SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA

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शिवाजी विद्यापीठ, कोल्हापुर - ४१६ ००४, महाराष्ट्र

दरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दरध्वनी ०२३१–२६०९०९३/९४

SU/BOS/Science/499

Date: 10/07/2023

1	
The Principal,	The Head/Co-ordinator/Director
All Concerned Affiliated Colleges/Instituti	ons All Concerned Department (Science)
Shivaji University, Kolhapur	Shivaji University, Kolhapur.

Subject: Regarding syllabi of M.Sc. Part-I (Sem. I & II) as per NEP-2020 degree programme under the Faculty of Science and Technology.

Sir/Madam,

Estd. 1962

"A++" Accredited by NAAC(2021) With CGPA 3.52

To.

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-I (Sem. I & II) as per NEP-2020 degree programme under the Faculty of Science and Technology.

	M.ScPart I (Sem. I & II) as per NEP-2020						
1.	Microbiology (HM)	10.	Data Science				
2.	Pharmaceutical Microbiology (HM)	11.	Computer Science				
3.	General Microbiology	12.	Information Technology (Entire)				
4.	Electronics	13.	Food Science & Technology				
5.	Embedded Technology	14	Food Science & Nutrition				
6.	Geology	15.	Biochemistry				
7.	Sugar Technology (Entire)	16.	Biotechnology				
8.	Alcohol Technology (Entire)	17.	Medical Information Management				
9.	Agro Chemical & Pest Management (AGPM)	18.	Environmental Science				
		19.	Physics				

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

Shivaji University, Kolhapur



NAAC "A++" Grade with CGPA 3.52

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)

Syllabus for

M.Sc. (Data Science)

(Under Faculty of Science and Technology)

PART-I SEMESTER- I & II

(Syllabus to be implemented from Academic Year 2023-24)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Program Structure M. Sc. Part -I(Level 6)

	Semester – I (Duration Six Months)									
Sr	Course Code	Teac	Teaching SchemeExamination Scheme							
No.		Theor	y and Prac	ctical	Universit	y Assessmen	t (UA)	Internal	Assessment	(IA)
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam Hours	Maximum Marks	Minimum Marks	Exam Hours
1.	MP- 101: Introduction to Statistics	4	4	4	80	32	3	20	8	
2.	MP-102: Database Management System	4	4	4	80	32	3	20	8	
3.	MPPR-103 Practical	-	6	4	80	32	3	20	8	
4.	MP-104 Python	2	2	2	40	16	2	10	4	
5.	ME-105: Elective 1) Data Mining 2) Data Structure	4	4	4	80	32	3	20	8	
6.	RM- 106 Research Methodology	4	4	4	80	32	3	20	8	
	Total (A)	-		22	440			110		
		1	1	1	1	1	1	1	1	

Course Code	Theory Lectures (Per week)	y and Prac Hours (Per	ctical Credit	Universit Maximum	y Assessment	t (UA)	Internal	Assessment	(TA)
201: tics- II	Lectures (Per week)	Hours (Per	Credit	Maximum		· · · ·		1 assessment	(\mathbf{IA})
01: tics- II	(Per week)	(Per			Minimum	Exam	Maximum	Minimum	Exam
201: tics- II	week)			Marks	Marks	Hours	Marks	Marks	Hours
201: tics- II	4	week)							
tics- II	4	4	4	80	32	3	20	8	
202:	4	4	4	80	32	3	20	8	
Programming									
R-203:		6	4	80	32	3	20	8	
ical									
204:	2	2	2	40	16	2	10	4	
Design									
205:	4	4	4	80	32	3	20	8	
ive									
) Image Processing									
) Big Data									
206:			4	80	32		20	8	
nship									
Total (B)	14	20	22	440			110		
			44	880			220		
15	Total (B)	Total (B) 14	Total (B) 14 20	Total (B) 14 20 22 44 44 44	Total (B) 14 20 22 440 44 880 80 <td>Total (B) 14 20 22 440 44 880</td> <td>Total (B) 14 20 22 440 44 880</td> <td>mp Total (B) 14 20 22 440 110 44 880 220</td> <td>Imp Imp Imp Imp Imp Total (B) 14 20 22 440 110 Imp Imp 14 880 220</td>	Total (B) 14 20 22 440 44 880	Total (B) 14 20 22 440 44 880	mp Total (B) 14 20 22 440 110 44 880 220	Imp Imp Imp Imp Imp Total (B) 14 20 22 440 110 Imp Imp 14 880 220

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• Students Contact Hours Per Week : 24 Hours(Min.)	• Total Marks for M.Sc-I : 1100
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for M.ScI (Semester-I and II): 44

 MP – Major Paper MPPR – Major Paper Practical ME- Major Elective RM – Research Methodology OJT –On Job Training Internship: Student must complete on job Training/ Internship during summer break after completion of First year 	 Practical Examination is Semester wise before theory examination. Examination for CCPR-103 shall be based on Semester-I Practical. Examination for CCPR-203 shall be based on Semester-II Practical. * Duration of Practical Examination as per respective BOS guidelines.
	• Separate passing is mandatory for Theory, Internal and Practical Examination
• Dequirement for Entry at Layel 6.	

• Requirement for Entry at Level 6 :

• Completed all requirements of the Bachelor's Degree(Level 5)

• Exit option at Level 6: Student can exit after level 6 with **Post Graduate Diploma in Data Science** if he/she completes the courses equivalent to minimum of **40-44** credits.

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) M.Sc. Program Structure M. Sc. Part -II(Level 6.5)

	Semester – III (Duration Six Months)										
Sr	Course Code	Teaching Scheme			Examination Scheme						
No.		Theor	y and Prac	tical	Universi	ty Assessment	t (UA)	Internal Assessment (IA)			
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam Hours	Maximum Marks	Minimum Marks	Exam Hours	
7.	MP- 301: Machine Learning	4	4	4	80	32	3	20	8		
8.	MP-302: R- Programming	4	4	4	80	32	3	20	8		
9.	MPPR-303 Practical		6	4	80	32	3	20	8		
10	MP-304 Power BI	2	2	2	40	16	2	10	4		
11	ME-305: Elective 1) Cyber Security 2) Software Project Management	4	4	4	80	32	3	20	8		
12	RP- 306 Research Project		6	4	80	32	3	20	8		
	Total (C)	14	26	22	440			110			
		1	1								

	Semester –IV (Duration Six Months)											
		Tea	Teaching Scheme			Examination Scheme						
Sr		Theo	ry and Pra	actical	Universi	ity Assessmer	nt (UA)	Intern	al Assessmen	t (IA)		
No	Course Code	Lectures	Hours	Credit	Maximum	Minimum	Exam	Maximum	Minimum	Exam		
INO.		(Per	(Per		Marks	Marks	Hours	Marks	Marks	Hours		
		week)	week)									
1	MP-401:	4	4	4	80	32	3	20	8			
	Internet of Things											
2	MP-402:	4	4	4	80	32	3	20	8			
	Data Visualization with Tableau											
3	MPPR-403:		6	4	80	32	3	20	8			
	Practical											
4	ME-405:	4	4	4	80	32	3	20	8			
	Elective:											
	1) Deep Learning											
	2) Soft Commuting											
5	RP-406:		10	6	100	40	3	50	20			
	Research Project											
	Total (D)	12	28	22	420			130				
Total	(C+D)			44	860			240				

• Students Contact Hours Per Week : 26 Hours(Min.)	• Total Marks for M.Sc-II : 1100
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for M.ScII (Semester- III and IV): 44
 MP– Major Paper MPPR – Major Paper Practical ME- Major Elective RP- Research Project 	 Practical Examination is Semester wise before theory examination. Examination for CCPR-303 shall be based on Semester-III Practical. Examination for CCPR-403 shall be based on Semester-IV Practical. * Duration of Practical Examination as per respective BOS guidelines. Separate passing is mandatory for Theory, Internal and Practical Examination.

- Requirement for Entry at Level 6.5 : Completed all Requirements of the relevant Post Graduate Diploma in Data Science (Level 6)
- Exit at Level 6.5 : Students will exit after level 6.5 with Master's Degree in Data Science if he/she completes the course equivalent to minimum of 88 credits.

	M.Sc. I	M.Sc. II	Total
Marks	1100	1100	2200
Credits	44	44	88

The name of the programme shall be Master of Science (M.Sc. in Data Science)

Duration of the Program

• The M.Sc. programme will be a full-time two years i.e. 4 semesters. Pattern of examination will be Semester System.

Medium of Instruction

• The medium of Instruction will be English only.

Admission Procedure

- **B.Sc.**(Statistics / Mathematics / Electronics / Physics / Chemistry) from recognized Indian University.
- **B.Sc.**(Computer Science), **B.C.S.**, **B.Sc**.(Entire Computer Science), (**BCA**)**Bachelor of Computer Application** from recognized Indian University.
- **Bachelor of Engineering**(Computer Engineering, Electronics Engineering, Electronics and Telecommunication Engineering, Mechanical Engineering and Electrical Engineering) from recognized Indian University.

Project work

At the end of III & IV semester student has to carry out a project work.

1. Project work at end of semester should be done in groups, each student must be given a responsibility for a distinct module and care should be taken to see the progress of individual modules is independent of others.

2. Students should take guidance from an internal guide and prepare a Project Report on "Project Work" to be submitted to the Department after evaluation.

3. The Project Report should contain an Introduction to Project, which should clearly explain the project scope in detail. Database/Webpage/ UI designs and a list of output reports should be included along with references.

4. The project Work should be of such a nature that it could prove useful or should be relevant from the societal/commercial/research angle.

5. The project report will be duly accessed by the internal guide of the project and internal marks will be communicated by the concerned guide.

6. Project viva-voce by the University panel will be conducted as part of Evaluation.

Assessment

The final total assessment of the candidate is made in terms of an internal assessment and an external assessment for each course.

1. For each theory paper, 20% marks will be based on internal assessment and 80% marks for semester examination (external assessment), unless otherwise stated.

2. Internal assessment of theory papers should be in the form of two internal tests of 10 marks each. Total 20 marks.

3. The projects will be evaluated by the university appointed panel.

4. The final practical examination will be conducted by the university appointed panel at the end of semester for each lab course and marks will be submitted to the university by the panel. The pattern of final Practical Examination will be as follows-

1	Coding and Execution of Program	60 Marks
2	Viva-voce	10 Marks
3	Journal	10 Marks
	Total	80 marks

Award of Class

There will be numerical marking on each question. At the time of declaration of the result the marks obtained by the candidate is converted into classes as per University norms.

Credit system implementation As per the University norms **Clarification of Syllabus**

The syllabus Committee should meet at least once in a year to study and clarify any difficulties from the Institutes. The Workshop on syllabi should be organised at the beginning of every semester.

Revision of Syllabus

As the computer technology is changing very fast, revision of the syllabus should be considered every 3 years.

PEO's for M.Sc. Program

Program Educational Objectives is to prepare graduates to:

1. Apply and continuously acquire knowledge, both theoretical and applied, related to core areas of data science.

2. To develop relevant programming abilities.

3. Demonstrate the ability to build and assess data-based models.

4. Demonstrate to apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

Program Outcomes (POs)

At the end of the Master of Science (Data Science) Program, graduating students/graduates will be able to:

1. Apply conceptual knowledge for complex computing problems and arrive at a solution based on user requirements.

2. Provide analytical skills necessary for arriving at solutions to socio economic problems.

3. Work in multi-disciplinary teams to develop interpersonal skills and project management techniques.

4. Apply mathematical foundations and computer science theory in the modeling and design of software systems.

5. Integrate the concepts of networks and security issues in the required fields

Program Specific Outcomes (PSOs)

1. Build foundational understanding of key technologies and tools driving data science to develop machine learning models for businesses at global level.

2. Inculcate research skills, develop novel ideas, and discover insights in diverse domains to develop data-driven solutions for sustainable development.

3. Apply quantitative modelling techniques and develop skills to present inferences using tools that are adaptable to evolving technologies, laying the

foundation for lifelong learning.

4. Be acquainted with the contemporary issues, latest trends in technological development and thereby innovate new ideas and solutions to existing problems.

M.Sc.-I Semester-I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP -101 Title of Course: Introduction to Statistics

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO) CO1 Study of basic features of the data CO2 Study the sample using different quantitative measures CO3 Study different forms of probability distribution CO4 Study how to build predictive models for sample data.

Unit No.	Title of Unit and Contents	
Ι	Descriptive Statistics: Measures of Central Tendency: Mean, Median, Mode Partition Values: Quartiles, Percentiles, BoxPlot Measures of Dispersion: Variance, Standard Deviation, Coefficient of variation, Skewness: Concept of skewness, measures of skewness, Kurtosis: Concept of Kurtosis, Measures of Kurtosis	(15)
II	Introduction to Probability: Probability - classical definition, probability models, axioms of probability, probability of an event. Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B) = P(A)$. $P(B A)$ Bayes' theorem (without proof) Concept of Posterior probability, problems on posterior probability. Definition of sensitivity of a procedure, specificity of a procedure. Application of Bayes' theorem to design a procedure for false positive and false negative. Concept and definition of independence of two events. Numerical problems related to real life situations.	(15)
III	Introduction to Random Variables Definition of discrete random and continuous random variable. Concept of Discrete and Continuous probability distributions. (p.m.f. and p.d.f.), Distribution function Expectation and variance, Numerical problems related to real life situations.	(15)
IV	Special Distributions, Binomial Distribution, Uniform Distribution, Poisson Distribution, Negative Binomial Distribution, Geometric Distribution, Continuous Uniform Distribution, Exponential Distribution, Normal Distribution Log Normal Distribution, Gamma Distribution, Weibull Distribution, Pareto Distribution.	(15)

References

1. Fundamentals of Applied Statistics (3rd Edition),Guptaand Kapoor, S.Chandand Sons, New Delhi,1987.

2. An Introductory Statistics, Kennedy andGentle.

3. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.

4. Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth

A. Peck, G. Geoffrey Vining, Wiley

5. Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.

6. Probability, Statistics, Design of Experiments and Queuing theory with

applications Computer Science, Trivedi K.S., Prentice Hall of India, NewDelhi,2001.

7. A First course in Probability 6th Edition, Ross, Pearson Publication,2006.

8. Introduction to Discrete Probability and Probability Distributions, Kulkarni

M.B., Ghatpande S.B., SIPF Academy,2007.

9. A Beginners Guide to R, Alain Zuur, Elena Leno, Erik Meesters, Springer,2009

10. Statistics Using R, SudhaPurohit, S.D.Gore, ShailajaDeshmukh, Narosa, Publishing Company

M.Sc.-I Semester-I (Data Science)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP- 102

Title of Course: Database Management System

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Describe different concepts of database management systems.

CO2 Discuss structure of relational databases and apply relational operations on it.

CO3 Apply the basic and advanced concepts of SQL language to solve the queries in the databases.

CO4 Analyze database requirements and determine the entities involved in the system and their relationship.

CO5 Write the queries to implement different functionalities of SQL language.

Unit No	Title of Units and Contents	
I	Introduction Database-system Applications Purpose of Database Systems View of Data-Data Abstraction, Instance and Schemas Data Models Data storage and querying: Storage Manager, The query processor Database Architecture.	(15)
Π	E-R model, Relational Model and SQL Entity Relationship Model Generalization Specialization Aggregation. Introduction to Relational Model Relational Model and Codd Rules Structure of Relational Databases Anomalies in a Databases The normalization process: (1NF, 2NF, 3NF, BCNF, 4NF, 5NF)	(15)

	Database Schema, Keys	
	SQL query language	
	SQL- Basic Types, Basic schema definition, Date and Time in SQL.	
	Integrity constraint- Constraints on a single relation, Not Null	
	Constraint, Unique constraint, referential integrity.	
	Basic structure of SQL queries- Queries on single relation.	
	Additional basic operations Set operations.	
	Aggregate Functions-Basic aggregation, Aggregation and grouping, The Having	
	clause, Nested Queries	
	Modification of the Database- Deletion, Insertion, Updates	
	Intermediate and Advanced SQL	
	Join Expressions- Join conditions, Outer joins, Join types.	
	Views- View definition, using views in SQL queries,	
	Materialized views, update a view	
	PL/SQL-	
III	PL /SQL Block	(15)
	Control Structures	
	Cursor	
	Trigger	
	Procedure	
	Function	
	Transaction and Concurrency Control	
IV	Acid Properties	
	Failure Classification	
	Recovery and atomicity	(15)
	Log- based recovery	
	Concurrency Control	

1. Abraham Silberschatz, Henry F. Korth, S. Sudarashan, Database System Concepts, McGraw-Hill International Edition, SixthEdition

2. Elmasri, Navathe, Fundamentals of Database Systems, Pearson Education, Third Education

3. Ramakrishnan, Gehrke, Database Management Systems, McGrawHill International Edition, ThirdEdition

4. Peter Rob, Carlos Coronel, Database System Concepts, Cengage Learning, India Edition

5. S.K.Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education,2006

6. Redmond, E. & Wilson, Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition:1stEdition.

M.Sc.-I Semester-I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MPPR-103 Title of Course: Practical- (Database Management System)

Syllabus to be implemented from Academic Year 2023-24

Course outcomes:

- 1. Create, modify and apply operations on table
- 2. Handling different keys on database
- 3. Handling different types of SQL queries on database
- 4. Handling different types of mathematical and statistical functions
- 5. Handling and write code using PL/SQL
- 6. Handling cursor in in PL/SQL

Lab assignments based on Database Management System course.

M.Sc.- I Semester- I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP-104 Title of Course: Python Programming Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

- CO1 Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
- CO2 Express proficiency in the handling of strings and functions
- CO3 Determine the methods to create and manipulate Python programs by Utilizing the data structures like lists, dictionaries, tuples and sets.
- CO 4 Identify the commonly used operations involving file systems and regular expressions
- CO5 Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Unit No.	Title of Unit and Contents	
I	Introduction To Python and Data Types Introduction, Various IDEs, Numeric data types: int, float, complex, String, list and list slicing, Tuples Control Flow, Functions, Modules Control Flow Conditional blocks using if, else and elif Simple for and while loops in python, For loop using ranges, string, list and dictionaries, Loop manipulation using pass, continue, break and else Functions Arguments, Lambda Expressions, Function Annotations Modules Organizing python projects into modules Importing own module as well as external modules.	(15)
Π	 Packages: Packages, Programming using functions, modules and external packages Python File Operation Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek Programming using file operations. 	(15)

REFERENCES

- 1. Learning Python, O'Reilly publication
- 2. Programming Python, O'Reilly publication
- 3. https://docs.python.org/3/tutorial/
- 4. <u>https://realpython.com/beautiful-soup-web-scraper-python</u>

M.Sc.-I Semester-I (Data Science)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)

Course Code: ME- 105.1

Title of Course: Data Mining

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO1 Ability to understand the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.

CO2 Apply preprocessing methods for any given raw data.

CO3 Extract interesting patterns from large amounts of data

CO4 Discover the role played by data mining in various fields.

Ι	Introduction Data Mining, Types of Data Mining- Relational Database, Data Warehouse, Data Repositories, Object-Relational Database, Transactional Database. Advantages of Data Mining, Disadvantages of Data Mining. Data Mining Application- Data Mining in Healthcare, Market Basket Analysis, Education, Manufacturing Engineering, CRM, Fraud Detection, Lie Detection, Financial Banking Challenges of Implementation in Data Mining Data Mining Techniques, Data Mining Implementation Process Data Mining Models, Data Mining Tools.	(15)
II	Classification: Preliminaries, general approach to solve classification problem, Decision tree induction, Rule-based classifier, Bayesian Classifiers, Support Vector Machine.	(15)
III	Association analysis: Problem definition, Frequent Itemset Generation, Apriori Principle and algorithm, Maximal Frequent itemset, closet frequent itemset. FP- growth algorithm, Sequential Patterns, Infrequent Patterns.	(15)
IV	Cluster analysis: Introduction, Types of clustering, Types of clusters. K- Means algorithm, Agglomerative Hierarchical clustering, DBSCAN, Prototype based clustering and Density based clustering.	(15)

References:

- 1) Introduction to Data Mining Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson education.
- 2) Data Mining concepts and techniques --- Jiawei Han and Micheline Kamber, Elsevier
- 3) Data Mining: Introductory and Advanced Topics Margaret H. Dunham, Pearson education

M.Sc.-I Semester-I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME-105.2 Title of Course: Data Structure

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Define algorithms and its properties.

CO2 Differentiate between types of algorithms based on problem solving approach.

CO3 Demonstrate major algorithms and data structures.

CO4 Analyze the asymptotic performance of algorithms.

CO5 Evaluate and select algorithmic design paradigms and methods of analysis.

CO6 Develop analytical and problem-solving skills to design algorithms.

Unit No	Title of Unit and Contents	
Ι	Introduction Definition of Algorithm & its characteristics, Recursive and Non-recursive Algorithms, Time & Space Complexity, Definitions of Asymptotic Notations, Insertion Sort (examples and time complexity), Heaps & Heap Sort (examples and time complexity)	(15)
II	 Divide and Conquer Concept of divide and Conquer, Binary Search (recursive), Quick Sort, Merge sort Greedy Method Fractional Knapsack problem, Optimal Storage on Tapes, Huffman codes, Concept of Minimum Cost Spanning Tree, Prim's and Kruskal's Algorithm 	(15)
ш	Dynamic Programming The General Method, Principle of Optimality, Matrix Chain Multiplication, 0/1 Knapsack Problem, Concept of Shortest Path, Single Source shortest path, Dijkstra's Algorithm, Bellman Ford Algorithm, Floyd- Warshall Algorithm, Travelling Salesperson Problem Branch & Bound Introduction, Definitions of LCBB Search, Bounding Function, Ranking	(15)
IV	 Function, FIFO BB Search, Traveling Salesman problem Using Variable tuple. Decrease and conquer Definition of Graph Representation, BFS, DFS, Topological Sort/Order, Strongly Connected Components, Biconnected Component, Articulation Point and Bridge edge Problem Classification Basic Concepts: Deterministic Algorithm and Non deterministic, Definitions of P, NP, NP-Hard, NP-Complete problems, Cook's Theorem (Only Statement and Significance) 	(15)

References:

- 1. IntroductiontoAlgorithms,ThomasH.Cormen,CharlesE.Leiserson,RonaldL.Rivestand CliffordStein,PHI.
- 2. Fundamental of Algorithms by Gills Brassard, PaulBratley, PHI.

3. Design and Analysis of Computer Algorithms by Aho, Hopcroft and Ullman, Pearson

4. The Algorithm Design Manual By Steve s. Skiena

M.Sc.-I Semester-I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: RM-106 Title of Course: Research Methodology

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO1 Identify appropriate topics for research work.

CO2 Carry out Literature Survey

CO3 Select and define appropriate research problem and parameters

CO4 Design the use of major experimental methods for research

CO5 Use appropriate tools, techniques, and processes of doing research in Data science

CO6 Become aware of the ethics in research, academic integrity and plagiarism **CO7** Write a research report and thesis

Ι	 Introduction to Research Methodology: Research: Definition, Characteristics, Objectives, Research and Scientific method Types of Research: Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research Research Problem: Research Problem, Selecting the problem, Necessity of Defining the problem, Technique Involved in Defining a Problem. 	(15)
п	 Research Design, and Data Collection Research Design: Meaning, Need, Features of Good Design, Concepts Relating to Research Design, Different Research Design, Basic Principle of Experimental Designs. Data Collection: Observation Method, Interview Method, Questionnaires, Case Study Method. 	(15)
ш	 Sampling Design and Scaling Techniques Sampling Design: Sample Survey, Implication of a Sample Design Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Designs, Different Types of Sample Designs. Scaling Techniques: Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques. 	(15)
IV	 Hypotheses and Report Writing Hypothese: What is Hypotheses?, Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Test of Hypotheses, Important Parametric Tests. Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layouts of Research Report, Types of Reports, Oral 	(15)

1. Kothari C.R., "Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978-81-224-1522-3.

2. David V Thiel, "Research Methods- for Engineers", Cambridge University Press, ISBN:978-1-107-61019-4

3. Caroline Whitbeck, "Ethics in Engineering Practice and Research", 2nd Ed., Cambridge University Press; ISBN :978-1-107-66847-8

4. Gordana DODIG-CRNKOVIC, "Scientific Methods in Computer Science", Department of Computer Science Malardalen University, Vasteas, Sweden; ISBN: 91-26-97860-1

M.Sc.-I Semester-II (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)

Course Code: MP-201 Title of the Course: Statistics - II Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Identify sampling methods from the pattern of the observed data.

CO2 Predict the future behavior of the time series data.

CO3 Predict different models of forecasting of time series data.

- CO4 Analyze sample data and identify the parameters and their probability distributions.
- CO5 Validate the hypothesis to ensure that the entire research process remains Scientific and reliable.
- CO6 Hypothesize and test an assumption regarding population parameters using Sample data.

Unit No.	Title of Unit and Contents	
I	Sampling Introduction to Sampling Simple random Sampling Stratified Random Sampling Cluster Sampling Concept of Sampling Error	(15)
П	Sampling Distributions Introduction to Sampling distributions Student's t distribution Chi square distribution Snedecor's F distribution Interrelations among t, chi-square and F distributions Central Limit Theorem (Various Versions) and its applications.	(15)

III	Testing of hypothesis Definitions: population, statistic, parameter, standard error of estimator. Concept of null hypothesis and alternative hypothesis, critical region, level of significance, type I and type II error, one sided and two- sided tests, p-value. Large Sample Tests Tests based on t, Chi-square and F-distribution	(15)
IV	Analysis of Variance One Way ANOVA Two Way ANOVA Application of ANNOVA to test the overall significance of Regression.	(15)

1. Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S.Chand and Sons, New Delhi, 1987.

2. Time Series Methods, Brockell and Devis, Springer, 2006.

3. Time Series Analysis,4th Edition, Box and Jenkin, Wiley, 2008.

4. Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.

5. Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi,2001.

6. Common Statistical Tests, Kulkarni M.B., Ghatpande S.B., Gore S.D., Satyajeet Prakashan, Pune, 1999.

7. Probability and Statistical Inference, 9th Edition, Robert Hogg, Elliot Tanis, Dale Zimmerman, Pearson education Ltd, 2015

8. A Beginners Guide to R, Alain Zuur, Elena Leno, Erik Meesters, Springer, 2009

9. Statistics Using R, Sudha Purohit, S.D.Gore, Shailaja Deshmukh, Narosa, Publishing Company

M.Sc.-I Semester-II (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP- 202 Title of Course: Java Programming

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Use the syntax and semantics of java programming language and basic concepts of OOP.

- **CO2** Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
- **CO3** Design event driven GUI and web related applications which mimic the real word scenarios.

CO4 Knowledge of the structure and model of the Java programming language.

CO5 Use the Java programming language for various programming technologies

CO6 Develop software in the Java programming language.

Unit No	Title of Unit and Contents	
I	Overview of features of java , History of Java, OOP in Java, Core Java Concept, Java virtual machine, JIT, Garbage collection, Exception handling, object serialization, Threading Swings : Introduction of JFC, swing features, Heavyweight v/s lightweight components, Swing components.	(15)
п	Java Database Connectivity. JDBC overview, Architecture, Types of JDBC Drivers, DriverManager class, database connection statements, Resultset, transaction, Metadata and Aggregate functions, callable statements. Java Networking: Remote Method Invocation – introduction, architecture, defining remote objects, creating stubs and skeleton, RMI activation, registrating remote objects, marshaled objects.	(15)
ш	Java Beans: Basics of designing JavaBeans, creating and using properties, usingevents to communicate with other components. Enterprise Java Bean: Preparing a Class to be a JavaBean, Creating a JavaBean, JavaBean Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean	(15)
IV	Java Servlets: Servlet basics, servlet life cycle, Generic and HTTP servlets, The Servlet API, javax.servlet and javax.servlet.http package, session tracking using session and cookies, web deployment descriptor, web.xml. Java Server Pages (JSP): Introduction to JSP tags and directive, Request String, User Sessions, Cookies,Session objects.	(15)

- 1. Java 2 Complete Reference (Tata McGraw Hill)
- 2. Java server pages
- 3. Java 2EE Ivan Bayross (PHI)
- 4. Java 2 Black Book –(DreamTech)
- 5. Valesky, "Enterprise Java Beans", Addison Wesley.
- 6. Java Primer : Balguruswamy
- 7. Advanced Java programming- Rajendra Salokhe, Suresh Nalawade- Aruta Publication.

M.Sc.-I Semester-II (Data Science)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MPPR-203 Title of Course: Practical- (Java Programming)

Syllabus to be implemented from Academic Year 2023-24

Course outcomes:

- CO 1 Able to write programs for solving real world problems using java collection frame work.
- CO 2 Able to write programs using abstract classes.

CO 3 Able to write multithreaded programs.

CO 4 Able to write GUI programs using swing controls in Java.

Lab assignments based on Java Programming course.

M.Sc. - I Semester - II (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP-204 Title of Course: Web Designing Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO 1 Define the principle of Web page design.

- CO 2 To develop skill and knowledge of web page design.
- CO 3 Visualize the basic concept of HTML.
- CO 4 Recognize the elements of HTML.

CO 5 Introduce the basic concept of CSS.

Unit No.	Title of Unit and Contents	
I	Introduction to Web Design: What is Web Design?, Domain Name & DNS, Client and Server Software, Static and Dynamic Web Pages, Designing Navigation Bar, Home Page Layout, History of Internet, World Wide Web, Web Standards	(15)
II	 HTML and CSS: Introduction to HTML, Basic Structure of HTML document, Mark Up Tags, Heading, Paragraph, Line Breaks, HTML Tags, Elements of HTML- Text, List, Tables and Frames, Hyperlink, Images, Forms and controls, Introduction to CSS: Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), CSS Id and Class, Working with List and Tables, CSS Color, Creating page Layout and Site Designs 	(15)

REFERENCES

- 1. A beginner's guide to HTML NCSA,14th May,2003
- 2. Murray, Tom/Lynchburg Creating a Web Page and Web Site College, 2002
- 3. Steven M. Schafer HTML, XHTML, and CSS Bible, 5ed Wiley India
- 4. John Duckett Beginning HTML, XHTML, CSS, and JavaScript Wiley India
- 5. Ian Pouncey, Richard York Beginning CSS: Cascading Style Sheets for Web Design Wiley India

M.Sc.- I Semester- II (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME - 205.1 Title of Course: Image Processing Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO 1 Be able to understand basic concepts image processing, image storage and types of transformations that can be applied to images.

- CO 2 Be able to compare the domains and methods of image processing.
- CO 3 Be able to check the correctness of algorithms using inductive proofs and loop invariants.
- CO 4 Learn Image Restoration & Enhancement techniques, colour image processing.
- CO 5 Be able to make proper use of image processing tools.
- CO 6 Familiar with morphological image processing.

Unit No.	Title of Unit and Contents	
I	Introduction to Computer Graphics: Introduction to coordinate representation and Pixel. Raster Scan and Random Scan Systems,	(15)
II	Introduction to Image Processing: Fundamentals, Applications, Image processing acquisition, sampling and quantization, Neighbors of pixel adjacency connectivity, regions and boundaries. Image Enhancement: Frequency and spatial Domain, Contrast Stretching, histogram Equalization, Low pass and High pass filtering.	(15)
ш	Image Restoration: Noise models, band reject, band pass and notch filter Image Compression: Fundamentals, Models, Error free and lossy compression, Standards.	(15)
IV	Morphological Image Processing: Boundary extraction, Region filtering, connected component extraction, Thinning, thickening, pruning, image segmentation.	(15)

REFERENCES

- 1. Digital Image Processing, Second Edition by Rafel C. Gonzalez and Richard E. Woods, Pearson Education
- 2. Digital Image Processing by Bhabatosh Chanda and Dwijesh Majumder, PHI
- 3. Fundamentals of Digital Image Processing by Anil K Jain, PHI
- 4. Digital Image Processing Using Matlab, Rafel C. Gonzalez and Richard E. Woods, Pearson Education

M.Sc.-I Semester-II (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME- 205.2 Title of Course: Big Data Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO) CO1 Identify Big Data and its Business Implications CO2 Develop Big Data Solutions using Yarn CO3 Develop Big Data Solutions using Hive CO4 Develop Big Data Solutions using Pig

Unit No	Title of Unit and Contents	
Ι	Big Data Introduction: What is Big Data?, Evolution of Big Data, Benefits of Big Data, characteristics of Bog Data, Types of Big Data, Sources of Big Data, Architecture of Big Data, Operational vs Analytical Big Data, Need for Big Data Analytics, Big Data Challenges.	(15)
п	Yarn: Introduction to Yarn, Importance of Yarn, Advantages of Yarn, Yarn Architecture, Resource Manager, Node Manager, Application Master, Application submission in Yarn, Yarn Applications.	(15)
Ш	Hive: Introduction to Hive, Features of Hive, Architecture of Hive, Components of Hive, Hive Data Models, Hive DDL statements, Hive Query Language.	(15)
IV	Pig: Introduction to Pig, Running Pig, Getting Started with Pig Latin, Working with operators in Pig, Working with functions in Pig.	(15)

- 1. BIG DATA Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization
- 2. Pete Warden, "Big Data Glossary", O'Reily, 2011.

M.Sc.-II Semester-III (Data Science)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)

Course Code: MP - 301 Title of the Course: Machine Learning Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO1: Acquire fundamental knowledge of learning theory

CO2: Design and evaluate various machine learning algorithms

CO3: Use machine learning methods for multivariate data analysis in various scientific fields CO4: Choose and apply appropriate Machine Learning Techniques for analysis, forecasting,

categorization and clustering of the data

I	Machine Learning Concepts: Introduction to Machine, Machine Learning applications, Types of learning: Supervised, unsupervised and semi-supervised, reinforcement learning technique, Models of Machine Learning: Geometric, Probabilistic, Logical, Grouping and grading models. Predictive and descriptive learning, Classification Concepts.	(15)
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П	Learning Theory Feature: Feature Extraction, Feature Construction and Transformation, Feature Selection. Principle Component Analysis, Independent Component analysis. Factor Analysis, Multidimensional Scaling	(15)
Ш	Geometric Models Regression, Logical regression, Overfitting, Multivariate Linear regression, Simple neural network, Kernel based methods, Support Vector Machines(SVM), Limitations of SVM, K-nearest neighbor algorithm	(15)
IV	Logical, Grouping and Grading Models Decision tree representation, decision tree algorithm, Regression trees, Clustering Tree, Association rule mining, K-means algorithm, Hierarchical clustering, Ensemble methods: Bagging and boosting.	(15)

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Cambridge University Press, 1st Edition, 2012, ISBN No.: 978-1-316-50611-0

2. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2nd edition, 2013, 978-0-262-01243-0

3. Kevin Murphy, Machine Learning: a Probabilistic Approach, MIT Press, 1st Edition, 2012, ISBN No.: 978-0262-30616-4

4. C.M. Bishop, Pattern Recognition and Machine learning, Springer, 1st Edition, 2013, ISBN No.: 978- 81-322-0906-5

5. Hastie, Tibshirani, Friedman, Introduction to statistical machine learning with applications in R, Springer, 2nd Edition, 2013, ISBN No.: 978-1-4614-7138-7

6. Tom Mitchell, Machine Learning, McGraw Hill, 1997, 0-07-042807-7

7. Parag Kulkarni, Reinforcement and Systemic Machine learning for Decision Making, Wiley-IEEE Press, 2012, 978-0-470-91999-6

8. M. F. Der, L. K. Saul, S. Savage, and G. M. Voelker (2014). Knock it off: profiling the online storefronts of counterfeit merchandise. In Proceedings of the Twentieth ACM Conference on Knowledge Discovery and Data Mining (KDD-14), pages 1759-1768. New York, NY.

9. J. T. Ma, L. K. Saul, S. Savage, and G. M. Voelker (2011). Learning to detect malicious URLs. ACM Transactions on Intelligent Systems and Technology 2(3), pages 30:1-24.

10. D.-K. Kim, G. M. Voelker, and L. K. Saul (2013). A variational approximation for topic modeling of hierarchical corpora. To appear in Proceedings of the 30th International Conference on Machine Learning (ICML-13). Atlanta, GA.

11. M. Bozorgi, L. K. Saul, S. Savage, and G. M. Voelker (2010). Beyond heuristics: learning to classify vulnerabilities and predict exploits. In Proceedings of the Sixteenth ACM Conference on Knowledge Discovery and Data Mining (KDD-10), pages 105-113. Washington, DC

M.Sc.-II Semester-III (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP- 302 Title of Course: R Programming Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Learn Fundamentals of R.

CO2 Apply OOP concepts in R programming

CO3 Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions.

CO 4 Apply various concepts to write programs in R

CO5 Cover the Basics of statistical data analysis with examples.

Unit No.	Title of Unit and Contents	
I	Introduction to R: What is R, Why R, Advantages of R over Other Programming Languages . R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed. packages(), package Description(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA. Inf and –inf.	(15)
п	R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame. R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables , R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators, R Decision Making: if statement, if – else statement, if – else if statement, switch statement, R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.	(15)
ш	R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, without an argument, calling a function with argument values, R-Strings : Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower(), R Vectors : Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting R List : Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector. R Matrices : Accessing Elements of a Matrix. R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements.	(15)
IV	Data Frames: Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() , Merging Data frames merge(), Melting and Casting data melt(), cast(). Loading and handling Data in R:	(15)

Getting and Setting the Working Directory – getwd(), setwd(), dir() – **R-CSV Files** – Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply(). **R** –**Pie Charts:** Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – R Histograms – Density Plot - R – Bar Charts: Bar Chart Labels, Title and Colors.

REFERENCES

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017.

2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018.

3. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015.

M.Sc.II- Semester-III (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MPPR- 303 Title of Course: Practical- (R Programming)

Syllabus to be implemented from Academic Year 2022-23

Course outcomes:

- 1. Demonstrate use of basic functions
- 2. Create their own customized functions
- 3. Construct tables and figures for descriptive statistics
- 4. Learn to understand new data sets and functions by yourself
- 5. Work on built in real time cases for analysis and visualization

Lab assignments based on R Programming course.

M.Sc.-II Semester-III (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP - 304 Title of Course: Power BI Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO 1 Identify the primary components of Power BI. CO 2 Identify common challenges in Power BI data models. CO 3 Implement smart solutions. CO 4 Understand Power Query.

Unit No.	Title of Unit and Contents	
I	Introduction to Power BI: Data Visualization, Reporting, Business Intelligence(BI), Traditional BI, Self- Serviced BI, Cloud Based BI, On Premise BI, Power BI Products, Power BI Architecture, A Brief History of Power BI.	(15)

	Power Query:	
	Data Transformation, Benefits of Data Transformation, Overview of	
	Power Query/ Query Editor, Query Editor User Interface, Datatypes,	
II	changing the datatype of a column filter, Filter a Column using Text	(15)
	Filters, Number Filters, Date Filters, Multiple Columns, Remove	
	Columns, rename a column, Sort Columns, PIVOT, UNPIVOT	
	Columns, Header Row or Use First Row as Headers	

REFERENCES

- 1. Mastering Microsoft Power BI Brett Powell
- 2. Beginning Power BI by Dan Clark
- 3. Microsoft Power BI Cookbook Brett Powell

M.Sc.-II Semester-III (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME – 305.1 Title of Course: Cyber Security

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO1 Realize the need for Cyber Security.

CO2 Understand the fundamental of Cyber crimes and cyber security

CO3 Understand the need for Security in day to day communication

 ${\bf CO4}\ {\bf understand}\ {\bf the}\ {\bf vulnerabilities}\ {\bf in}\ {\bf Network}\ {\bf and}\ {\bf computer}\ {\bf System}$

CO5 Understand the different security in different layers of protocol.

Unit No	Title of Unit and Contents	
	Introduction to Cyber Security: Cyber security, Cyber Threats: Cyber	
I	Cyber Vulnerabilities: Vulnerabilities in software, System administration, Complex Network Architecture, Weak Authentication.	(15)
	Cyber Security Safeguards: Access Control, Audit, Biometrics,	
II	Cryptography, Deception, Ethical Hacking, Detection Systems, Response,	(15)
	Scanning, Security Policy, Threat Management.	(13)
	Active Attack: Phisning, Sniffing, spoofing, Denial of Service attack.	
III	Symmetric key cryptography, Asymmetric key cryptography, Message Authentication, Digital Signature, Application of Cryptography.	(15)
	Firewalls: Types of Firewall, Security at the Application Layer: PGP and	
	S/MIME, Security at SSL and TLS, Security at Network Layer- IP Security.	
IV	Cyber Forensics: Introduction to cyber forensics, Handling preliminary investigation, Controlling an investigation, Investigating Information Hiding, Conducting disk-based analysis.	(15)

References:

1. Preston Gralla, How Personal and Internet Security Work, Que Publications

2. Alfred Basta and Wolf Halton, Computer Security Concepts, Issues and Implementation, Cengage Learning

- 3. Digital Defense: A Cybersecurity Primer by Joseph Pelton , Indu B. Singh
- 4. Cryptography and Network Security: Principles and Practice by William Stallings
- 5. Computer and Information Security Handbook by John R. Vacca .

M.Sc.-II Semester-III (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME – 305.2 Title of Course: Software Project Management

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

- CO 1 Identify the different project contexts and suggest an appropriate management Strategy.
- CO 2 Practice the role of professional ethics unsuccessful software development.
- CO 3 Identify and describe the key phases of project management.
- CO 4 Determine an appropriate project management approach through an evaluation of the business context and scope of the project

Unit No	Title of Unit and Contents	
I	Project Management: Concept of Project Management, Project Organization, Planning a software project Project Management Life Cycle Risk Management Identification	(15)
	of Risks, Risk Analysis, Risk Planning and Monitoring.	
II	Software Project Estimation: Concept of Project Estimation, Different methods of software project estimation, Function point analysis, Software Project Management Tools and Techniique- PERT and Gantt Charts	(15)
III	Software Quality Management and Testing: Quality Assurance and standard, Quality Planning, Quality control, Role of testing in software development, Testing Procedure, Defect Management.	(15)
IV	Configuration Management: CM Planning, Change Management, Version and Release, Management Configuration, Management Tools. Software Team Management: Characteristics of Performance management, High Performance Directive and Collaborative styles, Team Structure, Team Communication, Managing customer expectations, Group Behavior.	(15)

References:

- 1. Software Project management By Edwin Bennatan
- 2. Software Engineering By Roger S. Pressman
- 3. Software Engineering concepts by Richard Fairley
- 4. Software Project Management by S.A. Kelkar
- 5. Software Engineering by IAN Sommerville
- 6. System Analysis and Design Methods By J.L Whitten , L.D.Bentley and K.C. Dittman

M.Sc.-II Semester-IV (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option(NEP-2020) Course Code: MP - 401 Title of the Course: Internet of Things Syllabus to be implemented from Academic Year 2023-24

Course Outcomes(CO)

CO1 Apply the concepts of IoT.

CO2 Identify the different technologies.

CO3 Apply IoT to different applications.

CO4 Analysis& evaluate protocols used in IoT.

CO5 Design smart city in IoT.

CO6 Analysis data received through sensors in IoT.

Unit No	Title of Unit and Contents	
	Basics of IoT:	
I	Characterization of IoT, Physical design, Functional blocks,	
	Communication model, Communication APIs, ireless sensor	
	networks, Big data analytics,	
	M2M, Difference between IoT and M2M.	(15)
	IoTSmart-X applications:	
	Home Automation, Cities, Environment, Energy, Logistics,	
	Agriculture, Industry, Health & Lifestyle.	
II	Architecture for IoT:	
	Domain Model Specification, Information Model Specification,	(15)
	Service specification, IoT Level specification, Functional view,	
	Operational view, Device and Component Integration, User centered	
	design, Open source development.	
III	Towards web of things:	
	Platform design methodologies, Servicing through uniform interface,	(15)
	Future Web of things.	
	IoT physical devices and End points:	
	IoT devices, Raspberry Pl interfaces, Arduino interfaces, OtherIoT	
	devices.	
IV	IoT Analytics-	
	Business Process in IoT, Creative Thinking Techniques,	(15)
	Modification, Combination Scenarios, Decentralized and Inter	~ /
	operable, Approaches, Object.	

Reference Books:

- 1. Internet Of Things And Its Applications by Prof. Satish Jain Shashi Singh, BPB Publications.
- 2. Internet of Things: Architecture and design principles by Samrat Krishna Gaddam.
- 3. Internet of Things by Vijay Madisetti.

M.Sc.-II Semester-IV (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP - 402 Title of Course: Data Visualization with Tableau Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

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CO 1 Helps to understand the data precisely.

CO 2 Makes it easier to explore and manage data.

CO 3 Identify and share insights that can change businesses and world.

CO 4 Determine an appropriate project management approach through an evaluation of

the business context and scope of the project

Unit No	Title of Unit and Contents	
Ι	 Introduction: Acquiring and visualizing data, simultaneous acquisition and visualization, Application of Data Visualization, Exploring the Visual Data Spectrum: charting primitives(Data Points, Line Charts, Bar Charts, Pie Charts, Area Charts). Making use of HTML5 CANVAS, Integrating SVG. Basic of Data Visualization: Reading Data from standard text files(.txt, .csv, XML) Displaying JSON content Outputting Basic Table Data (Building table, Using Semantic Table, Configuring the columns), Assuring Maximum readability (Styling your table, Increasing readability, Adding dynamic Highlighting), Including computations, Using data 	(15)
п	Tableau: Getting Started, Overview, Environment, Navigation, Design Flow File Types, Data Types, Data Terminology, Data Source, Custom Data View, Extracting Data, Fields Operation, Editing Meta data	(15)
ш	Tableau Worksheets:Add Worksheet, Rename Worksheet, Save and Delete Worksheet, ReorderWorksheet, Paged WorkbookTableau Charts:Bar Chart, Line Chart, Pie Chart, Crosstab, Scatter Plot, Bubble Graph, GanttChart, Histogram	(15)
IV	Tableau Calculation:Operators, Functions, Numeric Calculation, String Calculation, DateCalculation, Table Calculation, Basic Sort, Basic Filters, Quick Filters	(15)

References:

- 1. Jon Raasch, Graham Murray, Vadim Ogievetsky, Joseph Lowery, "JavaScript and jQuery for Data Analysis and Visualization", WROX
- 2. Ritchie S. King, Visual story telling with D3" Pearson
- 3. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
- 4. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly
- 5. Andy Kirk, Data Visualization: A Successful Design Process, PAKT

6. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master

7. <u>https://www.tutorialspoint.com/tableau/tableau_data_terminology.htm</u>

M.Sc.II- Semester-IV (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: MP-403 Title of Course: Practical - (Tableau) Syllabus to be implemented from Academic Year 2023-24

Course outcomes:

- 1. Demonstrate use of basic functions
- 2. Create their own customized functions
- 3. Construct tables and figures for descriptive statistics
- 4. Learn to understand new data sets and functions by yourself
- 5. Work on built in real time cases for analysis and visualization

Lab assignments based on Tableau course.

M.Sc.-II Semester-IV (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME – 405.1 Title of Course : Deep Learning

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

CO 1 Understand the role of Deep Learning in Machine Learning Applications.

CO 2 To get familiar with the Deep Learning Applications.

CO 3 Critically Analyse Different Deep Learning Models.

CO 4 TO design and implement Convolutional Neural Networks

Unit No	Title of Unit and Contents	
I	Basic of Neural Networks: Basic concepts of Neuron, Perceptron Algorithm, Sigmoid Neuron, Shallow neural networks, Deep Neural networks, Feed Forward and Back Propagation Networks	(15)
II	Optimization and Deep learning: Learning Parameters of Feedforward neural network, the vanishing gradient problem, ways to mitigate it, ReIU Heuristics for avoiding bad local minima, Heuristics for fater training, Principal Component Analysis, Singular Value Decomposition.	(15)
ш	Convolutional Neural Networks: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, Visualizing Convolution Neural Networks, Deep Dream, Deep Art, Fooling Convolutional Neural Network.	(15)
IV	Applications of Deep Learning: Image Segmentation, object Detection, Automatic Image Captioning, Image Generation with Generative Adversarial networks, Video of Text with LSTM	(15)

Models, Attention Models for Computer Vision.	

- 1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
- 2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.
- 3. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
- 4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
- 5. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
- 6. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016Dittman

M.Sc.-I Semester-I (Data Science) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020) Course Code: ME- 405.2 Title of Course: Soft Computing

Syllabus to be implemented from Academic Year 2023-24

Course Outcomes (CO)

- CO 1 Differentiate Conventional AI and Computational Intelligence.
- CO 2 Discuss on machine learning through neural networks.
- CO 3 Apply knowledge in developing a Fuzzy expert system.
- **CO 4** Model Neuro Fuzzy system for clustering and classification.
- **CO 5** Discover knowledge to develop Genetic Algorithm and Support vector machine based machine learning system

Unit No	Title of Unit and Contents	
Ι	Introduction To Soft Computing: Evolution of Computing, Soft Computing Constituents, From Conventional AI to Computational Intelligence, Machine Learning Basics	(15)
II	Genetic Algorithm: Introduction to Genetic Algorithm, Application of genetic Algorithm, Genetic Operators, GGenetic based Machine Learning.	(15)
ш	Fuzzy Logic: Fuzzy Set, Operations on Fuzzy Set, Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	(15)
IV	Neuro- Fuzzy Modelling: Adaptive Neuro, Fuzzy Inference System, Coactive Neuro, fuzzy Modelling, classification and regression Trees, Data Clustering Algorithms, Rule based structure identification, Neuro-Fuzzy Control.	(15)

References:

- 1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
- 2. KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.

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