presentation and Content Creation, AI Chat bots and Virtual Assistants, Generative AI in Education, Healthcare, Business, Agriculture, and Software Development, Introduction to AI APIs and No-Code AI Tools (7 Hours)
UNIT-IV	Responsible AI and Future Trends Responsible AI: AI Ethics, Bias and Fairness, Privacy and Security, Copyright and Intellectual Property, Risks and Misuse of Generative AI, Future Trends in Generative AI, Introduction to Multimodal AI and Agentic AI (8 Hours)

Text Books

1. David M. Patel, Generative AI for Beginners: Build Intelligent Applications with Large Language Models, BPB Publications, 2024.
2. Chris Fregly and Antje Barth, Generative AI on AWS: Building Context-Aware Multimodal Reasoning Applications, O'Reilly Media, 2024.
3. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.

Reference Books:

1. Jay Alamar and Maarten Grootendorst, Hands-On Large Language Models, O'Reilly Media, 2024.
2. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers, O'Reilly Media, 2022.
3. Chip Huyen, AI Engineering: Building Applications with Foundation Models, O'Reilly Media, 2025.
4. Sebastian Raschka, Yuxi (Hayden) Liu, and Vahid Mirjalili, Python Machine Learning, 4th Edition, Packt Publishing, 2025.
5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
6. Tom Taulli, Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business, Apress, 2023.

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Theory	Course Code: 102CC301	Course Title:Generative AI	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Core Courses (CC) Course: Laboratory on Generative AI

102LabCC301	Laboratory on Generative AI	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Introduction to Generative AI tools (ChatGPT, Gemini, Microsoft Copilot)
2. Prompt Engineering using Zero-shot, One-shot, and Few-shot prompting
3. Generating professional documents such as reports, notices, and business letters using AI
4. Creating presentations, tables, and charts using AI-powered tools
5. Generating and editing AI images using tools such as DALL·E, Gemini, or Microsoft Designer
6. Using AI for program generation, code explanation, debugging, and documentation
7. Using AI for data analysis and spreadsheet assistance (Excel formulas, charts, summaries)
8. Developing a simple chatbot using no-code/low-code platforms
9. Text summarization, translation, grammar correction, and content rewriting using AI
10. Mini Project: Development of a simple AI-assisted application (e.g., chatbot, content generator, quiz generator, resume builder, or study assistant)

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Practical	Course Code: 102LabCC301	Laboratory on Generative AI	Max Marks: 40
Sr. No.	Assessment Criteria	Marks	
1.	Attendance/Regularity in practical's / Students' overall performance	10	
2.	Record book Preparation (Preferably handwritten)	10	
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce)	10	
4.	Internal Viva Voce	10	

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)				
Practical	Course Code:102LabCC301	Laboratory on Generative AI	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15

Ability Enhancement Courses (AEC) Course:Soft Skills

102TuAEC301	Soft Skills	1L:1T:5P	1 Credits
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Course Objectives:

CO1: To develop communication skills among students.

CO2: To enhance workplace communication between students.

CO3: To develop formal communication ability.

CO4: To develop interview ability among students.

Course Content:

Unit	Content	Teaching Hours.
1	Introduction To Soft Skills: Meaning & Definition of Soft Skills, Types of Soft Skills, Essentials of Soft Skills.	4
2.	Soft Skills for Employability: Career planning & goal setting, what is meant by Resume & CV, Difference between Resume & CV, Preparation of an ATR-friendly Resume/CV, Interview Etiquettes, What is meant by Group Discussion & Types of Group Discussions.	4
3.	Soft Skills at Workplace: Modes of Communication at the workplace, Development of listening ability, Active listener v/s Passive Listener, client meeting etiquette.	4
4.	Soft Skills for Managers: Problem-solving skills for managers, decision-making skills required for managers, conflict management at workplace, Empathy V/s Sympathy for managers.	4

list of practical's that should be conducted internally for students' evaluation:

Practical 1.	Preparation of an ATR-friendly resume.
Practical 2.	Profile Building on LinkedIn/Naukri/Glassdoor.
Practical 3.	Mock Interviews of students by industry experts.
Practical 4.	Formal email writing.
Practical 5.	Mock Presentation for Product/Service Pitching.

Reference Books/Text Books:

1. Mitra, B.K Personality Development & Soft Skills, Oxford University Press.
2. Raman, M. & Sharma, S. Technical Communication Principles & Practice, Oxford University Press.
3. Dhanavel, S.P. English & Soft Skills, Orient Black Swan.
4. Krishna Mohan & Meera Banerji, Developing Communication Skills, Macmillan India.
5. Rizvi, M. Ashraf. Effective Technical Communication, McGraw-Hill.
6. Alex K. Soft Skills: Know Yourself & Know the World, S.Chand.

Swayam/MOOC Courses Available for the course.

1. Developing Soft Skills & Leadership through Indian Knowledge System, Prof. Nagendra Kumar & Prof. Anurag Kumar, IIT-ROORKEE, SMVD University, course link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs133
2. Soft Skills, by Prof. Binod Mishra, IIT-ROORKEE, Course link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs193
3. Developing Soft Skills & Personality, by Prof. T. Ravichandran, IIT-Kanpur. Course link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs249

Assessment Rubric: Internal for Tutorial

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI			
BCA- III, Semester – V (101-Artificial Intelligence and Machine Learning)			
Theory	Course Code: 101TuAEC301	Course Title: Soft Skills	Max Marks: 50
Sr. No.	Assessment Criteria		Marks
1	Any One of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		10
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10
4	Conducting practical, Demonstration, Group Discussion etc. on Soft Skill		20

Skill Enhancement Courses (SEC) Course:Major Project [Initiated in 5th Semester]

102LabSEC304	Major Project [Initiated in 5 th Semester]	0L:0T:4P	4 Credits
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Major Project in Computer Application

Course Objectives:

1. To understand the research project development process.
2. To motivate students to undertake research projects and pursue innovations.
3. To cultivate a research and innovation mindset in students.
4. To create awareness about Design Thinking and innovative research idea generation.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Develop new research ideas and innovations.
2. Create innovative solutions for identified problems.
3. Use research tools effectively.
4. Develop feasible solutions aligned with Sustainable Development Goals (SDGs).

Guidelines:

1. The Project must be research or Application based and focus on innovation and problem-solving.
2. The research work needs to be carried out collaboratively and the topic shall be in area of Computer Science or an interdisciplinary in nature.
3. Single or at the most group of Four student will engage in Research Project.
4. Student or group of students responsible for regularly reporting the progress of their research project to their guide (Project In-charge).
5. The synopsis must be submitted within the timeframe provided by the guide (Project In-charge)/Department.
6. Students must submit the Title and Synopsis (5-8 pages) in the prescribed format provided by guide (Project In-charge)/Department.
7. Plagiarism is strictly prohibited. Projects found to contain plagiarism will be rejected.
8. The single or at the most group of four students will conduct the project.
9. Students must submit One copy of their final project report for examination to the department.
10. All students must adhere to the given schedule for submissions and presentations.
11. Students should ensure that their research work is aligned with ethical research practices.
12. The project report and synopsis should strictly follow the provided format for consistency.
13. Students are encouraged to seek funding or support from relevant bodies and publish their research where applicable.

Formats of the Proposal/Synopsis and Report

Synopsis Format:

1. Title Page
2. Certificate
3. Acknowledgement
4. Index/Table of Contents
5. Abstract
6. Introduction
7. Motivation
8. Aims and Objectives
9. Literature Review
10. Methodology
11. Proposed System/Model
12. Applications
13. References

Research Project Report Format:

1. Title Page
2. Certificate
3. Acknowledgement
4. Index/Table of Contents
5. Abstract
6. Introduction
7. Literature Review
8. Methodology
9. Proposed System/Model
10. Implementation
11. Results and Discussion
12. Conclusion and Future Scope
13. References

Assessment Rubric/Internal evaluation for the Project:

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – VI (102-Data Science)			
Project	Course Code:101LabSEC304	Project in Computer Application	Max Marks: 40
Sr. No.	Exercise		Marks
1	Innovativeness of Topic, Synopsis Preparation, Submission and Presentation etc.		20
2	Regular Attendance in Laboratory, Progress / objectives achievement in proposed plan of research (Clarity, structure, scientific accuracy, originality, and referencing)		20
Total:			40

Assessment Rubric/ External evaluation for the Project:

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI BCA- III, Semester – VI (102-Data Science)			
Project	Course Code:101LabSEC304	Project in Computer Application	Max Marks: 60
Sr. No.	Exercise		Marks
1	Project Report Quality Assessment/Submission/Evaluation (Clarity, structure, scientific accuracy, originality, and referencing Depth, relevance, etc.)		30
2	Viva-Voce /Presentation (PPT) (Visual clarity, and confidence, Findings etc.)		30
Total:			60

Discipline Specific Elective (DSE) Course:Big Data Analytics

102DSE304	Big Data Analytics	3L:0T:0P	3 Credits
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Course Objectives

CO1: Explain the concepts, characteristics, and challenges of Big Data.

CO2: Understand distributed storage systems and Big Data frameworks such as Hadoop.

CO3: Perform basic data storage, processing, and analytics using Hadoop and Apache Spark.

CO4: Apply Big Data Analytics techniques to solve business and real-world problems.

Course Content:

UNIT-I	Introduction to Big Data: Fundamentals of Big Data: Introduction to Data and Big Data, Characteristics of Big Data (5 Vs), Types of Data: Structured, Semi-Structured, Unstructured, Sources of Big Data, Big Data Ecosystem: Need for Big Data Analytics, Traditional Data Processing vs Big Data Processing, Big Data Architecture, Challenges in Big Data Analytics, Applications of Big Data: Media Analytics, E-Commerce Analytics, Healthcare Analytics, Smart Cities, IoT and Social Media Applications (11Hrs.)
UNIT-II	Hadoop Framework and Distributed Storage: Hadoop Fundamentals: Introduction to Hadoop, Hadoop Architecture, Hadoop Components, Hadoop Distributed File System (HDFS): HDFS Architecture, NameNode and DataNode, Data Storage and Replication, MapReduce Framework: Introduction to MapReduce, Working of Map and Reduce Functions, Word Count Example, Hadoop Ecosystem Overview: Hive, Sqoop, Pig, Flume [Overview] (11 Hrs.)
UNIT-III	Big Data Processing using Apache Spark: Introduction to Apache Spark: Need for Apache Spark, Spark Architecture, Spark Components, Spark vs Hadoop, Spark Data Processing Basics: Overview to RDDs, DataFrames, Spark Transformations and Actions, Data Analytics using Spark: Data Loading from CSV Files, Data Filtering and Processing, Data Aggregation Functions, Basic Data Visualization, Applications of Spark: Real-Time Data Analytics, Stream Processing Concepts, Applications in Business and Industry (12 Hrs.)
UNIT-IV	Applications and Trends in Big Data Analytics: Data Analytics Fundamentals: Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Applications of Big Data Analytics: Customer Analytics, Fraud Detection, Healthcare Analytics, Sales and Marketing, Analytics Emerging Trends: Big Data and Artificial Intelligence, Big Data in Cloud Computing, IoT and Big Data (11 Hrs.)

Text Books

1. Big Data Analytics – Seema Acharya & Subhasini Chellappan.
2. Big Data Fundamentals – Thomas Erl et al.

3. Hadoop: The Definitive Guide – Tom White.

Reference Books

1. Data Science and Big Data Analytics – EMC Education Services.

2. Learning Spark – Holden Karau et al.

3. Big Data Analytics for Beginners – Arshdeep Bahga& Vijay Madisetti.

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Theory	Course Code:102DSE304	Course Title:Big Data Analytics	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Discipline Specific Elective (DSE) Course:Laboratory on Big Data Analytics

102LabDSE304	Laboratory onBig Data Analytics	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Study and installation of Hadoop environment.
2. Configuration of Hadoop Distributed File System (HDFS).
3. Performing file operations in HDFS.
4. Implementation of MapReduce Word Count Program.
5. Data loading and querying using Hive.
6. Data processing using Pig scripts.
7. Importing/exporting data using Sqoop.
8. Data Visualization using Spark and Python Libraries (Matplotlib)
9. Introduction to Apache Spark and execution of Spark shell commands.
10. Data analysis using Spark DataFrames.
11. Mini Project: Big Data Analytics on a real-world dataset (sales, healthcare, social media, or e-commerce data).

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Practical	Course Code:102LabDSE304	Laboratory onBig Data Analytics	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1.	Attendance/Regularity in practical's / Students' overall performance		10
2.	Record book Preparation (Preferably handwritten)		10
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce		10
4.	Internal Viva Voce		10

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)				
Practical	Course Code:102LabDSE304	Laboratory onBig Data Analytics	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15

Discipline Specific Elective (DSE) Course:Exploratory Data Analysis

102DSE305	Exploratory Data Analysis	3L:0T:0P	3 Credits
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Course Objectives

- CO1:** Understand the fundamentals of exploratory data analysis and data preprocessing methods.
CO2: Apply statistical and visualization techniques to identify patterns, relationships, and trends in datasets.
CO3: Perform data cleaning, transformation, and feature analysis using analytical tools.
CO4: Develop practical EDA workflows and generate meaningful business insights through real-world datasets.

Course Content:

UNIT-I	Introduction to Data Science and Data Analytics, Concept of Exploratory Data Analysis (EDA) Types of Data: Structured, Semi-structured, Unstructured, Data Collection Methods and Sources, Data Understanding and Dataset Structure, Data Cleaning Techniques, Handling Missing Values, Duplicate Detection and Removal, Data Transformation and Standardization, Data Integration and Data Reduction, Introduction to Python Libraries for EDA (NumPy, Pandas)
UNIT-II	Descriptive Statistics, Measures of Central Tendency, Measures of Dispersion, Correlation and Covariance, Probability Distribution Basics, Data Summarization Techniques, Data Visualization Concepts, Charts and Graphs: Line Chart, Bar Chart, Histogram, Pie Chart, Box Plot, Scatter Plot, Heatmaps, Visualization using Matplotlib and Seaborn
UNIT-III	Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Outlier Detection Techniques, Feature Engineering Concepts, Feature Selection Methods, Data Aggregation and Grouping, Time Series Exploration, Categorical Data Analysis, Introduction to Dimensionality Reduction
UNIT-IV	EDA Workflow and Best Practices, Business Problem Understanding, Dataset Selection and Interpretation, Dashboard Fundamentals, Case Studies: Sales Analytics, Customer Behaviour Analysis, Educational Data Analysis, Healthcare Data Analysis, Data Storytelling Techniques, Report Preparation and Presentation

Text Books

1. Python for Data Analysis – Wes McKinney
2. Practical Statistics for Data Scientists
3. Data Science for Business
4. Exploratory Data Analysis

Reference Books

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow

2. Think Stats
3. Introduction to Data Mining
4. Data Analytics Made Accessible
5. Business Analytics

Assessment Rubric: Internal for Theory

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI THEORY EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Theory	Course Code:101DSE305	Course Title:Predictive Analysis	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1	Any Two of the Activity (weekly or monthly assignment/ Unit Test/Class Test) (CAT-1)		20
2	Any One of the Activity includes Open Book Test, MCQ Tests, / Theory related Class activity/Task etc.) etc. (CAT-2)		10
3	Participation in any one Activity includes Quiz, Seminar, Group Discussion, Industry visit, Case Study, Mini project, innovative work, etc. based on Theory Course. Involvement in subject related activities such as Conference, Workshop, Coding Competitions etc. (CAT-3)		10

Discipline Specific Elective (DSE) Course:Laboratory on Exploratory Data Analysis

102LabDSE305	Laboratory on Exploratory Data Analysis	0L:0T:4P	2 Credits
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Suggestive Laboratory Experiments

1. Installation and setup of Python and Jupyter Notebook
2. Importing datasets using Pandas
3. Data inspection and summary generation
4. Handling missing and duplicate values
5. Data cleaning and transformation
6. Statistical analysis using Pandas
7. Visualization using Matplotlib
8. Visualization using Seaborn
9. Correlation analysis and heatmaps
10. Univariate data analysis
11. Bivariate data analysis
12. Outlier detection and treatment
13. Feature engineering exercises
14. Mini project – Dataset exploration and reporting
15. Final practical examination and viva

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)			
Practical	Course Code:102LabDSE305	Laboratory on Exploratory Data Analysis	Max Marks: 40
Sr. No.	Assessment Criteria		Marks
1.	Attendance/Regularity in practical's / Students' overall performance		10
2.	Record book Preparation (Preferably handwritten)		10
3.	Internal Practical Examination (Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, Viva Voce		10
4.	Internal Viva Voce		10

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION BCA- III, Semester – VI (102-Data Science)				
Practical	Course Code:102LabDSE305	Laboratory on Exploratory Data Analysis	Max Marks: 60	Time: 4 Hrs.
Sr. No.	Exercise			Marks
1.	Single Program Writing, Algorithm, Flowchart, Execution, with Sample inputs and Outputs, and Printout			30
2.	Submitted Record book (Preferably handwritten)			15
3.	External Viva Voce			15