॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Computer Management (Single Major)
02	B.Sc. Information Technology (Single Major)
03	B.Sc. Software Engineering (Single Major)
04	B.Sc. Computer Network Technology (Single Major)
05	B.Sc. Computer Science (Single Major)
06	B.Sc. Artificial Intelligence & Machine Learning (Single Major)
07	B.Sc. BCA (Single Major)
08	B.Sc. Computer Maintenance
09	B.Sc. Computer Science
10	B.Sc. Information Technology
11	B. Sc. Computer Application
12	B. Sc. Software Development
13	B. Sc. Data Science
14	B. Sc. Computer Science (with data Science specialization)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/126
दिनांक १२.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

(**Credit Framework and Structure of Four Year UG Program with Multiple Entry and Exit Option as per NEP-2020**)

UNDERGRADUATE PROGRAM OF

SCIENCE & TECHNOLOGY UNDER THE BOS OF COMPUTER SCIENCE AND APPLICATION

SY-BCA (Single Major)

(Bachelor in Computer Application)

(Honours and Honours with Research)

Under the Faculty of Science & Technology

(Revised as per the Govt. Of Maharashtra circular Dt. 13-03-2024)

&

(Based on the AICTE model curriculum suggested in Sept 2024)

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power***", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve ***the 3Es, the equity, the efficiency*** and ***the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employ ability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students

will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the Sukanu Samiti given in the NEP Curriculum Framework-2023 have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students.

We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employ ability. Introduction of the mandatory On Job Training, Internship program for science background students is praise worthy and certainly help the students to imbibe first hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil

Dean

Faculty of Science and Technology

Program Specific Outcomes:

PSO 01: Students will be able to understand analyses and develop computer programs in the areas related to algorithm, system software, web design and networking for efficient design of computer-based system.

PSO 02: Apply standard software engineering practices and strategies in software project development using open-source programming environment to deliver a quality of product for business success.

PSO 03: Student will be able to know various issues, latest trends in technology development in the field of AI and thereby, innovate new ideas and solutions to existing problems.

PSO 04: Explore technical knowledge in diverse areas of computer applications and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hrs. Practical (P) per week	1 Credit

B. Course Code and definition:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
DSC (CT/CP)	Core Courses
AEC	Ability Enhancement Courses
MDE	Multi-Disciplinary Elective course
VEC	Value added Courses
SEC (ST/SP)	Skill Enhancement courses
DSE (ET/EP)	Discipline Specific Elective
GE/OE	Open Elective
OJT	On Job Training (Internship/ Apprenticeship)
FP	Field Project
CEP	Community Engagement and Service
CC	Co-Curricular Courses
RM	Research Methodology
RP	Research Project /Dissertation

Course Level/Duration/System:

A. Eligibility for Admission: As per the regulations of the SRTMUN, AICTE/DTE and Government of Maharashtra, issued from Time-to-time regarding admission process.

B. As per NEP-2020 policy, it is a UG program (3/4 years) (6/ 8 Semesters) with multiple entry and exit. The following option will be made available to the students joining BCA Research Program:

1. One year: Under Graduate Certificate in Computer Application
2. Two years: Under Graduate Diploma in Computer Application
3. Three years: Bachelor in Computer Application (BCA)
4. Four years: Bachelor in Computer Application with Honours: BCA (Honours) or Bachelor in Computer Application Honours with Research: BCA (Honours with Research)

Note: The students who are eligible for BCA (Honours with Research) shall have choice to pursue either BCA (Honours) or BCA (Honours with Research).

SEMESTER WISE CREDIT DISTRIBUTION: Semester wise credit distribution of proposed BCA [BCA (Honours) and BCA (Honours with research)] program:

Semester	Core Courses	Ability Enhancement Courses (AEC)	Multi-Disciplinary Elective Course (MDE)	Value Added Courses (VEC)	Skill Enhancement courses (SEC)	Discipline Specific Elective (DSE)	Total
I	8	2	2	2	5	-	19
II	12	-	-	2	7	-	21
III	11	-	-	2	4	3	20
IV	15	-	-	-	2	3	20
Higher Semester -Tentative Structure yet to be defined**							
V	-	-	-	-	-	-	19/20
VI	-	-	-	-	-	-	20/21
BCA (Honours) Tentative Structure yet to be defined**							
VII	-	-	-	-	-	-	19/20
VIII	-	-	-	-	-	-	20/21
BCA (Honours with Research) Tentative Structure yet to be defined**							
VII	-	-	-	-	-	-	19/20
VIII	-	-	-	-	-	-	20/21

Category-wise distribution to be followed as per AICTE norms. **

Description	Core Courses (DSC)	Ability Enhancement Courses (AEC)	Multi-Disciplinary Elective course (MDE)	Value Added Courses (VEC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Total Credits
BCA	50	3	2	6	28	31	120
BCA (Honours)	55	3	5	6	40	51	160
BCA (Honours with Research)	82	3	2	6	28	39	160

Note:

**** For BCA at SRTMUN, yet to be defined / will be finalised after complete detailing of 3 years or 4 years BCA as and when approved by BoS / Academic Council/ University norms.**

Choice will be given for Students to take extra credit course from their own institute/college/ department or from other institute/college/ department as per the Admitting Body / University norms.

Examination: It will be held twice a year as per the policy of the university, usually as mentioned below.

Sr. No.	Name of the Examination	Main Examination	Supplementary Examination
1	BCA –Semester I, III, V, VII (For Honours and Research)	Winter	Summer
2	BCA –Semester II, IV, VI, VIII (For Honours and Research)	Summer	Winter

The examination specified in the preceding paragraph shall be held semester-wise at such places and on such dates as prescribed by the University.

Mapping of Marks to Grades: The mapping of marks to grades may be done as per the policy and norms of the university, enacted time to time. The AICTE Model syllabus has recommended following table.

Range of Marks	Assigned Grade
91-100	A^+
81-90	A
71-80	B^+
61-70	B
51-60	C^+
46-50	C
40-45	D
< 40	F (Fail due to less marks)
-	F^R (Fail due to shortage of attendance and therefore, to repeat the course)

Eligibility Criteria for Higher Semester Examinations:

1) The university rules shall be followed when admitting students into the next higher semester for BCA. However, the AICTE Model syllabus has recommended following table

Sr. No.	Semester	ATKT/Promotion Rules
1	I	----------
2	II	Students enrolled in **Semester I** shall be allowed to keep the term for **Semester II**, provided they have appeared for at least one paper in the University Examination of Semester I.
3	III	The candidate must pass at least 40% of the total subjects (i.e., 6 papers out of 15, including Practicals) from both **Semester I** and **Semester II** combined.
4	IV	A student enrolled in **Semester III** shall be allowed to keep the term for **Semester IV**, provided they have appeared for at least one paper in the University Examination of Semester III.
5	V	The candidate must have cleared all papers from the first year (i.e., all papers from Semester I and Semester II, including Practicals) and must pass at least 40% of the total subjects (i.e., 5 papers out of 12, including Practicals) from both **Semester III** and **Semester IV** combined.

2) To be eligible for admission to the BCA (Honours) or BCA (Honours with Research) program, a student must have successfully completed a 3-year BCA program.

Language of Examination: The medium of instruction and examination will be English unless otherwise specified in the syllabus, except for Indian or foreign languages selected by students in the AEC course.

Semester wise Curriculum for UG Course in BCA Semester –III

S. No.	Course Code	Course Title	L	T	P	Credit	% of Assessment			
							UA	CA	Total	Minimum passing %
1	SBCACT1201	Probability and Statistics	3	0	0	3	60	15	75	40%
2	SBCACT1202	Data Base Management System	3	0	0	3	60	15	75	40%
3	SBCACP1201	Lab-1: Data Base Management System	0	0	4	2	30	20	50	40%
4	SBCAST1201	Python Programming	2	0	0	2	40	10	50	40%
5	SBCASP1201	Lab-1: Python Programming	0	0	4	2	30	20	50	40%
6	SBCACT1203	Software Engineering	3	0	0	3	60	15	75	40%
7	SBCAET1201* (Choose any one)	Professional Elective – I A. Data Science: Basics of Data Analytics using Spread sheet B. Artificial Intelligence and Machine Learning: Feature Engineering	1	0	0	1	00	25	25	40%
8	SBCAEP1201* (Any one related to above ET1201)	Lab-1 Professional Elective – I A. Data Science: Basics of Data Analytics using Spread sheet B. Artificial Intelligence and Machine Learning: Feature Engineering	0	0	4	2	30	20	50	40%
9	SBCAVA1201	Yoga/Sports/NCC/NSS/ Disaster Management	0	0	4	2	00	50	50	40%
Total			**12**	**0**	**16**	**20**	**310**	**190**	**500**	

Note: For University Assessment (UA), College Assessment (CA) Evaluation Rules, Practical Assessment and for Question Paper Pattern refer to policy of the university

Note : * To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science / Artificial Intelligence and Machine Learning / Full Stack Development proposed by AICTE / Universities as indicated at the appendix – A. However the more comprehensive list approved by the BoS of SRTMUN shall be made available with curriculum structure of Third Year and Forth Year.

*Students can choose their specialization i.e. Stream with Discipline Specific Elective [DSE] from Second year onwards. Indicative Appendix –A of AICTE Model syllabus available on below link (https://www.aicte-india.org/sites/default/files/Model_Curriculum/BCA%20FINAL(2%20year%20).pdf).

Semester-IV

S. No.	Course Code	Course Title	L	T	P	Credit	% of Assessment			
							UA	CA	Total	Minimum passing %
1	SBCACT1251	Entrepreneurship and Start-up Ecosystem	1	1	0	2	40	10	50	40%
2	SBCACT1252	Computer Networks	3	0	0	3	60	15	75	40%
3	SBCACP1251	Lab-2 Computer Networks	0	0	4	2	30	20	50	40%
4	SBCACT1253	Design and Analysis of Algorithm	3	0	0	3	60	15	75	40%
5	SBCACT1254	Artificial Intelligence	3	0	0	3	60	15	75	40%
6	SBCACP1252	Lab-3 Artificial Intelligence	0	0	4	2	30	20	50	40%
7	SBCAET1251* (Choose any one)	Professional Elective – II A. Data Science: Data Visualization B. Artificial Intelligence and Machine Learning: Introduction to ML	1	0	0	1	00	25	25	40%
8	SBCAEP1251* (Any one related to above ET1251)	Lab-2 Professional Elective – II A. Data Science: Data Visualization B. Artificial Intelligence and Machine Learning: Introduction to ML	0	0	4	2	30	20	50	40%
9	SBCAST1251	Design Thinking and Innovation	1	1	0	2	00	50	50	40%
Total			**12**	**2**	**12**	**20**	**310**	**190**	**500**	

Note: For University Assessment (UA), College Assessment (CA) Evaluation Rules, Practical Assessment and for Question Paper Pattern refer to policy of the university

Note : * To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science / Artificial Intelligence and Machine Learning / Full Stack Development proposed by AICTE / Universities as indicated at the appendix – A. **However the more comprehensive list approved by the BoS of SRTMUN shall be made available with curriculum structure of Third Year and Forth Year.**

Note:

- At the end of the Fourth Semester every student shall undergo Summer Training / Internship / Capstone for Eight Weeks in the industry/Research or Academic Institute. This component will be evaluated during the fifth semester.

- An **UNDER GRADUATE DIPLOMA IN COMPUTER APPLICATION** will be awarded, if a student wishes to exit at the end of Second year.

Exit Criteria after Second Year of BCA Programme:

- Students will have the option to exit the Bachelor of Computer Application (BCA) program after successfully completing the second year.
- Upon exit, they will be awarded a **UG Diploma in Computer Application**.
- To be eligible for this diploma, students must complete an additional 04 credits in one of the following areas:

    1. **Skill-Based Subject:** A specialized course aimed at enhancing technical and practical expertise in computer applications.
    2. **Work-Based Vocational Course:** A vocational course offered during the summer term, focused on building practical, industry-relevant skills.
    3. **Internship/Apprenticeship:** A professional internship or apprenticeship with a minimum duration of 08 weeks, conducted after the fourth semester, offering hands-on experience in a relevant field.
    4. **Social Responsibility & Community Engagement:** Involvement with an NGO or community-based organization for a minimum of 08 weeks, contributing to social initiatives and applying computer application knowledge to solve real-world challenges.
    5. **Capstone Project:** Completion of a capstone project integrating the skills and knowledge gained during the first two years of the program, which can be an independent or group project.

The specific mode of completing the additional credits will be decided by the **University/Admitting Body,** and students will be required to complete the 08-week program or project during the summer term following their fourth semester.

Students opting for this exit will also be required to submit an Internship/Apprenticeship Report or complete the Capstone Project as per the schedule outlined by the University/Admitting Body before they are awarded the UG Diploma.

Re-entry Criteria in to Third Year (Fifth Semester):

The student who takes an exit after second year with an award of Diploma may be allowed to re-enter into fifth Semester for completion of the BCA Program as per the University / Admitting Body schedule after earning requisite credits in the Second year.

Guidelines for the Course Assessment:

Continuous Assessment (CA) of theory and practical courses:

i. **For Theory Course:** CA shall be carried out over the entire semester. It shall be done by conducting Two Tests (Test I on 40% curriculum) and Test II (on remaining syllabus) and average of the marks scored by a student in these two tests of a particular course /paper shall be taken as the CA score.

ii. **For Practical Course:** CA shall be the marks scored by a student in the internal practical examination conducted by the concerned teacher.

iii. **For AE, MD, VA, AE, etc. courses:** CA marks are same as displayed in the structure and are given as per the policy of the university or in absence of university guidelines, as decided by the concerned teacher/ institution.

End Semester Assessment (80% of the Maximum Marks) of theory and practical courses:

Appendix- A

Proposed Streams with Discipline-Specific Electives - Data Science / Artificial Intelligence and Machine Learning / Full Stack Development proposed by AICTE / Universities.

Note: The following is indicative. Universities/Institutes may add streams / electives as per their specific requirements. However the more comprehensive list approved by the BoS of SRTMUN shall be made available with curriculum structure of Third Year and Forth Year.

1. Data Science

Sl.No	Semester	Professional Elective
1	III	Basics of Data Analytics using Spreadsheet
2	IV	Data Visualization
3	V	Introduction to Data Science
4	V	Time Series Analysis
5	V	Machine Learning
6	VI	Big Data Analytics
7	VI	Exploratory Data Analysis
8	VII	Business Intelligence & Analytics
9	VII	Data Mining & Warehousing
10	VIII	Advanced Data Visualization
11	VIII	Cloud Computing for Data Analytics
12	VIII	Data Security & Privacy

2. Artificial Intelligence & Machine Learning

Sl.No	Semester	Professional Elective
1	III	Feature Engineering
2	IV	Introduction to ML
3	V	Neural Network
4	V	Digital Image Processing
5	V	Natural Language Processing
6	VI	Deep Learning for Computer Vision
7	VI	Predictive Analysis
8	VII	Explainable AI
9	VII	Evolutionary Algorithm
10	VIII	Speech Recognition
11	VIII	Augmented Reality & Virtual Reality
12	VIII	Security aspects of ML

A. For illustration a course / paper of 03 credits / 60 marks has been considered. The Question Paper Pattern of the ESA:

Faculty of Science and Technology
BCA
Question paper format (As per NEP2020)

Time : 3 hrs ***Max. Marks: 60***

Instructions to the candidates:

1. *Question No. 1 is Compulsory.*
2. *From Q. No. 2 to 5 solve any three questions.*
3. *Figures to the right indicate full marks.*
4. *Assume suitable data, if necessary.*
5. *Use of any electronic media such as mobile phone, digital diary, and electronic calculator is not permitted.*

Q.1 Attempt the following (any three) **(15) Marks**
(Based on all units)

a)
b)
c)
d)
e)

Q. 2 Attempt of the following (any three) **(15) Marks**
(Based on unit 1)

a)
b)
c)
d)

Q. 3 Solve the following (any three) **(15) Marks**
(Based on unit 2)

a)
b)
c)
d)

Q. 4 Attempt of the following (any three) **(15) Marks**
(Based on unit 3)

a)
b)
c)
d)

Q. 5 Attempt of the following (any three) **(15) Marks**
(Based on unit 4)

a)
b)
c)
d)

******

B. For illustration a course / paper of 02 credits / 40 marks has been considered. The Question Paper Pattern of the ESA:

Faculty of Science and Technology
BCA
Question paper format (As per NEP-2020)

Instructions to the candidates:

1. *Question No. 1 is Compulsory.*
2. *From Q. No. 2 to 5 solve any three questions.*
3. *Figures to the right indicate full marks.*
4. *Assume suitable data, if necessary.*
5. *Use of any electronic media such as mobile phone, digital diary, and electronic calculator is not permitted.*

Q.1 Attempt the following (2 Marks each) **(10)**
(Based on all units)

a)
b)
c)
d)
e)

Q. 2 Attempt of the following (any two) **(10)**
(Based on unit 1)

a)
b)
c)

Q.3 Attempt of the following (any two) **(10)**
(Based on unit 2)

a)
b)
c)

Q. 4 Attempt of the following (any two) **(10)**
(Based on unit 3)

a)
b)
c)

Q. 5 Attempt of the following (any two) **(10)**
(Based on unit 4)

a)
b)
c)

*****

Detailed Syllabus

SEMESTER –III

SEMESTER –III

Probability and Statistics

SBCACT1201	Probability and Statistics	3L:0T:0P	3 Credits

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:

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.

UNIT II:

Correlation: Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient.

Regression: Linear regression-fitting by least square method and interpretation.

UNIT III:

Concepts of probability: Permutation and Combination, Random Experiment, sample space and events, Classical definition of probability, Axioms of probability, Probability of an event, basic probability theorem, applications of probability theorem, conditional probability.

Standard Probability Distributions: Binomial probability distribution, Poisson probability distribution, Normal probability distribution.

UNIT IV:

Concept of sampling, Types of samples, Hypothesis Testing, Type I and Type II Errors.

Large Sample Test (Z Test): Mean Test, Difference between two means, difference between two standard deviations.

Small Sample Test (t Test): Mean Test, Difference between two means of independent samples, difference between two means of dependent sample.

Chi Square Test and Test of Goodness of fit.

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

Database Management Systems

SBCACT1202	Database Management Systems	3L:0T:0P	3 Credits

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, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS

Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema

UNIT II:

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), Inner Join, Natural Join, Outer Join

UNIT III:

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

UNIT IV:

NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.

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 Hours", 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/apexds/domain/dev-community/category/sql_and_pl_sql
3. https://asktom.oracle.com/ords/f?p=100:1:0

SBCACP1201	Lab-1 Data Base Management System	0L:0T:4P	2 Credits

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping

Suggestive Laboratory Experiments:

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

Consider the following Schema

Supplier (SID, Sname, branch, city, phone)

Part (PID, Pname, color, price)

Supplies (SID, PID, qty, date_supplied)

DDL Commands

5. Create the above tables
6. Add a new attribute state in supplier table
7. Remove attribute city from supplier table
8. Modify the data type of phone attribute
9. Change the name of attribute city to address
10. Change a table's name, supplier to sup
11. Use truncate to delete the contents of supplies table
12. Remove the part table from database

DML Commands

1. Insert at least 10 records in tables supplier, part and supplies
2. Show the contents in tables supplier, part and supplies
3. Find the name and city of all suppliers
4. Find the name and phoneno of all suppliers who stay in 'Delhi'

5. Find all distinct branches of suppliers
6. Delete the record of the supplier whose SID is 204001
7. Delete all records of supplier table
8. Delete all records of suppliers whose city starts with capital A.
9. Find the supplier names which have ‘lk’ in any position
10. Find the supplier name where ‘R’ is in the second position
11. Find the name of supplier whose name starts with ‘V’ and ends with ‘A’
12. Change the city of all suppliers to ‘BOMBAY’
13. Change the city of supplier ‘Vandana’ to ‘Goa’

Queries with Constraints

1. Create the supplier table with Primary Key Constraint
2. Create supplies table with Foreign key Constraint
3. Create a part table with UNIQUE Constraint
4. Create supplier Table with Check Constraints
5. Create Supplier table with Default Constraint

Queries on TCL

1. Create Savepoints
2. Rollback to SavePoints
3. Use Commit to save on

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’

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 more than 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

Queries on Analytical, Hierarchical, Recursive nature.

1. Find out the 5 th highest earning employee details.
2. Which department has the highest number of employees with a salary above $80,000, and what percentage of employees in that department have a salary above $80,000
3. Retrieve employee table details using the hierarchy query and display that hierarchy path starting from the top level indicating if it is a leaf and there exists a cycle.
4. What is the average salary for employees in the top 2 departments with the highest average salary, and what is the hierarchy of departments and sub-departments for these top 2 departments?
5. Use recursion to retrieve the employee table and display the result in breadth first and depth first order.
6. Write a recursive query to show the equivalent of level, connect_by_root and connect_by_path
7. Use recursion to retrieve the employee table and display the result in depth first order showing id, parent_id, level, root_id, path and leaf.

Queries on Operators

1. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200 and 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 Model
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 ‘1 st may2000’, ‘12 JAN 2021’,’17 dec 2000’ ,’10 Jan 2021’
7. Find all the distinct costs of parts

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

PL/SQL Programs

1. Write a PL/SQL Code to add two numbers

2. Write a PL/SQL code for Fibonacci series

3. Write a PL/SQL Code for greatest of 3 numbers

4. Write a PL/SQL code for area and circumference of a circle

PL/SQL Programs on Cursors

1. Write a Program using CURSOR to display SID and city of 1 st record of supplier

2. Write a program using cursors to display the SID and City of all suppliers and then print the count of suppliers.

PL/SQL Programs on Triggers, Procedures and Functions

1. Write a Program using TRIGGER on UPDATE Model curriculum for UG Degree in BCA

2. Write a command to See the effect of trigger

3. Write a Program using PROCEDURE to increase the cost by Rs.1000 for part whose PID is passed as an argument.

4. Write a procedure to update the city of an supplier whose SID and city are passed as arguments and the procedure returns the name of supplier whose city is updated.

5. Write a function to return the total number of suppliers

6. Write a function to return the PID of part, for which the part name is passed

7. Write a function to find the sum total of costs of all parts.

PL/SQL Programs on Implicit Cursors

1. Insert a record using %ROWTYPE

2. Write a code using %NOTFOUND, %FOUND, %ROWCOUNT

3. Write a code using %TYPE

MongoDB Queries

1. Create a collection and insert documents into it using insertOne() and insertMany()

2. Select all documents in collection

3. Find the count of all suppliers
4. Find all records that have city = ‘Delhi’
5. Retrieve all documents that have color equal to ‘red’ or ‘green’
6. Retrieve all documents where part_name is ‘P1’ or price is less than 200.
7. Update the record of ‘Geeta’, set city = ‘Bombay’ and phoneno = ‘11223344’
8. Delete all records where price is greater than 5000
9. Display only the name and city of the supplier
10. Sort all suppliers on city and display only the first two records.

SBCAST1201	Python Programming	2L:0T:0P	2 Credits

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 data structures.

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.

UNIT II:

Control Flow Statements: Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit.

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;

UNIT III:

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.

UNIT IV:

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.

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, 2 nd edition, 2016, PHI India.

Web Resources:

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

SBCASP1201	**Lab-1 Python Programming**	**0L:0T:4P**	**2 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping.

Suggestive Laboratory Experiments:

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 parameterised 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 upto 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) witht1.
    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 ZeroDivisionError 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.

Software Engineering

SBCACT1203	**Software Engineering**	**3L:0T:0P**	**3 Credits**

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

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.

Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

UNIT III:

Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modelling, 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.

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.

Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE 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

Professional Elective -I

	Professional Elective -I	**1L:0T:4P**	**3 Credits**

	(Data Science / Artificial Intelligence and Machine Learning)		

Data Science

SBCAET1201	**Basics of Data Analytics using Spreadsheet**	**1L:0T:0P**	**1 Credits**

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.

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

Note: Case study is for discussion not to be considered for evaluation.

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, Cegage learning asia pet. 2015

3. “Mastering Excel” by WebTech Solutions, Khanna Publishing House, 2024.

SBCAEP1201	**Lab- Basics of Data Analytics using Spreadsheet**	**0L:0T:4P**	**2 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping.

PART – A: Understanding and Describing the Data

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, text files, web data)
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

PART- B: Beyond the Basics: Visualizing and Communicating Data

Advanced Spreadsheet Functions

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

Data Visualization Techniques

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

4. Creating and customizing PivotTables and Pivot Charts

Dashboard Creation

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

Artificial Intelligence & Machine Learning

SBCAET1201	**Feature Engineering**	**1L:0T:0P**	**1 Credits**

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 feature selection methods, including filter and wrapper methods.

CO5: Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning.

Prerequisite:

Basic knowledge of data analytics/machine learning and familiarity with any programming language.

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.

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.

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, MIT Licensed). GitHub. ISBN-10: 199957950X, ISBN-13: 978-1999579500.

5. Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.

6. Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047.

7. Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, 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). Practical time series analysis: 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. ISBN 9781617294433.

SBCAMD1101	**Lab: Feature Engineering**	**0L:0T:4P**	**2 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping.

Prerequisite: Knowledge of Python Programming language

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 datasets 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. Bin numerical data into discrete intervals for a dataset with a column containing numerical values.
7. Create polynomial and interaction features from numerical data in a dataset with two columns.
8. Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.
9. 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].
10. Preprocess text data (tokenization) for a dataset with a column 'Text'.
11. Preprocess text data (stemming) for a dataset with a column 'Text'.
12. Preprocess text data (lemmatization) for a dataset with a column 'Text'.
13. Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.
14. Apply TF-IDF transformation to text data for a column 'Text'.
15. Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.
16. Perform image augmentation resizing for a set of images.
17. Perform image augmentation normalization for a set of images.
18. Perform image augmentation rotation for a set of images.

19. Perform image augmentation translation for a set of images.

20. Decompose a time series into trend, seasonal, and residual components for a dataset with a column 'TimeSeries'.

21. Perform Principal Component Analysis (PCA) on a dataset and visualize the first two principal components.

SBCAVA1201	**Yoga and Physical fitness /Sports/NCC/NSS/Disaster Management**	**0L:0T:4P**	**2 Credits**

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):

i. Understand yoga's significance and its practical applications for holistic well-being.

ii. Explore subtle energy systems and their role in enhancing health through yogic practices.

iii. Examine various paths of yoga to foster self-realization and spiritual growth.

iv. Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.

v. Apply yogic principles to manage psycho-somatic ailments and promote resilience.

Course Content:

Unit-1

● 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 yaga, 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, dhyan, 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

● 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

● 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

● 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

- 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

- 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

● 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

● 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. Hoye, 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. Hoye, 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.

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.

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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

Unit 2:

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

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

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

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 in Action.

● 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.

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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 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

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

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

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

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 Swatch 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/strenghtening-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.

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DISASTER MANAGEMENT

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

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

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

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

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 Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.

4. Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability and Mitigation, 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, Ian Mason.

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

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SEMESTER –IV

SEMESTER –IV

Entrepreneurship and Startup Ecosystem

SBCACT1251	**Entrepreneurship and Startup Ecosystem**	**1L:1T:0P**	**2 Credits**

Course Objective(s):

- To understand Entrepreneurship and its types
- To understand that not all ideas can be turned into viable business models and guestimate business 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

- 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 of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.

Unit 2: Evaluating Business opportunity

- 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-SWOT, PESTLE & PORTER'S 5 Forces Model

Unit 3: Building Blocks of starting ventures

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

Unit 4: Start-up Ecosystem

- Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors, Bank
- Know various govt. schemes like Start-up India, Digital India, MSME etc.
- Sources of Funding-Venture, Angel Invest
- Source of Technology, Intellectual Property Rights (IPR)

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

7. Entrepreneurship Development & Management by Dr. Vasant Desai, Dr. Kulveen Kaur, Himalaya Publishing House

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

Computer Networks

SBCACT1252	**Computer Networks**	**3L:0T:0P**	**3 Credits**

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.

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

Network Protocols: Introduction to TCP/IP Protocol Suite, **IP Addressing:** IPv4 and IPv6

UNIT III: Network Layer and Transport Layer

Network Layer: IP Routing: Static vs. Dynamic Routing, **Routing Protocols:** RIP, OSPF, BGP

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

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.

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

SBCACP1251	**LAB-2: Computer Networks**	**0L:0T:4P**	**2 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping .

Suggested list of Experiments (not limited to):

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. Implement VLANs:

a) Configure VLANs on a switch and verify using simulation tools.

6. Set Up a Simple Web Server:

a) Deploy a basic web server and configure HTTP/HTTPS access.

7. Network Security Lab:

a) Implement basic firewall rules and VPN configurations.

b) Perform vulnerability scanning and analyze results.

8. Network Troubleshooting:

a) Diagnose and resolve common network issues.

b) Use troubleshooting commands and techniques to fix connectivity problems.

Design and Analysis of Algorithms

SBCACT1253	**Design and Analysis of Algorithms**	**3L:0T:0P**	**3 Credits**

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.

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.

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.

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.

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, 3 rd 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, 3 rd 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

Artificial Intelligence

SBCACT1254	**Artificial Intelligence**	**3L:0T:0P**	**3 Credits**

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.

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.

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 set theory.

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 include two case studies. Legal and Ethical Issues: Concerns related to AI.

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

SBCACP1252	**Lab-3 Artificial Intelligence**	**0L:0T:4P**	**2 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping.

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

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

d) Part of Speech tagging

e) Chunking

f) Named Entity Recognition (NER)

15. Perform Image classification for a given dataset using CNN. You may use Tensorflow / Keras.

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

Professional Elective -II

	Professional Elective -II **(Data Science / Artificial Intelligence and Machine Learning)**	**1L:0T:4P**	**3 Credits**

Data Science

SBCAET1251	**Data Visualization**	**1L:0T:0P**	**1 Credit**

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

UNIT II: Visualization tools & Data Storytelling

Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools. Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity

UNIT III: Designing Effective Visualizations

Principles of Good Visualization Design - Understanding and Using Color in Visualizations – Importance of Data Modelling in Visualization.

Text Books

1. "Storytelling 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

Lab-2 Programs for Data Visualization Using Power BI

SBCAEP1251	**Lab-2 Programs for Data Visualization Using Power BI**	**1L:0T:0P**	**1 Credits**

Note: Practicals are suggestive and as per CO-PO Mappings. Concerned teacher has freedom to modify, select all or a subset of these depending upon coverage of syllabus points. However, the modified list must match with CO-PO mapping.

Suggested list of Experiments (not limited to):

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 data types, 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.

Introduction to Machine Learning

SBCAET1251	**Introduction to Machine Learning**	**1L:0T:0P**	**1 Credits**

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. Labelled and Unlabelled 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.

UNIT II: Supervised Learning and Unsupervised Learning

Regression: Linear and non-linear Regression, Logistic Regression.

Classification: 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. Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures.

ML Applications: Ethical Considerations in Machine Learning, Case study and Real-world Applications.

Text Books:

1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2. Jeeva Jose (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 TensorFlow: 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.

Lab-2 Introduction to Machine Learning

SBCAEP1251	**Lab-2 Introduction to Machine Learning**	**1L:0T:4P**	**2 Credits**

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.

The lab experiments may be implemented in Python using relevant ML libraries, and datasets 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 dataset 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 Naive Bayes Classifier on a given dataset.
5. Build and evaluate a random 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 and plot the dendrogram.
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 AdaBoost 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.

Design Thinking and Innovation

SBCAST1251	**Design Thinking and Innovation**	**1L:1T:0P**	**2 Credits**

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

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

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

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

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.

- Analyse emotional experience and Inspect emotional expressions to better understand users while designing innovative products