



SHIVAJI UNIVERSITY, KOLHAPUR

REVISED SYLLABUS AND STRUCTURE
THIRD YEAR (C.B.C.S.) BACHELOR OF TECHNOLOGY
IN

Computer Sc.& Engineering (Data Science)

To be introduced from the academic year 2022-23
(w. e. f. July 2022) onwards

THIRD YEAR DATA SCIENCE ENGINEERING - CBCS PATTERN																
SEMESTER - V																
Sr. No.	Course Subject / Title	TEACHING SCHEME							EXAMINATION SCHEME							
		THEORY			TUTORIAL		PRACTICAL		THEORY				ORAL / PRACTICAL		TERMWORK	
		Credits	No. Of Lectures	Hours	Credits	No. of Hours	Credits	No. of Hours	mode	marks	Total Marks	MIN.	MAX	MIN.	MAX	MIN.
1	PCC-DS501 Fundamentals of Data Science	4	4	4			1	2	CIE	30	100	40	25	10	50	20
									ESE	70						
2	PCC- DS502 Feature Engineering	3	3	3	1	1			CIE	30	100	40			25	10
									ESE	70						
3	PCC- DS503 Data Mining & Data Warehousing	3	3	3					CIE	30	100	40				
									ESE	70						
4	PCC- DS504 Internet of Things	3	3	3			1	2	CIE	30	100	40			50	20
									ESE	70						
5	OEC- DS50 Information Security OEC-DS506 Object-Oriented Modeling & Design	3	3	3					CIE	30	100	40				
									ESE	70						
6	PCC- DS507 Object Oriented Programming	3	3	3			2	4					50	20	50	20
7	HM- DS508 Business English				1	2							25	10	25	10
	Total (SEM –V)	19	19	19	2	3	4	8			500		100		200	

THIRD YEAR DATA SCIENCE ENGINEERING - CBCS PATTERN																
SEMESTER – VI																
Sr. No.	Course Subject / Title	TEACHING SCHEME							EXAMINATION SCHEME							
		THEORY			TUTORIAL		PRACTICAL		THEORY				ORAL / PRACTICAL		TERMWORK	
		Credits	No. Of Lectures	No. of Hours	Credits	No. of Hours	Credits	No. of Hours	mode	marks	Total Marks	MIN.	MAX	MIN.	MAX	MIN.
1	PCC-DS601 Machine Learning	3	3	3			1	2	CIE	30	100	40			25	10
									ESE	70						
2	PCC- DS602 UNIX Shell Programming	3	3	3			1	2	CIE	30	100	40			25	10
									ESE	70						
3	PCC- DS603 Database Engineering	3	3	3			1	2	CIE	30	100	40	50	20	25	10
									ESE	70						
4	PCC- DS604 Computer Algorithms	4	4	4	1	1			CIE	30	100	40			25	10
									ESE	70						
5	OEC- DS605 E-Commerce & Digital Marketing OEC - DS606 ii) Cyber Security	3	3	3					CIE	30	100	40				
									ESE	70						
6	PCC- DS607 Java Programming	3	3	3			1	2					50	20	25	10
7	PW- DS608 Domain Specific Mini Project						1	2					50	20	25	10
	Total (SEM –VI)	19	19	19	1	1	5	10			500		150		150	
	Total (SEM - V+ SEM - VI)	38	38	38	3	4	9	18			1000		250		350	

CIE- Continuous Internal Evaluation

ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for T.Y. Sem V & VI : 800 + 800 = 1600
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for T.Y. Sem V & VI : 50 (SEM-V: 25 + SEM -VI: 25)
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

Note:

1. **PCC-CS:** Professional Core Course – Computer Science and Engineering are compulsory.
2. **HM-CS:** Humanities and Management- Computer Science and Engineering are compulsory.
3. **PW-CS:** Domain Specific Mini Project – Computer Science and Engineering are compulsory.
4. **#OEC-CS: Open Elective Course** – To be offered to Inter departmental students.
 - # - 60% of the students from other branches to be chosen on merit.
 - 40% of the students may be from same branch based on merit.
 - Number of students to be allowed should be 72(Max.) for the branch with intake of 60 students.
 - The above ratio should be followed in proportionate to the sanctioned intake.

OPEN ELECTIVE COURSE-I

Sr. No.	Name of the Subject	Name of the concern Branch
1	i) Information Security ii) Object-Oriented Modeling & Design	Data Science Engineering

OPEN ELECTIVE COURSE-II

Sr. No.	Name of the Subject	Name of the concern Branch
1	i) E-Commerce & Digital Marketing ii) Cyber Security	Data Science Engineering

T. Y. B. Tech (Data Science Engineering) Sem – V

1. Fundamentals of Data Science (PCC - DS501)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 4 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : 50 Marks
Practical : 2 Hrs./Week	Oral : 25 Marks

Pre-requisites: Knowledge of Statistics, Data Structures and Algorithms.

Course Objectives

1. To provide the students with the basic knowledge of Data Science.
2. To make the students develop solutions using Data Science tools.
3. To introduce them to Python packages and their usability.

Course Outcomes

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

1. Summarize the basics of data science and its process.
2. Construct solution to a given problem using knowledge of tools for Data Science.
3. Build a solution to a given problem using NumPy package.
4. Explain functions of Python libraries.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Data Science and Its Scope: What Is Data Science, Data Science and Statistics, Role of Statistics in Data Science, A Brief History, Difference between Data Science and Data Analytics, Knowledge and Skills for Data Science Professionals, Some Technologies used in Data Science, Benefits and uses of data science, Facets of data.	6
2.	The data science process: Overview, defining research goals and creating a project charter, retrieving data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, presenting findings and building applications on top of them.	7
3.	Data Analysis Tools for Data Science and Analytics: Data Analysis Using Excel: Introduction, Getting Started with Excel, Format Data as a Table, Filter and Sort, Perform Simple Calculations, Data Manipulation Sorting and Filtering Data Derived Data, Highlighting Data, Aggregating Data: Count, Total Sum Basic Calculation using Excel, Analyzing Data using Pivot Table/Pivot Chart, Descriptive Statistics using Excel, Visualizing Data using Excel Charts and Graphs, Visualizing Categorical Data: Bar Charts, Pie Charts, Cross Tabulation, Exploring the Relationship between Two and Three Variables: Scatter Plot Bubble Graph and Time-Series Plot.	8

4.	Introduction to NumPy: Creating Arrays from Scratch, NumPy Standard Data Types, The Basics of NumPy Arrays, Array Indexing, slicing, reshaping, Concatenation, splitting, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, Comparison operator, Boolean arrays.	7
5.	Data Manipulation with Pandas: Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing. Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables	7
6.	Visualization with Matplotlib: General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Bindings, and Density.	7

Term Work

- Minimum of 10 Experiments to be performed from the list given below.

Experiment List

1. Study assignment on Data science Process.
2. Implementation of data manipulation using Excel.
3. Implementation of Data Visualization using Excel.
4. Study assignment on Kaggle.
5. Implementation of Array operations using Numpy.
6. Implementation of universal function in Numpy.
7. Implementation of data Operation in Pandas.
8. Implementation of dataset Operations in Pandas.
9. Implementations of Different graphs in Matplotlib.
10. Implementations of Different chart, plots in Matplotlib.
11. Implementations of Histogram in Matplotlib.
12. Implementation of data preprocessing on dataset in kaggle

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science”,Manning Publications.[Unit 1 and 2]
2. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’REILLY Publication.[Unit 3,4,5]
3. DR.AmarSahay, “Essentials of Data Science and Analytics”, O’REILLY Publication. [Unit 1 and 3]

Reference Books

1. Data Science from Scratch: First Principles with Python, O’Reilly Media, 2015.
2. Glenn J. Myatt John, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, Wiley Publishers, 2000.

.....

T. Y. B. Tech (Data Science Engineering) Sem –V

2. Feature Engineering (PCC - DS502)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work: 25 Marks
Practical: -----	Practical: -----

Pre-requisites: Fundamentals of Mathematical Statistics, Basics of Python Programming.

Course Objectives

1. To know basics of feature engineering.
2. To know basics of feature representation.
3. To understand feature selection transformation process.

Course Outcome

1. Explain basics of feature engineering used for representing and generating process.
2. Describe features of different types of data with feature selection process.
3. Describe feature transformations process for converting high dimensional features to low dimensional features.
4. Explain feature learning process from the given input.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction to Feature Engineering: Motivating example – AI-powered communications, importance of feature engineering, introduction of feature engineering, Evaluation of machine learning algorithms and feature engineering procedures, Feature understanding, Feature improvement – cleaning datasets, Feature selection – removing bad attributes, Feature construction, Feature transformation, Feature learning.	6
2.	Basics of Feature Representation: Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling), ℓ_2 Normalization, Interaction Features, Feature Selection.	6
3.	Features of Text and Categorical Data: Bag-of-X: Turning Natural Text into Flat Vectors, Filtering for Cleaner Features, Atoms of Meaning: From Words to n-Grams to Phrases, Tf-Idf : A Simple Twist on Bag-of-Words, Putting It to the Test, Deep Dive, Encoding Categorical Variables, Dealing with Large Categorical Variables.	8

4.	Feature Selection: Importance of Feature Selection in Machine Learning, Goals of Feature Selection, Classes of Feature Selection Methodologies, Effect of Irrelevant Feature, Overfitting to Predictors and External Validation, Greedy Search Methods- Simple Filters, Recursive Feature Elimination, Stepwise Selection	6
5.	Feature Transformations: Intuition, Derivation, Linear Projection, Variance and Empirical Variance -Vector Formulation, General Solution of the Principal Components, Transforming Features, Implementing PCA, PCA in Action, Whitening and ZCA, Considerations and Limitations of PCA, Use Cases	8
6	Feature Learning: Parametric assumptions of data, Non-parametric fallacy, feature learning algorithms, Reconstructing the data, The Bernoulli RBM, Extracting PCA components from MNIST, Extracting RBM components from MNIST, Using RBMs in a machine learning pipeline, Learning text features – word vectorizations, Word embeddings, Application of word embeddings – information Retrieval	6

Text Books

1. Sinan Ozdemir, Divya Susarla, “Feature Engineering Made Easy”, Packt Publishing, ISBN 978-1-78728-760-0
2. Alice Zheng & Amanda Casari, “Feature Engineering for Machine Learning: Principles and Techniques for data scientist”, Oreilly.

Reference Books

1. Max Kuhn , Kjell Johnson, “Feature Engineering and Selection: A Practical Approach for Predictive Models” 1st Edition, Chapman & Hall/CRC Data Science Series, ISBN 13-978-1-138-07922-9.

.....

T. Y. B. Tech (Data Science Engineering) Sem – V

3. Data Mining and Data Warehousing(PCC - DS503)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : -----
Practical : -----	Oral : -----

Pre-requisites: Fundamentals of Computer Network and Internet, basics of C / C++ programming language.

Course Objectives

4. Define Data warehousing Architecture and Implementation
5. Explain Data mining principles and techniques and Introduce DM as a cutting-edge business intelligence
6. Interpret association rule mining for handling large data
7. Classification for the retrieval purposes
8. Explain clustering techniques in details for better organization and retrieval of data

Course Outcomes

1. Demonstrate Storing voluminous data for online processing, Preprocess the data for mining applications
2. Apply the association rules for mining the data
3. Design and deploy appropriate classification techniques
4. Cluster the high dimensional data for better organization of the data
5. Discover the knowledge imbibed in the high dimensional system.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction: Introduction and Data Preprocessing: Why data mining, what is data mining, What kinds of data can be mined, what kinds of patterns can be mined, Which Technologies Are used, which kinds of Applications are targeted, Major issues in data mining.	5
2.	Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization.	5
3.	Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation.	7
4.	Classification: Basic Concepts, Decision tree induction, Bayes Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy	7

5.	Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering.	6
6.	Data Mining Trends and Research Frontiers: Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining Trends	6

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining Concepts and Techniques, ELSEVIER(MK) 3rd edition 2012.

Reference Books:

1. The Data Warehouse Toolkit, 3rd Edition, Ralph Kimball
2. Data Mining: Concepts and Techniques (The Morgan Kaufmann Series in Data Management Systems) 3rd Edition, Jiawei Han , Micheline Kamber, Jian Pei Professor.

T. Y. B. Tech (Data Science Engineering) Sem – V

4. Internet of Things(PCC - DS504)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs/Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : 50 Marks
Practical : 2 Hr/Week	Oral : -----

Pre-requisites: Fundamentals of Computer Network and Internet, basics of C / C++ programming language.

Course Objectives

9. To learn Internet of Things Technology
10. To know the basics of RFID, Sensor technologies.
11. To know the basics of IoT systems like Raspberry Pi, Arduino, and Banana Pi.
12. To aware students about wireless communication technologies and IoT applications.

Course Outcome

1. Students will understand basic concepts of IoT
2. students will be able to learn and implement RFID technology in various applications.
3. Students will be able to write programs for basic applications
4. Student will understand and implement different communication technologies in IoT systems.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction: IoT, Objects / Things, IoT definitions, IoT frame work, Identification technologies, Internet in IoTs.	4
2.	Fundamental of IoT mechanisms: Identification of IoT objects and services, Traffic characteristics, scalability and interoperability, security and privacy, Communication capabilities, Mobility support and device power, Sensor technology, RFID technology and satellite technology.	6
3.	Radio Frequency Identification Technology: RFID, IoT objects and services, principles of RFID, Components of an RFID system, RFID reader, Tags, middleware, Sensor nodes, connecting nodes, networking nodes.	6
4.	IoT systems: Hardware and Software: Introduction to Raspberry Pi, Familiar with Raspberry Pi hardware, study of I/O ports, Programming with Raspberry Pi: Study of operating system, simple programs in C / C++, Introduction with Python programming.	8

5.	Communication Technologies: WPAN Technologies: Introduction to IEEE 802.15.4 standard, Bluetooth, Zigbee, IEEE 802.15.6; WBANS, NFC, IEEE 802.11 WLAN, Cellular and mobile technologies.	6
6.	IoT Application Examples: Smart Metering, advanced metering infrastructure, e-health / Body Area Network, City Automation (Smart City), Automotive Application, Environmental Applications, Home Automation, Control Applications.	6

Practical List

- Minimum 10 experiments should be conducted based on above topics and covering following list. At least two experiments should be conducted on each unit in the syllabus.

Experiment-1

1. Introduction of Arduino IDE
2. Write an arduino program to demonstrate setup () and loop () functions
3. Write an arduino program to demonstrate serial and serial.begin() statements
4. Write an arduino program to demonstrate serial.print() statement
5. Write an arduino program to demonstrate serial.available() statement
6. Write an arduino program to demonstrate serial.read() and serial.write() statements
7. Write an arduino program to demonstrate serial.analogRead() function
8. Write an arduino program to demonstrate user defined functions

Experiment-II

9. Write an arduino program to demonstrate data types.
10. Write an arduino program to demonstrate variables
11. Write an arduino program to demonstrate constants
12. Write an arduino program to demonstrate operators

Experiment-III

13. Write an arduino program to demonstrate if statements
14. Write an arduino program to demonstrate switch case
15. Write an arduino program to demonstrate loops
16. Write an arduino program to demonstrate arrays

Experiment-IV

17. Write an arduino program to demonstrate strings
18. Write an arduino program to demonstrate string object
19. Write an arduino program to demonstrate time based functions
20. Write an arduino program to demonstrate random numbers generation

Experiment-V

- 21. Write an arduino program to demonstrate digital I/O functions
- 22. Write an arduino program to demonstrate analog I/O functions

Experiment-VI

- 23. Write an arduino program to demonstrate light an LED
- 24. Write an arduino program to demonstrate the 7-segment display.
- 25. Write an arduino program to demonstrate button
- 26. Write an arduino program to demonstrate switch

Experiment-VII

- 27. Write an arduino program to demonstrate interrupts
- 28. Write an arduino program to demonstrate UART communication protocol

Experiment-VIII

- 29. Write an arduino program to demonstrate I2C communication protocol

Experiment-IX

- 30. Write an arduino program to demonstrate SPI communication protocol

Experiment-X

- 31. Write an arduino program for interfacing with potentiometer.
- 32. Write an arduino program for interfacing with temperature sensor
- 33. Write an arduino program for interfacing with PIR sensor

Experiment-XI

- 34. Write an arduino program for interfacing with infrared and ultrasonic sensor
- 35. Write an arduino program for interfacing with accelerometer
- 36. Write an arduino program for interfacing with PWM

Experiment-XII

- 37. Write an arduino program for interfacing with servo motor
- 38. Write an arduino program for interfacing with stepper motar.

Text Books

Sr. No.	Title	Author(s) Name	Publication & Edition
1	The Internet of Things - Connecting objects to the web	Hakima Chaouchi	Wiley Publications
2	Building the Internet of Things	Daniel Minoli	Wiley Publications
3	Raspberi Pi Beginner's Guide	Gareth Halfacree	Raspberi Press
4	Introduction to Wireless Telecommunications systems and Networks	Gary J. Mulett.	Cengage Learning (India Edition).

Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition
1	Raspberry Pi for Dummies	Sean McManus, Mike Cook	A Wiley Brand
2	Architecting the Internet of Things	Bernd Scholz, Reiter	Springer

T. Y. B. Tech (Data Science Engineering) Sem – V

1. Open Elective Course - I (OEC - DS505)

Information Security(OEC - DS505)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : -----
Practical : -----	Practical : -----

Pre-requisites: Computer Network, Modular Arithmetic & Number Theory, C / C++.

Course Objectives

1. To introduce the principles of Crypto-Systems.
2. To expose students to various security services and mechanisms used.
3. To make the students aware of the security features of PGP, S/MIME, Digital Signatures, IPSec & SSL.
4. To make the students understand the system level security issues concerning threats, intruders and use of firewalls and trusted systems.
5. To make students to explore non-cryptographic and software vulnerabilities.

Course Outcomes

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

1. Understand principles of Crypto-systems.
2. Compare and analyze various security services and mechanisms.
3. Apply and use the features of PGP, S/MIME, DSA, IPSec, SSL in their profession.
4. Take precautions of their personal computing system from possible threats and attacks.
5. Explore newer vulnerabilities and provide the solutions to them.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Classical Encryption Techniques and DES: The OSI Security Architecture, Symmetric Cipher Models: Substitution Techniques, Transposition Techniques, Block Cipher Principles, The Data Encryption Standard.	6
2.	Public-Key Cryptosystems, Key Management and Authentication : Principles of Public-Key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, Authentication requirements, Authentication functions, MAC and Hash functions and their requirements.	7

3.	Digital Signatures and Authentication Applications: Digital Signature, Digital Signature Standard, Authentication applications - Kerberos, X.509 Authentication service.	5
4.	Electronic mail and IP security: Email Security - PGP, S/MIME, IP Security-IP Security Architecture, Authentication Header and Encapsulating Security Payload.	5
5.	Web and System Security: Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction, Intruders, Intruder Detection, Password Management, Firewall Design Principles, Trusted Systems.	6
6.	Non-Cryptographic Protocol Vulnerabilities: DoS and DDoS, Session Hijacking and Spoofing, Pharming attacks. Software Vulnerabilities - Phishing, Buffer Overflow, Format String attacks, SQL Injection.	7

Text Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1	Cryptography and Network Security	William Stallings	Pearson Edition	(Unit I to V)
2	Network Security and Cryptography	Bernard Menezes	Cengage Learning	Unit -VI

Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition
1	Cryptography and network security	Atul Kahate	TMGH
2	Cryptography and Network Security	B. A. Forouzan	TMGH
3	Network Security Know it All	Joshi et. al	Morgan Kaufmann Publisher

.....

T. Y. B. Tech (Data Science Engineering) Sem – V

Open Elective Course - I (OEC - DS506)

Object-Oriented Modeling&Design(OEC-DS506)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : -----
Practical : -----	Practical : -----

Pre-requisites: Software Engineering & Object Oriented Concepts.

Course Objectives

1. To Understand the Object Based View of the System
2. To design Problems using Object Oriented Analysis and Design Techniques
3. To Understand UML notations and compare with OMT
4. To inculcate necessary skills to handle complexities in Software Design

Course Outcomes

1. Ability to analyze and model software systems
2. Ability to construct OO view of the system
3. Ability to design a Software System using OMT design techniques.
4. Ability to design a Software System using UML design techniques.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction: Ability to analyze and model software systems Object oriented themes, modeling as a design technique. Object Modeling: Object, classes, Link & association, advanced link & Association concepts, generalization & Inheritance, grouping constructs, aggregation, abstract classes, generalization as extension & restriction, multiple inheritance, metadata, candidate key & constraints.	8

2.	Dynamic & Functional Modeling: Dynamic modeling: Events & states, operations, nested state diagrams, concurrency, advanced dynamic modeling concepts & simple dynamic model, relation of object dynamic models. Functional Modeling: functional model, data flow diagrams, specifying operations, construction, a simple functional model, relation of functional to object & dynamic model.	7
3.	Design Methodology: OMT methodology, Impact of an object-oriented approach, analysis, system design with examples, combining models, design algorithms, design optimization, implementation of controls, design association & physical packaging.	3
4.	Introducing the UML: An overview of the UML, Conceptual Model of UML, Architecture of UML Structure modeling Using UML: Classes, Relationship, Diagrams, Class Diagrams.	7
5.	Behavioral Modeling: Interactions, Use Cases, Use Case Diagram, Interaction diagrams, Activity diagrams, Events & Signals, State Machines, Process & Threads, Time & Space, State chart diagrams.	5
6.	Architectural Modeling: Components, Deployment, Collaboration, Patterns & frameworks, component diagrams, Deployment diagrams.	6

Text Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1	Object-orientated Modeling & Design: (Unit 1 to 3)	James Rambaugh, Michael Blaha, William Premerlani, Frederick Eddy, William Lorensen	PHI	Unit 1 to 3
2	The Unified Modeling Language User Guide	Grady Booch, James Rambaugh, Lvar Jacobson	Addison Wesley	Unit 4 to 6

Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition
1	Object oriented analysis & design using UML	H. Srimathi, H. Sriram, A. Krishnamoorthy	SCITECH PUBLICATION 2nd Edition
2	Object Oriented analysis& Design	Andrew High	TMG
3	Practical Object Oriented Design with UML	Mark Priestley	McGraw-Hill Education
4	Threat first Object oriented analysis & design	Breet Mclaughline, Garry Police & Devide West	OREILLY

T. Y. B. Tech (Data Science Engineering) Sem – V

6. Object Oriented Programming (PCC - DS507)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : -----
Tutorial : -----	Term work : 50 Marks
Practical : 4 Hrs./Week	Oral : 50 Marks

Pre- requisites: Basics Of C Programming Language

Course Objectives:

1. To learn advanced features of the C++ programming language as a continuation of the previous course.
2. To learn the characteristics of an object-oriented programming language: data abstraction and information hiding, inheritance, and dynamic binding of the messages to the methods.
3. To learn the basic principles of object-oriented design and software engineering in terms of software reuse and managing complexity.
4. To enhance problem solving and programming skills in C++ with extensive programming projects.
5. To become familiar with the LINUX software development environment.

Course Outcomes:

After the completion of this course, a successful student will be able to do the following:

- 1) Use the characteristics of an object-oriented programming language in a program.
- 2) Use the basic object-oriented design principles in computer problem solving.
- 3) Use the basic principles of software engineering in managing complex software project.
- 4) Program with advanced features of the C++ programming language.
- 5) Develop programs in the LINUX programming environment.

Unit No.	Contents	No. of Lectures
1	Basics of Object Oriented Programming The Origins of C++, Features of Object Oriented Programming, relations of Classes & Structures, Classes & Objects, Encapsulation, Data Abstraction, Inheritance, Inline Function, Constructor & Destructor, function overloading & Operator overloading, Static class member, Static Member Function, Scope resolution Operator, Access members Data member & member Function, Defining member functions, Passing Object to Functions, Nested classes, local classes, Friend functions, Friend class	6
2	Pointers , Arrays, Dynamic allocation Operator Arrays Of Object, Pointers to Object, THIS pointer, type checking C++ Pointers, Pointers to Derived types, Pointers to Class members Dynamic Allocation Pointers :-New & Delete Operator	5
3	Functions & Operator Overloading Functions Overloading, Operator Overloading, Types Of Constructors, Destructors, Operator Overloading Using Friend Function, Unary & Binary Operator Overloading(Arithmetic, Comparison Operator Overloading), Assignment Operator Overloading(=, +=)	5
4	Inheritance & Virtual Function Inheritance, Single Inheritance, Types of Derivations, Passing parameters to base ,Multiple Inheritance, Multilevel Inheritance, Hybrid Inheritance ,Hierarchical Inheritance , Virtual function, Calling a Virtual function through a base class reference, Virtual functions are hierarchical, Pure virtual functions, Abstract classes, Early and late binding.	7
5	Templates & Exception handling Function Template ,Class Template, Generic Classes ,Generic Functions, Applying Generic Functions Type Name, export keyword Power of Templates Standard Template Library (STL):-STL Container, STL Algorithm, STL iterator. Exception handling :-Exception handling fundamentals, Catching, Throwing ,& Handling Exception, Exception handling options,	7
6	I/O System Basics,File I/O Streams ,File Pointers & Redirections Streams, C++ stream, C++ Predefined stream classes, Formatted I/O, C++ file I/O, manipulators, fstream and the File classes, File operations, namespaces, std namespaces	6

TERM WORK

- It should consist of minimum 10-12 experiments based on the syllabus and concepts mention below. Students of different batches should implement different programs based on the following guidelines
- Student should perform the Practical's on Linux platform

List of Experiments

1. Classes & objects
2. Constructors & destructors
3. Friend function and Friendclass
4. Inline Function, Static data members & memberfunctions,
5. Array, Array of Objects, Pointer to Object, THIS pointer, Dynamic allocation operators (New & Delete)
6. Function overloading, Operator overloading (unary/binary/arithmetic/comparison)
7. Inheritance (multilevel, multiple, hybrid, Hierarchical)
8. Virtual function and Virtual class, early and latebinding
9. Generic function & classes
10. STL
11. ExceptionHandling
12. Filehandling

TEXT BOOKS:

1. The Complete Reference C++ by Herbert Schild(Tata McGraw Hill) 4th Edition and onwards.
2. Object oriented Programming in C++ by Rajesh K.Shukla(Wiley) India Edition

REFERENCE BOOKS:

- 1 Object-Oriented Programming with C++ by E. Balaguruswamy. (Tata McGraw-Hill) 6th Edition and onwards
2. Object oriented Programming with C++- by SouravSahay (Oxford) 2nd edition

T. Y. B. Tech. (Data Science Engineering) Sem – V

7. Business English (HM - DS508)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : -----	Theory : -----
Tutorial : 2 Hrs./Week	Term work : 25 Marks
Practical : -----	Oral : 25 Marks

Pre-requisites:

- 1) Knowledge of functional grammar and vocabulary in English
- 2) Knowledge of the importance of business English in their career path
- 3) Knowledge of linguistic competence and understand intricacies involved in technical communication

Course Objectives

1. Develop basic skills to deal with people in business situations
2. Increase their knowledge of key business concepts worldwide
3. Write and read basic business reports, letters, e-mails etc
4. Expand vocabulary related to general business situations
5. Develop confidence to deal with people and basic issues in the business world

Course Outcomes

1. Learn to communicate with others in practical, business oriented situations
2. Learn to express themselves in English with greater fluency, accuracy and confidence
3. Learn to handle themselves in English in a variety of business contexts, from negotiating, to using the telephone, to making presentations, to socialising
4. Enhance the skills of listening, speaking, pronunciation skills, as well as business vocabulary
5. Acquire the communicative competencies crucial for appropriate workplace behavior

UNIT NO.	UNIT NAME & DETAILS
1.	Getting acquainted with professional culture: • First day at work • Induction program • Company hierarchy • Behavior pruning
2.	Vocabulary building and Reading comprehension: • Reading techniques and comprehension skills • Synonyms and antonyms • One-word substitution • Prefixes and Suffixes • Idioms and phrases • Homonyms and homographs • Irregular verbs like (write, wrote, written) • Situational vocabulary
3.	Effective vocal Communication: • Effective Meetings • Video Conferencing • Effective Telephonic Communication • Breaking Bad news
4.	Effective written Communication: • Business letters • Resume Writing • E-mail writing • Report writing • Minutes of meeting • Memo writing
5.	Public speaking and Presentation Skills: • Preparing and conducting presentation • Body language • Overcoming stage fear • Best practices • Interviewing and being interviewed
6.	Miscellaneous: • Group Discussion • Handling Complains • Negotiation Skills • Business Etiquettes

Term Work

- Individual Performance or Presentation to be Evaluated Continuously
- Group Activity Performance to be Evaluated in the Batch
- Assignments or Write up (Minimum 10)

Assignment List

1. Case study of organizational hierarchy
2. Match the following on antonyms & synonyms
3. Irregular verb list (like choose, chose, chosen)
4. Word building by using prefixes suffixes (eg. ir-regular, im-possible)
5. Minutes of Meeting – writing
6. Report writing (any report)
7. Comprehension/paragraph writing
8. Business letter / resume writing / email writing
9. PPT presentation on any non-technical topic. PPT handout should be attached
10. Do's & Dont's of group discussion & Business etiquettes

Textbooks / Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1.	Technical Communication	Ashraf Rizvi	Tata McGraw Hill, 2005	1, 2, 3, 4, 6
2	Effective Business Communication	M. V Rodriques	Concept Publishing Company Pvt. Ltd. 2013	1, 2, 3, 4, 6
3	English for Technical Communication	K. R. Laxminarayan	SCITECH 2 nd Edition 2014	2, 4, 3
4.	Technical English	Dr. M. Hemamalini	Wiley, 2014	2, 3, 4, 5
5	Business English	T. Thomson	Heinle & Heinle 2004	1, 3, 5, 6
5	Business Communication; The Real World and Your Career	Senguin J	South-Western 1999	1, 3, 4, 6

T. Y. B. Tech (Data Science Engineering) Sem – VI

1. Machine Learning (PCC - DS601)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : 25 Marks
Practical : 2 Hrs./Week	Oral : -----

Pre-requisites: Linear Algebra, Statistics, Probability Theory.

Course Objectives

1. To understand Machine Learning Aspects.
2. To understand primitives in learning process by Computer.
3. To understand nature of problems solved with Machine Learning.

Course Outcomes

On completion of the course, student will be able to

1. Explain Machine Learning concepts.
2. Analyze the Machine Learning model.
3. Design solution using Machine Learning techniques.
4. To tackle real world problems in domain of data mining, information retrieval, computer vision, linguistics and bioinformatics, etc.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction to Machine Learning: Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Lifecycle, Performance measures, tools and framework, data visualization.	06
2.	Regression: Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, simple regression in matrix form. Multivariate Linear Regression – multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression	08

3.	Classification- logistic regression & Naïve Bayes : Definition, logistic regression – hypothesis representation, decision boundary, cost function, gradient descent for logistic regression. multiclass classification, Regularization - Overfitting & Underfitting, cost function, Regularized Linear Regression, Regularized Logistic Regression Neural Networks- Neuron representation and model, Hypothesis for neuron, cost function, solution of a problem using single neuron. Gradient descent for a neuron. Neural network, Multiclass classification with neural network. Learning in neural network-backpropagation algorithm.	07
4.	Naïve Bayes Classifier, Entropy: Decision trees: definition, terminology, the need, advantages, and limitations. constructing and understanding Decision trees, common problems with Decision trees, Decision tree algorithms, random forest, examples. Conditional probability and Naïve Bayes Classifier Instance-based classifier – K- Nearest Neighbour Classifier	05
5.	Unsupervised learning : Clustering, K Means clustering, Hierarchical clustering, Association Rule mining.	05
6.	Recommendation System and Time Series Analysis: Basic Text Processing with Python, regular expression, Natural Language Processing, Text Classification, Topic modeling Popularity based recommender engines, Content based recommendation engines, Classification based recommendation engine, collaborative filtering Date and Time Handling, Window functions, Correlation, Time Series Forecasting.	05

Practical List

Minimum of 10 to 12 experiments should be carried out based on the following experiments.

1. Study and installation of python
2. Study and implementation of Simple Linear Regression
3. Write a program to implement Multiple Linear Regression
4. Write a program to implement Logistic Regression.
5. Write a program to implement Multi-class Classification
6. Write a program to implement Neural Network
7. Write a program to implement Backpropagation algorithm of Neural Network
8. Write a program to implement K-means Clustering
9. Write a program to implement association rule mining
10. Write a simple program to identify next point of time series analysis
11. Write a program to build naïve bay's classifier for text data
12. Demonstrate simple recommendation system.

Text Books:

1. Machine Learning with Python- an approach to applied ML, by Abhishek Vijayvargia, BPB publications
2. Practical Machine Learning by Sunila Gollapudi Packt Publishing Ltd.
3. Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition

References Books:

1. Machine Learning for dummies John Paul Muller, Willey Publication
2. EthemAlpaydin : Introduction to Machine Learning, PHI 2nd Edition-2013

T. Y. B. Tech (Data Science Engineering) Sem –VI

2. UNIX Shell Programming (PCC - DS602)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : 25 marks
Practical : 2 Hrs./Week	Practical : -----

Pre-requisites: Data Structures, Concepts of Process, deadlock and System calls.

Course Objectives

1. To help the students to understand effective use of Unix concepts, commands and terminology.
2. Identify, access, and evaluate UNIX file system.
3. Understand UNIX command syntax and semantics.
4. Ability to read and understand specifications, scripts and programs.
5. Analyze Facility with UNIX Process.

Course Outcomes

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

1. Know the basics of Unix concepts and commands.
2. Evaluate the UNIX file system.
3. Apply Changes in file system.
4. Understand scripts and programs.
5. Analyze Facility with UNIX system process

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction of UNIX - Introduction, History, Architecture, Experience the Unix environment, Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, & bc.	6
2.	UNIX File System - The file, what's in a filename? The parent-child relationship, pwd, the Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames, The UNIX file system.	6
3.	Basic File Attributes - Is - l, the -d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find.	6
4.	Introduction to the Shell Scripting - Introduction to Shell Scripting, Shell Scripts, read, Command Line Arguments, Exit Status of a Command, The Logical Operators && and , exit, if, and case conditions, expr, sleep and wait, while, until, for, \$, @,	6

	redirection. The here document, set, trap, Sample Validation and Data Entry Scripts.	
5.	Introduction to UNIX System process: Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file.. Signals.	6
6.	Process Control: - Process Creation, Signals, Process Termination, Awaiting Process Termination, Invoking Other Programs, The User ID of a Process, The Shell, System Boot and the Init Process.	6

Term Work

- It should consist of minimum 10-12 experiments based on the above topics and covering the following list of experiments.

Experiment 1 (Shell scripts)

Write a shell script program to display list of user currently logged in.

Write a shell script program to display "HELLO WORLD".

Write a shell script program to develop a scientific calculator

Experiment 2 (Shell Scripts)

Write a shell Script program to check whether the given number is even or odd.

Shell script Program to search whether element is present in the list or not.

Experiment 3 (Shell scripts and sed)

Shell script program to check whether given file is a directory or not.

Shell script program to count number of files in a Directory.

Experiment 5 (awk, perl scripts)

Write a perl script to compute the power of a given number

Write an awk script to display the pattern of given string or number.

Experiment 6 (Shell programming)

Write a shell script program to display the process attributes.

Write a shell script to change the ownership of processes.

Experiment 7 (Shell script programming)

Write a shell script program to check variable attributes of file and processes.

Shell Script program for changing process priority.

Experiment 8 (Programming)

Demonstration of UNIX Process Management – from process creation to process termination.

Experiment 9 (Programming)

Program for simulation of UNIX commands.

Experiment 10 (Programming)

Study & Implementation of signal () system call.

Experiment 11 (Installations)

Installation of VirtualBox (VMWare) on a PC having other operating system.

Experiment 12 (Installations)

Installation of Unix/Linux packages.

Experiment 13 - Study of compilation of Linux kernel.

Text Books

1. Unix Concepts & Applications 4th Edition, Sumitabha Das, Tata McGraw Hill [Unit 1-5]
2. The design of Unix Operating System-Maurice J. Bach ,PHI Publications [Unit 6]

Reference Books

1. Unix Shell Programming, Yashwant Kanetkar
2. Introduction to UNIX by M G Venkatesh Murthy.

.....

T. Y. B. Tech (Data Science Engineering) Sem – VI

3. Database Engineering (PCC - DS603)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : 25 marks
Practical : 2 Hrs./Week	Practical : 50 Marks

Pre-requisites: Set Theory, Operating System, Data Structures.

Course Objectives

1. To understand fundamental concepts and algorithms of Database Systems.
2. To gain familiarity with SQL and DBMS.
3. To learn database design techniques.

Course Outcomes

1. Understand fundamentals of database management systems.
2. Represent logical design of database using E-R Diagram.
3. Analyze & construct good database design.
4. Apply SQL queries to design & manage the database.
5. Understand transactions, concurrency control and apply to database system.
6. Understand failures in database and appropriate recovery techniques.

UNIT NO.	UNIT Name and Contents	NO. OF LECTURES
1.	Introduction to DBMS Introduction, Traditional file system v/s DBMS, views of data, instance and schema, Data Models – Relational and ER model, Keys, Database design process, Schema diagram, Extended E-R Features- Specialization, Generalization and Aggregation, Database system structure, Database users. Relational algebra, Tuple relational calculus, Domain relational calculus.	8
2.	Structured Query Language Introduction to SQL, data types. DDL Statements – Create, Alter, Drop, Rename, Truncate. DML Statements- Select, Insert, Update, Delete. DCL Statements – Commit, Rollback. Aggregate functions, Group by clause, having clause, order by clause, set operations, Joins, Nested Queries, Views PL/SQL- Functions, Procedures, Triggers, Cursors	08

3	Functional Dependency and Normalization Integrity constraints – domain constraints, referential integrity, Pitfalls in Relational-Database Design, Functional dependency, types of functional dependency, closure of set of functional dependency, Closure of Attribute Sets, canonical cover. Normalization – Purpose of normalization, First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form(3NF), Boyce-Codd Normal Form (BCNF), Fourth Normal Form (4NF), Fifth Normal Form (5NF)	7
4	DATA STORAGE & INDEXING File organization, Organization of records in file, Buffer Management. Indexing – Ordered indices – primary indices, secondary indices, dense and sparse indices, multilevel indexing, B tree indexing, B+ tree indexing and multiple key access. Hashing – static hashing – open hashing, closed hashing, dynamic hashing, Bitmap indices..	5
5	Transaction Processing and Concurrency Control Transaction Processing – Concept, ACID properties, Transaction model, Schedule, Serializability – conflict and view Serializability, Recoverable schedule. Concurrency Control Mechanisms – Lock based protocols, Multiple Granularity, Timestamp based protocols, Thomas's Write Rule, Validation based protocols	7
6	Deadlock Handling and Data Recovery Deadlock Handling – Deadlock prevention, deadlock detection and deadlock recovery. Data Recovery – Failure Classification, Storage, Log based recovery,.	5

Term Work

Minimum 12 -14 Experiments based on the following topics.

1. Installation and Demonstration of DBMS like MySQL
2. Draw E-R Diagram for different applications like – Library Management Systems, College Management Systems, Hospital Management Systems etc.
3. Convert E-R Diagrams into relational tables.
4. Use DDL Statements to Create, Alter, Drop, Rename, Truncate Tables
5. Use DML Statements to Insert, Select, Update, Delete Data
6. Use of aggregate functions, group by – having clause and order by clause.
7. Use of Joins
8. Use of Set Operations
9. Creation of Indices and Views in SQL
10. Implement PL/SQL procedure and Function
11. Implement PL/SQL Cursor.
12. Implement Triggers in PL/SQL.
13. Find Canonical Cover and Closure for set of functional dependencies.
14. Demonstration of Indexing – Dense index, Sparse index, B+ tree index
15. Demonstration of Hashing – Static hashing, Dynamic hashing
16. Demonstration of Log based recovery.
17. Study of concurrency control mechanisms

Text Books:

1. “Database System Concepts”, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 6th edition, McGraw- Hill.
2. “Database Systems - A Practical Approach to Design, Implementation and Management”, Thomas Connolly, Carolyn Begg, 4th Edition, Addison Wesley.
3. “MySQL Cookbook”, Paul DuBois, 3rd edition, O'REILLY.

References Books:

1. “Fundamentals of Database Systems”, Ramez, Elmasri, Shamkant B. Navathe, 6th Edition, Addison Wesley.
2. “Database Systems – Design, Implementation and Management”, Rob & Coronel, 5th Edition, Thomson Course Technology.

*

T. Y. B. Tech (Data Science Engineering) Sem – VI

4. Computer Algorithms (PCC - DS604)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 4 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial :1 Hrs./Week	Term work : 25 marks
Practical : -----	Practical : -----

Pre-requisites: Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts.

Course Objectives

1. To introduce algorithm design methods / techniques with analysis
2. To devise algorithm for given problem statement
3. To introduce complex computational problems
4. Introducing parallel algorithms

Course Outcomes

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

1. Understand and demonstrate algorithm design methods with analysis
2. Devise algorithm for given problem statement and analyze its space and time complexity by using recurrence relation
3. Categorize the problem to determine polynomial and non-polynomial based on its nature
4. Understand and demonstrate basic concepts of parallel algorithms

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Unit 1 : Divide and Conquer: What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms. Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, DC Selection Algorithm, analysis of Divide and Conquer algorithms.	10
2.	The Greedy Method: The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim's and Kruskal's Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths.	7
3.	Dynamic Programming: The general method, Multistage graphs, All pair shortest paths, 0/1 knapsack, Reliability design, Traveling Sales person problem.	7
4.	Basic Traversal and Search Techniques and Backtracking: Techniques for Binary Trees, Game Tree; Techniques for Graphs – Breadth First Search & Traversal, Depth First Search	13

	& Traversal, AND/OR graphs; Connected components and Spanning Trees; Bi-connected components and depth first search. Backtracking - The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Coloring.	
5.	NP Hard and NP Complete Problems: Basic Concepts, Introduction to NP Hard Graph Problems.	4
6.	Introduction to Parallel Algorithm: Computational Model and Fundamental Techniques and Algorithms – PRAM, MESH and HYPERCUBE.	7

Term Work

It should consist of minimum 10-12 assignments based on following guidelines

- A batch of students will be assigned different algorithms and expected to analyze the algorithms in terms of time and space complexity
- Solve different exercise problems in text book mentioned in syllabus
- Student need to perform at least 6 programs from the syllabus. Perform Priori Analysis and Posteriori Measurement on the same.

Text Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1	Fundamentals of Computer Algorithms	Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaram	Universities Press, Second Edition	All Units

Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition
1	Fundamentals of Algorithmics	Gilles Brassard, Paul Bratley	Pearson Education
2	Mastering Algorithms with C	Kyle Loudon	SPD O'Reilly
3	Computer Algorithms- Introduction to Design and Analysis	Sara Baase, Allen Van Gelder	Pearson Education

T. Y. B. Tech (Data Science Engineering) Sem –VI

1. Open Elective Course - II (OEC- DS605)

E- Commerce & Digital Marketing (OEC - DS605)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : -----
Practical : -----	Practical : -----

Course Objectives:

1. To get the knowledge about business advantages of the e-commerce and digital marketing and its importance
2. To develop a digital marketing plan and to make SWOT analysis
3. To get introduced with various digital channels, business tools in social networking
4. To understand the optimization of a Web site and SEO optimization

Course Outcomes:

1. Students will be able to identify the importance of the e-commerce and digital marketing for business success
2. Students will be able to create a digital marketing plan, starting from the SWOT analysis and defining a target group
3. Students will be able to identifying digital channels, business tools used in social networking
4. Students will be able to demonstrate the optimization of web site using business tools.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Introduction to E-commerce, frameworks & architectures Introduction: The term “E-Commerce”, Business models related to E-Commerce, Technical and economic challenges Frameworks and architectures: Actors and stakeholders, Fundamental sales process, Technological elements	(4)
2.	B2C business, B2B business B2C Business: The process model and its variants, The pricing challenge, The fulfillment challenge, The payment challenge, B2C-business and CRM, B2C software systems B2B business: The process model and its variants, B2B software systems	(5)

3.	Introduction to Digital Marketing How digital technologies transformed marketing?, Definitions-digital marketing and multichannel marketing- Paid, owned and earned media, the growing range of digital marketing platform, digital marketing strategy-key features of digital marketing strategy, applications of digital marketing, benefits of digital marketing, alternative digital business models, difference between e-commerce and e-business, challenges in developing and managing digital marketing strategy	(6)
4.	Online marketplace analysis & macro environment Introduction: situation analysis for digital marketing, the digital marketing environment, understanding customer journeys, online consumer behavior and implications for marketing, business models for e-commerce Online macro environment: Technological forces, economic forces, political forces, Legal forces, social forces and cultural forces	(8)
5.	Digital Marketing Strategy and relationship marketing Digital Marketing strategy development: how to structure digital marketing strategy, strategy implementation Relationship marketing using digital platforms: Introduction, the challenge of customer engagement, customer lifecycle management	(6)
6.	Marketing Communications Marketing Communications using digital media channels: Introduction, search engine marketing, online public relations, e-mail marketing and mobile text messaging, social media and viral marketing, offline promotion techniques. Case study: How the ministry of food processing took to social media or world food India 2017.	(7)

Text Books:

1. Introduction to E-commerce: Combining Business & Information Technology 1st Edition, (2016) Martin Kutz. & bookboon.com
2. Digital Marketing: Strategy, Implementation and Practice, 6th Edition by Dave Chaffey, Fiona Ellis-Chadwik, Pearson Education.

Reference Books:

1. The Beginner's Guide to Digital Marketing (2015). Digital Marketer. Pulizzi, J.(2014) Epic Content Marketing, McGraw Hill Education.
2. “Electronic Commerce”, Jeffrey F Rayport and Bharat Bhasker, Tata McGraw Hill.

It should consist of assignments on following topics within group of 4-5 students & its evaluation will be considered for CIE

1. Define a target group (working in groups)
2. Creating web sites, MS Expression (working in groups)
3. Writing the SEO content (working in groups)
4. Google AdWords (working in groups)
5. CRM strategy (working in groups)

T. Y. B. Tech (Data Science Engineering) Sem – VI**5. Open Elective Course - II (OEC - DS606)****Cyber Security (OEC - DS606)**

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : ESE 70 Marks CIE 30 Marks
Tutorial : -----	Term work : -----
Practical : -----	Practical : -----

Prerequisite: Fundamental knowledge of Data Communication, Networking and Information Security.

Course Objectives:

1. To gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks
2. To examine secure software development practice
3. To understand key terms and concepts in I.T. ACT
4. To incorporate approaches for incident analysis and response

Course Outcomes:

On completion of the course, student will be able to

1. Explain the cyber security concepts.
2. Describe the cyber security vulnerabilities and prevention techniques.
3. Explain the different rules and regulations under I.T. ACT.
4. Explain the concepts of digital forensics & incident management

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Computer and Network Security Introduction to Computer Security - Introduction, How Seriously Should You Take Threats to Network Security?, Identifying Types of Threats, Basic Security Terminology, Concepts and Approaches, Online Security Resources Networks and the Internet : Introduction, Network Basics, How the Internet Works, Basic Network Utilities , Advanced Network Communications Topics	06
2.	Cyber Frauds, DoS, Viruses: Cyber Stalking, Fraud, and Abuse: Introduction, How Internet Fraud Works, Identity Theft, Cyber Stalking, Protecting Yourself	06

	Against Cyber Crime. Denial of Service Attacks: Introduction, DoS, Illustrating an Attack, Malware: Introduction, Viruses, Trojan Horses, The Buffer-Overflow Attack. The Sasser Virus/Buffer Overflow, Spyware, Other Forms of Malware, Detecting and Eliminating Viruses and Spyware	
3.	Techniques Used by Hackers : Introduction, Basic Terminology, The Reconnaissance Phase, Actual Attacks, Malware Creation, Penetration Testing	06
4.	Computer Security Technology: Introduction, Virus Scanners, Firewalls, Antispyware, IDS, Digital Certificates, SSL/TLS, Virtual Private Networks, Wi-Fi Security	06
5.	I.T. ACT: Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, I.T. Act	06
6.	Introduction to Forensics: Introduction, General Guidelines, Finding Evidence on the PC, Finding Evidence in System Logs , Getting Back Deleted Files, Operating System Utilities, Operating System Utilities, Mobile Forensics: Cell Phone Concepts	06

Text Books:

1. Computer Security Fundamentals - Chuck Easttom, Pearson, third edition.

Reference Books:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, Incident Response & Computer Forensics, McGraw-Hill Osborne Media, 3rd edition, 2014.
2. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Real Digital Forensics: Computer Security and Incident Response, Paperback – Import, 2005.
3. John Sammons, the Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics Paperback, February 24, 2012.
4. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill, 2005.
5. Ethical Hacking, Thomas Mathew, OSB Publisher, 2003.
7. Dave Shackleford, Virtualization Security: Protecting Virtualized Environments, John Wiley & Sons, 2012.
8. BRAGG, Network Security: The Complete Reference, McGraw Hill Professional, 2012

T. Y. B. Tech (Data Science Engineering) Sem – VI

6. Java Programming (PCC - DS507)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : 3 Hrs./Week	Theory : -----
Tutorial : -----	Term work : 25 Marks
Practical : 2 Hrs./Week	Oral : 50 Marks

Pre-requisites: C++ and html.

Course Objectives

1. To introduce the concept of object-oriented programming using java.
2. To learn how to implement reliable and secure application using exception handling and package concept.
3. Have the ability to write program to perform file operations.
4. To understand how to design components with java Swing API and present mechanism of multithreading.
5. To familiarize database connectivity through JDBC and learn the collection framework.
6. To explore the concept of networking and web programming using java servlet and jsp.

Course Outcomes

1. Students will be able to articulate the principle of object-oriented problem solving & programming.
2. Students will be able to illustrate code reusability, security and abstraction using inheritance, package and interface.
3. Students will be able to develop reliable and user-friendly applications using exception handling and file handling.
4. Students will be able to create desktop apps using SWING and event handling and also illustrate multithreading concepts.
5. Students will be able to use JDBC & collection framework.
6. Students will be able to apply network programming concept & develop web applications using servlet and jsp.

UNIT NO.	UNIT NAME & DETAILS	NO. OF LECTURES
1.	Fundamental Programming in Java: The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, Hotspot, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Big Numbers, Arrays-Jagged Array. Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword, Object Cloning, Class Design Hints,	5
2.	Inheritance, Interface and Packaging: Inheritance: Definition, Super classes, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Nested classes & Inner Classes, finalization and garbage collection. Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving Interfaces, and Default Methods. Packages: Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and Class Files. Developing and deploying (executable) Jar File.	7
3.	Exception and I/O Streams: Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, Re-throwing and Chaining Exceptions, finally clause, Advantages of Exceptions, Tips for Using Exceptions. I/O Streams: Byte Stream – Input Stream, Output Stream, Data Input Stream, Data Output Stream, File Input Stream, File Output Stream, Character Streams, Buffered Stream, Scanner, ,Random File Access File.	4
4.	Graphical User Interfaces using Swing and Multithreading Introduction to the Swing, Swing features, Swing Top Level Containers-Creating a Frame, Positioning a Frame, Displaying Information in a Panel, The Model-View-Controller Design Pattern, The JComponent Class. Layout Management: Introduction to Layout Management, APIs for Border Layout, Flow Layout, Grid Layout	6

	Event Handling: Basics of Event Handling, The AWT Event Hierarchy, Semantic and Low- Level Events in the AWT, Low-Level Event Types User Interface Components: Text Input, Choice Components, Menus, Dialog Boxes Setting the Look and Feel of UI, Introduction to JApplet Multithreading: Processes and Threads, Runnable Interface and Thread Class , Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization	
5.	Collection and Database Programming Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework Database Programming: The Design of JDBC, The Structured Query Language, JDBC Installation, Basic JDBC Programming Concepts, Query Execution, Scrollable and Updatable Result Sets, Metadata, Row Sets, Transactions	7
6.	Networking and Web: Networking: Overview of Networking, Networking Basics, Working with URLs, Creating a URL, Parsing a URL, Reading Directly from a URL, Connecting to a URL, Reading from and Writing to a URL Connection, Sockets, Reading from and Writing to a Socket, Writing the Server Side of a Socket, Datagram, Writing a Datagram Client and Server. Servlet and JSP: Introduction to Servlet, The servlet Lifecycle, Retrieving Information and Sending Information, Database Connectivity using servlet, Introduction to JSP, Writing Scriplets, The jsp Lifecycle, Retrieving Information and Sending Information, Database Connectivity using jsp	7

Term Work

- 25 marks for performance in practical and experiments as part of continuous evaluation
 - 25 marks for Two Practical Tests and oral (Each of 25 Marks) to be conducted during the semester. Minimum 15 experiments should be conducted based on above topics and covering following list. At least two experiments should be conducted on each unit in the syllabus.
1. Create a class called Employee that includes three pieces of information as instance variables- first name, a last name and a monthly salary. Your class should have a constructor that initializes the three instance variables. Provide a set and a get method for each instance variable. If the monthly salary is not positive, set it to 0.0. Write a test application named EmployeeTest that demonstrates class

Employee's capabilities. Create two Employee objects and display each object's yearly salary. Then give each Employee a 10% raise and display each Employee's yearly salary again.

2. Create class SavingsAccount. Use a static variable annualInterestRate to store the annual interest rate for all account holders. Each object of the class contains a private instance variable savingsBalance indicating the amount the saver currently has on deposit. Provide method calculateMonthlyInterest to calculate the monthly interest by multiplying the savingsBalance by annualInterestRate divided by 12 this interest should be added to savingsBalance. Provide a static method modifyInterestRate that sets the annualInterestRate to a new value

Write a program to test class SavingsAccount. Instantiate two savingsAccount objects, saver1 and saver2, with balances of Rs 2000.00 and Rs 3000.00, respectively. Set annualInterestRate to 4%, then calculate the monthly interest and print the new balances for both savers. Then set the annualInterestRate to 5%, calculate the next month's interest and print the new balances for both savers.

3. Create Vehicle Interface with name, maxPassanger, and maxSpeed variables. Create LandVehicle and SeaVehicleInteface from Vehicle interface. LandVehicle has numWheels variable and drive method. SeaVehicle has displacement variable and launch method. Create Car class from LandVehicle, HoverCraft from LandVehicle and SeaVehicle interface. Also create Ship from SeaVehicle. Provide additional methods in HoverCraft as enterLand and enterSea. Similarly provide other methods for class Car and Ship. Demonstrate all classes in a application.
4. Create abstract class Shape which has instance variables side, area and perimeter
And methods calculateArea(), calculatePerimeter() as abstract methods and display() as concrete method. Write subclasses which extend Shape class like Triangle, Rectangle, Circle, Cube and Squere and override abstract methods and display methods in subclass take instance variable if needed as per the formula. And use parameterized constructor to initialize instance variables using “this” reference variable

Write Test class and Create a reference variable of Shape which will hold the objects of all the sub classes and calculate respective area, perimeter and display the results.

5. Create the interface stack which has variable size, abstract methods push (), pop (), display (), overflow () and underflow (). We need to implement 3 subclasses IntegerStack, StringStack and DoubleStack respectively by implementing interface. All the methods in interface are declared for string. And in subclass for integerStack convert string to integer. Same thing to all other. Create one test class and check for the working of all the classes.
6. Develop a mathematical package for Statistical operations like Mean, Median, Average, Standard deviation. Create a sub package in the math package -convert. In “convert” package provide classes

- to convert decimal to octal, binary, hex and vice-versa. Develop application program to use this package, and build executable jar file of it.
7. Develop application which can handle any 5 combination of predefined compile time and runtime exceptions using multiple catch blocks. Use throws and finally keywords as well.
 8. Develop a BankAccount class which should contain all methods of Bank i.e. balanceEnquiry(), withdraw(), transfer() and deposit(). You should create at least two objects of BankAccount using array and do all operations mentioned above. Also generate user defined exception LowBalanceException, NegativeNumberException and PasswordMismatchException whenever required. To transfer amount from one account to another use two BankAccount objects.
 9. Take file name as input to your program through command line, if file exists the open and display contents of the file. After displaying contents of file ask user – 1.do you want to add the data at the end of file or 2.replace specified text in file by other text. Based on user's response, then accept data from user and append it to file. If file is not existing then create a fresh new-file and store user data into it. Also. User should type exit on new line to stop the program. Do this program using Character stream classes.
 10. Take Student information such as name, age, weight, height, city, phone from user and store it in the file using DataOutputStream and FileOutputStream and Retrieve data using DataInputStream and FileInputStream and display the result. Use Serialization concept and Bytestream classes.
 11. Develop a Swing GUI based standard calculator program. Use event handling, Layout of swing package.
 12. Create Stop Watch with Swing GUI and Multithreading. Provide Facility for Lap Counting.
 13. Write a program to read a text file one line at a time. Read each line as a String and place that String object into a LinkedList. Print all of the lines in the LinkedList in reverse order.
 14. Fill a HashMap with key-value pairs. Print the results to show ordering by hash code. Extract the pairs, sort by key, and place the result into a LinkedHashMap. Show that the insertion order is maintained.
 15. Write a GUI based program to create a student registration and Login. Store Registration data in Database and take Login information from Database.
 16. Create GUI Based chat application using TCP or UDP.
 17. Design a student registration form which contains all the registration details and after registration display success page which should display all the entered details. And also design login form , home page and logout form using servlet.
 18. Write a program to store the above form information in database. And while login check with database. Display all student names in home page. Give one search field and button to search for

particular student record and display all his information as search result using servlet and jsp using MVC.

1. Text Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1	Core Java- Volume I Fundamentals	Cay Horstmann and Gary Cornell	Pearson, Eight edition	Unit 1 to Unit 4
2	Core Java- Volume II Advanced Features	Cay Horstmann and Gary Cornell	Pearson, Eight edition	Unit 5 and Unit 6
3	Java Servlet Programming	Jason Hunter	O'Reilly Publication, 2nd Edition	Unit 6
4	Core-Servlet and Java Server Pages Volume – 1	Marty Hall, Larry Brown	Pearson Education	Unit 6

Reference Books

Sr. No.	Title	Author(s) Name	Publication & Edition	Units Covered
1	JAVA-The Complete Reference	Herbert Schildt	McGraw Hill, Oracle Press	Ninth edition
2	Head First Java	Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra	O'Reilly Publication	3 rd edition
3	Head First Servlets and JSP	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly Publication	2nd Edition

T. Y. B. Tech (Data Science Engineering) Sem – VI

7. Domain Specific Mini-project (PW - DS608)

TEACHING SCHEME	EXAMINATION SCHEME
Theory : ----	Theory : ----
Tutorial : ----	Term work : 25 marks
Practical : 2 Hrs./Week	Practical : 50 marks

Pre-requisites:

1. Software Engineering Concepts
2. Object Oriented Concepts

Course Objectives

1. To expose the students to use engineering approach to solve domain specific real time problem.
2. To use the appropriate and newer technologies while developing the project.
3. To learn the skills of team building and team work.

Course Outcomes

Upon successful completion of this course, the student will be able to –

1. Identify specific problem statement from a selected domain.
2. Analyze the problem and prepare SRS and design document.
3. Write code and carry out testing.
4. Write a report covering details of the project and give presentation on a project.

Contents

The students should form group of 4 to 5 students and every group is supposed to choose a specific domain (preferably from Smart India Hackathon problem statement) to do the mini project. Further the group should identify the relevant problem in the selected domain and propose the solution, which can be implemented as a mini-project using suitable technology. The mini-project work should be evaluated by a team of teachers appointed by the department. The evaluation and marking should include Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) during which the group should give presentation and demonstration of their work done. Care should be taken to avoid out-sourcing of the work.