DATTA MEGHE INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

SAWANGI (MEGHE), WARDHA

DEPARTMENT OF FACULTY OF SCIENCE & TECHNOLOGY

COURSE CURRICULUM FOR

BACHELOR OF SCIENCE IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

B.SC. AI & DS

UNDER

SCHOOL OF ALLIED SCIENCES

W.E.F. 2021-22

Contents

Addition, Deletion and Modification of contents are highlighted with different colour codes

1. Green for addition,

2. Yellow for modification,

3. Red for deletion ,

4. Blue for Contents relevant to Gender, Environment and Sustainability, Human Values, Health Determinants, Right to Health Issues, Emerging demographic changes and Professional Ethics in the curriculum

1. PREAMBLE

Datta Meghe Institute of Higher Education and Research undertakes important measures to enhance academic standards and quality in education including innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The university formulates various regulations and guidelines from time to time to improve the education system and maintain minimum standards and quality.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students.

2. ABOUT THE COURSE

The program revolves around the field of Artificial Intelligence and Data Science which is essentially about storing processing securing and managing information. Students learn how to analyze computer problems and system performance manage large amounts of data provide quality customer service and maintain a safe secure network system. This programme is useful to learn how to actively monitor and defend the network and furthermore make fundamental security approach and methods.

3. AIM

This course, Bachelor of Science in Artificial Intelligence and Data Science, is designed and introduced by University to bridge the gap and produce employable graduate in Science & technology which will enable the industry to grow and the graduates to become successful in the field of Artificial Intelligence and Data science.

Goals

- To enable a learner to pursue any area of knowledge domain depending upon his / her interest.
- To widen the horizon of learner's intellectual insight.
- Rigidity of present system does not allow pursuit of areas of interest as well as widening the educational horizon of the learner, and
- Provision of choice is an essential condition for broad-based learner's profile across areas of knowledge.

4. OBJECTIVES:

The objectives of the program are to -

1. Impart knowledge of computer and programming logic environment with AI & DS
2. Impart Knowledge of Artificial Intelligence & Data Science based applications in different business sectors
3. To equip students with the technical knowledge required for an AI & DS professional to handle multi-tasking and multi-programming situations and to assess and develop ML based Applications
4. Evaluate and compare cutting edge technologies and techniques and its application in the solution of common AI & DS based problems.
5. Develop the capacity to continuously learn and adapt to the changing technologies and organizational environments.

5. ELIGIBILITY CRITERIA:

The aspiring candidate should have passed the Higher Secondary (10+2) or equivalent examination recognized by any Indian University or a duly constituted Board.

6. INTAKE CAPACITY-

20 candidates per year

7. TEACHING LEARNING METHODOLOGY –

- The modality of teaching for teaching learning modules will be in the form of didactic
- Lectures, self directed learning, seminars presentation Microteaching etc.

8. MEDIUM OF INSTRUCTION:

- English shall be the medium of instruction for all the subjects of study and for examination of the course.

9. ATTENDANCE:

A candidate has to secure minimum 80% attendance in overall with at least-

1. 75% attendance in theoretical
2. 80% in Skills training (practical) for qualifying to appear for the final examination

10. COURSE DURATION-

- The B.Sc. AI & DS Course is of 3 years duration, divided into six Semesters (2 semesters each year) including dissertation/Project in sixth semester.

Skill based outcomes and monitorable indicators for B.Sc. AI & DS:

On completion of the B.Sc. (Artificial Intelligence & Data Science) students are able to:

1. Serve as the Data Scientist.
2. Serve as the Data Analyst, Data Engineer.
3. Work as the Data Mining Engineer and Research Analyst.
4. Serve as the Business Intelligence Analyst, Business Analyst and Analytics Manager.
5. Can work as Artificial Intelligence Programmers or the Software Engineers with the sound knowledge of practical and theoretical concepts for developing software.
6. Work as the System Engineers and System integrators.

11. EDUCATIONAL PROGRAM

A) Distribution of Course duration

First Semester– Foundation Course

Sl. No.	Course Titles
BSDS101	Discrete Mathematics
BSDS102	Digital Computer Fundamentals
BSDS103	Statistics & Probability
BSDS104	Principles of Data Science
BSDS105	Python Programming
BSDS106(PR-1)	Data Analysis Using Advance Excel Lab
BSDS107(PR-2)	Python Programming Lab
BSDS108	Communication skills/ English

Second Semester

Sl. No.	Course Titles
BSDS201	Digital Electronics
BSDS202	Operating Systems
BSDS203	Introduction to AI
BSDS204	Data Structure
BSDS205	Probability Models (Discrete and Continuous Data)
BSDS206 (PR-1)	Data Structures Lab
BSDS207(PR-2)	R Programming and Statistical Modelling Lab
BSDS208	Environmental Science

Third Semester

Sl. No.	Course Titles
BSDS301	Principles of Machine Learning
BSDS302	Applied Linear Algebra
BSDS303	Optimization Techniques
BSDS304	Object Oriented Programming Using Java
BSDS305	Database Management Systems
BSDS306 (PR-1)	Database Management Systems Lab
BSDS307(PR-2)	Java Programming Lab
SECC	Computer Vision & Image Processing (MOOC)

Fourth Semester

Sl. No.	Course Titles
BSDS401	Data Analytics
BSDS402	Artificial Intelligence & Knowledge Presentation
BSDS403	Statistical Inference
BSDS404	Web Technologies
BSDS405	Software Engineering
BSDS406 (PR-1)	Artificial Intelligence Lab
BSDS407(PR-2)	Web Technologies Lab
SECC	IEGCE – 2

Fifth Semester

Sl. No.	Course Titles
BSDS501	Big Data Programming
BSDS502	Artificial Neural Networks and Deep Learning
BSDS503	Technologies in Data Science
BSDS504	Block-chain with AI
	Internet of Things (IoT)
BSDS505	Data Warehousing & Mining
BSDS506(PR-1)	Big Data Programming Lab
BSDS507(PR-2)	Deep Learning Models Lab
SECC	IEGCE – 3

Sixth Semester

Sl. No.	Course Titles
BSDS601	AI in Cloud Computing
BSDS602	Web Analytics
BSDS603	Project & Seminar
BSDS604	Data Security
	Cyber Security
BSDS605	Internship

INDUSTRY ENABLED GLOBAL CERTIFICATION ELECTIVES (IEGCE)

Sr. No	Semester	Course Code	Course Name	Total Credits
1	II	-	MTC – M365 – Microsoft	**2**
2	II	-	MTA – Python	**2**
3	IV	-	Administer Oracle Cloud Database	**2**
4	IV	-	MTA – Java	**2**
5	V	-	Microsoft Azure AI and Data Certifications	**2**
6	V	-	Big Data 2017 - Implementation Essentials	**2**

Summary of the Program: B.Sc. (AI & DS)

Sr. No	Particulars	Total Courses	Total Credits	Total Marks
1	Core Courses	26	101	2600
2	Ability Enhancement Compulsory Course (AECC)	2	4	200
3	Skill Enhancement Compulsory Course (SEC)	10	10	1000
4	**Industry Enabled Global Certification Electives (1 Certification in II, IV, V Semester)**	**3**	**9**	**300**
5	Generic Elective Course (GE)	2	8	200
6	**Open University Elective Courses (OE)**	**1**	**4**	**100**
7	Project & Seminar	1	2	100
8	Internship	1	3	100
	Total	**47**	**144**	**4700**

B) Distribution of Hours and Credits

First Semester – Foundation Course

Course Code	Course Name	Lectures (L)	Tutorial (T)	Pra/Activity (P)	Credits
BSDS101	Discrete Mathematics	3	1	0	4
BSDS102	Digital Computer Fundamentals	3	0	2	4
BSDS103	Statistics & Probability	3	1	0	4
BSDS104	Principles of Data Science	3	1	0	4
BSDS105	Python Programming	3	1	0	4
BSDS106(PR-1)	Data Analysis Using Advance Excel Lab	0	1	2	2
BSDS107(PR-2)	Python Programming Lab	0	1	2	2
BSDS108	Communication skills/ English	2	0	0	2
	Total	17	6	6	26

Second Semester

Course Code	Course Title	L	T	P	Credits
BSDS201	Digital Electronics	3	1	0	4
BSDS202	Operating Systems	3	1	0	4
BSDS203	Introduction to AI	3	1	0	4
BSDS204	Data Structure	3	1	0	4
BSDS205	Probability Models (Discrete and Continuous Data)	3	1	0	4
BSDS206 (PR-1)	Data Structures Lab	0	1	2	2
BSDS207(PR-2)	R Programming and Statistical Modelling Lab	0	1	2	2
BSDS208	Environmental Science	2	0	0	2
		17	7	4	26

Third Semester

Course Code	Course Title	L	T	P	Credits
BSDS301	Principles of Machine Learning	3	1	0	4
BSDS302	Applied Linear Algebra	3	1	0	4
BSDS303	Optimization Techniques	3	1	0	4
BSDS304	Object Oriented Programming Using Java	3	1	0	4
BSDS305	Database Management Systems	3	1	0	4
BSDS306 (PR-1)	Database Management Systems Lab	0	1	2	2
BSDS307(PR-2)	Java Programming Lab	0	1	2	2
SECC	Computer Vision & Image Processing (MOOC)	2	0	2	3
		17	7	6	27

Fourth Semester

Course Code	Course Title	L	T	P	Credits
BSDS401	Data Analytics	3	1	0	4
BSDS402	Artificial Intelligence & Knowledge Presentation	3	1	0	4
BSDS403	Statistical Inference	3	1	0	4
BSDS404	Web Technologies	3	1	0	4
BSDS405	Software Engineering	3	1	0	4
BSDS406 (PR-1)	Artificial Intelligence Lab	0	1	2	2
BSDS407(PR-2)	Web Technologies Lab	0	1	2	2
SECC	IEGCE – 2	2	0	2	3
		17	7	6	27

Fifth semester

Course Code	Course Title	L	T	P	Credits
BSDS501	Big Data Programming	3	1	0	4
BSDS502	Artificial Neural Networks and Deep Learning	3	1	0	4
BSDS503	Technologies in Data Science	3	1	0	4
BSDS504	Block-chain with AI	3	1	0	4
	IoT	3	1	0	4
BSDS505	Data Warehousing & Mining	3	1	0	4
BSDS506(PR-1)	Big Data Programming Lab	0	1	2	2
BSDS507(PR-2)	Deep Learning Models Lab	0	1	2	2
SECC	IEGCE – 3	2	0	2	3
		17	7	6	27

Sixth Semester

Course Code	Course Title	L	T	P	Credits
BSDS601	AI in Cloud Computing	3	1	0	4
BSDS602	Web Analytics	3	1	0	4
BSDS603	Project & Seminar	0	0	4	2
BSDS604	Data Security Cyber Security	3	1	0	4
BSDS605	Internship	0	0	6	3
		9	3	10	17

C) Distribution of teaching hours

First Semester							
Sl. No.	Course Titles	Hours			Credits		
		Theory	Practical	Total	Theory	Practical	Total
1	Discrete Mathematics	60	0	60	4	0	4
2	Digital Computer Fundamentals	45	30	75	3	1	4
3	Statistics & Probability	60	0	60	4	0	4
4	Principles of Data Science	60	0	60	4	0	4
5	Python Programming	60	0	60	4	0	4
6	Data Analysis Using Advance Excel Lab	15	30	45	1	1	2
7	Python Programming Lab	15	30	45	1	1	2
8	Communication skills/ English	30	0	30	2	0	2
TOTAL		**345**	**90**	**435**	**23**	**3**	**26**

Second Semester							
Sl. No.	Course Titles	Hours			Credits		
		Theory	Practical	Total	Theory	Practical	Total
1	Digital Electronics	60	0	60	4	0	4
2	Operating Systems	60	0	60	4	0	4
3	Introduction to AI	60	0	60	4	0	4
4	Data Structure	60	0	60	4	0	4
5	Probability Models (Discrete and Continuous Data)	60	0	60	4	0	4
6	Data Structures Lab	15	30	45	1	1	2
7	R Programming and Statistical Modelling Lab	15	30	45	1	1	2
8	Environmental Science	30	0	30	2	0	2

TOTAL	**360**	**60**	**420**	**24**	**2**	**26**

D) Curriculum Design

The Bachelor of Science in AI & DS Program is organized into six teaching Semesters Minimum 180 working days will be available for teaching, learning and evaluation (TLE) in each year of study and 90 working days shall be available for each semester.

One Credit will be awarded to 1 contact hour of teaching and learning for Theory and one Credit will be awarded to 2 contact hours of teaching and learning for Practical and Studentship. For elective courses 2 contact hours shall be awarded one credit.

E) Program Outcomes for BSC AI & DS

PO1) Computational knowledge: Acquire knowledge of Computing Fundamentals, Basic Mathematics, Computing Specialization and Domain Knowledge of proper computing models from defined problems.

PO2) Problem analysis: Identify, formulate review research literate and analyze complex engineering problems reading substantiated conclusions using first principles mathematics, computing science and relevant domains.

PO3) Design/development of solutions: Ability to design system s/w or process as per global needs and specifications.

PO4) Conduct investigations of complex computing problems: Use research-based knowledge and research methods including design of experiments, analysis & interpretation of data & synthesis of information to provide valid conclusions.

PO5) Modern Tool Usage: Ability to demonstrate skills to use modern s/w & h/w tools to analyze problems.

PO6) Professional Ethics: Apply ethical principles and commit to professional ethics and cyber regulations.

PO7) Life-Long Learning: Ability to develop confidence for self-education and life-long learning in the global context of technological change.

PO8) Project management and finance: Ability to demonstrate knowledge & understanding of the engineering and management principles and apply them as a member & as a leader in a global team to manage multidisciplinary projects.

Details of Syllabus

BSc. AI & DS: SEMESTER I

Course: Discrete Mathematics	Course Code: BSDS101

Teaching Scheme (Hrs/Week)				Continuous In- course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand the propositional calculus.
2	To understand and apply normal forms.
3	To understand predicate calculus and inference.
4	To understand the concept of quantifier.
5	To understand the concept of Graph theory

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Propositional Calculus** • Connectives, Negation, conjunction, Disjunction, statement formulas • Truth tables, conditional and Bi-conditional, • Tautologies and Contradiction, Equivalence of Proposition, duality law, Tautologies implications.	12
2		**Types of Normal Forms** • Disjunctive normal forms, • connective normal forms • Principal disjunctive normal form, Principal conjunctive normal form.	12
3		**Predicate Calculus** • The theory of Inference for statement Calculus, • Validity using truth tables, • Rules of inference	12

		Consistency of premises and indirect method of Proof	
4		**Quantifier** • Introduction, • Quantifier, Predicate formulas, • Free and Bound variables, Theory of predicate calculus.	12
5		**Graph Theory** • Basic concepts • Types of graphs • Representation of graph in memory • Euler path and circuits • Hamiltonian Path and circuits • Trees • Basic concepts • Labeled trees • Undirected trees	12
		Total No. of Hrs	60

Course Outcome
Students should able to
CO1:Understand the implementation of propositional calculus.
CO2: execute the concept of normal forms and its evaluation.
CO3: solve the predicate calculus, inference and its applications for societal needs
CO4: examine the concept of quantifier, predicate formulas.
CO5: develop graphs and trees using graph theory

Recommended Resources	
Text Books	1. Discrete Mathematical Structures with applications to computer Science byJ. P. Tremblay& R. Manohar, (TMH) 2. Discrete Mathematical Structures by Kolman Busby and Ross (Pearson) 3. Discrete Mathematics by Norman Biggs. (Oxford). 4. Logic and Discrete Mathematics: Grassmann, Tremblay (Pearson)
Reference Books	1. Introduction to Automata Theory, Languages, and computation: Hopcroft, Motwani and Ullman (Pearson) 2.An introduction to the theory of computer science, languages and machines: Sudkamp 3. Kenneth H Rosen Discrete Mathematics &it's Applications TMH

CO-PO Correlation	Program Outcomes									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	2	-	-	2	-	-	-	-
CO2	2	2	2	-	-	-	-	-	2	2
CO3	2	2		-	3	-	-	-	2	-
CO4	2	2		3	3	-	-	-	2	-
CO5	3	3		2	-	-	2	3	2	2
Co Average	2.20	2.20	2.00	2.50	3.00	2.00	2.00	3.00	2.00	2.00

Course: Digital Computer Fundamentals	Course Code: BSDS 102

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	0	2	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand basic organization of computer.
2	To understand computer organization and memory structure.
3	To understand the operating system and its concept.
4	To study internet and its tools.
5	To know emerging trends in IT.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Computer Basics	1.1.Introduction 1.2.Evolution of Computers 1.3.Characteristics of computers 1.4.Computer Generations 1.5.Classification of Computers 1.6.Computer Applications 1.7.Limitations of computers	09
2	Computer Organization, Memory and Storage	2.1Introduction 2.2 Basic Computer Organization 2.3Input Devices 2.4Output Devices 2.5Central Processing Unit 2.6The System Bus Architecture 2.7Memory or Storage Unit	09
3	Information Technology Basics	3.1 Types of software 3.2 Operating System 3.3 Information Technology 3.4 History of Browsers 3.5 Need for Information Storage and Processing 3.6 Information Technology Components 3.7 Role of Information Technology 3.8 Information Technology and the Internet	09

4	Internet and its Tools	4.1 Introduction 4.2 Internet Evolution 4.3 Basic Internet Terminology 4.4 Data Over Internet 4.5 Modes of Data Transmission 4.6 Types of Networks 4.7 Types of Topologies 4.8 Protocols used in Internet 4.9 Getting Connected to Internet Applications 4.10 Internet Applications 4.11 Email, Mailbox, Email creating and sending. 4.12 Google Sheet 4.13 E-commerce	09
5	Emerging Trends in IT	5.1 Introduction 5.2 Electronic Commerce 5.3 Electronic Data Interchange 5.4 Smart Cards 5.5 Mobile Communication 5.6 Internet Protocol TV	09
		Total No. of Hrs	**45**

Course Outcome
Students should able to
CO1: Understand basic organization of computer.
CO2: Demonstrate i/o devices and work with computer organization and memory structure.
CO3: Implement the operating system concept.
CO4: Classify internet and its tools.
CO5: Examine emerging trends in IT as per global needs

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	2	-	2	-	-	-	-	3	2	2
CO2	3	-	-	2	3	-	2	3	2	2
CO3	-	2	3	-	-	-	-	-	2	2
CO4	3	2	2	-	3	-	-	-	3	3
CO5	-	2	3	2	-	2	3	3	3	3

Co Average	**2.67**	**2.00**	**2.50**	**2.00**	**3.00**	**2.00**	**2.50**	**3.00**	**2.40**	**2.40**

RecommendedResources -

Text Books

1. V Rajaraman. Introduction to Information Technology, 3rd Edition, PHI Learning Private Limited, 2018
2. Title of Book Author Publication "Computer Fundamentals "Goel, Anita Pearson Education, New Delhi.
3. Computer Basics Absolute Miller. Michael QUE Publishing; 8th edition August, Beginner's Guide, Windows 10.
4. Linux: Easy Linux for Alvaro, Felix Create Space Independent Beginners Publishing Platform.
5. Microsoft Office 2010: On Johnson, Steve Pearson Education, New Delhi India, Demand.

Reference Books

1. Microsoft Office 2010 for Schwartz. Steve Pearson Education, New Delhi India, | Windows: Visual Quick.
2. OpenOffice.org for Leete. Gurdy, Wiley Publishing, New Delhi. 2003 Dummies Finkelstein Ellen, Mary Leete
3. Computer Fundamentals Dr. Rajendra Devraj Publications, Dist. Solapur. | Kawale Maharashtra

List of Programs DCF : 2 Credits (15 Hrs)

1. To identify: Input devices, connections and peripherals of computer system.
2. To identify: Output devices, connections and peripherals of computer system.
3. To manage files and folders using operations Create, copy, rename, delete, move and searching.
4. To perform application installation and creating shortcut on desktop.
5. To learn basics of Operating System and identify user interface.
6. To manage and adjust computer settings using control panel.
7. To create an E-Mail account and manipulate operations on it.
8. To create, share and update data in Google Sheet, Google Docs and Slides.
9. User Account creation and its feature on Windows Operating System and Changing resolution, color, appearances, and Changing System Date and Time.
10. Describe the use and function of protocols: i. HTTP & HTTPS
    ii. FTP
    iii. TCP/IP
11. Create your first Web page using Notepad in HTML. Write a program to illustrate HTML color coding methods with color attribute.
12. Write a program in HTML using Hyperlink tag (anchor tag). Show links to pages, text, Image.
13. Write a program in HTML using List tagand its attributes.
14. Write a program in HTML using Table tag and its attributes.
15. Write a program in HTML using Image tag and its attributes.

Course: Statistics and Probability	Course Code: BSDS 103

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To introduce the basic and scope of statistics
2	To obtain the measures of central tendency
3	To introduce probability and its types
4	To focus on the random variable, mathematical expectation, and different types of distributions.
5	To understand the basic concepts in mathematical expectations.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction to Statistics	Definitions of Statistics, Importance & Scope of Statistics, Limitation & Distrust of Statistics, Statistical Data Collection, Presentation and Classification and its tools, Frequency Distributions.	12
2	Descriptive Measures	Measures of Central Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis, Correlation and Regression Introduction, Coefficients and their Properties.	12
3	Probability	Introduction, Types of Probabilities, Mathematical Tools, Mathematical Laws of Probabilities, Bayes Theorem on Probability.	12
4	Random Variables and Distribution Functions	Discrete and Continuous Random Variable, Probability Mass Function, Probability Density Function, Discrete and Continuous Distribution Function.	12
5	Mathematical Expectation and Variance	Introduction, Theorems of Expectation, Co-variance, Expectation & Variance of a Linear Combination of Random Variables, Moment Generating Function, Characteristics Function, Cumulant Generating Function.	12
		Total No. of Hrs	60

Course Outcome
Students should able to
CO1:Explain the basic and scope of statistics
CO2: Examine the measures of central tendency
CO3: Implement probability and its types
CO4: Solve problems on random variable, mathematical expectation, and different types of distributions as per societal applications
CO5: Formulate the basic concepts in mathematical expectations.

CO-PO Correlation	Program Outcomes									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3		-	--	3	3	2	3	-
CO2	3	3	-	-	--	-	2	2	2	3
CO3	3	3	2	-	--	-	3	2	3	2
CO4	3	2	2	3	--	-	3	3	3	2
CO5	2	3	-	2	3	-	2	3	2	3
Co Average	2.80	2.80	2.00	2.50	3.00	3.00	2.60	2.40	2.60	2.50

Recommended Resources	
Text Books	1. Fundamental of Mathematical Statistics : Gupta & Kapoor, Sultan Chand & Sons. 2. Probability & Statistics with Reliability, Queuing and Computer Science Applications : KishorTrivedi, Wiley.
Reference Books	1. Fundamental of Statistics: A. K. Agrawal & Sahib Singh, Sultan Chand & Sons. 2. Statistics for Management: Levin, PHI. 3. Statistics: Murray R. Spiegel, Schaum Series.

Course: Principles of Data Science	Course Code: BSDS 104

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Provide a strong foundation for data science and application areas related to it.
2	Understand the underlying core concepts and emerging technologies in data science.
3	Learn the process of working with data on large scale.
4	Explore the concepts of Data Processing.
5	Learn basic concepts of Machine Learning.
6	Prepare students for advanced courses in Data Science.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Data Evolution:	**Data to Data Science** – • Understanding data: Introduction • Type of Data • Data Evolution – Data Sources. • Quantitative Data types • Data Evolution & data sources • Preparing and gathering data and knowledge • Philosophies of data science • Data all around us: the virtual wilderness • Data wrangling: from capture to domestication • Data science in a big data world • What is big data? • Difference between data science and big data • Benefits of data science • Benefits of big data • Uses of data science and big data • Facets of data. • Data wrangling • Goals of data wrangling	12
2	Digital Data:	• Data Exploration • Use cases for Data Exploration	12

	An Imprint	• Introduction to Big Data: - Evolution of Big Data. • Sources of Big Data. • Characteristics of Big Data 6Vs • Big Data-Challenges of Conventional Systems • Data Processing Models – Limitation of Conventional • Data Processing Approaches – Big Data. • Big Data Exploration - The Big data Ecosystem and Data science. • Security with big data • Overview of the data science process - retrieving data - Cleansing, integrating, and transforming data.	
3	**Machine learning :**	• Introduction to machine learning • Machine Learning Foundations • Learning system • Design of a Learning System • Varieties of machine learning • Learning input/output functions, sample application. • Boolean functions and their classes, • CNF, DNF, decision lists. • Version spaces for learning, version graphs. • Learning search of a version space, candidate elimination methods • Types of Machine Learning – Supervised Learning , Unsupervised Learning and reinforcement learning. • Applications of Machine Learning • Modelling Process – Training model – Validating model • Predicting new observations • Exploratory data analysis.	12
4	**First steps in big data:**	• Distributed data • distributed file system • Distributing data storage and processing with frameworks • Distributed programming frameworks • Data integration frameworks • Case study: Assessing risk when loaning money - Join the NoSQL movement – • Introduction to NoSQL - Case Study. • Graph databases • The rise of graph databases – Introducing connected data and graph databases.	12
5	**Ethics and Data Science:**	• Doing Good Data Science • Data ethics amongst technical reserchers: sharing, reuse, replicability • Data Ownership, • Privacy & research data reuse, Privacy in research data • Ethics in research data project • The Five Cs: Consent, Clarity, Consistency & Trust, Control & Transparency, Consequences, • Implementing the Five Cs, • Ethics and Security Training, Developing Guiding	12

		• Principles, Building Ethics into a Data-Driven Culture, Regulation, Building Our Future • Case Study.	
		Total No. of Hrs	**60**

Course Outcome
Students should able to
CO1: Understand the fundamental concepts of data science.
CO2: Describe the data analysis techniques for applications handling large data and Demonstrate the data science process for global needs
CO3: Implement concept of machine learning used in the data science process.
CO4: Visualize and present the inference using various tools.
CO5: Construct the ethics surrounding privacy and data sharing.

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	2	-	2	-	-	3	2	3	2	2
CO2	-	3	2	-	3	-	-	3	3	2
CO3	3	2	-	-	2	-	2		3	3
CO4	-	3	3	3	-	-	3	3	2	2
CO5	3	-	3	2	-	2	-	3	3	2
Co Average	**2.67**	**2.67**	**2.50**	**2.50**	**2.50**	**2.50**	**2.33**	**3.00**	**2.60**	**2.20**

Recommended Resources	
Text Books	1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali,Manning Publications, 2016. 2. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017. 3. Ethics and Data Science, Mike Loukides, Hilary Mason and D J Patil, O'Reilly, 1st edition, 2018.
Reference Books	1. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015. 2. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013 3. Ian Goodfellow, "Deep Learning", MIT Press, 2017. 4. Josh Patterson, "Deep Learning: A Practitioner's Approach", PACKT, 2017. 5. Dipayan Dev, " Deep Learning with Hadoop", PACKT, 2017.

6. Francois Challot, " Deep learning with Python", Manning, 2017.

Course: Python Programming	Course Code: BSDS 105

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment)	CIA-3 (Prelim- MCQ)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To know the basics of Programming.
2	To structure a Python Program as a set of functions.
3	To use Python data structures-lists, tuples, dictionaries.
4	To do input/output with files in Python.
5	To construct Python programs as a set of objects.

Course Content			
Unit No.	Module No.	Content	Hours
1.	**Introduction to Python Programming**:	Python Interpreter and InteractiveMode– Variablesand Identifiers – Arithmetic Operators – Values and Types – Statements,Reading Input, PrintOutput, Type Conversions, The type() Function and Is Operator, Dynamic and StronglyTyped Language. **Control Flow Statements**: The if, The if…else,The if…lif…else Decision ControlStatements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.	12
2	**Functions**:	Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables,Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. **Strings**: Creating and Storing Strings, Basic String Operations, Accessing Characters inString by Index Number, String Slicing and Joining, String Methods, Formatting Strings.	12
3	**Lists**:	list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples : tuple assignment, tuple as return value; Dictionaries: operationsand	12

		methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.	
4	**Files and exception**:	text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.	12
5	**Object-Oriented Programming**:	Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism. **Functional Programming**: Lambda. Iterators, Generators, List Comprehensions.	12
		Total No. of Hrs	60

Course Outcome
Students should able to
CO1: Develop algorithmic solutions to simple computational problems and execute simple Python programs as per societal applications.
CO2: implement a Python program with functions.
CO3: experiment compound data using Python lists, tuples, dictionaries.
CO4: design python programs to read and write data from/to files.
CO5: design python programs with classes and objects.

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	2	2	-	2	3
CO2	3	2	3	-	-	-	3	-	2	2
CO3	2	-	2	3	-	-	3	-	2	2
CO4	2	-	-	-	2	2	-	2	3	3
CO5	-	3	3	3	3	-	-	3	3	3
Co Average	**2.50**	**2.50**	**2.75**	**3.00**	**2.67**	**2.00**	**2.67**	**2.50**	**2.40**	**2.60**

Recommended Resources	
Text Books	1. Introduction to Python Programming. Gowrishankar S., Veena A. CRC Press, Taylor& Francis Group, 2019 2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition,Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/) 3. P. K. Sinha &Priti Sinha, "Computer Fundamentals", BPB Publications, 2007. 4. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010. 5. T. Budd, Exploring Python, TMH, 1st Ed, 2011
Reference Books	1.Learning To Program With Python. Richard L. Halterman. Copyright © 2011 2. Python for Everybody, Exploring Data Using Python 3. Dr. Charles R. Severance.

Course: Data Analysis Using Advanced Excel Lab	Course Code: BSDS106

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	1	2	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	Learn Basic of Excel
2	Learn Basics and advance functions for calculation
3	Learn how to organize raw data using Excel
4	Learn Statistical Analysis using Excel
5	Learn Advance Excel for data mining, descriptive and predictive analysis

List of Programs

1. Getting started with excel: Create a blank Workbook, Save Workbook, Modify an excel Spreadsheet, enter text values in excel, Merge and center text, apply Style, create basic formulas.

2. Basic data manipulation techniques: sorting, filtering, conditional formatting.

3. Using Excel Execute the statistical functions: Sum, mean, median, mode, Min, Max.

4. Perform Conditional Operations by Using Function.

5. Securing the Excel Document (Protect Cells and Workbook)

6. Solve Problem using Lookup Function.

7. The file Product.xlsx contains monthly sales for six products. Use the INDEX function to compute the sales of Product 2 in March. Use the INDEX function to compute total sales during April.

8. Use Text function to manipulate given Data.

9. Analyze Data using COUNTIF, COUNTIFS, COUNT, COUNTA, and COUNTBLANK Functions.

10. Use SUMIF, AVERAGEIF, SUMIFS, and AVERAGEIFS Functions to Evaluate Given dataset.

11. Pivot Table Generation for Given Data using Excel.

12. Using Solver to Determine the Optimal Product Mix

13. Using Excel Execute the statistical functions: quartiles, range, inter quartile range.

14. Using Excel Functions Calculate the standard deviation, variance, co-variance of given Data.

15. Perform the hypothetical testing in Excel.

16. Perform ANOVA one way classification, t test using Excel

17. Time series: forecasting Method of least squares, moving average method. Inference and discussion of results.

Course Outcome
Students should able to
CO1:Perform Basic of Excel.
CO2: Implement Basics and advance functions for calculation.
CO3: Demonstrate how to organize raw data using Excel.
CO4: Design and implement Statistical Analysis using Excel.
CO5: Develop Advance Excel for data mining, descriptive and predictive analysis for societal applications

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	3	-	3	-	-	-	3	-	3	3
CO2	3	3	-	-	3	-	3	-	3	3
CO3	3	-	-	-	3	-	3	-	3	3
CO4	-	3	3	3	-	-	-	3	3	3
CO5	3	-	-	-	3	3	3	-	3	3
Co Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**

Course: Python Programming Lab	Course Code: BSDS107

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	1	2	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To write, test, and debug simple Python programs.
2	To implement Python programs with conditionals and loops.
3	Use functions for structuring Python programs.
4	Represent compound data using Python lists, tuples, and dictionaries.
5	Read and write data from/to files in Python.

List of Programs

1. Write a program to demonstrate basic data type in python.

2. Write a program to implement various operators in python.

3. Write a program to implement various conditional statements in python.

4. Write a program to implement various looping statements in python.

5. Write a program to implement various string operations.

6. Write a program to demonstrate list & related functions in python.

7. Write a program to demonstrate tuple & related functions in python.

8. Write a program to demonstrate Dictionary & related functions in python.

9. Write a program to read and write from a file, and copy a file

10. Write a program to implement numpy and pandas packages.

11. Write a program to Import Excel File and csv File and perform operation in it

12. Write a Program to Create Different Types of Chart by importing CSV file.

13. Write a Program to Import the data , Clean Data, Train Data.

Course Outcome
Students should able to
CO1:Understand and develop Computational Thinking concepts for societal applications
CO2:Describe python programs that appropriately utilize built-in functions and control flow Statements
CO3: design and represent compound data using Python lists- tuples- dictionaries
CO4: develop input/output with files in Python.

CO-PO Correlation	Program Outcomes									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	-	3	-	-	-	3	3	3	3
CO2	-	3	-	-	3	-	3	-	3	3
CO3	3	-	3	3	3	-	-	-	3	3
CO4	-	3	3	-	3	3	-	3	3	3
Co Average	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Course: Communication Skills	Course Code:BSDS108

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
2	0	0	2	10	10	10	70	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To identify key elements and principles of communication.
2	To demonstrate understanding of the communication process using listening and reading.
3	To describe their own writing skills strengths and growth areas.
4	To identify letter writing skills.
5	To demonstrate ability to prepare and present a short oral presentation.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction and Theory of Communication:	• Nature, function & scope; The 7 Cs of communication, The communication Process: classification, components and models of communication; Problems in communication (Filters), Channels of communication: Formal v/s Informal, Upward, Downward, Horizontal, Grapevine; Barriers to communication.	6
2	Verbal and Non-verbal communication:	• Listening, Kinesics, Paralanguage, Proxemics, Essentials of effective verbal communication: Voice modulation, Tone, Pitch, Knowledge and self confidence, Meetings: Types; purpose. Group Discussions: Do's and Don'ts; Committees: Types, Advantages and disadvantages, effectiveness. Public Speaking: Preparation, Attire, Posture and Delivery techniques	6
3	Principles of Communication:	• Definition, Purpose, Process, Types, Barriers to Communication, Listening, Feedback, Nonverbal Communication Written Communication: Composing Business Letters/email Request, Enquiry, Placing Order, Instruction, Action, Complaint, Adjustment, Sales, Reference, Good News & Bad News, Acknowledgement, Circulars, Notices, Memos, Agenda and Minutes, Resume/CV, Facsimiles (Fax)], Preparing Notes, Punctuation, Using simple words, Proof Reading, Vocabulary, Basic Grammar, Comprehension, précis, preparing user manual, Report Writing: Report	6

		Planning, Types of Reports, Developing an outline, Nature of Headings, Ordering of Points, Logical Sequencing, Graphs, Charts, Executive Summary, List of Illustration, Annual Report.	
4	Communication and Culture:	• Intercultural sensitivities, Business etiquette when dealing with people from different nationalities. Understanding cultural diversity and Business etiquette with foreign clients Impact of modern Technology on Business Communication: the paperless office, use of modern devices Methods of effective audiovisual communication, EMPLOYMENT COMMUNICATION: Writing CVs and Application Letter, Group discussions, interview, types of interview, candidates preparation, Interviewers preparation; Impact of Technological Advancement on Business Communication; Communication networks, Intranet, Internet, teleconferencing, videoconferencing	6
5	Group Communication	• Meetings: need, importance and planning of Meetings, drafting of notice, agenda, minutes and resolutions of Meeting, writing memorandum, press release, press conference, Business etiquettes, telephonic and table etiquettes. Presentation Skills: What is a presentation: elements of presentation, designing a presentation, advanced visual support for business presentation, types of visual aid, appearance and posture, practicing delivery of presentation. Corporate Communication: Definition, scope, importance and components of corporate communication, professional communicator responsibilities, corporate communication and Public Relation, role of social media in communication.	6
		Total No. of Hrs	30

Course Outcome
Students should able to
CO1: describe ability to write error free by optimum use of correct business communication
CO2: distinguish between various hierarchy of organizational communication and communication barriers
CO3: implement principles of critical thinking problem solving with technical proficiency in business communication for societal applications
CO4: Develop effective interpersonal communication skills that maximize team dynamics
CO5: Develop and understanding of communication process in an organizational setup

Recommended Resources	
Text Books	1. Public Speaking and Influencing Men in Business: Dale Carnegie. 2. Professional Communication Skills: Bhatia and Sheikh. 3. Business Communication: K. K.Sinha.
Reference Books	1. Communication Skills: Dr.P.Prasad. 2. Technical Communication: Raman and Sharma.

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	-	-	-	2	2	3	3	2	-	-
CO2	-	-	-	2	2	2	2	2	2	2
CO3	-	-	-	2	3	2	3	2	2	1
CO4	-	-	-	2	2	2	2	2	3	-
CO5	-	-	-	2	2	3	3	3	3	-
Co Average	-	-	-	**2.00**	**2.20**	**2.40**	**2.60**	**2.20**	**2.50**	**1.50**

BSc. AI & DS: SEMESTER II

Course: Digital Electronics	Course Code: BSDS 201

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand the concepts of digital electronics.
2	To understand the basic working of different logic gates and laws of Boolean algebra, De Morgan theorem, NOR & NAND logic for simplification of circuits.
3	To understand the basic working of multiplexer, de-multiplexer, half adder, full adder.
4	To understand the basic working of sequential circuits and flips flop.
5	To understand the basic working of shift registers and counters.

Course Content			
Unit No.	Module No.	Content	Hours
1.		1. Introduction to Digital and Analog system: • Overview of Analog System • Overview of Digital System • Logic Systems Representation -Positive and negative • Waveform Representation of Analog and Digital system 2. Detail of Digital Signal: 2.1Advantages of Digital system • Disadvantages • Difference between Analog and Digital System • Binary Digit 3. Boolean Algebra: • Rules and laws of Boolean algebra • Simplification examples based on rules of Boolean algebra • De-morgan's Theorems • Boolean Expressions and Truth Tables • Min-term and Maxterms • Principal of Duality	12
2		1. Basic of Logic Gates: • Logical Operators, Logic Gates-Basic Gates • NOT, AND, OR Gates 2. Other gates and Universal Gate	12

		• NAND Gate • NOR Gate • XOR Gate • EX-CLUSIVE OR Gate • EX-CLUSIVE NOR Gate • Implementation of Other Gates using Universal Gates 3. Introduction to Number Systems: • Types-Decimal, Binary, Octal, Hexadecimal • Conversion from Binary number to BCD and vice-versa • Binary arithmetic operations; Addition and Subtraction • Representation of Negative Numbers • 1's complement and 2's complement and their examples	
3		1. Introduction to combinational Circuits • Design procedure of Combinational circuit • Multiplexer • De-Multiplexer. • Encoder, Decoder • Difference between Decoder and Multiplexer 2. Arithmetic circuit: Adders • Difference between Serial and Parallel Adder • Half-Adder, • Full-Adder • Difference between Half and Full Adder • Concept of Subtractor	12
4		1. Introduction to Sequential Circuits: • Overview of Sequential circuit • Classification of Sequential circuit-Synchronous and Asynchronous and their difference • Introduction of Latches 2. Types of Flip-flop: • RS, T, D, JK; Master-Salve JK • T Flip-flop • D Flip-flop • JK Flip-flop • Mater-Slave JK Flip-flop 3. Difference between Combinational and sequential circuits.	12
5		1. Introduction to shift registers: • Basic shift register • Types of shift registers- Serial in to serial out Serial in to parallel out • Parallel in to Serial out Parallel in to Parallel out 2. Introduction to counters:	12

		• Overview of counters • Types of counters • Difference between synchronous and asynchronous counter • Application of Counter	
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Know basics of digital electronics.
CO2	Understand the basic working of different logic gates and laws of Boolean algebra, De Morgan theorem, NOR & NAND logic for simplification of circuits.
CO3	Understand and implement the basic working of multiplexer, de-multiplexer, half adder, full adder.
CO4	Understand and implement the basic working of sequential circuits and flips flop.
CO5	Understand the basic working of shift registers and counters.

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	3	2	2	-	3	3
CO2	2	2	2	2	1	-	2	2
CO3	2	2	3	2	2	-	2	2
CO4	2	2	2	2	3	-	2	2
CO5	2	2	3	2	3	-	2	2
Co Average	2.20	2.00	2.60	2.00	2.20	-	2.20	2.20

Recommended Resources	
Text Books	1. Digital Design- Morris Mano, PHI, 3rdEdition. 2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition. 3. Fundamentals of Logic Design" Charles H.Roth., 6th Edition, Thomson Learning, 2013. 4. Modern Digital Electronics- R.P. Jain, 4th Edition.
Reference Books	1. Bakshi, U. A. & Godse, A. P., 2009. Analog and Digital Electronics, Technical Publications 2. Godse, A. P. & Godse, D. A., 2009. Digital Electronics and Logic Design, Technical Publications.

Course: Operating Systems	Course Code: BSDS 202

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment)	CIA-3 (Prelim- MCQ)	Theory	T/P	
3	1	0	4	10	10	10		100	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To know the operating system structure and process management.
2	To understand CPU scheduling and process synchronization.
3	To understand deadlock and starvation.
4	To understand memory management and allocation methods.
5	To understand I/O management and file allocation methods.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Operating System Structure:** Simple structure, Layered approach, Modules. System Boot. Operating System functions, Characteristics of OS. Process Management: What is Process? Process states, Creation, Termination. Process Control block. Operations on Process, Concurrent process, Processes Threads, Multithreading, and Micro Kernels. Process creation using fork (), Process termination. Inter-process Communication – Shared memory system, Message passing systems. Multithreading Models.	12
2		**CPU Scheduling:** Schedulers, Scheduling Methodology, CPU Scheduling Algorithm: FCFS, SJF, RR, Priority Scheduling. Context switch. Preemptive scheduling, Dispatcher. Performance comparison: Deterministic Modeling, Queuing analysis, Simulators. Process Synchronization: Background, Critical Section Problem, Semaphores: Usage, Implementation. Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem.	12
3		**Deadlock and Starvation:** System Model. Resource Allocation Graph, Conditions for Dead Lock,	12

		Dead Lock Prevention, Deadlock Avoidance: - Safe state, Resource allocation graph algorithm, Banker's Algorithm Dead Lock Detection. Recovery from Deadlock: Process termination, Resource pre-emption.	
4		**Memory Management:** Logical Vs. Physical Address Space, Swapping, Memory Management Requirement, Dynamic Loading and Dynamic Linking and shared libraries. Memory Allocation Method: Single Partition allocation, Multiple Partitions, Compaction, paging, Shared Pages. Segmentation, Segmentation with paging. Advantages and Disadvantages of Segmentation. Protection. Fragmentation. Virtual Memory Management – Background, Demand paging, Performance of demand paging, Page replacement – FIFO, OPT, LRU, Second chance page replacement.	12
5		**I/O Management:** I/O hardware, I/O Buffering, Disk I/O, Raid, Disk Cache. File Management: File Management system. File Accessing Methods: Sequential, Direct, Other access methods. File Directories. File Allocation Methods: Contiguous allocation, Linked allocation, Indexed allocation. Directory and Disk Structure – Storage structure, Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic graph directory, General graph directory. File Space Management, Disk Space Management, Record blocking. Free Space Management – Bit vector, Linked list, Grouping, Counting, Space maps.	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Know the operating system structure and process management.
CO2	Understand CPU scheduling and process synchronization.
CO3	Understand deadlock and starvation.
CO4	Understand memory management and allocation methods.
CO5	Understand I/O management and file allocation methods.

Recommended Resources

Text Books	1. Modern Operating Systems Andrew S. Tanenbaum, Herbert Bos Pearson 4th 2014 2. Operating Systems – Internals and Design Principles William Stallings Pearson 8th 2009
Reference Books	1. Operating System Concepts Abraham Silberschatz, Peter B. Galvineg Gagne Wiley 8th 2. Operating Systems Godbole and Kahate McGraw Hill 3

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	2	2	2	2	2	-
CO2	3	2	2	2	3	2	2	-
CO3	3	2	3	2	2	1	1	-
CO4	3	2	3	1	3	2	3	-
CO5	2	2	2	1	2	1	3	-
Co Average	2.80	2.00	2.40	1.60	2.40	1.60	2.20	-

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Understand AI concepts and types.
2	Understand knowledge representation in AI.
3	Understand problem solving methodology.
4	Understand basic concept of Natural language Processing.
5	Understand basic concept of Machine learning and its cycle.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Introduction to AI** • Definition , scope , history, • Advantages & Disadvantages , • Types of AI, • Intelligent Agent: definition, • Characteristics of Agents, • Types of agent, • Agent environment , • Turning test in AI	14
2		**Knowledge Representation in AI** • Representation of knowledge, • Types of knowledge, • Knowledge based Agent, • AI knowledge cycle, • Techniques, • Propositional Inference, • Rules of inference, Types of inference, • PEAS, • First order logic, Syntax of FOL, Inference in FOL, Resolution of FOL, • Forward chaining and Backward chaining	12
3		**Problem solving & Adversarial Search** • Search algorithm,	12

		• uninformed search algorithm, • Informed search algorithm, • Hill Climbing Algorithm, • Means-End Analysis • Adversarial search, • Minimax algorithm, • Alpha-beta Pruning	
4		**Understanding Reasoning** • Reasoning in AI, types of reasoning, Bayes' theorem,	12
5		**Processing:** Natural Language processing, Pattern recognition, expert systems.	10
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Know Types of AI and functionality.
CO2	Perform Problem solving techniques and algorithms.
CO3	Implement Natural Language Processing and Machine Learning concepts and their types.
CO4	Understand Life cycle of Machine learning.

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	2	3	-	3	2
CO2	2	3	3	2	2	-	2	2
CO3	2	3	2	3	3	-	3	2
CO4	3	2	3	2	3	-	3	3
Co Average	2.50	2.75	2.50	2.25	2.75	-	2.75	2.25

Recommended Resources	
Text Books	
Reference Books	W. Bibel, Fundamentals of Artificial Intelligence. Springer, 2007. 2. Knowledge Representation and Reasoning (The Morgan Kaufmann Series in Artificial Intelligence) Hardcover -by Ronald Brachman (Author), Hector Levesque Dr. (Author) 3. Machine Learning- Author – Tom M. Mitchell Latest Edition – First Publisher – McGraw Hill Education

	4. The Elements of Statistical Learning: Data Mining, Inference, and Prediction-Author – Trevor Hastie, Robert Tibshirani, and Jerome Friedman Latest Edition – Second Publisher – Springer 5. Artificial Intelligence for Advanced Problem Solving Techniques IoannisVlahavas (Aristotle University, Greece) and Dimitris Vrakas (Aristotle University, Greece

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand general concepts of data structure.
2	To understand the concept of stack.
3	To understand the concept of queue.
4	To understand the concept of linked list representation.
5	To understand the concept of tree and graph.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**General Concepts and Linear Data Structures:** Abstract data structure, Time and space analysis of algorithms, Big oh and theta notations and omega notations, Average, best and worst case analysis, Representation of Arrays -Single and Multi-dimensional- Address calculation using column and row major ordering.	12
2		**Stacks:** Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix & prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem.	12
3		**Queue:** Representation of Queues in Memory, Circular Queue. Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation. SORTING (Numerical Problem and Algorithm): Selection Sort, Insertion Sort, Merge Sort, SEARCHING (Numerical Problem and Algorithm): Linear Search, Binary Search. Efficiency of Sorting Methods, Big-O Notations. Hash Tables, Hashing Technique, Collision Resolution Technique.	12
4		**Linked List:** Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, all possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.	12
5		**Trees** Basic Terminologies, Representation of Binary Trees in Memory,	12

		Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Types of trees. GRAPHS: Basic Terminologies, Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs: BSF, DFS Method.	
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Understand general concepts of data structure.
CO2	Understand the concept of stack.
CO3	Understand the concept of queue.
CO4	Understand the concept of linked list representation.
CO5	Understand the concept of tree and graph.

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	2	3	3	2	2	1	2	2
CO2	3	3	2	2	3	1	2	3
CO3	2	2	3	2	2	2	2	3
CO4	3	3	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	3
Co Average	2.40	2.60	2.60	2.00	2.20	1.60	2.00	2.60

Recommended Resources

Text Books	1. Classical Data Structures: D. Samanta. PHI, New Delhi. 2. DATASTRUCTURE: LIPSCTUZ SCHUM OUTLINE SERIES 3. Data structure Using C++: Y. Kanetkar 4. Data Structures Using C++: Tenenbaum
Reference Books	1. Data structures by Tremblay Sorenson 2. Data structures by Bhagat Singh.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To study probability of events
2	To Study random variables
3	To study distributions
4	To study discrete stochastic processes
5	To study continuous stochastic processes

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Basics of Probability:** • Sample space, events, Probability defined on events, Conditional Probability, Independent events, Baye's Formula.	12
2		**Random variables:** • Random variables, Discrete random variables, Bernoulli Random variable, Binomial random variable, Geometric random variable, Poisson random variable. • Continuous random variable, Uniform random variable, gama random variable, Normal random variable, Expectation of random variables, covariance and variance of random variables, • Probability density functions.	12
3		**Distribution Functions:** • Moment Generating functions, Binomial Distribution, Poisson Distribution, Exponential Distribution, Normal Distribution, • Joint distribution of sample means and sample variance from a normal population.	12
4		**Probabilistic Models:** • Stochastic Process in Discrete time: • Branching Process, Random Walks • Markov chains in Discrete Time	12
5		**Markov Chains:** • Markov Chains in Continuous time, Forecasting the Weather, A Communication System. Transporting a problem into a Markov chain. • A Random Walk Model, A Gambling Model, Chapman-Kolmogorov Equations, Classification of states.	12
		Total No. of Hrs	**60**

Course Outcome

Students should able to	
CO1	Apply concept of probability in various problems as per societal applications
CO2	Understand the probability distributions
CO3	Learn Markov chains

CO-PO Correlation	Program Outcomes							
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	2	3	-	2	-
CO2	2	3	2	2	1	1	2	-
CO3	3	3	2	2	2	1	3	-
Co Average	2.67	3.00	2.00	2.00	2.00	1.00	2.33	-

Recommended Resources	
Text Books	1. Introduction to Probability Models, Eleventh Edition By Sheldon M. Ross
Reference Books	1. Probability Models by John Haigh, Second Edition

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	0	4	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To provide a practical exposure to data structures and its applications.

List of Programs

1. Implement creation, insertion, deletion, update in an array.

2. Implement concatenation of arrays, find the length of the arrays.

3. Implementation of Single Linked List performing the following operations

(i)Creation (ii) insertion (iii) deletion (iv) traversal

4. Array implementation of Stacks.

5. Array Implementation of queues.

6. Implementation of Stack using Linked list.

7. Implementation of Queue using Linked list.

8. Implementation of linear search.

9. Implementation of Binary Search.

10. Implementation of Insertion sorting.

11. Implementation of selection sorting.

12. Implementation of merge sort.

13. Implementation of Sorting Algorithm - Separate chaining and Open Addressing Hashing Technique

14. Implementation of Binary Search Tree

a. Create a binary search tree.

b. Traverse the above binary search tree recursively in pre-order, post-order and in- order

c. Count the number of nodes in the binary search tree. LIST

15. Write Python programs to create a tree and implement the following graph traversal algorithms - a.

Depth first search. b. Breadth first search.

Course Outcome	
Students should able to	
CO1	Acquire the knowledge to build the logic and develop solution for a problem statement as per societal needs

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	2	2	3	2	3	1	3	3
Co Average	2.00	2.00	3.00	2.00	3.00	1.00	3.00	3.00

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Observation Note Book)	CIA-2 (Output Result & Regularity)	CIA-3 (Model Examination)	Theory	T/P	
0	0	4	2	10	10	10	-	70	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To enable students to understand and develop programs in R environment.

List of Programs

1. Write a program to demonstrate basic data type in python.
2. Write a program to implement various operators in python.
3. Write a program to implement various conditional statements in python.
4. Write a program to implement various looping statements in python.
5. Write a program to implement various string operations.
6. Write a program to demonstrate list & related functions in python.
7. Write a program to demonstrate tuple & related functions in python.
8. Write a program to demonstrate Dictionary & related functions in python.
9. Write a program to read and write from a file, and copy a file
10. Write a program to implement numpy and pandas packages.
11. Apply scaling mechanism by considering the employee data (based on the given data set).
12. Demonstrate the normalization process and implement the same with customer data of bank.
13. Apply at least 3 sampling techniques to get the best data from the population.
14. Demonstrate the missing value imputations.
15. Demonstrate the usage of outlier detection.
16. Apply various data summarization techniques in student data.
17. Demonstrate the techniques to handle the imbalanced data sets.

Course Outcome

Students should able to

CO1	Demonstrate data handling in R.
CO2	Perform exploratory data analysis using R.
CO3	Perform statistical modelling using R.

CO-PO Correlation	**Program Outcomes**							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	2	3	-	2	-
CO2	2	3	2	2	1	1	2	-
CO3	3	3	2	2	2	1	3	-
Co Average	2.67	3.00	2.00	2.00	2.00	1.00	2.33	-

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment)	CIA-3 (Prelim- MCQ)	Theory	T/P	
1	1	0	2	10	10	10	100		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand multidisciplinary nature of environmental studies.
2	To understand Renewable and non-renewable resources.
3	To understand characteristic features, structure and function of the ecosystem.
4	To understand biodiversity and its conservation.
5	To understand environmental pollution and social issues.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:** 1.1 Basic definitions related to environment; 1.2 Scope, environmental science and environmental engineering; 1.3 Uses of environmental degradation, 1.4 Atmospheric composition and associated spheres, 1.5 habitat and climate; 1.6 Objective, goals and principles involved in environmental education, 1.7 Environmental awareness, 1.8 Environmental ethics, 1.9 Environmental organization and their involvement	6
2		**NATURAL RESOURCES:** 1.1 Renewable and non-renewable resources; 1.1.1 forest resources, over-exploitation, and deforestation / afforestation; 1.1.2 water resources, impact of over-utilization of surface and ground water, floods, drought, conflicts over water, dams 1.1.3 mineral resources: dereliction of mines, environmental effects of extracting and using mineral resources; 1.1.4 Food resources, modern agriculture and its impact, problem associated with fertilizer and pesticide, water logging, salinity ; 1.2 energy resources, renewable, non- renewable energy sources,	6

		1.2.1 solar energy, 1.2.2 wind energy, 1.2.3 hydro energy, 1.2.4 biomass energy, 1.2.5 geothermal energy, 1.2.6 nuclear energy and its associated hazards; 1.3 land as a resource, 1.3.1 land degradation, 1.3.2 man induced landslides, 1.3.3 soil erosion and desertification	
3		**ECOSYSTEMS:** 3.1 Concept of an ecosystem, 3.1.1 structure and function of an ecosystem, 3.1.2 producers, consumers and decomposers, 3.1.4 energy flow in the ecosystem, 3.2 ecological succession, 3.2.1 food chains, 3.2.2 food webs and ecological pyramids; 3.3 characteristic features, structure and function of the following ecosystem – 3.3.1 forest ecosystem, 3.3.2 grassland ecosystem 3.3.3 desert ecosystem 3.3.4 aquatic ecosystems.	6
4		**BIODIVERSITY AND ITS CONSERVATION:** 4.1 Bio-geographical classification of India; 4.1.1 biodiversity at global, national and local levels, 4.1.2 India as a mega-diversity nation, 4.1.3 hot-spots of biodiversity; 4.1.4 value of biodiversity-consumptive use, productive use, social, ethical aesthetic and option values; 4.1.5 threats to biodiversity; 4.1.6 conservation of biodiversity: in- situ and ex-situ conservation of biodiversity.	6
5		**ENVIRONMENTAL POLLUTION AND SOCIAL ISSUES:** 5.1 Pollution 5.1.1 Causes, effects and control measures of air pollution, 5.1.2 water pollution, 5.1.3 soil pollution, 5.1.4 marine pollution, 5.1.5 noise pollution, 5.1.6 thermal pollution; 5.2 solid waste management,	6

		5.2.1 e-waste management; 5.3 disaster management –floods, earthquake, cyclone and landslides. Water conservation, rain water harvesting, watershed management; 5.4 climate change, 5.5 global warming, 5.6 acid rain, 5.7 ozone layer depletion; 5.8 Environmental Protection Act, 5.8.1 Air (Prevention and Control of Pollution)Act, 5.8.2 Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.	
		Total No. of Hrs	30

Course Outcome	
Students should able to	
CO1	Understand multidisciplinary nature of environmental studies.
CO2	Understand characteristic features, structure and function of the ecosystem
CO3	Understand biodiversity and its conservation.
CO4	Know environmental pollution and social issues.

Recommended Resources	
Text Books	**1.** Agarwal, K.C., "Environmental Biology", 2nd Edition, Nidhi Publ. Ltd., Bikaner, 2001. 2. BharuchaErach, "The Biodiversity of India", 2nd Edition, Mapin Publishing Pvt. Ltd.,2006. 3. Kaushik, Anubha, and Kaushik, C.P., "Perspectives in Environmental Studies", 4thEdition, **4.** New Age International Publishers,2004 5. Brunner R. C., "Hazardous Waste Incineration", 1st Edition McGraw Hill Inc.,1989.
Reference Books	1. Clark R.S., "Marine Pollution", 1st Edition Clanderson PressOxford,1989 2. Cunningham, W.P., Cooper, T.H. Gorhani, E. & Hepworth, M.T., Environmental Encyclopedia", 2nd Edition, Jaico Publ. House,2001.

3. De, A. K., “Environmental Chemistry”, 2nd Edition, Wiley Eastern,1989
4. Jadhav, H. and Bhosale, V.M ., “Environmental Protection and Laws”, 1st Edition, Himalaya Pub. House, Delhi, 1995.
5. Mckinney, M.L. and Schocl. R.M., “Environmental Science Systems & Solutions”, 2nd Edition, Web enhanced edition,1996

CO-PO Correlation	Program Outcomes							
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	1	2	3	3	1
CO2	-	-	-	1	2	2	2	1
CO3	-	-	-	1	3	2	3	2
CO4	-	-	-	1	2	2	2	1
Co Average	-	-	-	1.00	2.25	2.25	2.50	1.25

BSc. AI & DS: SEMESTER III

Course: Principles of Machine Learning	Course Code: BSDS 301

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Understand concepts of Machine Learning
2	Understand concept of Artificial Neural Networks
3	Understand Algorithms & Culturing in Machine Learning
4	Understand decision tree & Bayesian learning
5	Understand concepts of inductive & analytical learning

Course Content			
Unit No.	Module No.	Content	Hours
1.	**Introduction to Machine Learning**	• Introduction • Evolution of machine learning • Difference between AI and Machine learning • Developments in machine learning • Introduction to K-nearest neighbour method, different phases of predicative modelling	12
2	**Aspects of Machine Learning& Modelling**	• Definition of learning System • Goals and applications of machine learning • Aspects of developing a learning system: training data, concept representation, function approximation • ML Modelling flow, How to treat Data in ML • Types of machine learning, performance measures • Bias-Variance Trade-Off • Overfitting & Underfitting, Bootstrap Sampling, Bagging • Aggregation	12
3	**Support Vector Machines**	• Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, • Maximum Margin linear separators, • Non-linear SVM, • Kernels for learning non-linear functions.	12
4	**Supervised**	• Linear regression with one variable, Linear regression	12

	Learning & Unsupervised Learning	with multiple variables, Logistic regression; • Linear Methods for Classification; Linear Methods for Regression; Decision trees, overfitting. • Learning from unclassified data, Clustering - Hierarchical Agglomerative Clustering, K-means partitional clustering, • Expectation maximization (EM) for soft clustering; Dimensionality reduction – Principal • Component Analysis, factor Analysis, Multidimensional scaling, Linear Discriminant Analysis.	
5	**Applications of Machine Learning**	• Strategies, guidelines for good design, • Performance measurement, Reading Data, • Pre-Processing Data, • Handwriting recognition, • Object detection, • Face detection.	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	To learn set of rules in Machine Learning
CO2	Problem solving algorithms
CO3	To solve problems using Bayesian theorem
CO4	Artificial Neural Networks & it's applications as per societal needs
CO5	Learning techniques in ML

Recommended Resources	
Text Books	• Machine Learning for Absolute Beginners: A Plain English Introduction by Oliver Theobald. • Machine Learning by Tom M. Mitchell.
Reference Books	• Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010 • Tom Mitchell, Machine Learning, McGraw-Hill, 1997 • Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012. • Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.

- Richert & Coelho, Building Machine Learning Systems with Python

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70		100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand the concept of matrices.
2	To understand and solve linear equations.
3	To understand and implement vectors.
4	To understand the concept of Linear Transformations.
5	To understand Eigenvalues and Eigenvectors.

Course Content			
Unit No.	Module No.	Content	Hours
1.	**Matrices:**	Definition, Properties, Basic operations , Determinants of Matrices and applications of determinants for 3rd and Higher order, Inverse of matrix ,Trace of matrix, Partition of matrix, Rank of matrix, echelon forms, canonical form.	12
2	**Vectors:**	Generalized inverse, Solving linear equations, Characteristic roots and characteristic vectors, properties of characteristics roots , Idempotent matrix, Quadratic forms, positive and Positive semi definite matrix.	12
3	**Vector Spaces:**	Definitions and Examples. Vector Subspaces. Linear Independence. Basis and Dimensions of a Vector Space. Row and Column Spaces of a matrix. Row rank and Column rank	12
4	**Linear Transformations:**	Linear Transformations and Examples. Representation by a matrix. Kernel and Image of a Linear Transformation. Rank-Nullity theorem. Linear Isomorphism. L (V, W) is a vector space. Dimension of L(V,W) (Statement only)	12
5	**Eigenvalues and Eigenvectors**:	Finding Eigenvectors Use of Eigenvectors in Data Science: PCA algorithm. Singular Value Decomposition of a Matrix	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Understand and implement the concept of matrices.
CO2	Understand and solve linear equations.
CO3	Understand and implement vectors.
CO4	Understand the concept of Linear Transformations.
CO5	Understand Eigenvalues and Eigenvectors.

Recommended Resources	
Text Books	1. Fraleigh, J. B., A First Course in Abstract Algebra, 7th ed., Pearson, New Delhi, 2002. 2. Artin, M., Abstract Algebra, 2nd ed., Pearson, Upper Saddle River, NJ, 2011. 3. Gallian, J. A., Contemporary Abstract Algebra, 4th ed., Narosa Publishing House, New Delhi, 1999. 4. Hoffman, K. and R. Kunze, Linear Algebra, 2nded.,Pearson Education (India), 2003. 5. Gilbert Strang, Linear Algebra and Its Applications, Thomson/Brooks Cole (Available in a Greek Translation) 6. D. Poole, Linear Algebra: A Modern Introduction, 4th Edition, Brooks/Cole, 2015.
Reference Books	1. Herstein, I.N., Topics in Algebra, Wiley, New York, 1996. 2. Malik, D.S., J. N. Mordeson and M. K. Sen, Introduction to Abstract Algebra, : McGraw-Hill, New York, 2007. 3. Rose, H.E., Linear Algebra, Birkhauser, 2002. 4. Lax, P., Linear Algebra, John Wiley & Sons, New York, Indian Ed. 1997.

Course: Computer Based Optimization Techniques	**Course Code: BSDS 303**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To learn the optimization problems.
2	To Solve the optimization problems.
3	To Understand the use genetic algorithms for solving optimization problems.
4	To find the usage the optimization algorithms for data science tasks.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Linear Programming –** • Mathematical Model assumption of linear Programming – • Graphical method - Principles of Simplex method, Big-M Method ,Duality, Dual simplex method.	12
2		**Transportation–** Transportation and assignment problem - Integer Programming Branch and Round Techniques - Assignment and Traveling Salesman Problem.	12
3		**Game Theory –** Concept of Pure and Mixed Strategies – Solving 2 x 2 matrixwith and without saddle point - n x 2 - 2 x m games. Replacement models - Elementary Replacement models - present value - rate of return - depreciation - Individual replacement – Group replacement.	
4		**Queuing Theory -** • *(Derivations not included)* Queuing Theory - definition of waiting line model	12

		• Queue discipline - traffic intensity - poison arrival – Birth death process – Problem from single server: finite and infinite population model – Problems from multi server: finite and infinite population model.	
5		**PERT & CPM** • Network representation - backward pass - Forward pass - computation - Pert Network - Probability factor – updating and Crashing.	12
		Total No. of Hrs	**60**

Course Outcome	
Students should able to	
CO1	Understand the optimization problems.
CO2	Solve the optimization problems.
CO3	Understand the use genetic algorithms for solving optimization problems for society
CO4	Implement the optimization algorithms for data science tasks.

Recommended Resources	
Text Books	1. OPERATIONS RESEARCH - Manmohan, P.K. Gupta, Kanthiswarup, S. CHAND & SONS - 1997.
Reference Books	1. OPERATIONS RESEARCH - Hamdy A Taha, Pearson Education, 7th edition, 2002 2. PROBLEMS IN OPERATIONS RESEARCH – P.K. Gupta, D.S. Hira, S. Chand Pub

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand basic concepts of java and programming in java.
2	To understand object oriented concept with inheritance and constructors.
3	To understand and implement interfaces and exception handling.
4	To understand java applet.
5	To understand swing programming.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Object oriented and Java Basics:** Need for OOP paradigm, summary of OOP concepts, History of Java, Java buzzwords, JVM –The heart of Java , Java's Magic Bytecode. Data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, using final with variables, garbage collection.	12
2		**Overloading methods and constructors**: Recursion, nested and inner classes, exploring string class. Extending Classes and Inheritance, Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance.	12
3		**Interfaces:** differences between classes and interfaces, Packages & Interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces. Exception handling: Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. String handling, Exploring java.util	12

4		**Java applets**: Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. • Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. AWT classes, window fundamentals, working with frame window, creating frame window in applet, working with, graphics, colors, font, AWT controls.	12
5		**Swing:** Introduction, limitations of AWT, components & containers, exploring swing-Japplet, Jframe and Jcomponent, Icons and Labels, text fields, buttons – The Jbutton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables. Handling menus, graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Understand basic concepts of java and programming in java as per societal needs
CO2	Understand object oriented concept with inheritance and constructors.
CO3	Understand and implement interfaces and exception handling.
CO4	Understand programming in java applet.
CO5	Understand swing programming.

Recommended Resources -	
Text Books	1. Java the complete reference, Herbert schildt, 7th editon, TMH. 2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.
Reference Books	1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John wiley and sons. 2. An Introduction to OOP, T. Budd, 3rd edition, pearson education. 3. Introduction to Java programming, Y. Daniel Liang, Pearson Education. 4. An introduction to Java programming and object oriented application development, R.A. Johnson- Thomson. 5. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary 6. Cornell, 8th Edition, Pearson Education.

Course: Database Management Systems	**Course Code: BSDS305**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
2	1	0	3	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To understand Database Management System Concepts.
2	To understand Data Model and Types of Data Model.
3	To understand RDBMS properties and its implementations.
4	To understand Relational Algebra and its Operations.
5	To understand the concept of normalization and its forms.

Course Content			
Unit No.	Module No.	Content	Hours
1.		**Introduction & DBMS Architecture** Introduction- Data- Database- Database management system- Characteristics of the database approach -Role of Database administrators- Role of Database Designers-End Users-Advantages and limitations of Using a DBMS and When not to use a DBMS. DBMS Architecture – Data Models – Categories of Data models- Schemas-Instance and Database states- DBMS Architecture and Data Independence – The Three schema architecture- Data Independence- DBMS language and interface-Classifications of Database Management Systems.	9
2		**Data Modelling Using Entity-Relationship Model** Using high level conceptual Data models for Database Design- Example Database Applications. Entity types- Entity Sets- Attributes and Keys. Relationships- Relationship types- Roles and Structural constraints. Weak Entity Types and Drawing E- R Diagrams.	9
3		**Database Design** Functional dependencies and Normalization for Relational Databases - Normalization on concepts first, second, third normal forms-BCNF.	9
4		**Transaction Processing Concepts and Concurrency Control** Transaction and System concepts – Desirable properties of Transactions – Schedules and	9

		Recoverability. Lock-Based Protocols – Locks-Granting of Locks and Two- phase locking protocol.	
5		**Database Connectivity and NoSQL** Introduction and implementation of database connectivity - Introduction to NoSQL – Advantages and disadvantages-Types	9
		Total No. of Hrs	**45**

Course Outcome	
Students should able to	
CO1	Understand Database Management System Concepts for societal applications
CO2	Understand Data Model and Types of Data Model.
CO3	Understand the concept of normalization and its forms.
CO4	Understand Transaction and System Concepts
CO5	Understand database connectivity

Recommended Resources	
Text Books	Elmasri Ramez and Navathe Shamkant B, Fundamentals of Database Systems, Addison-Wesley, 6th Edition, 2010
Reference Books	1. Silberschatz, Korth, Sudarshan, Database System Concepts, 5 Edition, McGraw Hill, 2006. 2. O`neil Patricand, O`neil Elizabeth, Database Principles,Programming and Performance, 2nd Edition, Margon Kaufmann Publishers Inc, 2008. 3. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill PublishingCompany, 2003.

Course: Database Management Systems Lab	**Course Code: BSDS2306**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	0	4	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To learn and understand Database Programming Paradigms.
2	To learn and understand NoSQL.
3	To learn Relational Database (Open source) such as MongoDB/ Oracle/MySQL.

List of Programs

1. Write a program to demonstrate basic data type in python.
2. Write a program to implement various operators in python.
3. Write a program to implement various conditional statements in python.
4. Write a program to implement various looping statements in python.
5. Write a program to implement various string operations.
6. Write a program to demonstrate list & related functions in python.
7. Write a program to demonstrate tuple & related functions in python.
8. Write a program to demonstrate Dictionary & related functions in python.
9. Write a program to read and write from a file, and copy a file
10. Write a program to implement numpy and pandas packages.
11. Apply scaling mechanism by considering the employee data (based on the given data set).
12. Demonstrate the normalization process and implement the same with customer data of bank.
13. Apply at least 3 sampling techniques to get the best data from the population.
14. Demonstrate the missing value imputations.
15. Demonstrate the usage of outlier detection.
16. Apply various data summarization techniques in student data.
17. Demonstrate the techniques to handle the imbalanced data sets.

Course Outcome	
Students should able to	
CO1	Understanding of Database Programming Languages.
CO2	Master the basics of database languages and construct queries using SQL, PLSQL, NoSQL for societal applications
CO3	Understand how analytics and big data affect various functions now and in the future.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	0	4	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To enable students to understand and develop difference between C++ and Java.
2	To develop and testing java application as a practical course work.
3	To develop the concept of UI design in java using SWING.

List of Programs

1. To implement different entry controlled and exit controlled looping statements
2. To Implement nesting of switch statement
3. To Implement single and multi-dimensional arrays
4. To implement constructor overloading and method overloading
5. To implement static keyword
6. To Implement multilevel inheritance
7. To implement super and this keyword
8. To implement abstract and final keyword
9. To implement the concept packages
10. To implement the concept of interfaces
11. To Implement exception handling and custom exceptions
12. To implement Byte oriented stream classes
13. To implement character-oriented stream classes
14. To Implement multithreading
15. To implement generic classes
16. To implement mouse and keyboard events
17. To implement different layout managers

18. To design a customer registration form using advanced swing components

Course Outcome	
Students should able to	
CO1	Demonstrate their ability to understand the concepts of Object-oriented programming and will model the real-world applications using Object Oriented programming concepts.
CO2	Apply the concept of Multithreading in concurrent programming.
CO3	design GUI applications using SWING and Event Handling for societal applications

BSc. AI & DS: SEMESTER IV

Course: Data Analytics	Course Code: BSDS 401

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	**T**	**P**	**C**	**CIA-1 (Class participation)**	**CIA-2 (Assignment 1 & 2)**	**CIA-3 (Mid Test 1 & 2)**	**Theory**	**T/P**	
3	**1**	**0**	**4**	**10**	**10**	**10**	**70**	**00**	**100**
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To provide knowledge of data analysis.
2	To understand the sources of analytics.
3	To learn feature selection.
4	To explore data visualization with different tools.
5	To explore data visualization with tableau.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction to Data Analytics	Knowledge Discovery Process, Data, Types of Data, Types of Analytics: Exploratory data analysis, Confirmatory analytics, descriptive analytics, Prescriptive analytics and Predictive Analytics, Data Mining v/s Data Analysis v/s Data Analytics. Data Analytics Life Cycle. Tools for Data Analytics: R, Python, Google Colab, Kaggle, Big Data Analytics - MapReduce, Hadoop, Hive, Sharding, NoSQL Databases.	12
2	Sources of Analytics	Data warehousing Architecture- Data Sources- ETL process- Data warehouse Best practices, gathering and selecting the data- data cleansing and preparation- data mining best practices- Types of charts- tips for data visualization.	12
3	Feature Selection	Feature Selection- Feature Scaling and Normalization techniques- Confusion Matrix- Area Under Curve- Receiver operating characteristic Curve- Statistical methods for Evaluation- Correlation and Regression.	12
4	Introduction to Data Visualization	Definition – Methodology – Seven Stages of Data Visualization – Data Visualization Tools. Visualizing Data: Mapping Data onto Aesthetics – Visualizing Amounts - Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions: – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.	12
5	Visualizat	Tableau Software Ecosystem, Toolbar Icons, Data Window and	12

	ion with Tableau	Aggregation, Connect to Data, Sorting Data, Measure Names, Number of Records & Measures, Cross-tabulation, Heat Maps, Tree maps, Bar Chart, Line Chart, Pie Chart, Scatter Plot, Histogram, Boxplot.	
		Total No. of Hrs	**60**

Course Outcome	
Students should able to	
CO1:	Understand data analysis.
CO2:	Understand the sources of data analytics.
CO3:	Learn feature selection.
CO4:	Explore data visualization with different tools.
CO5:	Develop data visualization with tableau.

Recommended Resources	
Text Books	1. A. Maheshwari- Data Analytics made Accessible-Seattle: Amazon Digital Services- 2015. 2. EMC Education Services- Data Science and Big Data Analytics: Discovering- AnalyzingVisualizing and Presenting Data- Wiley- 2015. 3. Ben Fry, "Visualizing Data: Exploring and Explaining Data with the Processing Environment", O'Reilly, 1st Edition, 2008. 4. Dan Murray, Christian Chabot," Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software", Wiley 2013. 5. Michael Bowles, Machine Learning in Python, Essential techniques for predictive analysis, Wiley 6.Lillean Pearson, Data Science For Dummies, John Wiley and Sons, 2015.
Reference Books	1. V Granville- Developing Analytic Talent: Becoming a Data Scientist- John Wiley & Sons2014. 2. Al Sweigart, "Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To achieve basic perspective of AI and its foundations
2	To become familiar with basic principles of AI towards problem solving, inference, perception, knowledge representation and reasoning
3	To investigate applications of AI techniques in intelligent agents, expert systems and other machine learning models
4	To acquire the knowledge of real world knowledge representation
5	To understand the concept of robotics

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction	Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behaviour: Concept of Rationality, Nature of Environments, Structure of Agents.	12
2	Logic and Inferences	Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining	12
3	Heuristic Search	Problem-Solving Agents, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.	12
4	Structured Knowledge Representations	The Schema, Semantic Net, Scripts Goals, Plans and MOPS, Inheritance in taxonomies, Description Logics, Conceptual Graphs	12
5	Robotics	Robot Introduction- Seven Criteria of Defining a Robot, Robot Controllers-Major Components, Robot Vocabularies- Robotics Middleware Basics.	12
		Total No. of Hrs	60

Course Outcome

Students should able to	
CO1	Understand various searching techniques, constraint satisfaction problem and game playing techniques.
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and reasoning
CO3	Analyse and design a real world problem for implementation and understand the dynamic behaviour of a system
CO4	Acquire the knowledge of real world knowledge representation
CO5	Understand the concept of robotics

Recommended Resources	
Text Books	1) Patterson "Introduction to Artificial Intelligence & Expert Systems" (PHI) 2) Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002. 3) Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
Reference Books	1) G. K. Gupta :"Database Management Systems", McGraw – Hill. 2) 2. Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017. 3) 3. Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, 4) O'Reilly Media 2018. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley,India- ISBN: 978-0-470-51250-0 5) Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication,ISBN: 9788126519934

Course: Statistical Inference	Course Code: BSDS 403

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To introduce the concepts of estimation and testing of hypotheses.
2	To understand the concept of parametric tests for large and small samples.
3	To provide knowledge about non-parametric tests and its applications.
4	To enable students to understand the concept of estimation, test of hypothesis.
5	To apply appropriate estimation technique and test of hypothesis.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction	Concept of Population- Sample- Sample Space- Parameter and Statistic- Parameter Space Sampling distribution of a statistic- Standard error. Derivation of Standard Error of sample mean variance (without derivation)- proportion and difference between variances. Concept of Order Statistic.	12
2	Theory of Estimation	Point Estimation, Concept of Estimator and Estimate- properties of Point estimator – Unbiasedness- Consistency- Efficiency- relative efficiency- Minimum variance unbiased estimators- Sufficiency- Cramer Rao Inequality (Statement only)- Rao Blackwell Theorem (Statement only)- Neyman Factorization Theorem (Statement only). Methods of Estimation: Maximum likelihood- Least Squares and Minimum Variance. Concept of Interval Estimation.	12
3	Tests of Significance I	Concept of Statistical hypotheses- Type I and Type II error- Critical Region and power of the test. Neyman-Pearson lemma (Statement only). Large sample tests: Tests for single mean- equality of two means- single variance and equality of two variances for Normal population- Tests of single proportion and	12

		equality of two proportions.	
4	Tests of Significance II	Sampling distributions of Chi-square- t and F statistics: derivation of Mean- variance- M.G.F and properties. Small sample tests: Tests for single mean- equality of two means- single variance and equality of two variance- Tests of proportions based on t and F statistics. ANOVA-test for equality several means. Chi-square tests for independence of attributes and goodness of fit.	12
5	Nonparametric Tests	Concept of Nonparametric tests- Run test for randomness- Sign test and Wilcoxon Signed Rank Test for one sample and paired samples. Run test- Median test and Mann-Whitney-Wilcoxon tests for two samples. Kruskal Wallis H test.	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Demonstrate the concepts of point and interval estimation and use point estimators for estimating unknown parameters.
CO2	Use sampling distributions in testing of hypotheses.
CO3	Apply various parametric and nonparametric tests for one sample and two samples and interpret their results.

Recommended Resources	
Text Books	1) V. K. Rohatgi- Statistical Inference- Dover Publication- New York- 2013. 2) S. C. Gupta and V. K. Kapoor- Fundamentals of Mathematical Statistics-12th ed.- Sultan Chand & Sons- New Delhi- 2017.
Reference Books	1) R. E. Walpole, R. H. Myers and S. L. Myers- Probability and Statistics for Engineers and Scientists- 9th ed.- Pearson- New Delhi- 2017. 2) V. John- Using R for Introductory Statistics- 2nd ed.- CRC Press- Boca Raton- 2014. 3) M. Rajagopalan and P. Dhanavanthan- Statistical Inference-1st ed. - PHI Learning (P) Ltd.- New Delhi- 2012. 4) V. K. Rohatgi and E. Saleh- An Introduction to Probability and Statistics- 3rd ed.- John Wiley & Sons Inc- New Jersey- 2015.

Course: Web Technologies	Course Code: BSDS 404

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To introduce web designing principles & basic programming.
2	To understand enhancing web pages.
3	To gain knowledge of javascript Coding.
4	To be able to perform PHP programming.
5	To be able to perform Node JS programming.

Course Contents			
Unit No.	Module No.	Content	Hours
1	**Web Design Principles & Introduction to HTML**	• Web Standards, Static Web Page, Dynamic Web Page • Browser, Page Layout and linking, HTTP Protocol • Publishing website, Designing effective navigation, Server and its types • Basics of HTML: HTML Tags, Formatting and Fonts • HTML Color, Formatting Text, Lists and Links • Images and Tables • HTML Frames, HTML Forms, • HTML Multimedia (Audio and Video)	12
2	**Enhancing HTML using CSS**	• Need for CSS, introduction to CSS • Basic Syntax and Structure Using CSS • Inserting Stylesheet, Background Images • Colors and Properties • Manipulating Texts Using Fonts • CSS Tables, DIV Formatting Borders and Boxes, Margins • Padding Lists Positioning using CSS • Bootstrap using CSS.	12
3	**JavaScript**	• Introduction to JavaScript • Understanding JS Syntax • Introduction to Document and Window Object	12

		• Variables and Operators • Data Types , Math and String Manipulation • Conditional Statements, Switch Case • Looping in JS, Functions • Objects and Arrays • Date and Time • Events in JavaScript • Form Validation	
4	**PHP & MySQL**	• Basic commands with PHP examples • PHP variables and Constants • PHP Strings, PHP operators • Controls Statements, loop structures • Embed PHP in HTML • PHP Global variables. PHP functions and Arrays. • Introduction to MySQL • Connection to Server ,Connecting PHP with MySQL • Creating Database ,Selecting a Database • Creating different CRUD command using MySQL • User Interface application.	12
5	**Introduction to JS**	• Node JS Overview: Node js - Basics and Setup • Node js Console, Node js Command Utilities • Node js Modules, Node js Concepts • Node js Events, Node js with Express js • Node js Database Access • Angular JS: Template & Live Data Binding (Directives & scope), Model ,View; • Controller (MVC), Dependency Injection (AngularJS services) • Modules, ng-Model Directive, ng-Model Controller • Form Controller, Custom Validation, Input Directive	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1:	Introduce web designing principles and basic programming.
CO2:	Understand enhancing web pages.
CO3:	Gain knowledge of javascript coding.
CO4:	Perform PhP programming.
CO5:	Perform Node JS programming.

CO-PO Correlation	**Program Outcomes**	**PSO**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3	3	2	2	3	3	3	3	2
CO2	3	3	2	3	3	3	3	3	2	2
CO3	3	3	3	3	2	2	2	3	3	2
CO4	2	3	3	2	3	2	2	3	2	3
CO5	3	2	3	3	3	3	3	2	3	3
Co Average	**2.80**	**2.80**	**2.80**	**2.60**	**2.60**	**2.60**	**2.60**	**2.80**	**2.60**	**2.40**

Recommended Resources	
Text Books	1. Thomas Powell, ”HTML& CSS: The Complete Reference”, Fifth Edition 2. Jon Duckett, “Beginning HTML, XHTML, CSS, and JavaScript”. – Wrox Publication.
Reference Books	1. Head First HTML with CSS & XHTML – O’Reilly Publication. 2. HTML, CSS, JavaScript for Dummies.

Teaching Scheme (Hrs/Week)				Continuous In- course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Knowledge of basic Software engineering methods and practices, and their appropriate application.
2	Understanding of software requirements and the SRS documents.
3	Understanding of software testing approaches such as unit testing and integration testing.
4	Describe software measurement and software risks.
5	Understanding on quality control and how to ensure good quality software.

Course Content			
Unit No.	Module No.	Content	Hours
1.	**Introduction to Software Engineering:**	**Introduction to Software Engineering:** The evolving role of software, changing nature of software, software myths. A **Generic view of process**: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.	12
2	**Software Requirements:**	**Software Requirements**: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. **Requirements engineering process**: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management. **System models:** Context models, behavioral models, data	12

		models, object models, structured methods.	
3	**Design Engineering:**	**Design Engineering:** Design process and design quality, design concepts, the design model. **Creating an architectural design:** software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.	12
4	**Testing Strategies:**	**Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. **Product metrics:** Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.	12
5	**Metrics for Process and Products:**	**Metrics for Process and Products:** Software measurement, metrics for software quality. Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. **Quality Management:** Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.	12
		Total No. of Hrs	60

Course Outcome
Students should able to

CO1: Explain Basic knowledge and understanding of the analysis and design of complex systems
CO2: Define software requirements and the SRS documents.
CO3: Identify software testing approaches such as unit testing and integration testing.
CO4: Describe software measurement and software risks.
CO5: Identify quality control measures and ensure good quality software.

CO-PO Correlation	Program Outcomes									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	2	-	-	2	-	-	-	-
CO2	2	2	2	-	-	-	-	-	2	2
CO3	2	2		-	3	-	-	-	2	-
CO4	2	2		3	3	-	-	-	2	-
CO5	3	3		2	-	-	2	3	2	2
Co Average	2.20	2.20	2.00	2.50	3.00	2.00	2.00	3.00	2.00	2.00

Recommended Resources	
Text Books	1 Software Engineering-A Practitioner's Approach (Sixth Edition)-Roger Pressman (TMH) 2. Software Engineering (Ninth Edition)-Ian Summerville (Pearson Education) 3. Software Engineering: Theory and Practice (Fourth Edition – Pfleeger 4. Software Engineering- Mishra /Mohanty (Pearson Education)
Reference Books	1. Software Engineering-Schaum's Series (TMH) 2. Software Project Management - Sanjay Mohapatra (Cengage Learning) 3. Quantitive techniques in project management byRettyvellayudam

Course: Artificial Intelligence Lab	**Course Code: BSDS 406**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Observation Note Book)	CIA-2 (Output Result & Regularity)	CIA-3 (Model Examination)	Theory	T/P	
0	0	4	2	10	10	10	00	70	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To understand the world of Artificial Intelligence and its applications through games, activities and multi-sensorial learning to become AI-Ready.
2	To introduce the learners to three domains of AI in an age appropriate manner.
3	To allow the learners to construct meaning of AI through interactive participation and engaging hands-on activities.
4	To introduce the learners to AI Project Cycle.
5	To introducing the learners to programming skills - Basic python coding language.

List of Programs

1. Select a problem statement relevant to AI. Formulate the problem and give PEAS Description.
2. Implement simple PROLOG programs.
3. Implement any search strategy algorithm to reach goal state.
4. Write a Program to implement BFS/DFS search method.
5. Write a Program to implement informed A* search method.
6. Write a Program to implement Hill Climbing/Minimax search algorithm.
7. Construct a knowledge base and apply inference in FOL – FC or BC or Resolution.
8. Implement decision tree for restaurant waiting problem.
9. Case study on AI applications.
10. Implement Mario problem with deep reinforcement learning.

Course Outcome

After completing the course, students should able to	
CO1	understand the world of Artificial Intelligence and its applications through games, activities and multi-sensorial learning to become AI-Ready.
CO2	introduce the learners to three domains of AI in an age appropriate manner.
CO3	allow the learners to construct meaning of AI through interactive participation and engaging hands-on activities.
CO4	introduce the learners to AI Project Cycle.
CO5	introducing the learners to programming skills - Basic python coding language.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	0	4	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To design basic framework.
2	To implement different tags for designing front end.
3	To implement web development tools.

List of Programs

1. Write a program in HTML to display a message using basic tags, Heading tag and Paragraph tag. Use Line break and HR rule.

2. A. Write a program in HTML using Unordered List tag.

3. Write a program in HTML using Ordered List tag.

4. Write a program in HTML using marquee tag and its attributes.

5. Write a program in HTML using Image tag and its attributes.

6. Write a program in HTML using Hyperlink tag (anchor tag). Show links to pages, text, Image.

7. Write a program in CSS to create a web page

8. Write a program to perform the validation on email.

9. Design a web page for user interface application using PHP and MySQL

10. Design a mini project using HTML, CSS and JavaScript technologies in Web Development and write its report.

Course Outcome	
Students should able to	
CO1	design basic framework.
CO2	implement different tags for designing front end.
CO3	implement web development tools.

BSc. AI & DS: SEMESTER V

Course: Big Data Programming	Course Code: BSDS501

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Understand the Big Data Platform and its Use cases.
2	Provide an overview of Apache Hadoop and HDFS Concepts and Interfacing with HDFS.
3	Understand Map Reduce Jobs.
4	Provide hands on Hadoop Eco System.
5	Apply analytics on Structured, Unstructured Data and exposure to Data Analytics with R.

Course Content

Unit No.	Module No.	Content	Hours
1	**INTRODUCTION TO BIG DATA AND HADOOP**	Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere Big Insights and Big Sheets.	12
2	**HDFS (Hadoop Distributed File System)**	The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, File-Based Data structures.	12
3	**Map Reduce**	Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	12
4	**Hadoop Eco System**	Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Megastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction.	12

5	**Data Analytics with R Machine Learning**	Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big-R.	12
		Total No. of Hrs	**60**

Course Outcome	
Students should able to	
CO1	Understand Big Data, Components of Hadoop and Hadoop Eco-System.
CO2	Understand Hadoop Distributed File System.
CO3	Understand Concept of Map-Reduce.
CO4	Develop Big Data Solutions using Hadoop Eco System.
CO5	Apply Machine Learning Techniques using R.

Recommended Resources	
Text Books	1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012. 2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
Reference Books	1. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013). 2. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R. 3. Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press. 4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012. 5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012. 6. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013. 7. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", MC Press, 2012.

	8. Paul Zikopoulos, Dirk DeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corigan, "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

Course: Artificial Neural Networks and Deep Learning	Course Code: BSDS502

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	To provide fundamental knowledge of neural networkand deep learning.
2	To understand supervised learning.
3	To understand convolutional Neural Network.
4	To understand recurrent neural network.
5	To understand auto encoder.

Course Content

Unit No.	Module No.	Content	Hours
1	INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS	Neural Networks-Application Scope of Neural Networks- The Artificial Neural Network-Biological Neural Network-Comparison between Biological Neuron and Artificial Neuron-Evolution of Neural Network. Basic models of ANN-Learning Methods-Activation Functions-Importance Terminologies of ANN.	12
2	SUPERVISED LEARNING NETWORK	Shallow Neural Networks- Perceptron Networks-Theory-Perceptron Learning rule, Architecture-Flowchart for training Process-Perceptron Training Algorithm for sinle and Multiple Output Classes. Back Propagation Network-Theory-Architecture-Flowchart for training process-Training Algorithm-Learning Factors for Back-Propagation Network.	12
3	CONVOLUTIONAL NEURAL NETWORK	Introduction - Components of CNN Architecture – Convolution Layer, Rectified Linear Unit (ReLU) Layer Exponential Linear Unit (ELU, or SELU) - Unique Properties of CNN, Building CNN Model. Applications of CNN,	12
4	RECURRENT NEURAL NETWORK	Introduction- The Architecture of Recurrent Neural Network-The Challenges in Training Recurrent Networks- Echo-State Networks- Long Short-Term Memory (LSTM) -Building RNN Model , Applications of RNN.	12

5	**AUTO ENCODER**	AUTO ENCODER AND RESTRICTED BOLTZMANN MACHINE: Introduction - Features of Auto encoder, Types of Auto-encoder, Restricted Boltzmann Machine- Boltzmann Machine - RBM Architecture -Working -Example - Types of RBM.	12
	Total No. of Hrs		**60**

Course Outcome	
Students should able to	
CO1	Understand the major technology trends in neural networks and deep learning.
CO2	Understand neural networks and fully connected deep neural networks
CO3	Design Deep Learning model for CNN model
CO4	Build RNN Model
CO5	

Recommended Resources	
Text Books	1. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley-India, 3rdEdition, 2018. 2. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D. Karthika Renuka, Deep LearningUsing Python, Wiley-India, 1st Edition, 2019
Reference Books	1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, September2018. 2. Francois Chollet, Deep Learning with Python, Manning Publications; 1st edition,2017 **3.** John D. Kelleher, Deep Learning (MIT Press Essential Knowledge series), The MPress, 2019.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	100	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Provide a strong foundation for data science and application areas related to it.
2	Understand the underlying core concepts and emerging technologies in data science.
3	Learn the process of working with data on large scale.
4	Explore the concepts of Data Processing.
5	Learn basic concepts of Machine Learning.

Course Content

Unit No.	Module No.	Content	Hours
1.	The data science process	1.1 Overview of the data science process 1.2 Step 1: Defining research goals and creating a project charter 1.3 Step 2: Retrieving data 1.4 Step 3: Cleansing, integrating, and transforming data 1.5 Step 4: Exploratory data analysis 1.6 Step 5: Build the models 1.7 Step 6: Presenting findings and building applications on top of them	12
2	Machine learning	2.1 What is machine learning and why should you care about it? 2.2 The modelling process 2.3 Types of machine learning Supervised learning, Unsupervised learning 2.4 Semi-supervised learning	12
3	Handling large data on a single computer	3.1 The problems you face when handling large data 3.2 General techniques for handling large volumes of data 3.3 General programming tips for dealing with large data sets 3.4 Case study 1: Predicting malicious URLs Step 1: Defining the research goal Step 2: Acquiring the URL data Step 3: Data exploration Step 4: Model building 3.5 Case study 2: Building a recommender system inside a database	12
4	Join the NoSQL movement	4.1 Introduction to NoSQL ACID: the core principle of relational databases CAP Theorem: the problem with DBs on many nodes The BASE principles of NoSQL databases NoSQL database types	12
5	Big Data	5.1 Distributing data storage and processing with frameworks Hadoop: a framework for storing and processing large data sets	12

		Spark: replacing MapReduce for better performance 5.2 Case study: Assessing risk when loaning money Step 1: The research goal Step 2: Data retrieval Step 3: Data preparation Step 4: Data exploration & Step 6: Report building	
	Total No. of Hrs		**60**

Course Outcome	
Students should able to	
CO1	Understand the fundamental concepts of data science.
CO2	Evaluate the data analysis techniques for applications handling large data and Demonstrate the data science process.
CO3	Understand concept of machine learning used in the data science process.
CO4	Visualize and present the inference using various tools.
CO5	Learn to think through the ethics surrounding privacy, data sharing.

Recommended Resources	
Text Books	1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016. 2. Ethics and Data Science, Mike Loukides, Hilary Mason and D J Patil, O'Reilly, 1st edition, 2018. 3. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.
Reference Books	7. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013 8. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015. 9. Ian Goodfellow, "Deep Learning", MIT Press, 2017. 10. Josh Patterson, "Deep Learning: A Practitioner's Approach", PACKT, 2017. 11. Francois Challot, " Deep learning with Python", Manning, 2017. 12. Dipayan Dev, " Deep Learning with Hadoop", PACKT, 2017.

Elective: BSDS504

Course: Blockchain with AI	Course Code: BSDS504

Teaching Scheme (Hrs/Week)				Continuous In- course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Understand the basics of blockchain.
2	It introduces some of the application areas where blockchain can be applied.
3	Apply the concept with AI.
4	Evaluate the concepts using AI knowledge.
5	Describe ethereum enterprise blockchain.

Course Content			
Unit No.	Module No.	Content	Hours
1.	Introduction to blockchain	What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Building Blocks of Blockchain, Types of Blockchain.	12
2	Bitcoin Blockchain	Introduction to Bitcoin, Bitcoin Block, Bitcoin Wallets, Bitcoin Transaction, Bitcoin Scripts, Bitcoin Attacks, Bitcoin Network, Bitcoin Mining.	12
3	Ethereum Blockchain	Introduction to Ethereum, Swarm and whisper, Remix IDE, Truffle Framework, Ethereum Networks, Ethereum Wallets, Ethereum Clients, Web3.js NFT.	12
4	Enterprises Blockchain	Enterprise Blockchain, Hyperledger, Hyperledger Sawtooth, Hyperledger Iroha, Hyperledger Indy, Hyperledger Burrows , Hyperledger Fabric, Hyperledger Fabric Transaction, Fabric Network , Fabric Network Types, Fabric Explorer.	12
5	Ethereum Smart Contracts	Smart Contract Lifecycle, Solidity, Solidity Variables, Solidity Compilation and Deployment, Solidity Functions, Truffle,	12

		Security Consideration, Web3	
		Total	60

Course Outcomes	
After completing the course, students will be able to	
1	Understand the basics of blockchain.
2	It introduces some of the application areas where blockchain can be applied.
3	Apply the concept with AI.
4	Evaluate the concepts using AI knowledge.
5	Describe ethereum enterprise blockchain.

Text Book:

1. Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World Reprint Edition, Kindle Edition **by** Don Tapscott (Author), Alex Tapscott.
2. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects 1st ed. Edition, **by Elad Elrom.**
3. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them (Cryptography, Derivatives Investments, Futures Trading, Digital Assets, NFT) Hardcover – Illustrated, September 15, 2018 **by** Antony Lewis

Teaching Scheme (Hrs/Week)				Continuous In- course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
3	1	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Understand the basics of Internet of things and protocols.
2	It introduces some of the application areas where Internet of Things can be applied.
3	Students will learn about the middleware for Internet of Things.
4	To understand the concepts of Web of Things.
5	Students will be explored to the interconnection and integration of the physical world and the Cyber space.

Course Content			
Unit No.	Module No.	Content	Hours
1.	**IOT**	**IOT**– What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.	12
2	**IOT Protocols**	**IOT PROTOCOLS** - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer– Security	12
3	**IOT Architecture**	**IOT ARCHITECTURE** - IoT Open source architecture (OIC)- OIC Architecture &Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.	12
4	**Web of Things**	**WEB OF THINGS** - Web of Things versus Internet of Things – Two Pillars of the Web– Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.	12

5	**IOT Applications**	**IOT APPLICATIONS** - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middle ware, IoT-A, Hydra etc.	12
		Total	60

Course Outcome	
Students should able to	
CO1	Describe the application areas of IOT.
CO2	Explain the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
CO3	Define building blocks of Internet of Things and characteristics.
CO4	Describe difference between IOT and WOT
CO5	Identify IoT protocols for communication.

CO-PO Correlation	**Program Outcomes**									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	2	2	-	2	3
CO2	3	2	3	-	-	-	3	-	2	2
CO3	2	-	2	3	-	-	3	-	2	2
CO4	2	-	-	-	2	2	-	2	3	3
CO5	-	3	3	3	3	-	-	3	3	3
Co Average	**2.50**	**2.50**	**2.75**	**3.00**	**2.67**	**2.00**	**2.67**	**2.50**	**2.40**	**2.60**

Recommended Resources	
Text Books	1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012. 2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer, 2011. 3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.

	4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
Reference Books	1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014 2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013 3. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Course: Data Mining and Warehousing	**Course Code: BSDS 505**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

COURSE OBJECTIVE:

1 Be familiar with mathematical foundations of data mining tools.
2 Understand and implement classical models and algorithms in data warehouses and data mining
3 Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
4 Master data mining techniques in various applications like social, scientific and environmental context.
5 Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Contents			
Unit No.	Module No.	Content	Hours
1	Introduction to data warehouse	Introduction, Definition, Components, Warehousing databases, Users, Advantages, Features, Data Granularity, Information Flow Mechanism, Metadata, Classes of Data, Lifecycle of Data, Data Flow. Architecture of Data Warehouse, characteristics, Goals, Data Marts, Building Data Marts, Pushing and Pulling Data.	
2	Schema & Dimensional Modeling	Data Warehousing Schema, Dimensional Modeling, Star Schema, Snowflake Schema, Aggregate Tables, Fact Constellation Schema, Data Modeling, Dimensional Modeling: Dimension Table, Fact Tables, Fatless Fact Tables, Updates to Dimension Tables, other types of dimension table, Performance of Data Warehouse. ETL Process: Data Extraction, Data Transformation, Data Loading, Data Quality.	
3	Data warehousing design Review	Data warehousing design Review, Developing data warehouse, Testing, Monitoring, Tuning, Feedback Loops. OLAP in Data warehouse: OLAP, ROLAP, HOLAP, Multidimensional Analysis, OLAP Functions, OLAP Application\s, OLAP Models, OLAP Considerations, Tools and Products, Data Design, Administration and Performance,	

		OLAP Platforms	
4	Data Mining	Introduction, Definitions, KDD Vs Data Mining, DBMA Vs Data Mining, Data Mining Problems, Data Models, OLAP, User Perspectives, Issues, Challenges, Trends, Application Areas and Applications Frequent Pattern Mining: Basic Problem Definition, Association Rule, Mining Association Rule, Applications, Variations, Interestingness, Methods of Discovering Association Rule, Priori Algorithm, Frequent Item set Mining (FIM) Algorithm, Comparison of FIM Algorithm, Optimal FIM Algorithm, Incremental Mining, Conciseness of Results, Sequential Rule.	
5	Classification	Classification, Definition, Applications, Evaluations of Classifiers, Issues, Classification Techniques, Optimal Classification Algorithm, Regression Decision Tree, Tree Construction Principal, Best Split, Splitting Indices, Splitting Criteria, Decision Tree Construction Algorithm.	12
		Total No. of Hrs	**60**

Course Outcomes (COs): At the end of this course students will be able to
1. Understand warehousing architectures and tools for systematically organizing large databaseand use their data to make strategic decisions.
2. Understand KDD process for finding interesting pattern from warehouse.
3. Remove redundancy and incomplete data from the dataset using data preprocessing methods.
4. Characterize the kinds of patterns that can be discovered by association rule mining.
5. Discover interesting patterns from large amounts of data to analyze for predictions and classification as per societal applications

Recommended Resources	
Text Books	1. Rema Thareja Data Warehousing Oxford University Press 2. Alex Berson, S. J. Smith, Data Warehousing, Data Mining & OLAP, TMH 3. George M Marakas, Modern Data Warehousing, Mining and Visualization, Pearson Education.
Reference Books	1. Vikram Pudi, Data Mining Oxford University Press 2. Arun K Pujari Data Mining Technique, University Press (India) Private Limited 3. Alex Berson, S. J. Smith, Data Warehousing, Data Mining & OLAP, TMH.

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	1	2	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	To implement file management with Hadoop
2	To create map-reduce program.
3	To apply database and tables in hive.
4	To apply pig scripts.
5	To analyse the implementation of Big data using R.

List of Programs

1. File Management tasks in Hadoop
    a. Creation of Directory
    b. Listing the contents of directory
    c. Uploading and Downloading file in HDFS
    d. Displaying contents of file
    e. Copy file from source to destination
    f. Move file from source to destination
    g. Display last few lines of file
    h. Display aggregate length of file
    i. Remove Directory
2. Word count program using Map-Reduce
3. Weather Report POC-Map Reduce Program to analyse time-temperature statistics and generate report with max/min temperature
4. Implementing Matrix Multiplication with Hadoop Map Reduce
5. Implementation of Pig Latin scripts to sort,group, join your data
6. Implementation of pig Latin scripts for project, and filter your data.
7. Implementation of Databases in Hive
8. Implementation of Tables in Hive

9. Implementation of View in Hive
10. Implementation of Functions in Hive
11. Implementation of Index in Hive
12. Implementation of Big Data Analytics using R.

Course Outcomes- After completing the course, students will be able to	
1	implement file management with Hadoop
2	create map-reduce program.
3	apply database and tables in hive.
4	apply pig scripts.
5	analyse the implementation of Big data using R.

Course: Deep Learning Models Lab	Course Code: BSDS507

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Lab participation/ Attendance)	CIA-2 (Written Practical Logbook)	CIA-3 (Viva/Oral)	Written Performance	Viva / Oral	
0	1	2	2	10	10	10	50	20	100
Max. Time, End Semester Exam (Practical) – 3Hrs.									

Course Objectives	
1	Understand the mathematical and statistical prospectives of machine learning algorithms through python programming.
2	Design and evaluate the CNN models through python in built functions.
3	Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
4	Design and apply various reinforcement algorithms to solve real time complex problems.
5	Design and develop the code for recommender system using Natural Language processing.

List of Programs

1. Learning XOR Problem
2. Building of a feed-forward Neural Network
3. Building Deep Learning Model
4. Building CNN Model for Image Classification
5. Building CNN Model for digit Identification
6. Building CNN Model for Face Mask Detection
7. Pre-processing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
8. Morphological Analysis in NLP
9. N-Gram Model in NLP
10. POS Tagging
11. Chunking and Named Entity Recognition

12. Building Simple RNN model

13. Implementation of Autoencoder

14. Implementation of Deep CNN Autoencoder

15. Implementing Denoising Autoencoder

16. Implementing RBM Autoencoder

Course Outcomes	
After completing the course, students will be able to	
1	Understand the mathematical and statistical prospectives of machine learning algorithms through python programming.
2	Design and evaluate the CNN models through python in built functions.
3	Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
4	Design and apply various reinforcement algorithms to solve real time complex problems.
5	Design and develop the code for recommender system using Natural Language processing.

BSc. AI & DS: SEMESTER VI

Course: AI in Cloud Computing	**Course Code: BSDS601**

Course Objectives	
1	Describe architecture and underlying principles of cloud computing.
2	Explain need, types and tools of Virtualization for cloud
3	Describe Services Oriented Architecture and various types of cloud services
4	Understand the concept of AI in cloud computing
5	Understand the impact of AI in Cloud Computing

Course Content

Unit No.	Module No.	Content	Hours
1.	Introduction	Overview of Cloud Computing: Types of Cloud, Cyber infrastructure, Service Oriented Architecture Cloud Computing Components: Infrastructure, Storage, Platform, Application, Services, Clients, Cloud Computing Architecture.	12
2	Cloud Architecture, Services And Storage	Cloud Architecture, Services And Storage: Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers	12
3	Resource Management And Security In Cloud	Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.	12
4	AI applications	Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving	12
5	AI in cloud computing	Artificial Intelligence in Cloud Computing, How AI is Affecting Cloud Computing, Benefits of AI in Cloud Computing, Role of AI in Cloud Computing, Challenges in	12

		Deploying AI in Cloud Environments. Impact Of AI in Cloud Computing: Cloud-Based AI Services, Role of AI improving Cloud Computing. critical functions of an AI cloud platform, Cloud delivery models, artificial intelligence (AI) cloud platforms, Cloud technologies	
		Total No. of Hrs	**60**

Course Outcome	
Students should able to	
CO1	Analyse architecture and underlying principles of cloud computing.
CO2	Describe Services Oriented Architecture and various types of cloud services.
CO3	Understand the AI applications
CO4	Apply the concept of AI in cloud computing
CO5	Understand the Impact Of AI in Cloud Computing

Recommended Resources	
Text Books	1) Patterson "Introduction to Artificial Intelligence & Expert Systems" (PHI) 2) Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002. 3) Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
Reference Books	1) Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the 2) Internet of Things", Morgan Kaufmann Publishers, 2012. 3) Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017. 4) Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

Course: WEB ANALYTICS	Course Code: BSDS602

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment)	CIA-3 (Prelim- MCQ)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	CO1: Understand the role of web analytics within the digital marketing landscape
2	CO2: Identify, define and interpret commonly used web metrics and KPIs
3	CO3: Understand analytical methods to transform social media data into marketing insights
4	CO4: Understand the process of informed decision making using case based method
5	CO5: Understand how to effectively use insights to support website design decisions, campaign optimisation, search analytics, etc.

Course Contents			
Unit No.	Module No.	Content	Hours
1	**Introduction**	• Definition, Process, Key terms • Site references, Keywords and Key phrases • building block terms • Visit characterization terms • Content characterization terms • Conversion metrics • Categories: Offsite web, On site web • Web analytics platform • Web analytics evolution • Need for web analytics	

		• Advantages, Limitations	
2	**Research data**	• Mindset, Organizational structure, Timing; • Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data. • Qualitative Analysis: • Heuristic evaluations: Conducting a heuristic evaluation, • Benefits of heuristic evaluations; • Site Visits: • Conducting a site visit • Benefits of site visits; • Surveys: Website surveys, Post-visit surveys, Creating and running a survey • Benefits of surveys.	
3	**Web Analytic fundamentals**	• Capturing data: Web logs or JavaScripts tags • Separate data serving and data capture • Type and size of data, Innovation • Integration, Selecting optimal web analytic tool • Understanding. clickstream data quality, Identifying unique page definition • Using cookies, Link coding issues. • Web Metrics: • Common metrics: Hits, Page views, Visits, • Unique visitors, Unique page views, Bounce • Bounce rate, Page/visit, Average time on site, New visits;	
4	**Web analytics**	• Web analytics 1.0, Limitations of web analytics 1.0 • Introduction to analytic 2.0 • Competitive intelligence analysis : CI data sources, Toolbar data, • Panel data ,ISP data, • Search engine data, Hybrid data • Website traffic analysis: Comparing long term traffic trends • Analyzing competitive site overlap and opportunities	
5	**Google Analytics**	• Brief introduction and working • Adwords, Benchmarking • Categories of traffic: Organic traffic • Paid traffic; Google website optimizer • Implementation technology • Limitations, Performance concerns	12

		• Privacy issues • Relevant technologies: Internet & TCP/IP, Client / Server Computing, HTTP (HyperText Transfer Protocol) • Server Log Files & Cookies, Web Bugs.	
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Understand the role of web analytics within the digital marketing landscape
CO2	Identify, define and interpret commonly used web metrics and KPIs
CO3	Perform analytical methods to transform social media data into marketing insights
CO4	Apply the process of informed decision making using case based method.
CO5	Implement how to effectively use insights to support website design decisions, campaign optimisation, search analytics, etc.

Recommended Resources	
Text Books	a. Web Analytics 2.0: The Art of Online Accountability & Science of Customer Centricity (SYBEX) Paperback 2013 by Avinash Kaushik Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc. (2010), 2nd ed. b. Kaushik A., Web Analytics 2.0 The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. (2010),1st ed.
Reference Books	1) Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons (2002). 2) Actionable Web Analytics - Using Data to Make Smart Business Decisions (English, Paperback, Burby J.)

Course: Project & Seminar	Course Code: BSDS603

Elective: BSDS604- Data Security/ Cyber Security

Course: Data Security	Course Code: BSDS604

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment)	CIA-3 (Prelim- MCQ)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Explaining the key security requirements aligning with type of threats and vulnerabilities that attack the security of information or database systems.
2	Presenting symmetric and asymmetric cryptographic systems and covering most important parts of cryptology through introducing many cryptography techniques and algorithms.
3	Describing the most important advance encryption theories aligning with the number theories that necessary as requirements.
4	Explaining the hash function as an application of cryptography aligning with the concept of message integrity and digital signature authentication.
5	Understand the issues involved in using asymmetric encryption to distribute symmetric keys.

Course Contents			
Unit No.	Module No.	Content	Hours
1	Introduction	• History of Cryptography. • Mathematical background: • Probability theory • Information theory • Complexity theory, Number theory.	12

		• Symmetric (Private) Key • Cryptographic Systems: Caesar Affine – Monoalphabetic Substitution • Transposition • Homophonic substitution – Vignere • Beauford and DES Family – Product ciphers – Lucifer and DES.	
2	Symmetric (Public) Key Cryptographic Systems	• Classical Encryption Techniques (Substitution -1) • Substitution -2 • Transposition -1,Transposition -2 • Block Ciphers, Data Encryption Standard • Advance Encryption Standard (Structure) • Transformation Function + Key Expansion • Implementation of an example • Multi Encryption – Triple DES • Random bit generation and stream ciphering	12
3	Asymmetric (Public) Key Cryptographic Systems:	• Concept of PKCS, • RSA Cryptosystem- • Variants of RSA – Primality testing – Security of RSA – Merkle – Hellamn – Security of Merkle – Hellaman, ElGamal. • Elliptical Curve Cryptography. • Stream ciphers and block ciphers: • The one time pad – Synchronous stream ciphers – Self-synchronizing stream ciphers • Feedback shift registers – Linear Complexity – Non-linear feedback shift registers • Stream ciphers based LFSRs. Non-linear Combination generators • Non linear filter generators – Clock controlled generators – The alternating step generators – The shrinking generators.	12
4	Digital Signatures	• Properties, • Generic signature schemes – Rabin Lamport – Matyasmeyer, – RSA – Multiple RSA and ElGamal • Signatures – Digital signature standard – Blind Signatures- RSA Blind. • Secret Sharing Algorithms: • Threshold secret sharing – Shamir scheme, Blakley scheme and modular Scheme. • Pseudo random number generators: Definition of randomness and pseudo-randomness – Statistical tests of randomness – Linear congruential generator – Modern PRNGs (a brief description).	12
5	Cryptography	• Cryptography Data Integrity: • Hash Function • Two Simple Hash Function • Secure Hash Algorithm (SHA-3) • Message Authentication Codes	12
		Total No. of Hrs	60

Course Outcome	
Students should able to	
CO1	Presenting the most important key security requirements that required for any security systems generally and specifically.
CO2	Utilizing and code developing for encryption algorithms that required to achieve confidentiality key security.
CO3	Building an appropriate encrypting system that designed for specific key size and message length.
CO4	Investigating the suitability of a hash function for verifying the message integrity and digital signature authentication.
CO5	Appreciate the role of distributed symmetric key in improving the asymmetric encryption systems.

Recommended Resources	
Text Books	1. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011. 2. Josef Pieprzyk, Thomas Hardjono and Jenifer Seberry, "Fundamentals of Computer Security", Springer 2010.
Reference Books	1. Douglas R Stinson, "Cryptography:Theory and Practice", CRC Press 2005. 2. Alfred J Menezes, Paul C Van Oorshot and Scott A. Vanstone, "Handbook of Applied Cryptography", CRC press 1996.

Course: Cyber Security	**Course Code: BSDS604**

Teaching Scheme (Hrs/Week)				Continuous In- Course Assessment (CIA) (30%)			End Semester Examination (70%)		Total
L	T	P	C	CIA-1 (Class participation)	CIA-2 (Assignment 1 & 2)	CIA-3 (Mid Test 1 & 2)	Theory	T/P	
4	0	0	4	10	10	10	70	00	100
Max. Time, End Semester Exam (Theory) -3Hrs.									

Course Objectives	
1	Define key knowledge areas of cyber security
2	Justify the need of various measures to protect cyber space
3	Identify various threads to cyber security
4	Explain server management and firewalls.
5	Describe system and application security.

Course Contents			
Unit No.	Module No.	Content	Hours
1	Pre-requisites in Information and Network Security:	Overview of Networking Concepts: TCP/IP Protocol Stacks, Wireless Networks. Information Security Overview: Types of Attacks, Goals for Security, Computer Forensics, Steganography.	12
2	Security Threats and Vulnerabilities:	Overview of Security threats, Weak / Strong Passwords and Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs, Cyber crime and Cyber terrorism, Information Warfare and Surveillance. Cryptography / Encryption: Introduction to Cryptography / Encryption, Digital Signatures , Public Key infrastructure, Applications of Cryptography, Tools and techniques of Cryptography.	12
3	Security Management:	Security Management Practices: Overview of Security Management, Information Classification Process, Security Policy, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices. Security Laws and Standards: Security Assurance, Security Laws, IPR. Information and Network Security: Access Control and Intrusion Detection,	12

		Overview of Identification and Authorization, Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems.	
4	Server Management and Firewalls:	User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall features. Security for VPN and Next Generation Technologies: VPN Security, Security in Multimedia Networks, Various Computing Platforms: HPC, Cluster and Computing Grids, Virtualization and Cloud Technology and Security.	12
5	System and Application Security:	Security Architectures and Models, Designing Secure Operating Systems, Controls to enforce security services, Information Security Models. Browser security. System Security: Desktop Security, Email security: PGP and SMIME, Web Security: web authentication. Wireless Networks and Security: Components of wireless networks, Security issues in wireless.	12
		Total No. of Hrs	60

Course Outcomes:	
Students should be able to understand	
1	key knowledge areas of cyber security
2	the need of various measures to protect cyber space
3	various threads to cyber security
4	server management and firewalls.
5	system and application security.

Course: Internship	**Course Code: BSDS605**

SCHEME OF EXAMINATION

12. SCHEME OF EXAMINATION: FOR B.Sc. AI & DS

Following are the types of paper under consideration:

I. Theory Only Course
II. Theory with practical course (where practical is tool based or lab based Only)
III. Theory with project course (where project is Social or Industry)
IV. Practical Only Course (where practical is tool based or lab based Only) Mini Project or

Project

V. Project/ Mini Project as credit course

I) Theory Only courses - Course without any practical/ Project component-

INTERNAL ASSESSMENT (UG)				
Assessment tool	**Total Marks**	**Marks reduced to**	**Modality**	**Duration**
Mid test I	35	5	MCQ, BAQ, SAQ, LAQ	1.5 Hrs
Mid test II	35	5	MCQ, BAQ, SAQ, LAQ	1.5 Hrs
Mini Project/ Assignment		10	Individual project to be submitted by the Learners and presentation/Viva- voce supervised by the concerned faculty (or) MCQ of not less than 20 may be administered spreading over all units (or) Seminar regarding topics of relevance (or) Two assignments in relevant areas each carrying 5 marks (or) May include combination of any of the above mentioned assessment (or) Completion of One edx / Cousera/ Swayam or NPTEL courses specified by the Faculty	Semester long
Attendence		10		
Total		**30 Marks**		

SUMMATIVE EXAMINATION			
Assessment tool	**Total Marks**	**Modality**	**Duration**
End Semester Examination	70	**UG:** 10 MCQ (1 mark each), 10 BAQ (2 marks each), 5 SAQ (4 marks each), 2 LAQ (10 marks each)	3 hours
Total	100		

II) Theory with LAB Practical (where practical is tool based or lab based Only) courses - Course with practical component-

COURSE NATURE: PRACTICAL

Assessment Method (Max. Marks:100)						
Internal Assessment	**Assessment Tool**	**Observation Note Book**	**Output Result**	**Model Examination**	**Regularity and Discipline**	**Total**
	Marks	10	10	5	5	30
Summative Assessment	**No Practical in Summative exams**					

INTERNAL ASSESSMENT- Theory (UG+PG)

Assessment Tool	**Total Marks**	**Marks reduced to**	**Modality**	**Duration**
Mid test I	35	5	MCQ, BAQ, SAQ, LAQ	1.5 Hrs
Mid test II	35	5	MCQ, BAQ, SAQ, LAQ	1.5 Hrs
Mini Project/ Assignment		**10**	**Individual project to be submitted by the Learners and presentation/Viva- voce supervised by the concerned faculty** **(or)** **MCQ of not less than 20 may be administered spreading over all units (or)** **Seminar regarding topics of relevance** **(or)** **Two assignments in relevant areas each carrying 5 marks** **(or)** **May include combination of any of the above mentioned assessment** **(or)** **Completion of One edx / Cousera/ Swayam or NPTEL courses specified by the Faculty**	
Attendence		**10**		
Total		**30**		**30**

SUMMATIVE EXAMINATION

Assessment Tool	**Total Marks**	**Modality**	**Duration**
End Semester Examination	**70**	**UG:** **10 MCQ (1 mark each),** **10 BAQ (2 marks each),** **5 SAQ (4 marks each),** **2 LAQ (10 marks each)**	**3 hours**

COURSE NATURE: PRACTICAL			
Total	**100**		

Summative Assessment-Theory		
Assessment tool	**Marks**	**Duration**
Written Test **UG:** 10 MCQ (1 mark each), 10 BAQ (2 marks each), 5 SAQ (4 marks each), 2 LAQ (10 marks each)	70	3 hours
Total (Theory + Practical)	100	

III) Theory with project – Social or Industry (where project is Social or Industry engagement) courses

COURSE NATURE : MINI PROJECT/ PROJECT						
Assessment Method (Max.Marks: 30)						
Internal Assessment	**Assessment Tool**	**Review1 (Abstract)**	**Review 2 (Analysis)**	**Review 3 (Findings and Conclusion)**	**Viva- Voce**	**Total**
	Marks	5	10	10	5	30
Summative Assessment	**No Project in Summative exams**					
Total						30

IV) Courses with Only LAB practical

Assessment Method (Max.Marks:100)						
Internal Assessment	**Assessment Tool**	**Observation Note Book**	**Output Result**	**Model Examination**	**Regularity and Discipline**	**Total**
	Marks	10	10	5	5	30
Summative Assessment	**Assessment Tool**	**Record Notebook**	**Program Writing/ Practical experiment**	**Debugging/ Development**	**Result / Output**	**Total**
	Marks	20	20	20	10	70

V) Courses with Only project component

Project assessment

COURSE NATURE : MINI PROJECT/ PROJECT						
Assessment Method (Max.Marks: 100)						
Internal Assessment	**Assessment Tool**	**Review1 (Abstract)**	**Review 2**	**Review 3**	**Viva- Voce**	**Total**
	Marks	5	10	10	5	30
Summative Assessment	**Assessment Tool**	**Report and Presentation**	**Analysis**	**Findings and Conclusion**	**Viva- Voce**	**Total**
	Marks	10	10	20	30	70
Total						100

Format of secondary templates for the formative and summative examination will be same for all the ODL, OL and regular courses.

Secondary Template

Total marks 100(70+30)

Set A /B/C

Topic	Weightage	%of total syllabus	Marks attributed		LAQ (10 marks each) 2/4	SAQ (4 marks each) 5/6	BAQ (2 marks each) 10/11	MCQ (1 mark each) 10/10
Unit I	20%	20%	20			1	6	4
Unit II	20%	20%	19		01	2		1
Unit III	20%	20%	19		01	2		1
Unit IV	20%	20%	19		01	1	2	1
Unit V	20%	20%	19		01		3	3
Total	100%	100%	96		04	06	11	10

MID TEST I & II:

Assessment tool	**Total Marks**	**UG Modality**	**Duration**
Mid test I	35	MCQ, BAQ, SAQ, LAQ	1.5 Hour
Mid test II	35	MCQ, BAQ, SAQ, LAQ	1.5 Hour
Total Mid Test Marks	70 (to be reduced to 10)		

MID TEST/ Formative Assessment Paper Pattern:
UG: (35 Marks)
MCQ: Solve 5 5 Q x 1 M = 5 M
BAQ: Solve 5 out of 6 5 Q x 2 M = 10 M
SAQ: Solve 2 out of 3 2 Q x 5 M = 10 M
LAQ: Solve 1 out of 2 1Q x 10 M = 10 M

Summative Assessment Paper Pattern:

DATTA MEGHE INSTITUTE OF HIGHER EDUCATION AND RESEARCH

First Semester, Faculty of Science and Technology,

Allied Sciences Graduate Degree In

Bachelor of Science in Artificial Intelligence and Data Science (BSc AI DS)

Paper- I,II,III…….

Time: 3.00 HOURS **Max. Marks - 70 M**

Instructions:

1) Number to the right indicate full marks
2) Draw neat diagrams wherever necessary
3) Use Single answer book

Q.1. MULTIPLE CHOICE QUESTION: Solve ALL 10 out of 10 (1 Marks x10 = 10 Marks)

MCQ 1)
MCQ 2)
MCQ 3)
MCQ 4)
MCQ 5)
MCQ 6)
MCQ 7)
MCQ 8)
MCQ 9)
MCQ 10)

Q.2. BRIEF ANSWER QUESTION: Solve any 10 out of 11 (2 Marks X 10 = 20 Marks)

BAQ 1)
BAQ 2)
BAQ 3)
BAQ 4)
BAQ 5)
BAQ 6)
BAQ 7)
BAQ 8)
BAQ 9)
BAQ 10)
BAQ 11)

Q.3. SHORT ANSWER QUESTION: Solve any 5 out of 6 (4 Marks x 5 = 20 Marks)

SAQ 1)
SAQ 2)
SAQ 3)

SAQ 4)
SAQ 5)
SAQ 6)

Q.4. LONG ANSWER QUESTION: Solve any 2 out of 4 (10 Marks x 2 = 20 Marks)

LAQ 1)
LAQ 2)
LAQ 3)
LAQ 4)

Letter Grades and Grade Points (GP) Based on the aggregate of marks obtained through internal assessment and external assessment, each student is awarded a final letter grade at the end of the semester, in each Course. The letter grades and the corresponding grade points, as recommended by UGC, are asfollows:

Letter Grade	Grade Points	Normalized Mark Range
O (Outstanding)	10	91-100
A+ (Excellent)	9	81-90
A (Very Good)	8	71-80
B+ (Good)	7	61-70
B(Above Average)	6	56-60
C (Average)	5	50-55
F (Fail)	0	<50 Failure due to insufficient marks in the course
Ab(Absent)	0	Failure due to non-appearance in examination
I (Incomplete)	0	Failure due toinsufficient attendance in thecourse.