HSNC UNIVERSITY, MUMBAI
(2023-2024)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Programme Under

The Faculty of Science & Technology

Curriculum – Part I Information Technology

Postgraduate Programme

2023-2024

Syllabus for M.Sc. I.T Part I

(With effect from the academic year 2023-2024)

Department of M.Sc I.T Board of Studies

(i) The Board of Studies shall consist of the following members, namely: —

(a) One head of the Department from amongst the Schools, Centers and Constituent Colleges, of the University in the relevant subject of the University nominated by the Vice Chancellor in consultation with the Dean concerned; -

Sr. No.	Name	Designation	Contact Details
1.	Dr. Rakhi O. Gupta	Chairperson HOD Dept. of IT, KC College, HSNC University	9619914191 rakhi.gupta@kccollege.edu.in

(b) Two to five teachers each having minimum five years teaching experience amongst the full time teachers of the Departments, Schools, Centers and Constituent Colleges of the University in the relevant subject nominated by the Vice-Chancellor in consultation with the Dean of the respective faculty; -

Sr No.	Name	Designation	Contact Details
1.	Ms. Pragati V.Thawani	Co-chairperson Dept. of IT, KC College, HSNC University	9960782000 pragati.thawani@kccollege.edu.in
2.	Ms. Sandhya Bhavsar	Assistant Professor Dept. of IT,KC College,HSNC University	8446677643 sandhya.bhavsar@kccollege.edu.in

3.	**Ms. Neha Patel**	**Assistant Professor** **Dept. of IT,KC College, HSNC University**	**9820609142** **Neha.patel@kccollege.edu.in**
4.	**Ms. Nashrah Gowalker**	**Assistant Professor** **Dept. of IT,KC College, HSNC University**	**9664774108** **nashrah.gowalker@kccollege.edu.in**

(c) One Professor / Associate Professor from other Universities or professor / Associate Professorfrom colleges managed by Parent Body; nominated by Parent Body; --

Sr. No.	Name	Designation	Contact Details
1.	**Dr. R. Kamatchi**	**Director, ISME School of Management Studies and Entrepreneurship, Lower Parel.**	**9224450454** **rkamatchiiyer@gmail.com**
2.	**Dr. Ajay Patil**	**Professor, School of Computer Sciences, KNMU, Jalgaon.**	**9423975215** **ajaypatil.nmu@gmail. com**

(d) Four external experts from Industry / Research / eminent scholar in the field relevant to thesubject nominated by the Parent Body;

Sr. No.	Name	Designation	Contact Details
1.	Dr. Hiren Dand	Head of Department (IT)Mulund Collegeof Commerce.	9821140717 Hiren.dand@mccmulund.ac.in
2.	Mr. Asif K. Rampurawala	Vice Principal, Vidyalankar School Of Information Technology	9820765273 asif.rampurawala@vsit.edu.in
3.	Mr. Kaushal Shah	Senior Manager Reliance Power Ltd.	9869069203 Kaushalshah78@gmail.com
4.	Mr. Prabhav Daga	Proprietor at Curaksha Partner at Gianda TradingSolutions, LLP.	8850252861 prabhav@curaksha.com

(e) Top rankers of the Final Year Graduate and Final Year Post Graduate examination of previousyear of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year nominated by Vice Chancellor. The Board of Studies, at its first meeting, shall elect one of the members as a Chairperson of theBoard of Studies from amongst its members, subject that no person shall be Chairperson of the Board of the studies, for a second consecutive term whether as an elected, nominated orco-opted member, as the case may be.

Sr. No.	Name	Contact Details
1.	Ms. Kimberly Moniz	9619147188 kimberlythemoniz@gmail.com

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. **: The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From TheAcademicYear2020-2021 Are As Under:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/ Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject to study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from anunrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to asGeneric Elective.

Choice Base Credit System: CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

3. **Honors Program:** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honors Program will have
40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

A learner who joins Regular Undergraduate Program will have to opt for Honors Program in the first year of the Program. However, the credits for honors, though divided across three years can be completed within three years to become eligible for award of honors Degree.

4. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

5. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

6. **Bridge Course:** Bridge courseis visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester,will be specified. The Bridge Course can be conducted in online mode. The Online content canbe created for the Bridge Course Topics.

7. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

8. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums ,fieldwork, internships etc.

Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved

In the topics earmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor,who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studiesand Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per therecommendations of the Board of Studies and Academic Council from time to time.All decisions regarding evaluation need to be taken and communicated to the stakeholders may be preferably before the commencement of a semester. Some exceptions made in exigencies, like the current situation arising from the lockdown, but such adhoc decisions are to be kept to the minimum possible.

10. Credit Point: Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 15 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner whosuccessfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. Learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits ashe completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number ofCredits transferred to different programs or credit exemptions given may also bestored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another

academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken forgranted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60%marks by conducting the theory examination.

Teaching Hours –

Unit (1 to 3)	Total Lectures	Credit	Total Marks
Theory	45	3	60
Practical	30	1	40

Evaluation Pattern – 100 Marks

Theory Assessment– 60 Marks

Q-No.	Particulars	Marks
Q-1	All Units	15 Marks
Q-2	Unit-I	15 Marks
Q-3	Unit-II	15 Marks
Q-4	Unit-III	15 Marks

Internal Assessment– 15 Marks

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation – Active participation in routine class instructional deliveries Overall Performance – Attendance Record	15 Marks

Practical Assessment– 25 Marks (50 Marks converted into 25 Marks)

Sr. No	Evaluation type	Marks
1	Two Best Practical a. Evaluation of One Program	20
	b. Evaluation of Second Program	20
2	Journal	05
3	Viva	05

HSNC University, Mumbai

D.M. Harish Building, 47, Dr. R. G. Thadani Marg, Worli, Mumbai - 400 018

Date:	**Time:**	**Semester: I**	**Total Marks: 60**
Subject Code:	**Program: M.Sc. Information Technology**	**Subject:**	

N.B. – (1) All questions are compulsory. (2) Figures to the right indicate full marks

Q.1	**A**	**Attempt any Three out of Six of the following: - (5 Marks Each)**	**15 Marks**
	1.	**Unit - I**	
	2.	**Unit – I**	
	3.	**Unit - II**	
	4.	**Unit – II**	
	5.	**Unit – III**	
	6.	**Unit - III**	
Q2		**Attempt any Three out of Six of the following: - (5 Marks Each)**	**15 marks**
	1.	**Unit - I**	
	2.	**Unit - I**	
	3.	**Unit - I**	
	4.	**Unit - I**	
	5.	**Unit - I**	
	6.	**Unit - I**	
Q.3		**Attempt any Three out of Six of the following: - (5 Marks Each)**	**15 marks**
	1.	**Unit - II**	
	2.	**Unit - II**	
	3.	**Unit - II**	
	4.	**Unit - II**	
	5.	**Unit - II**	
	6.	**Unit - II**	
Q.4		**Attempt any Three out of Six of the following: - (5 Marks Each)**	**15 marks**
	1.	**Unit - III**	
	2.	**Unit - III**	
	3.	**Unit - III**	
	4.	**Unit - III**	
	5.	**Unit - III**	
	6.	**Unit - III**	

Project and Assignment:

- Project or Assignment, which can in the following forms

3.

  - Case Studies
  - Videos
  - Blogs
  - Research paper(Presented in Seminar/Conference)
    Field Visit Report

- Presentations related to the subject
- Internships (Exposition of theory into practice)
- Open Book Test
- Any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

Self-Learning Evaluation

- 20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMICRESOURSE SPECIFIED IN THE CURRICULUM.
- HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ONSELF LEARNING TOPICS
- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks. CLUB the self-learning topics into 3-4 GROUPS OFTOPICS ONLY FOR EVALUATION.
- PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS

Sub Topics

- Each evaluative session shall carry 3 Marks (3 x 3 Units = 9Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

Sub Topics

Each evaluative session shall carry 2.5 Marks (2.5 x 4 Units = 10 Marks)

EVALUATION OF SELFLEARNING TOPICS CAN COMMENCE IN REGULAR LECTURESASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE

Evaluative sessions

Each evaluative session shall carry 3 Marks (3 x 3 = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

Evaluative sessions

Each evaluativesession shall carry 2.5 Marks (2.5 x 4 =10Marks).

<u>Methods for Evaluation of Self-learning topics:</u>

Seminars/presentation (PPT or poster), followed by Q&A − Objectivequestions /Quiz / Framing of MCQ

Questions.

- Debates
- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Viva Voce

Any other innovative method

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGEEXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYSBEFORETHECOMMENCEMENT OFTHE EVALUATIONSESSION

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Syllabus for M.Sc. I.T Part I

(With effect from the academic year 2023-2024)

Section D

Preamble

The M.Sc. Information Technology program is started with an aim to make the students employable after Post-Graduation and impart industry oriented training.

1. **Course Objective:** The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems related to human, technology and environmental factors.
- To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programs.
- To be capable of managing complex IT projects with consideration of various factors.
- To work effectively as a part of a team to achieve a common stated goal.
- To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- To develop an aptitude to engage in continuing educational and professional development.
- To build on the basics and the core concepts learnt during relevant undergraduate program.

The new syllabus is aimed to achieve the following objectives. The syllabus spanning two years covers the industry endorsed relevant courses. The students will be ready for the jobs available in different fields like:

- Networking
- Security
- Machine Learning
- Artificial Intelligence
- Big Data
- Image Processing
- Cloud Computing and Applications
- AI Chat Bot (The Department plans to introduce it in Part2)
- And many others

2. **Process adopted for curriculum designing:** The department has conducted multiple meetings with academic partners, industry partners. After discussion with them, the changes in the syllabus were introduced with the view that students need to learn the core concepts in detail.

3. **Salient features, how it has been made more relevant:** After discussion and interaction with the industry partners and understanding the requirement of the industries certain changes in the syllabus are introduced. Upcoming Technologies like AI, Big Data, etc. have been added keeping the upcoming trends in the field of Information Technology.

4. **Learning Outcomes:** It is expected to improvise the soft skill as well as hardware skills for the students.

- **Input from stakeholders (Which sections have been modified) with relevant introduction:** There are modifications suggested by the Industry person to make changes in the syllabus provided by University of Mumbai and add a few more topic to the already developed syllabus.

PROGRAM OUTCOMES :

Program Outcomes (POs)	
On successful completion of the M.Sc. Information Technology program	
PO1	**Advanced Disciplinary and Interdisciplinary Knowledge**: Demonstrate a comprehensive understanding of the core and advanced concepts in the specific field of science (e.g., Physics, Chemistry, Mathematical sciences, Life sciences, , Computers and Information Technology etc). Apply the knowledge from related disciplines to address complex scientific challenges
PO2	**Research Proficiency**: Develop the ability to design and conduct experiments, analyze data, and interpret results using modern scientific methods and tools
PO3	**Critical Thinking, Problem Solving, Data Analysis and Interpretation**: Employ logical reasoning and innovative approaches to solve complex scientific problems. Use quantitative and qualitative methods, including statistical and computational tools, to draw valid conclusions
PO4	**Use of Technology, Laboratory and Technical Skills**: Gain proficiency in handling advanced laboratory equipment and techniques specific to the field of study. Effectively use modern software, tools, and technologies relevant to the discipline
PO5	**Use of Technology, Laboratory and Technical Skills**: Gain proficiency in handling advanced laboratory equipment and techniques specific to the field of study. Effectively use modern software, tools, and technologies relevant to the discipline
PO6	**Ethics and Professionalism**: Uphold ethical principles in research and professional practices, ensuring honesty, integrity, and accountability.
PO7	**Environmental and Social Responsibility**: Demonstrate awareness of the environmental, societal, and global impacts of scientific endeavors
PO8	**Independent Learning ability and Preparation for Higher Studies**: Cultivate an attitude of continuous learning to adapt to advancements in science and technology. Be prepared to pursue doctoral programs or other advanced studies in the chosen field.
PO9	**Carrier development**: This program brings together the graduates who wish to enhance their skills and gives them an opportunity to develop their careers in a particular direction. The programme provides in-depth knowledge of particular subject and arouses interest of the students towards research in that particular field.
PO10	**Employability and entrepreneurship**: The masters of Science program provides the candidate with understanding, general proficiency, and methodical abilities on an advanced level required in industry, consultancy, education, entrepreneurship or public administration etc

Structure and Titles as per NEP

Program Name: M.Sc. Subject: IT

List of Papers

(Theory: 15 Lecture hours= 1 Credit & Practical: 30 Lecture hours= 1 Credit;Change no. of hours accordingly wherever applicable)

MAJOR/MINOR COURSE

YEAR	Sem	Theory / Practical	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	I	**Theory**	BIT501B	Applied Artificial Intelligence	3	45	8+4=12 (Major)
		Practical		Applied Artificial Intelligence Practical	1	30	
		Theory	BIT502B	Introduction to DS and Big Data Analytics	3	45	
		Practical		Introduction to DS and Big Data Analytics Practical	1	30	
		Theory	BIT503B	Fundamentals of Information Security	3	45	
		Practical		Fundamentals of Information Security Practical	1	30	
		Theory	BIT511B	Advanced Cloud Computing	3	45	4 (DSE)
		Practical		Advanced Cloud Computing Practical	1	30	
		OR					
		Theory	BIT505B	Blockchain	3	45	4 (DSE)
		Practical		Blockchain Practical	1	30	
		Mi 20 (RM)	CHE501A	Research Methodology	4	60	4(Minor)

YEAR	Sem	Theory / Practical	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	II	**Theory**		Machine Learning	3	45	8+4=12 (Major)
		Practical		Machine Learning Practical	1	30	
		Theory		Principles of Data Science Theory	3	45	
		Practical		Principles of Data Science Practical	1	30	
		Theory		Security Assessment, Architecture & Design	3	45	
		Practical		Security Assessment, Architecture & Design Practical	1	30	
		Theory		Micro service Architecture	3	45	4 (DSE)
		Practical		Micro service Architecture Practical	1	30	
		OR					
		Theory		User Experience Design Theory	3	45	
		Practical		User Experience Design Practical	1	30	

Note: Choices of Electives will be decided with discussion with Head/Course Coordinator.

Internship/Apprenticeship

Year	Sem.	Paper	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	I						
	II			**Internship/Apprenticeship**	4	60	4

SEMESTER – I – Detailed Syllabus

Applied Artificial Intelligence

Unit	Details	Lectures
1	**Review of AI:** History, foundation, Agent and Applications. **Expert System and Applications:** Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert System, Application of Expert Systems. **Introduction of soft computing:** soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering,	**15**
2	**Machine Learning Paradigms:** Machine Learning systems, supervised and un-supervised learning, inductive learning, deductive learning, clustering, support vector machines, cased based reasoning and learning. **Artificial Neural Networks:** Fundamental concept, Evolution of Neural Networks, Single-Layer feed-forward networks, multi-layer feed-forward networks, McCulloh-Pitts Neuron, Linear Separability, Hebb Network, design issues of artificial neural networks and recurrent networks **Probability Theory:** joint probability, conditional probability, Bayes's theorem, probabilities in rules and facts of rule based system, cumulative probabilities, rule based system and Bayesian method	**15**
3	**Fuzzy Sets and Fuzzy Logic:** Fuzzy Sets, Classical sets, Fuzzy sets, Fuzzy set operations, Types of Member ship Functions, fuzzy relations, Multi-valued Logic, Fuzzy Logic, Linguistic variables and Hedges, fuzzy membership functions. Examples based on classical sets and fuzzy sets **Evolutionary Computation:** genetic algorithms, Biological Background, basic terminologies, genetic programming concepts, general genetic algorithm, evolutionary programming, swarm intelligence, advantages and limitations and applications of genetic Algorithm.	**15**

SLE Topics

- Hebb Network, design issues of artificial neural networks and recurrent networks
- Advanced Knowledge Representation Techniques: Conceptual dependency theory, script structures, CYC theory, script structure, CYC theory, case-grammars, and semantic web.

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
3. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
4. https://www.udemy.com/share/101XEQ3@ZiqaBVhWGV-8Osj9mYLn02bewG8bWiVaYfBiI4AdS8quGmpeXD2bw0du0hHzKND2/
5. https://www.udemy.com/course/the-complete-healthcare-artificial-intelligence-course-2021/?kw=the+complete+artificial&src=sac

Practical List

1. Design a simple linear neural network model. Calculate the output of neural network using binary and bipolar sigmoidal function.	
2. Implementation of Hebb Rule with AND function.	
2. Implementation of Probability – 1) Join Probability 2) Conditional Probability.	
3. Implementation of crisp and fuzzy logic.	
5. Implementation of supervised learning-Linear Regression	
6. Implementation of Unsupervised learning - Clustering	
7. Implement the following: Generate AND/NOT function using McCulloch-Pitts neural net.	
8. Write a program for to implement Rule based system.	

9. Design an Expert system using AIML.	
10. Design a bot using AIML.	

Introduction to Data Science and Big Data Analytics

Unit	Details	No. of Lectures
1	**1.1Introduction to Data Science :** Definition, objectives and scope of Data Science Data Science workflow Types of data: Structured, Semi-structured, And Unstructured Data Science vs Business Intelligence vs Data Analytics Roles in data science: Data Scientist, Engineer, Analyst **1.2 Data Collection, Preprocessing & Cleaning :** a) Data collection techniques: APIs, scraping, sensors, databases b) Data preprocessing steps c) Handling missing values mean/mode/median, interpolation) d) Outlier detection: Z-score, IQR e) Normalization & Standardization f) Feature engineering & feature selection basics **1.3 Exploratory Data Analysis (EDA) :** Descriptive statistics Measures of central tendency Measures of dispersion Correlation & covariance Data visualization: Histogram, Boxplot, Scatterplot, Heatmap	**15**
2	**2.1 Fundamentals of Statistical Modeling :** Concepts of population & sample,Probability basics,Hypothesis testing: 1. Null and alternative hypothesis 2. One-tailed & two-tailed tests 3. p-value, confidence intervals Regression (linear & logistic), Evaluation metrics: RMSE, MSE, Accuracy, Precision, Recall **2.2 Machine Learning Essentials** Types of ML: Supervised, Unsupervised, Reinforcement Algorithms: 1. KNN 2. Naive Bayes 3. Decision Trees 4. K-Means Clustering 5. PCA Bias-variance tradeoff Overfitting, underfitting, cross-validation **2.3 Working with Big Data Systems** Definition and characteristics of Big Data (5Vs) Hadoop ecosystem: HDFS, YARN, MapReduce Introduction to Hive, Pig NoSQL databases: MongoDB, Cassandra Apache Spark: 1. Architecture 2. RDDs, DataFrames Transformation & action operations	**15**

3	**BIG DATA ANALYTICS, VISUALIZATION & REAL-WORLD APPLICATIONS** **3.1 Big Data Analytics Techniques** Batch vs Real-time analytics Spark MLlib overview Text analytics & NLP basics Sentiment analysis Streaming analytics (Kafka, Spark Streaming**)** **3.2 Data Visualization & Storytelling** Principles of effective visualization Choosing the right chart Tools: Tableau, Power BI, Python Matplotlib, Seaborn Dashboard design principles Data storytelling techniques **3.3 Applications & Ethical Aspects of Data Science** Industry applications: Healthcare, Finance, Ecommerce, IoT Case studies: Fraud detection Recommendation engines Predictive maintenance Ethical issues: data privacy, fairness, bias, anonymization	**15**

Primary Textbooks

1. **"Data Science for Business" – Provost & Fawcett**
2. **"Python for Data Analysis" – Wes McKinney**
3. **"Introduction to Statistical Learning (ISLR)" – James, Witten, Hastie, Tibshirani**

Big Data & Hadoop

4. **"Hadoop: The Definitive Guide" – Tom White**
5. **"Big Data: Principles and Practices" – Nathan Marz**

Machine Learning

6. **"Hands-On Machine Learning with Scikit-Learn and TensorFlow" – Aurélien Géron**
7. **"Pattern Recognition and Machine Learning" – Christopher Bishop**

Visualization

8. **"Storytelling with Data" – Cole Nussbaumer Knaflic**

SLE Topics

1. Data Science Project: Conduct a data science project from start to finish. Choose a dataset of interest, perform data exploration, data cleaning, and data preprocessing. Apply appropriate data analytics techniques such as descriptive statistics, hypothesis testing, and machine learning algorithms for predictive modeling or clustering. Document your process, findings, and insights in a comprehensive report.
2. Big Data Technologies: Explore and compare various big data technologies, such as Apache Spark, Apache Kafka, Apache Cassandra, and Elasticsearch. Set up a small-scale data processing pipeline using these technologies and analyze their performance and scalability.
3. Linear Algebra Applications: Select a real-world problem that can be solved using linear algebra techniques. Implement algorithms for solving linear equations, matrix operations, and least squares regression. Discuss how these techniques are applicable in data science and machine learning contexts.
4. Exploratory Data Analysis (EDA): Choose a dataset and perform exploratory data analysis. Create visualizations to gain insights into the data distribution, relationships between variables, and potential outliers. Summarize your findings and make recommendations for further analysis or modeling.
5. Data Science Project: Conduct a data science project from start to finish. Choose a dataset of interest, perform data exploration, data cleaning, and data preprocessing. Apply appropriate data analytics techniques such as descriptive statistics, hypothesis testing, and machine learning algorithms for predictive modeling or clustering. Document your process, findings, and insights in a comprehensive report.

Practical List

1.	**Data Cleaning and Preprocessing Using Python** : Load a raw dataset (e.g., student performance or sales data) and perform complete data preprocessing. Include handling of missing values, detection and removal of duplicates, treatment of outliers using the IQR method, and normalization of numerical attributes.
2.	**Exploratory Data Analysis and Visualization :** Perform full Exploratory Data Analysis (EDA) on a dataset such as Titanic or Iris. Generate at least 5 visualizations (histogram, scatterplot, boxplot, heatmap, pairplot) and write a short interpretation for each graph.
3.	**Hypothesis Testing on Real-World Data :** Conduct a hypothesis test to compare two groups (e.g., average marks of male vs female students or average sales before and after a marketing campaign). State H_0 and H_1 clearly, perform a one-tailed or two-tailed test, and interpret the p-value.
4.	**Linear Regression Model for Prediction :** Build a Simple Linear Regression model in Python (e.g., predicting house prices using area or predicting sales based on advertisement spend). Evaluate the model using RMSE, MSE, and R^2 score. Plot the regression line and interpret the coefficients.
5.	**Classification Using Decision Trees** : Train a Decision Tree classifier on any dataset (e.g., loan approval, employee attrition, Iris dataset).Visualize the tree, generate confusion matrix, calculate accuracy, precision, and recall. Write a conclusion on the model's performance.
6.	**K-Means Clustering for Customer Segmentation :** Apply K-Means clustering to a customer dataset containing attributes like age, income, and spending score. Determine the optimal number of clusters using the Elbow Method and visualize the clusters using scatterplots.
7.	**Working with Hadoop HDFS and Basic PySpark Program :** Execute basic HDFS commands (mkdir, put, get, ls) to upload and retrieve files. Write and run a simple PySpark program (e.g., word count or filtering data).
8.	**Sentiment Analysis Using Text Data :** Perform sentiment analysis on a small set of tweets, reviews, or comments. Clean the text using tokenization, stopword removal, and stemming/lemmatization. Use a lexicon-based or ML-based approach to classify sentiments as positive, negative, or neutral.

Fundamentals of Information Security

Unit	Details	No. of Lectures
1	**1.1 Security and Risk Management** Explain some fundamental concepts with respect to information security. Understand and apply concepts of confidentiality, integrity and availability. Evaluate and apply security governance principles. Privacy requirements. Risk Management Concept. Threat Modelling. General Sources of Risk. Risks associated with hardware, software and networks. Lifecycle of Risk Management. Best practices to support risk management. **1.2 Asset Security** Identify and classify information and assets, Determine and maintain information and Asset ownership. Protect privacy and Ensure appropriate asset retention. Determine Data security controls. Establish information and asset handling requirements. **1.3 Security Architecture and Engineering** Implement and manage engineering processes using secure design principles. Understand the fundamental concepts of security models. Select controls based upon systems security requirements. Assess and mitigate the vulnerabilities of security architectures, designs, and solution elements.	
2	**2.1 Cyber Attacks and Cyber Law** What is cybercrime, History of Cyber threats? Common Types of Cyber Attacks. Evolution of the IT Act, Salient features of the IT Act 2000 and 2008 , various authorities under IT Act and their powers, Penalties & Offences, amendments, E- Commerce and related Laws in India. Role of Cyber Laws in Cyber security. Need for Digital Forensics and its other aspects. **2.2 Identity and Access Management (IAM)** Authentication and Authorization. Encryption and Decryption. Control physical and logical access to assets. Manage identification and authentication of people, devices, and services. Integrate identity as a third-party service. Implement and manage authorization mechanisms. **2.3 Communication and Network Security** Implement secure design principles in network architectures. Secure network components, Implement secure communication channels according to design Open System Interconnection (OSI) and Transmission. TCP/IP Model. Understand methods of cryptanalytic attacks	

3	**3.1 Software Development Security** Understand and integrate security in the Software Development Life Cycle (SDLC). SDLC MODELS, Identify and apply security controls in development environments, Assess the effectiveness of software security, assess security impact of acquired software. **3.2 Security Operations** Understand and support investigations. Understand requirements for investigation types. Conduct logging and monitoring activities. Securely provisioning resources. Understand and apply foundational security operations concepts. Implement and support patch and vulnerability management, Implement and manage physical security, Address personnel safety and security concerns. **3.3 Security Assessment and Testing** Security Assessment and Testing Introduction, Design and validate assessment, test and audit strategies Conduct security control testing. Analyze test output and generate report.	

SLE Topics

UNIT 1: Cia Triad, Information Security Requirements. Assess and mitigate vulnerabilities in web-based systems. Assess and mitigate vulnerabilities in mobile systems. Assess and mitigate vulnerabilities in embedded devices. Security Awareness Training: Study the significance of educating users and employees about security best practices to mitigate risks associated with human error.

UNIT 2: Ransomware attacks in India, Mobile Security: Explore the security challenges related to mobile devices, apps, and mobile communications. Cloud Security: Understand the unique security considerations when using cloud services and how to secure data in the cloud. Access Control: Learn about authentication methods, authorization, and access control models like RBAC (Role-Based Access Control) and ABAC (Attribute-Based Access Control). Security Policies and Procedures: Understand the importance of security policies, standards, and procedures in an organization's information security framework.

UNIT3: Ethical Hacking and Penetration Testing: Familiarize yourself with ethical hacking techniques and penetration testing methodologies to identify and fix vulnerabilities before malicious hackers exploit them. Secure Software Development: Learn about secure coding practices, software development lifecycle, and how to build secure applications. Privacy and Data Protection: Understand the importance of privacy laws, data protection regulations, and best practices for handling and securing sensitive data.

Online Sources

Website: **https://www.cybrary.it/**

https://www.coursera.org/

https://www.nist.gov/topics/cybersecurity

https://owasp.org/

Security Courses on Swayam or NPTEL:- **https://swayam.gov.in/** **or** **https://nptel.ac.in/**

Practical List

Practical No	Details
1	Checking data integrity using simple parity check.
2	Checking data integrity using Two-dimensional parity check.
3	Fundamental of Computers a. IPaddress b. MACaddress
4	Information gathering tool
5	Implementing Scanning Tool
6.	Implement Information/Email Harvesting
7	Implement steganography a. S-Tool b. Snow
8.	Using Hash for password.
9.	Understanding Buffer Overflow and Format String Attack
10.	Implementation of Networking Tools

Advanced Cloud Computing (DSE)

Unit	Details	No. of Lectures
1	**1.1 Introduction to Cloud Computing**: Introduction, Building Cloud Computing Environments, Principles of Parallel and Distributed Computing: Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributedcomputing. **1.2 Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device,Cloud usage monitor, Resource replication, Ready-made environment.	15
2	**2.1 Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Rolesand boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud. **2.2 Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. Industrial Platforms and New Developments: Amazon Web Services, GoogleApp Engine, Microsoft Azure.	15
3	**3.1 Specialized Cloud Mechanisms:** Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. Cloud Management Mechanisms: Remote administration system, Resource Management System, SLA Management System, Billing Management System. **3.2 Cloud Security Mechanisms**: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images **3.3 Service Quality Metrics and SLAs:** Service Quality Metrics, SLA Guidelines	15

Self-Learning topics

Topics
• Cloud Security • Cloud Deployment Model • Green Cloud Computing • Mobile Cloud Computing • Cloud Cryptography • Cloud Load Balancing • Big Data • Cloud Scalability

Online Resources

- Google Cloud Computing Foundations - Course (nptel.ac.in)
- Cloud Computing - Course (nptel.ac.in)

Reference Books:

- Mastering Cloud Computing Foundations and Applications Programming, Rajkumar Buyya,Elsevier, 2013
- Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Prentice Hall, 2012.
- Distributed and Cloud Computing, FromParallel Processing to the Internet of Things, Kai Hwang, MK Publishers,2013

Practical No	Details
1	Write a program for implementing Client Server communication model using TCP.
2	Write a program for implementing Client Server communication model using UDP.
3	A multicast Socket example
4	Write a program to show the object communication using RMI.
5	Implement hosting of multiple websites on Apache server and enable virtual host.
6.	Show the implementation of web services.
7	Implementing Cloud Server Security on Linux (User Creation + SSH Keys)”
8.	Server Hardening: Firewall, Auditing & Resource Control.

Blockchain(DSE)

Unit	Details	No. of Lectures
1	**.1 Blockchain:** Introduction, History, Centralized versus Decentralized systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases , Blockchain funding and ICO's. **1.2 Working of Blockchain:** Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions, blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling blockchain **1.3 Working of Bitcoin:** Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets. **1.4 Introduction to Ethereum:** three parts of blockchain, Ether as currency and commodity, Building trustless systems, Smart contracts, Ethereum Virtual Machine, The Mist browser, Wallets as a Computing Metaphor, The Bank Teller Metaphor, Breaking with Banking History **1.5 Advance Ethereum:** How Encryption Leads to Trust, System Requirements, Using Parity with Geth, Anonymity in Cryptocurrency, Central Bank Network, Virtual Machines, EVM Applications, State Machines, Guts of the EVM, Blocks, Mining's Place in the State Transition Function, Renting Time on the EVM, Gas, Working with Gas, Accounts, Transactions, and Messages, Transactions and Messages, Estimating Gas Fees for Operations, Opcodes in the EVM	15
2	**2.1 Solidity Programming:** Introduction, Global Banking Made Real, Complementary Currency, Programming the EVM, Design Rationale, Importance of Formal Proofs, Automated Proofs, Testing, Formatting Solidity Files, Reading Code, Statements and Expressions in Solidity, Value Types, Global Special Variables, Units, and Functions **2.2 Hyperledger:** Overview, Fabric, composer, installing hyperledger fabric and composer, deploying, running the network, error troubleshooting. **2.3 Smart Contracts and Tokens:** EVM as Back End, Assets Backed by Anything, Cryptocurrency Is a Measure of Time, Function of Collectibles in Human Systems, Platforms for High-Value Digital Collectibles, Tokens as Category of Smart Contract, Creating a Token, Deploying the Contract, Playing with Contracts **2.4 Mining Ether:** Why? Ether's Source, Defining Mining, Difficulty, Self-Regulation, and the Race for Profit, How Proof of Work Helps Regulate Block Time, DAG and Nonce, Faster Blocks, Stale Blocks, Difficulties, Ancestry of Blocks and Transactions, Ethereum and Bitcoin, Forking, Mining, Geth on Windows, Executing Commands in the EVM via the Geth Console, Launching Geth with Flags, Mining on the Testnet, GPU Mining Rigs, Mining on a Pool with Multiple GPUs.	15
3	**3.1 Cryptoecnomics:** Introduction, Usefulness of cryptoeconomics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios , Case Study **3.2 Blockchain Application Development:** Decentralized Applications, Blockchain Application Development, Interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum—Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions, Public vs. Private Blockchains, Decentralized Application Architecture, **3.4 Building an Ethereum DApp:** The DApp, Setting Up a Private Ethereum Network, Creating the Smart Contract, Deploying the Smart	15

	Contract, Client Application, **3.5 DApp deployment:** Seven Ways to Think About Smart Contracts, DApp Contract Data Models, EVM back-end and front-end communication, JSON-RPC, Web 3, JavaScript API, Using Meteor with the EVM, Executing Contracts in the Console, Recommendations for Prototyping, Third-Party Deployment Libraries, Creating Private Chains. **4.6 Case Studies on practical Blockchain implementation: Suggested Case Studies: Case Studies of Enterprise Blockchain :** Overview of enterprise-level blockchain implementations such as JP Morgan's Quorum, Ripple, Tendermint, and HyperLedger . **Case study of PolkaPlay (polkaplay.io):** Polkaplay is a unique platform where users can create images, short videos, and NFTs seamlessly while earning rewards. Measures that governments have taken to regulate and control blockchain technology e.g. Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations, anonymity goals, and government techniques for deanonymization of entities on blockchain	

Self-Learning topics

Sub Unit	Topic
3.5	Case Studies on practical blockchain implementation Suggested Case Studies: **1.** Case Studies of Enterprise Blockchain: Overview of enterprise-level blockchain implementations such as JP Morgan's Quorum, Ripple, Tendermint, and HyperLedger. **2.** Case study of PolkaPlay (polkaplay.io): Polkaplay is a unique platform where users can create images, short videos, and NFTs seamlessly while earning rewards. **3.** Measures that governments have taken to regulate and control blockchain technology e.g. Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations, anonymity goals, and government techniques for deanonymization of entities on blockchain

Online Resources

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

References

- Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal,
- Gautam Dhameja, Priyansu Sekhar Panda,Apress,2018
- Introducing Ethereum and Solidity, Chris Dannen,Apress,2017
- The Blockchain Developer, Elad Elrom,Apress.2019
- Mastering Ethereum, Andreas M. Antonopoulos ,Dr. Gavin Wood, O'Reilly,First,2018
- Blockchain Enabled Applications,Vikram Dhillon,David Metcalf,Max Hooper,Apress,2017

Practical

Practical No	Details
1	i. Perform Visual demonstration of Blockchain. Case Study on any application of Blockchain
2	**Write the following programs for Blockchain in Python :** i. A Simple client class that generates the private and public keys by using the built in Python RSA algorithm and test it. ii. A transaction class to send and receive money and test it.
3	**Write the following programs for Blockchain in Python :** i. Create multiple transactions and display them. ii. Create a blockchain, a genesis block and execute it.
4	**Write the following programs for Blockchain in Python :** i. Create a mining function and test it. ii. Add blocks to the miner and dump the blockchain.
5	**Implement and demonstrate the user of the following in Solidity** i. Variable ii. Operations iii. Loops iv. Decision Making v. Strings
6.	**Implement and demonstrate the user of the following in Solidity** i. Arrays ii. Enums iii. Mappings iv. Ether Units V. Special Variables
7	**Implement and demonstrate the user of the following in Solidity:** i. Functions ii. View Functions iii. Pure Functions iv. Fallback Functions v. Function Overloading vi. Mathematical Functions vii. Cryptographic Functions viii. Generate Random Number

8.	**Implement and demonstrate the user of the following in Solidity:** i. Contracts ii. Inheritance (Single and Multiple) iii. Constructors iv. Abstract Class Interfaces
9.	**Implement and demonstrate the user of the following in Solidity:** i. Libraries Error Handling

Research Methodology

Unit	Content	No. of Lectures
1	**1.1** Research: What does it mean? Characteristics of Research **1.2** Research Methods versus Methodology, Research and Scientific Method. **1.3** Types of Research: Descriptive versus Analytical, Applied versus Fundamental, Quantitative versus Qualitative, Conceptual versus Empirical. Research Process. **1.4** Formulating a Research Problem: Reviewing Literature, formulating a Research Problem, Identifying Variables, Constructing Hypothesis	**15**
2	**2.1** The Research Design: Meaning, Need for Research Design, Important Concepts, Different Research Designs, Basic Principles of Experimental Designs. **2.2** Sampling Design: Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample. **2.3** Collecting Data: Considering Ethical Issues in Data Collection, Methods of Data Collection.	**15**
3	**3.1 Processing and Analysis of Data:** Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes. **3.2 Hypothesis Testing:** What is a Hypothesis?, Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Tests of Hypotheses, One sided and Two sided hypothesis, Critical region, p-value, Confidence intervals, Conducting a Hypothesis Test, Type – I and Type – II errors.	**15**
4	**4.1 Technical Writing:** Writing a Research Proposal, What is a Scientific Paper? Ethics in Scientific Publishing. **4.2 Preparing the Text:** How to Prepare the Title, How to List the Authors and Addresses, How to Prepare the Abstract, How to Write the Introduction, How to Write the Materials and Methods Section, How to Write the Results, How to Write the Discussion, How to State the Acknowledgments, How to Cite the References. **4.3 Preparing the Tables and Figures**: How to Design Effective Tables, How to Prepare Effective Graphs, How to Prepare Effective Photographs. **4.4 Publishing the Paper:** Rights and Permissions, How to Submit the Manuscript, How and When to Use Abbreviations, How to Write a Thesis, Outcome of Research	

References:

1. Kothari C.R., Research Methodology, New Age International Publication, New Delhi.
2. Ranjit Kumar, Research Methodology-A Step-by-Step Guide for Beginners, (4th ed.),2014, Singapore, Pearson Education**.**
3. Robert, A. Day, How to Write and Publish a Scientific Paper, Cambridge University Press,Great Britain.

SLE topics was given on the topics related to Chapter 1 to 5.

Semester II

Machine Learning

Unit	Details	No of lecture

1	**Machine Learning Concepts & Mathematical Foundations**
	• ML paradigms: supervised, unsupervised, semi-supervised, reinforcement
	• ML pipeline, bias–variance trade-off
	• Mathematical foundations:
	  ○ Linear algebra (vectors, matrices, eigenvalues)
	  ○ Probability basics & distributions
	  ○ Gradient Descent introduction
	Data Handling, Exploration & Preprocessing
	• Advanced data wrangling using Pandas
	• Exploratory Data Analysis (EDA) and visualization
	• Handling imbalanced data (SMOTE, resampling techniques)
	• Feature engineering: transformation, encoding, binning
	Feature Selection & Dimensionality Reduction
	• Filter, wrapper, embedded methods
	• Lasso/Ridge for feature selection
	• PCA and t-SNE for dimensionality reduction
	• Curse of dimensionality discussion
		15

2	Regression & Ensemble Methods
	• Linear, Ridge, Lasso, ElasticNet Regression
	• Polynomial Regression and Spline Regression
	• Ensemble models:
	  ○ Bagging, Random Forest
	  ○ Boosting: AdaBoost, Gradient Boosting, XGBoost
	• Regression performance metrics
	Classification Algorithms & Performance Evaluation
	• Logistic Regression, SVM (linear & kernel)
	• KNN, Naïve Bayes
	• ROC–AUC, precision-recall curve
	• Multi-class vs multi-label classification
	• Cross-validation techniques
	Model Optimization & Hyperparameter Tuning
		15

	• Overfitting/underfitting diagnostics • Regularization (L1, L2) • Grid Search, Random Search, Bayesian Optimization • Introduction to AutoML tools	

3	Clustering & Association Analysis
	
	• K-Means, K-Medoids, DBSCAN, Hierarchical clustering
	• Cluster validity indices (silhouette score, Davies–Bouldin index)
	• Association Rules: Apriori, FP-Growth
	• Market basket analysis
	
	Deep Learning Foundations
	
	• Perceptron, activation functions
	• Feed-forward neural networks
	• Backpropagation algorithm
	• Introduction to CNNs & RNNs
	• Overview of TensorFlow/Keras frameworks
	
	ML System Design & Deployment
	
	• Model storage, versioning, and pipelines
	• Serving models using Flask, FastAPI, or Streamlit
	• Basics of MLOps:
	  ○ CI/CD for ML
	  ○ Monitoring ML models in production
		15

SLE Topics

Supervised Learning Project:
Choose a dataset suitable for supervised learning, such as a classification or regression task. Split the data into training and testing sets, select appropriate machine learning models, and evaluate their performance using various metrics. Compare the results and fine-tune the models to achieve better accuracy or performance.

Unsupervised Learning and Clustering:
Select a dataset and apply unsupervised learning techniques like clustering (e.g., K-means or hierarchical clustering). Explore different clustering algorithms and evaluate their effectiveness. Visualize the clustered data to gain insights into underlying patterns and structures.

Feature Engineering and Selection:
Take a dataset and perform feature engineering by creating new features or transforming existing ones. Compare the performance of machine learning models using different feature sets. Apply feature selection techniques to identify the most relevant features and observe the impact on model accuracy.

Model Interpretability and Explain ability:
Choose a complex machine learning model and investigate techniques for model interpretability and explain ability. Use tools like LIME, SHAP, or feature importance to understand how the model makes predictions and identify which features contribute the most to those predictions.

Time Series Analysis and Forecasting:
Select a time series dataset and apply time series analysis techniques like decomposition, trend identification, and seasonality estimation. Use forecasting models (e.g., ARIMA, Exponential Smoothing) to make future predictions based on historical data. Evaluate the forecast accuracy and adjust the models if necessary.

Practical List

Q. Perform end-to-end machine learning workflow covering exploratory data analysis, preprocessing, feature engineering, dimensionality reduction, regression, classification, ensemble models, clustering, association rule mining, neural networks, and model deployment. Specifically, you are required to:

1.	Load a real dataset (such as Titanic, Diabetes, Heart Disease, etc.) and perform advanced Exploratory Data Analysis by cleaning missing values, detecting outliers, normalizing/standardizing data, and generating statistical summaries along with boxplots, pairplots, and heatmaps.
2.	Apply feature engineering techniques including label encoding, one-hot encoding, binning, and feature scaling; implement PCA, plot the variance explained, and compare model performance with and without dimensionality reduction.
3.	Build regression models including Linear Regression, Ridge, Lasso, and ElasticNet using a dataset like Boston Housing, and compare their performance using MAE, MSE, RMSE, and R^2 along with visualizing regression residuals and prediction errors.
4.	Use a classification dataset (Breast Cancer, Iris, or Student Performance) to train SVM (linear & kernel), KNN, and Logistic Regression models, and evaluate them using confusion matrix, precision, recall, F1-score, and ROC–AUC curves.
5.	Implement ensemble learning methods such as Random Forest, AdaBoost, Gradient Boosting, and XGBoost, perform feature importance analysis, and compare ensemble model performance with baseline models.
6.	Apply unsupervised learning techniques like K-Means, Hierarchical Clustering, and DBSCAN on datasets (Mall Customers or Wholesale Customers), visualize clusters, compute silhouette score, and perform Apriori or FP-Growth on a transactional dataset to extract strong association rules.
7.	Build a basic Artificial Neural Network using TensorFlow/Keras for MNIST or any binary classification dataset by setting activation functions, loss, optimizer, and metrics, and train/validate the model while plotting accuracy and loss curves.
8.	Train any machine learning model (classification or regression), save the model using pickle or joblib, and deploy it using Flask or Streamlit by creating a web interface that accepts user input and provides real-time predictions

Reference Books:

Core Texts

1. **Ethem Alpaydin – Introduction to Machine Learning**
2. **Christopher M. Bishop – Pattern Recognition and Machine Learning**
3. **Kevin P. Murphy – Machine Learning: A Probabilistic Perspective**

Applied & Practical Texts

4. **Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow**
5. **Sebastian Raschka – Python Machine Learning**
6. **Ian Goodfellow – Deep Learning**

Additional

7. **Han, Kamber & Pei – Data Mining: Concepts and Techniques**
8. **Trevor Hastie, Tibshirani, Friedman – The Elements of Statistical Learning**

Principles of Data Science

Unit	Details	No of lectures
1	**1.Introduction to Data Science:** What is Data Science? Data Science process / lifecycle Applications of Data Science **2.Statistical Inference** Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R language. **3.Types of Data** • Structured, Semi-structured, Unstructured data, Quantitative vs Qualitative data, Continuous vs Categorical data, Data scales: Nominal, Ordinal, Interval, Ratio	15

2	**1.Data Collection & Data Preprocessing**
	• Data acquisition methods
	• Data cleaning
	  ○ Handling missing values
	  ○ Removing duplicates
	  ○ Outlier detection
	• Data integration
	• Data transformation & normalization
	• Feature selection and extraction
	•
	2.Machine Learning Fundamentals
	
	Supervised vs Unsupervised learning
	Model training, testing, validation
	Overfitting vs Underfitting
	Cross-validation
	
	3.Data Wrangling with Python
	• Using Pandas for data handling
	• NumPy basics
	• DataFrames operations
	• Reading/writing CSV, Excel, JSON
	• Data summarization
		15

3	**1.Machine Learning Algorithms** **Supervised Learning** • Linear Regression • Logistic Regression • Decision Trees • Random Forest • Support Vector Machines (SVM) **Unsupervised Learning** • k-Means Clustering • Hierarchical Clustering • PCA (Principal Component Analysis) **2.Data Visualization Techniques** • Matplotlib • Seaborn • Plotly (optional) • Dashboards (Power BI / Tableau basics) **3.Data Ethics & Privacy** • Bias in data • Ethical AI • GDPR & data protection principles	**15**

SLE Topics

- Different Form/Types/Ways for Data Visualizations
- Machine Learning Algorithms
- Web Scrapping concept in Data Science

Reference Book

- Doing Data Science, Rachel Schutt & Cathy O`Neil

Practical List:

Practical	Topic
1	**1. Reading and Displaying Data** Write a Python program to read data from a CSV file using Pandas and display first/last 10 rows.
2	**Data Cleaning – Missing Value Handling** Load a dataset and: • Identify missing values • Replace them using mean/median/mode
3	**Data Cleaning – Removing Duplicates & Outliers** • Remove duplicate rows • Detect outliers using Z-score or IQR
4	**.Data Visualization – Basic Charts** Use Matplotlib/Seaborn to create: • Histogram • Bar chart • Line chart
5	**Data Visualization – Advanced Charts** Create: • Box plot • Heatmap (correlation heatmap) • Pair plot
6	**Linear Regression Model** Build a simple linear regression model to predict a numerical value.
7	**Multiple Linear Regression** Use 2–3 independent variables to predict an output.
8	**Logistic Regression** Build a binary classification model (e.g., predict pass/fail, 0/1).
9	**Decision Tree Classifier** Train and visualize a decision tree.
10	**Random Forest Classifier** Train a random forest model and measure accuracy.
11	**K-Means Clustering** Perform clustering and plot the clusters using scatter plot

Security Assessment Architecture and Design

UNIT	Details	Lecture
1	**Introduction:** Security Assessments, What Is a Security Assessment? The Organizational Viewpoint The System Viewpoint, Pre-Assessment Preparation, The Security Assessment Meeting Describe the Application Security Process, Identify Assets, Identify Vulnerabilities and Threats Identify Potential Risks Examples of Threats and Countermeasures **Security Architecture Basics**-Security As an Architectural Goal ,Corporate Security Policy and Architecture ,Security and Software Architecture System ,Security Architecture Definitions ,Security and Software Process ,Security Principles ,Additional Security-Related Properties ,Hard-to-Provide Properties ,Inference Aggregation ,Least Privilege Self-Promotion ,Graceful Failure ,Safety Authentication ,User IDs and Passwords, Tokens ,Biometric Schemes , **Architecture patterns in Security** -Pattern Goals ,Common Terminology ,Architecture Principles and Patterns ,The Security Pattern Catalog ,Entity Principal, Context Holders Session Objects and Cookies ,Ticket/Token	15
2	**Middleware Security** - Middleware and Security ,Service Access ,Service Configuration ,Event Management ,Distributed Data Management ,Concurrency and Synchronization, Reusable Services ,Secure Communications through SSL ,Why Is SSL Popular? Application-Unaware Security Application-Aware Security **Web Security** -Web Security Issues ,Questions for the Review of Web Security ,Web Application Architecture ,Web Application Security Options, Securing Web Clients **Application and OS Security** Structure of an Operating System ,Structure of an Application ,Application Delivery Application and Operating System Security ,Hardware Security Issues ,Process Security Issues ,Software Bus Security Issues ,Data Security Issues ,Network Security Issues , Configuration Security Issues,	15
3	**Security Components** - Secure Single Sign-On Scripting Solutions ,Network Authentication ,Secure SSO Issues ,Public-Key Infrastructures ,Certificate Authority Registration Authority ,Repository Certificate Holders ,Certificate Verifiers Firewalls ,Firewall Configurations ,Firewall Limitations ,Intrusion Detection Systems **Security and Other Architectural Goals**- Metrics for Non-Functional Goals ,Normal Architectural Design ,Good Architectural Design ,High Availability Security Issues Robustness Binary Patches Security Issues, Reconstruction of Events Security Issues **Enterprise Security Architecture** - Security as a Process ,Applying Security Policy Security Data ,Databases of Record ,Enterprise Security as a Data Management Problem ,The Security Policy Repository ,The User Repository ,The Security	15

	Configuration Repository ,The Application Asset Repository ,The Threat Repository	

SLE Topics

The Five-Level Compliance Model
Security Assessment Balance Sheet Model
Why Are Assessments So Hard?
Why Assessments Are Like theKnapsack Problem
Why Assessments Are Not Like the Knapsack Problem
Vendor Bashing for Fun and Profit
Other Abstractor
The Common Object Request Broker Architecture
The OMG CORBA Security Standard
The CORBA Security Service
Specification Packages and Modules in the Specification
Vendor Implementations of CORBA
Security CORBA
Security Levels
Secure Interoperability
The Secure Inter-ORB Protocol
The Java 2 Enterprise Edition
StandardServer-SideJava
Java Servlets Servlets and Declarative Access Control
Enterprise Java Beans
Control CGI Scripts
JavaScript
Active Content Scripting Languages
UNIX Pluggable Authentication Modules
UNIX Access Control Lists
Solaris Access Control Lists
HP-UX Access Control Lists
Procedural Extensions to SQL Wrapper
Sentinel Security through Restrictive Clauses
Virtual Private Database Oracle Label Security ad and Write Semantics
S2ML SAML XML Key Management Service XML and Other Cryptographic Primitives
J2EE Servlet Security Specification
HGP: A Case Study in Data Management
The XML Security Services Signaling Layer
Kerberos
Kerberos Components
Enterprise Web Server Architectures
Security Based on Object-Oriented Encapsulation
Strong, Shared Authentication
LDAP and X.500 Directories
The Distributed Sandbox
Why Code Review Is Important
The Security Pattern Catalog Revisited
Security Design Forces against Other Goals
Extensible Markup Language (XML)
XML and Data Security
XML and Security Standards
XML Signatures
XML Encryption
XML-Enabled Security Data
Force Diagrams around Security

PKI Usageand Administration
PKI Operational Issues

Reference Books:

1. Ross Anderson, Security Engineering 2nd 3rd Edition.
2. Charles P. Pfleeger, Security in Computing, 5th Edition, Prentice Hall, 2015, ISBN-10: 0134085043, Recommended.
3. The Official (ISC)² CISSP CBK Reference, 5th Edition by John Warsinske, Mark Graff, Kevin Henry, Christopher Hoover, Ben Malisow, Sean Murphy, C. Paul Oakes, George Pajari, Jeff T. Parker, David Seidl,Mike Vasquez, Publisher: Sybex (2019)
4. Enterprise Security Architecture: A Business-Driven Approach by Nicholas A Sherwood
5. Enterprise Information Security Architecture A Complete Guide by Gerardus Blokdyk
6. Designing Security Architecture Solutions by Jay Ramachandran
7. https://security-and-privacy-reference-architecture.readthedocs.io/en/latest/index.html

Practical List

1. Create a model Security Assessment Report for practical use case or scenario (as defined by faculty)
2. Create a model Security Architecture Diagram for practical use case or scenario (as defined by faculty)
3. Demonstrate implementation (encryption) of RSA Cipher with Python for practical use case or scenario (as defined by faculty)
4. Demonstrate implementation (decryption) of RSA Cipher with Python for practical use case or scenario (as defined by faculty)
5. Demonstrate cracking (via any method) of RSA Cipher with Python for practical use case or scenario (as defined by faculty)
6. Demonstrate practical implementation of SSL upon any locally installed webserver for practical use case or scenario (as defined by faculty)
7. Demonstrate implementation of firewall on Ubuntu Server (latest edition) in headless mode (using SSH) for practical use case or scenario (as defined by faculty)
8. Demonstrate secure configuration of any 1 webserver for practical use case or scenario (as defined by faculty)
9. Create a model Enterprise Security Architecture Diagram for practical use case or scenario (as defined by faculty)
10. Configure a secure SQL installation to prevent SQL Injection for practical use case or scenario (as defined by faculty)

Micro services Architecture (DSE)

Unit	Details	No. of Lectures
1	**Microservices:** Understanding Microservices,Adopting Microservices, The Microservices Way. **Microservices Value Proposition:** Deriving Business Value, Defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. **Designing Microservice Systems:** The Systems Approach toMicroservices, A Microservices Design Process, **Establishing a Foundation:** Goals and Principles, Platforms, CultureService Design: Microservice Boundaries, API design for Microservices,Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Micro services,dealing with Dependencies. **System Design and Operations**: Independent Deployability,More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting **Adopting Microservices in Practice:** Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance,Services Guidance.	**15**
2	**Building Microservices with ASP.NET Core**: Introduction, Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to DickerHub. Building Configuring Microservice Ecosystems: Using Environment Variables ,,Docker, Using Spring Cloud Config Server, Configuring Microservices with etcd. **Backing Services**: Microservices Ecosystems,Building the location Service,Enhancing Team Service **Creating Data Service**: Choosing a Data Store,Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories,Exercise the Data Service.	**15**
3	**Event Sourcing and CQRS:** Event Sourcing, CQRS pattern, Event Sourcing and CQRS,Running the samples **Building an ASP.NET Core Web Application:** ASP.NET CoreBasics, Building Cloud-Native Web Applications. **Service Discovery:** Cloud Native Factors,Netflix Eureka, Discovering and Advertising ASP.NET Core Services. DNS and Platform Supported Discovery **Securing Applications and Microservices:** Security in the Cloud,Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices **Building Real-Time Apps and Services:** Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider,Building the Proximity Monitor.	**15**

SLE topics

- ASP.NET Core Web Apps
- Integration Testing Real Repositories
- Building Cloud-Native Web Applications.
- Real-Time Applications using Micro service.

Reference book

- Sam Newman-Building micro services Designing fine grained system Oreilly
- Nirmal Singh and Zack Dawood Building micro services with Macronaut

Practical List:

Practical No	Details
1	Building APT.NET Core MVC Application.
2	Building ASP.NET Core REST API.
3	Working with Docker, Docker Commands, Docker Images and Containers
4	Installing software packages on Docker, Working with Docker Volumes andNetworks.
5	Working with Docker Swarm.
6	Working with Circle CI for continuous integration.
7	Creating Microservice with ASP.NET Core.
8	Working with Kubernetes.
9	Creating Backing Service with ASP.NET Core.

USER EXPERIENCE DESIGN (DSE)

Unit	TOPIC	NO. OF LECTURES
I	1.1 Introduction : What is UX, Ubiquitous interaction, Emerging desire for usability, From usability to user experience, Emotional impact as part of the user experience, User experience needs a business case, Roots of usability 1.2 The Wheel: A Lifecycle Template :Introduction, A UX process lifecycle template, Choosing a process instance for your project, The system complexity space, Meet the user interface team, Scope of UX presence within the team, More about UX lifecycles 1.3 Contextual Inquiry: Eliciting Work Activity Data Introduction, The system concept statement, User work activity gathering, Look for emotional aspects of work practice, Abridged contextual inquiry process, Data-driven vs. model-driven inquiry, History. ,Contextual Analysis, Extracting Interaction Design Requirements, Constructing Design-Information Models.	**15**
II	2.1 Design Thinking, Ideation, and Sketching,Prototyping: Introduction, Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching, More about phenomenology, Mental Models and Conceptual Design, Wireframe, Prototyping 2.2 UX Evaluation: UX Goals, Metrics and Targets, UX Evaluation Techniques. - Formative vs summative, Analysis.	**15**
III	3.1 The Interaction Cycle and the User Action Framework: Introduction, The interaction cycle, The user action framework—adding a structured knowledge base to the interaction cycle, Interaction cycle and user action framework content categories, Role of affordances within the UAF, Practical value of the UAF 3.2 UX Design Guidelines: Introduction, Using and interpreting design guidelines, Human memory limitations, Selected UX design guidelines and examples, Planning, Translation, Physical actions, Outcomes, Assessment, Overall	**15**

Text Books:

1. The UX Book by Rex Hartson and Pardha Pyla

2. Smashing UX Design by Jesmond Allen and James Chudley

3. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden

4. Don’t Make Me Think, Revisited by Steve Krug

5. The User Experience Team of One by Leah Buley

6. The Elements of User Experience by Jesse James Garrett

7. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

References:

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler

2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill

3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler

Human Computer Interaction by Alan Dix

Practicals:

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1. Perform user research
2. User requirement collection
3. User Requirement Analysis
4. Create User personas, user scenarios , customer journey maps etc
5. Conceptual Design- Site Maps
6. Create Wireframe
7. Create Prototype
8. Set UX Goals
9. Perform UX Evaluation
10. Perform UX Reporting