Sri Sri University

FACULTY OF SCIENCE

DOCS-Department of Computer Science

B.Sc. (Hons.) Data Science (2019-22/2020-23)

As per LOCF(Learning Outcome Based Curriculum Framework)

Preamble

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes in undergraduate program in professional streams of higher education like computer science. One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programs in colleges, universities and HEIs in general. So Bsc (Hons) Data Science at Sri Sri University is designed as per LOCF & as per UGC guidelines.

The main objective of Bsc(Hons) Data Science program at Sri Sri University is to prepare a comprehensive course structure with detailed syllabus along with quality reading material in order to have a uniform standard of education in undergraduate Data Science programme among students. This document shall serve as a model document across the higher education institutes (HEIs) in the country for teachers, students and academic administrators. It is a student centric framework where they are expected to learn fundamentals of Data science along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence,Cloud Computing along with advanced skill sets that include Mobile Application Development, Object Oriented Programming among many other courses. It will help the students to be equipped with fundamental as well as advanced and latest technologies in Data science after completion of the programme

Introduction

Data Science (DS) has been evolving as an important branch of science and engineering throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Data science is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Now a days, practically everyone is a computer user, and many people are even computer programmers. Data Science can be seen on a higher level, as a

science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of Data science also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both Data science expertise and knowledge of the particular application domain.

Data science has a wide range of specialties. These include Machine Learning, Data Mining, Data Analytic, Artificial Intelligence, Computational Science, and Software Engineering. Drawing from a common core of data science knowledge, each specialty area focuses on specific challenges. Data Science is practiced by mathematicians, scientists and engineers. Mathematics, the origins of Data Science, provides reason and logic. Science provides the methodology for learning and refinement.

Sri Sri University has started Bsc(Hons) Data Science in the year 2019, as this discipline evolved itself to a multidisciplinary discipline. Information Technology is growing rapidly. Increasing applications of computers in almost all areas of human endeavor has led to vibrant industries with concurrent rapid change in technology. Unlike other basic disciplines, developing core competency in this discipline that can be reasonably stable becomes a challenge.

Career Objective

Bsc (Hons) in Data Science aimed at undergraduate level training facilitating multiple career paths. Students so graduated, can take up postgraduate programmes in Data Science leading to research as well as R&D, can be employable at IT industries, or can pursue a teachers' training programme such BEd in Computer Education, or can adopt a business management career. BSc with Data Science aims at laying a strong foundation of Data Science at an early stage of the career along with two other subjects such as Physics, Mathematics, Machine Learning, Statistics etc. There are several employment opportunities and after successful completion of an undergraduate programme in Data Science, graduating students can fetch employment directly in companies as Web Developer, Software Engineer, Data Analyst, Data Scientist, or AI/ML personnel.

The Learning Outcome-based Curriculum Framework in Data Science is aimed at allowing flexibility and innovation in design and development of course content, in method of imparting training, in teaching learning process and in assessment procedures of the learning outcomes. The emphasis in computer science courses, in outcome-based curriculum framework, help students learn solving problems, accomplishing IT tasks, and expressing creativity, both individually and collaboratively. The proposed framework will help Students learn programming techniques and the syntax of one or more programming languages.

Many of the learning outcomes of Data Science can be achieved only by programming a computer for several different meaningful purposes. All students must, therefore, have access to a computer with a modern programming language installed. The Data science framework does not prescribe a specific language. The teacher and students will decide which modern programming languages students will learn. More importantly, students will learn to adapt to changes in programming languages and learn new languages as they are developed.

The present Learning Outcome-based Curriculum Framework for bachelor's degrees in Data Science is intended to facilitate the students to achieve the following.

1.To develop an understanding and knowledge of the basic theory of Data Science and Information Technology with good foundation on theory, systems and applications such as algorithms, data structures, data handling, data communication and computation.

2.To develop the ability to use this knowledge to analyze new situations

3.To acquire necessary and state-of-the-art skills to take up industry challenges. The objectives and outcomes are carefully designed to suit to the above-mentioned purpose.

4.The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the real-life problems

5.To learn skills and tools like mathematics, statistics and analytic skills to find the solution, interpret the results and make predictions for the future developments.

Curriculum Planning- Learning Outcomes-based Approach for B.Sc. (Hons) Data Science

B.Sc. (Hons) Data Science in India is generally a three-year degree program which develops advanced theoretical and research skills in subject in which Honours is opted. It is a specialized programme offering specialization in one Computer science subject and another auxiliary science subject. This programme helps in building an advanced professional or academic career. It is an appropriate course for students who wish to pursue a Master of Computer Science M.Sc(Data Science) or Doctor of Philosophy (PhD) in Data Science and a research or academic career. This program facilitates students who wish to pursue an independent research project in an area of interest under the supervision of an academic. B.Sc.(Hons) Data Science differs from general BSc in the number of courses in the subject in which Honours Data Science is opted. Thus BSc(Hons) Data Science has more Data Science courses than that of BSc programme.

Aims of B.Sc. (Hons) Data Science Programme

The B.Sc. (Hons) Data Science emphasizes problem solving in the context of algorithm development, data analysis and prediction and prepares students for effectively using modern computer systems in various applications. The curriculum provides required Data science courses such as programming languages, data structures, machine learning, algorithms, database systems, operating systems, and cloud computing; as well as elective courses in artificial intelligence, computer-based communication networks, distributed computing, information security, graphics, human-computer interaction, multimedia, scientific computing, web technology, and other current topics in data science. The main aim of this Bachelor's degree is to deliver a modern curriculum that will equip graduates with strong theoretical and practical backgrounds to enable them to excel in the workplace and to be lifelong learners. The purpose of the BS programs in computer science are twofold: (1) to prepare the student for a position involving the design, development and implementation of computer software/hardware, and (2) to prepare the student for entry into a program of postgraduate study in computer science/engineering and related fields.

BSc(Hons) in Data Science focus on the concepts and techniques used in the design and development of software systems. Students in this program explore the conceptual underpinnings of Data Science -- its fundamental algorithms, programming languages, operating systems, and software engineering techniques. In addition, students choose from a rich set of electives that includes data science, time series analysis, artificial intelligence, database systems, operating systems, and computer networks, among other topics. A generous allotment of free electives allows students to combine study in computer science with study in auxiliary fields to formulate a program that combines experiences across disciplines.

Programme Learning Outcomes for B.Sc. (Hons) Data Science

The B.Sc. (Hons) Data Science program enables students to attain, by the time of graduation:

PLO-A. Demonstrate the aptitude of Computer Programming and Computer based problem solving skills.

PLO-B. Display the knowledge of appropriate theory, practices and tools for the specification, design, implementation

PLO-C. Ability to learn and acquire knowledge through online courses available at different MOOC Providers.

PLO-D. Ability to link knowledge of Computer Science with other two chosen auxiliary disciplines of study.

PLO-E. Display ethical code of conduct in usage of Internet and Cyber systems.

PLO-F. Ability to pursue higher studies of specialization and to take up technical employment.

PLO-G. Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate .

PLO-H. Ability to operate, manage, deploy, configure computer network, hardware, software operation of an organization.

PLO-I.Ability to present result using different presentation tools.

PLO-J. Ability to appreciate emerging technologies and tools.

PLO-K. Apply standard Software Engineering practices and strategies in real-time software project development

PLO-L. Design and develop computer programs/computer -based systems in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytic.

PLO-M. Acquaint with the contemporary trends in industrial/research settings and thereby innovate novel solutions to existing problems

PLO-N. The ability to apply the knowledge and understanding noted above to the analysis of a given information handling problem.

PLO-O. The ability to work independently on a substantial software project and as an effective team member.

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Semester	Lectures per Week	Program Credits	Marks
1st Semester	26	24	700
2nd Semester	26	24	700
3rd Semester	28	26	750
4th Semester	28	26	750
5th Semester	28	22	750
6th Semester	14	14	600
Total		Program Credits – 136	4250

Course structure

B.Sc. (Hons.) Data Science Semester-I

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS101	Programming Methodology	CC-1	4		4		4	40	60		100
BDS102	Computer System Architecture	CC-2	6		6		6	40	60		100
BDS103	Environmental Science	AEC-1	4		4		4	40	60		100
BDS104	Foundational Mathematics	GEC-1	6		6		6	40	60		100
BDS105	Programming Methodology LAB	CC-1		2X2=4		2	2	40		60	100
Total			**20**	**4**	**20**	**2**	**22**	**200**	**200**	**60**	**500**
Total Contact Hours per Week=24 Total Credits=22											

Semester-II

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS201	Data Structure	CC-3	4		4		4	40	60		100
BDS202	Discrete Structures	CC-4	6		6		6	40	60		100
BDS203	English Communication	AEC-2	4		4		4	40	60		100
BDS204	Electricity & Magnetism	GEC-2	4		4		4	40	60		100
BDS205	Data Structure LAB	CC-3		2X2=4		2	2	40	----	60	100
BDS206	Electricity & Magnetism Lab	GEC-2		2X2=4		2	2	40		60	100
Total			**18**	**8**	**18**	**4**	**22**	**240**	**240**	**120**	**600**
Total Contact Hours per Week=26 Total Credits = 22											

B.Sc. (Hons.) Data Science Semester-III

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS301	Operating System	CC-5	6		6		6	40	60		100
BDS302	Algorithms	CC-6	4		4		4	40	60		100
BDS303	Computer Networks	CC-7	6		6		6	40	60		100
BDS304	Probability & Statistics	GEC-3	6		6		6	40	60		100
BDS305	Object Oriented Programming	SEC-1	4		4		4	40	60		100
BDS306	Algorithms Lab	CC-6		2X2=4		2	2	40	----	60	100
BDS307	Object Oriented Programming LAB	SEC-1		2X2=4		2	2	40	----	60	100
Total			**26**	**8**	**26**	**4**	**30**	**280**	**300**	**120**	**700**
Total Contact Hours per Week=32 Total Credits=34											

Semester-IV

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS401	Software Engineering	CC-8	6		6		6	40	60		100
BDS402	Data Base Management System	CC-9	4		4		4	40	60		100
BDS403	Programming in Java	CC-10	4		4		4	40	60		100
BDS404	Optimization Techniques	GEC-4	6		6		6	40	60		100
BDS405	Web Programming	SEC-2	4		4		4	40	60		100
BDS406	Data Base Management System Lab	CC-9		2X2=4		2	2	40	----	60	100
BDS407	Programming in Java Lab	CC-10		2X2=4		2	2	40	----	60	100
Total			**24**	**8**	**24**	**4**	**28**	**280**	**300**	**120**	**700**
Total Contact Hours per Week=32 Credits=28							**Total**				

B.Sc. (Hons.) Data Science Semester-V

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS501	Internet Technologies	CC-11	6		6		6	40	60		100
BDS502	Artificial Intelligence	CC-12	4		4		4	40	60		100
BDS503	Data Analytics	DSEC-1	6		6		6	40	60		100
BDS504	Theory of Computation	DSEC-2	4		4		4	40	60		100
BDS505	Artificial Intelligence Lab	CC-12		2X2 =4		2	2	40	----	60	100
BDS506	Theory of Computation Lab	DSEC-2		2X2 =4		2	2	40	----	60	100
Total			**20**	**8**	**20**	**4**	**24**	**240**	**240**	**120**	**600**
Total Contact Hours per Week=28 Total Credits=24											

Semester-VI

Subject Code	Subjects Name	Type of course	Contact Hours per Week		Credits			Examination Scheme			
			L	P	L	P	Total	Internal Assessment	Theory	Prac	Total
BDS601	Computer Graphics	CC-13	4		4		4	40	60		100
BDS602	Machine Learning	CC-14	6		6		6	40	60		100
BDS603	Computational Intelligence	DSEC-3	6		6		6	40	60		100
BDS604	Cloud Computing	DSEC-4	4		4		4	40	60		100
BDS605	Computer Graphics Lab	CC-13		2X2 =4		2	2	40	----	60	100
BDS606	Cloud Computing Lab	DSEC-4		2X2 =4		2	2	40	----	60	100
Total			**20**	**8**	**20**	**4**	**24**	**240**	**240**	**120**	**600**
Total Contact Hours per Week=28 Total Credits=24											

Abbreviations used:

1. **CC- Core Courses**
2. **AEC- Ability Enhancement Courses**
3. **GEC- General Elective Courses**
4. **DSEC- Discipline Specific Elective Courses**

Prescribed credits

14X6=84
2X4=8
4X6=24 (1 in each semester from 1 to 4)
4X6=24 (2 in each 5^{th} & 6^{th} Semester)

Total = 148

List of Skill Enhancement Courses (SEC)	
1	MATLAB Programming
2	**Programming in Java**
3	Python Programming
4	Mobile Application Development
5	**Web Programming**
6	GIMP(GNU Image Manipulation Program)
List of Ability Enhancement Courses(AEC)	
1	**English**
2	**Environment Science**
3	English/Hindi/ MIL Communications

List of Domain Specific Electives (DSE)	
1	Image Processing
2	Data Analytics
3	Computer Ethics
4	**Data Analytics**
5	Human Computer Interface
6	Modeling and Simulation
7	**Theory of Computation**
8	**Computational Intelligence**
9	**Cloud Computing**
10	Internet of Things

Detail syllabus in Annexure-I

SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-I

(Session 2019-22/2020-23)

BDS101- Programming Methodology

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In **Section B** ,each question having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment: 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 60**

Learning Outcomes: After completion of this course successfully the students will be able to:

1. Learn to develop simple algorithms and flow charts to solve a problem.
2. Develop problem solving skills coupled with top down design principles.
3. Learn about the strategies of writing efficient and well -structured computer algorithms/programs.
4. Develop the skills for formulating iterative solutions to a problem.
5. Learn array processing algorithms coupled with iterative methods.
6. Learn text and string processing efficient algorithms.
7. Learn searching techniques and use of pointers.
8. Understand recursive techniques in programming.

UNIT I. Introduction to Programming, Program Concept, Characteristics of Programming, Stages in Program Development, Algorithms, Notations, Design, Flowcharts, Types of Programming Methodologies, Introduction to C++ Programming - Basic Program Structure In C++, Variables and Assignments, Input and Output, Selection and Repetition Statements.

UNIT II. Top-Down Design, Predefined Functions, Programmer -defined Function, Local Variable, Function Overloading, Functions with Default Arguments, Call -By-Value and Call-By-Reference Parameters, Recursion.

UNIT III. Introduction to Arrays, Declaration and Referring Arrays, Arrays in Memory, Initializing Arrays. Arrays in Functions, Multi-Dimensional Arrays.

UNIT IV. Structures - Member Accessing, Pointers to Structures, Structures and Functions, Arrays of Structures, Unions.

UNIT V. Declaration and Initialization, Reading and Writing Strings, Arrays of Strings, String and Function, Strings and Structure, Standard String Library Functions.

UNIT VI. Searching Algorithms - Linear Search, Binary Search. Use of files for data input and output. merging and copy files.

TEXT AND REFERENCE BOOKS

1. Problem Solving and Program Design in C, J. R. Hanly and E. B. Koffman, Pearson, 2015.
2. Programming and problem solving with C++: brief edition, N. Dale and C. Weems, Jones & Bartlett Learning, 2010.

BDS102- Computer System Architecture

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In **Section B** ,each question having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment: 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 6** **Lectures:- 60**

Learning Outcomes: After completion of this course successfully the students will be able to:

1. To make students understand the basic structure, operation and Characteristics of digital computer.
2. To familiarize the students with arithmetic and logic unit as well as the concept of the concept of pipe-lining.
3. To familiarize the students with hierarchical memory system including cache memories and virtual memory.
4. To make students know the different ways of communicating with I/O devices and standard I/O-interfaces.

UNIT I Fundamentals of Digital Electronics: Data Types, Complements, Fixed -Point Representation, Floating-Point Representation, Binary Codes, Error Detection Codes, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip - Flops, Sequential Circuits, Registers, Counters, Multiplexer, D-multiplexer, Decoder, Encoder.

UNIT II Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus & Memory Transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operation.

UNIT III Basic Computer Organization: Instruction codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycles, Memory Reference Instruction, Input - Output & Interrupts, Complete Computer Description & Design of Basic Computer.

UNIT IV Processor and Control Unit: Hardwired vs. Micro programmed Control Unit, General Register Organization, Stack Organization, Instruction Format, Data Transfer & Manipulation, Program Control, RISC, CISC, Pipe-lining.

UNIT V Memory and I/O Systems: I/O Interface, Data Transfer Schemes, Program Control, Interrupt, DMA Transfer, I/O Processor. Memory Hierarchy, Processor vs. Memory Speed, High-Speed Memories, Cache Memory, Associative Memory, Interleave, Virtual Memory, Memory Management.

UNIT VI Parallelism: Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multi-threading – Multi-core processors

TEXT BOOKS

1. Computer System Architecture, M. Morris Mano, 3rd Edition, Prentice Hall.
2. Computer Organization and Design, David A. Patterson and John L. Hennessey, Fifth edition,Morgan Kauffman /Elsevier,2014.

REFERENCE BOOKS

1. Computer Architecture: A Quantitative Approach, John L. Hennessy, David A. Patterson, 4th Edition.
2. Computer Organization and Architecture, William Stallings, Prentice Hall.

BDS103- Environment Science

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In **Section B** ,each question having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment: 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 60**

Learning Outcomes: After successful completion of this course, the students are able to:

1. Explain the eco-system and need to protect it.
2. Aware about the various danger to environment and how to protect it.

SECTION-A (2+6=8L)

Unit 1 : Introduction to environmental studies : Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems : What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

SECTION-B (8+8=16L)

Unit 3 : Natural Resources : Renewable and Non--renewable Resources:

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation :

- Levels of biological diversity : genetic, species and ecosystem diversity; Bio-geographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega--biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity : In--situ and Ex--situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

SECTION-C (8+7=15L)

Unit 5 : Environmental Pollution :

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution

- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Unit 6 : Environmental Policies & Practices:

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

SECTION-D (6+5=11L)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems--pond, river, Delhi Ridge, etc.

Recommended Books:

1. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
2. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
3. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
5. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
6. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

BDS104– Foundational Mathematics

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from the entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In **Section B** ,each question has an internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment: 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 60**

Learning Objectives: This course aims to provide a foundational understanding about fundamentals of mathematics to students. The course will explain the basis of calculus, differential equations, matrix linear algebra and vector algebra.

Learning Outcomes:
After successful completion of this course the students are able to:

- Simplify the solutions of Differential and Integral Calculus problems.
- Determine the degree and order of differential equations.
- Determine the solution of integral equations and systems of differential equations using Laplace transforms.
- Obtained the reduced matrix and the solutions of vector calculus.

SECTION-A (15L)

Calculus, Differential and Integral Calculus: The real line and its geometrical representation. Statement of limit and continuity. Properties of limit and classification of discontinuities. Properties of continuous functions. Differentiability and differentials. Successive differentiation and Leibnitz Theorem. Statement of Rolle's Theorem. (Mean Value Theorem), Taylor and Maclaurin's Theorems(for function with two variables), (Taylor Series Expansion), indeterminate forms. Partial derivatives. Methods of Integration: Partial fractions. Definite integrals. Statement of the Fundamental Theorem. Applications. Concavity, convexity, and points of inflection. Extrema.

SECTION-B (15L)

Differential Equations: Elementary Methods in Ordinary Differential Equations. Formation of a differential Formation of a differential equation.
Solutions: General, particular, and singular. First order exact equations and integrating factors. Degree and order of a differential equation.
Equations of first order and first degree. Equations in which the variables are separable.
Homogeneous equations. Linear equations and equations reducible to linear form. Homogeneous linear ordinary differential equations.

SECTION-C (15L)

Ordinary Differential Equations: Solution of nth order linear differential equations with constant coefficients, solution of homogeneous and non-homogeneous linear differential equation by operator method, Series solutions of differential equations: Power series method about ordinary point, Legendre differential equation and its solution, use of Rodrigue's formula. Introduction to Laplace Transformation and its uses in solving differential equations,
Numerical solution of first order differential equations by Euler's method, Modified Euler's method and Runge Kutta method.

SECTION-D (15L)

Vector Algebra: Operations with vectors, Cross Product, Dot Product, Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors. Vector Calculus. Scalar-valued functions and Vector valued functions. Grad, Curl and Div of a function and its uses.

Matrix Theory and Linear Algebra: Systems of linear equations, Matrices,
elementary row operations, consistent linear equations . Solution of systems of linear equations by Gauss Jacobi method & Gauss-Seidel method.

Recommended Books:

- Advanced Engineering Mathematics By Erwin Kreyszig.
- K.Sankara Rao,Partial Differential Equations,PHI
- Shanti Narayan Dr.P.K.Mittal,Differential calculus,S.Chand
- David.C.Lay, Linear algebra & its applications, Pearson
- S.L. Ross, Ordinary Differential equation, Wiley Publication
- I.N. Sneddon, Elements of Partial Differential Equation, Dover Publication

BDS105- Programming Methodology Lab

4-Hours/Week **2 Credits**

1. Given the problem statement, students are required to formulate problem, develop flowchart/algorithm, write code, execute and test it. Students should be given assignments on following :

    a. To learn elementary techniques involving arithmetic operators and mathematical expressions, appropriate use of selection (if, switch, conditional operators) and control structures

    b. Learn how to use functions and parameter passing in functions, writing recursive programs.

2. Write Programs to learn the use of strings and string handling operations.

    a. Problems which can effectively demonstrate use of Arrays. Structures and Union. b. Write programs using pointers.

    c. Write programs to use files for data input and output.

    d. Write programs to implement search algorithms.

SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-II

(Session 2019-22/2020-23)

BDS201 – Data Structures

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks	**Internal Assessment: 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: On completion of the course students should be able to:

1. To be familiar with fundamental data structures and with the manner in which these data structures can best be implemented; become accustomed to the description of algorithms in both functional and procedural styles
2. To have a knowledge of complexity of basic operations like insert, delete, search on these data structures.
3. Ability to choose a data structure to suitably model any data used in computer applications.
4. Design programs using various data structures including hash tables, Binary and general search trees, heaps, graphs etc.
5. Ability to assess efficiency trade-offs among different data structure implementations.
6. Implement and know the applications of algorithms for sorting, pattern matching etc.

UNIT I. Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis, Linear and Non Linear data structures, Singly Linked Lists-Operations, Concatenating, circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations. Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

UNIT II. Stack- Operations, Array and Linked Implementations, Applications- Infix to Postfix Conversion, Postfix Expression Evaluation, Recursion Implementation, Queue- Definition and Operations, Array and Linked Implementations, Circular Queues - Insertion and Deletion Operations, Dequeue (Double Ended Queue).

UNIT III. Trees, Representation of Trees, Binary tree, Properties of Binary Trees, Binary Tree Representations- Array and Linked Representations, Binary Tree Traversals, Threaded Binary Trees, Priority Queue- Implementation, Heap- Definition, Insertion, Deletion.

UNIT IV. Graphs, Graph ADT, Graph Representations, Graph Traversals, Searching, Static Hashing- Introduction, Hash tables, Hash functions, Overflow Handling.

UNIT V. Sorting Methods, Comparison of Sorting Methods, Search Trees- Binary Search Trees, AVL Trees- Definition and Examples.

UNIT VI. Red-Black and Splay Trees, Comparison of Search Trees, Pattern Matching Algorithm- The Knuth-Morris-Pratt Algorithm, Tries (examples).

TEXTBOOKS

1. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and
2. Susan Anderson-Freed, Universities Press.

3. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.
4. Lipschutz: Schaum's outline series Data structures Tata McGraw-Hill

BDS202 – DISCRETE STRUCTURES

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks	**Internal Assessment: 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: On completion of the course students should be able to:

1. Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
2. Understand the basics of combinations, and be able to apply the methods from these subjects in problem solving.
3. Be able to use effectively algebraic techniques to analyze basic discrete structures and algorithms.
4. Understand asymptotic notation, its significance, and be able to use it to analyze asymptotic performance for some basic algorithmic examples.
5. Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

UNIT I. Sets: Finite and Infinite Sets, Uncountable Infinite Sets; Functions, Relations, Properties of Binary Relations, Closure, Partial Ordering Relations; Counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

UNIT II. Growth of Functions: Asymptotic Notations, Summation Formulas and Properties, Bounding Summations, Approximation by Integrals

UNIT III. Recurrences: Recurrence Relations, Generating Functions, Linear Recurrence Relations with Constant Coefficients and their Solution, Substitution Method, Recurrence Trees, Master Theorem

UNIT IV. Graph Theory: Basic Terminology, Models and Types, Multi-graphs and Weighted Graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and Properties of Trees, Introduction to Spanning Trees

UNIT V. Propositional Logic: Logical Connectives, Well -formed Formulas, Tautologies, Equivalences, Inference Theory

REFERENCE BOOKS

1. C.L. Liu & Mahopatra, Elements of Discrete mathematics, 2nd Sub Edition 1985, Tata Mc-Graw Hill
2. Rosen, Discrete mathematics and Its Applications, Sixth Edition 2006
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, Prentice Hall India (3rd edition 2009)
4. M. O. Albertson and J. P. Hutchinson, Discrete mathematics with Algorithms 1988 John wiley Publication

BDS203 - English Communication

Note: Total **5 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. In question paper, each question of **Section B** having internal choice. A candidate is required to attempt two **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment : 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 30**

Learning Outcomes: On completion of this course students should be able to:

To unlock the communicator in them by using English appropriately and with confidence for further studies or in professional spheres where English is the indispensable tool of communication.

Unit 1 [10] Introduction

1. What is communication?
2. Types of communication: Horizontal, Vertical, Interpersonal, Grapevine
3. Uses of Communication

Prescribed Reading: Chapter 1 Applying Communication Theory for Professional Life: A Practical Introduction
by Dainton and Zelley
http://tsime.uz.ac.zw/claroline/backends/download.php?url=L0ludHJvX3RvX2NvbW11bmljYXRpb25fVGhlb3J5LnBkZg%3D%3D&cidReset=true&cidReq=MBA563

Unit 2 [10] Language of Communication

1. Verbal: spoken and written
2. Non-verbal: ProxemiDS, KinesiDS, HaptiDS, ChronemiDS, Paralinguistic
3. Barriers to communication

Unit 3 [10] Reading Comprehension

1. Locate and remember the most important points in the reading
2. Interpret and evaluate events, ideas, and information
3. Read “between the lines” to understand underlying meanings
4. Connect information to what they already know

Unit 4 [10] Writing

1. Expanding an Idea
2. Note Making
3. Memo
4. Writing Formal Email
5. Writing a Business Letter
6. Report Writing

BDS-204 Electricity & Magnetism

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In **Section B,** each question having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam: 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment: 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 60**

Learning Outcomes: After successful completion of this course, the students are able to:

1. Identify various aspects of electricity & magnetism
2. Know the working principl of different Electrostatic energy of system of charges.
3. Familiar with the different emerging technologies of electricity & magnetism
4. Able to perform different operations of electricity & magnetism

SECTION-A (10+4=14L)

1.Electric Field and Electric Potential: Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson, equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

SECTION-B (14L)

2.Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet, and (2) Sphere.

SECTION-C (6+8=14L)

3.Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in DI-electrics.

SECTION-D (10+8=18L)

4.Magnetic Field: Magnetic force between current elements and definition of Magnetic FieldB. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Recommended Books:

1. S. Mahajan & Choudhury, "Electricity, Magnetism & Electromagnetic Theory, 2012, Tata McGraw Hill
2. Edward M. Purcell,"Electricity and Magnetism", 1986 McGraw-Hill Education
3. M.N.O. Sadiku, "Elements of Electromangetics", 2010, Oxford University Press.
4. J.H.Fewkes & J.Yarwood , "Electricity and Magnetism",. Vol. I, 1991,Oxford Univ. Press

BSC205- Data Structure Lab

4-Hours/Week **2 credits**

Students are required to write and practically execute programs to solve problem using various data structures. The teacher can suitably device problems which help students experiment using the suitable data structures and operations. Some of the problems are indicated below.

1. Write program that uses functions to perform the following:

a) Creation of list of elements where the size of the list, elements to be inserted and deleted

are dynamically given as input.

b) Implement the operations, insertion, deletion at a given position in the list and search for an element in the list

c) To display the elements in forward / reverse order

2. Write a program that demonstrates the application of stack operations (Eg: infix expression to postfix conversion)

3. Write a program to implement queue data structure and basic operations on it (Insertion, deletion, find length) and code at least one application using queues.

4. Write a program that uses well defined functions to Create a binary tree of elements and Traverse the a Binary tree in pre-order, in-order and post-order,

5. Write program that implements linear and binary search methods of searching for an elements in a list

6. . Write and trace programs to understand the various phases of sorti ng elements using the methods

a) Insertion Sort
b) Quicksort
c) Bubble sort

7. Write and trace programs to Create a Binary search tree and insert and delete from the tree.

8. Represent suitably a graph data structure and demonstrate operations of traversals on it.

BDS206- Electricity & Mangetism Lab

4-Hours/Week **2 Credits**

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SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-III

(Session 2019-22/2020-23)

BDS301 - Operating System

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: On successful completion of this course, the students are able:

1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
2. To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.
3. Understanding of design issues associated with operating systems.
4. Understand various process management concepts including scheduling, synchronization, and deadlocks.
5. To have a basic knowledge about multi-threading.
6. To understand concepts of memory management including virtual memory.
7. To understand issues related to file system interface and implementation, disk management.
8. To understand and identify potential threats to operating systems and the security features design to guard against them.
9. To have sound knowledge of various types of operating systems including Unix and Android.
10. Describe the functions of a contemporary operating system with respect to convenience, efficiency, and the ability to evolve.

UNIT I. (Introduction to Operating System) What is Operating System? History and Evolution of OS, Basic OS functions, Resource Abstraction, Types of Operating Systems– Multi-programming Systems, Batch Systems, Time Sharing Systems; Operating Systems for Personal Computers, Workstations and Hand-held Devices, Process Control & Real time Systems.

UNIT II. (Operating System Organization and Process Characterization) Processor and User Modes, Kernels, System Calls and System Programs, System View of the Process and Resources, Process Abstraction, Process Hierarchy, Threads, Threading Issues, Thread Libraries; Process Scheduling, Non-Preemptive and Preemptive Scheduling Algorithms.

UNIT III. Process Management (Deadlock) Deadlock, Deadlock Characterization, Necessary and Sufficient Conditions for Deadlock, Deadlock Handling Approaches: Deadlock Prevention, Deadlock Avoidance and Deadlock Detection and Recovery.

UNIT IV. (Inter Process Communication and Synchronization) Concurrent and Dependent Processes, Critical Section, Semaphores, Methods for Inter-process Communication; Process Synchronization, Classical Process Synchronization Problems: Producer-Consumer, Reader-Writer.

UNIT V. (Memory Management) Physical and Virtual Address Space; Memory Allocation Strategies– Fixed and -Variable Partitions, Paging, Segmentation, Virtual Memory.

UNIT VI. (File and I/O Management, OS security) Directory Structure, File Operations, File Allocation Methods, Device Management, Pipes, Buffer, Shared Memory, Security Policy

Mechanism, Protection, Authentication and Internal Access Authorization.

UNIT VII. (Introduction to Android Operating System) Introduction to Android Operating System, Android Development Framework, Android Application Architecture, Android Process Management and File System, Small Application Development using Android Development Framework.

REFERENCE BOOKS

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.
3. G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
4. W. Stallings, Operating Systems, Internals & Design Principles 2008 5th Edition, Prentice Hall of India.
5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

BDS302 - Algorithms

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: On successful completion of this course, the students are able:

1. To learn good principles of algorithm design;
2. To learn how to analyze algorithms and estimate their worst -case and average- case behavior (in easy cases);
3. To become familiar with fundamental data structures and with the manner in which these data structures can best be implemented; become accustomed to the description of algorithms in both functional and procedural styles;
4. To learn how to apply their theoretical knowledge in practice (via the practical component of the course).

UNIT I. Introduction: Basic Design and Analysis Techniques of Algorithms, Correctness of Algorithm. Algorithm Design Techniques: Iterative Techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.

UNIT II. Sorting and Searching Techniques: Elementary Sorting techniques– Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques- Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques- Medians & Order statistics, complexity analysis

UNIT III. Graphs Algorithms: Graph Algorithms– Breadth First Search, Depth First Search and its Applications, Minimum Spanning Trees. String Processing

UNIT IV. Lower Bounding Techniques: Decision Trees, Balanced Trees, Red -Black Trees

UNIT V. Advanced Analysis Technique: Randomized Algorithm, Distributed Algorithm,

Heuristics

RECOMMENDED BOOKS

- T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3rd Edition 2009
- Sara basse & A.V. Gelder Computer Algorithm – Introduction to Design and Analysis, Publisher – Pearson 3rd Edition 1999

BDS303 - Computer Networks

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: On successful completion of this course, the students are able:

1. Understand the structure of Data Communications System and its components. Be familiarize with different network terminologies.
2. Familiarize with contemporary issues in network technologies.
3. Know the layered model approach explained in OSI and TCP/IP network models
4. Identify different types of network devices and their functions within a network.
5. Learn basic routing mechanisms, IP addressing scheme and internet working concepts.
6. Familiarize with IP and TCP Internet protocols.
7. To understand major concepts involved in design of WAN, LAN and wireless networks.
8. Learn basics of network configuration and maintenance.
9. Know the fundamentals of network security issues.

UNIT I. Introduction to Computer Networks and Networking Elements: Network Definition, Network Topologies, Network Classifications, Network Protocol, Layered Network Architecture, Overview of OSI Reference Model, Overview of TCP/IP Protocol Suite, Hub, Switch (Managed and Un-managed), Routers

UNIT II. Data Communication Fundamentals and Techniques: Analog and Digital Signal, Data-Rate Limits, Digital to Digital Line Encoding Schemes, Pulse Code Modulation, Parallel and Serial Transmission, Digital to Analog Modulation - Multiplexing Techniques- FDM, TDM, Transmission Media.

UNIT III. Networks Switching Techniques and Access Mechanisms: Circuit Switching, Packet Switching- Connection-less Data-gram Switching, Connection- Oriented Virtual Circuit Switching; Dial-Up Modems, Digital Subscriber Line, Cable TV for Data Transfer.

UNIT IV. Data Link Layer Functions and Protocol: Error Detection and Error Correction Techniques, Data -Link Control- Framing and Flow Control, Error Recovery

Protocols-Stop and Wait ARQ, Go-Back-N ARQ, Point to Point Protocol on Internet.
UNIT V. Multiple Access Protocol and Network Layer: DSMA/CD Protocols, Ethernet LANS; Connecting LAN and Back -Bone Networks- Repeaters, Hubs, Switches, Bridges, Router and Gateways, Networks Layer Functions and Protocols (6Lectures) Routing, Routing Algorithms, Network Layer Protocol of Internet - IP Protocol, Internet Control Protocols.

UNIT VI. Transport Layer and Application Layer Functions and Protocols: Transport Services- Error and Flow Control, Connection Establishment and Release- Three Way Handshake, Overview of Application Layer Protocol (5 Lectures) Overview of DNS Protocol; Overview of WWW & HTTP Protocol.

REFERENCE BOOKS

1. B. A. Forouzan: Data Communications and Networking, Fourth edition, THM Publishing Company Ltd 2007.
2. A. S. Tanenbaum: Computer Networks, Fourth edition, PHI Pvt. Ltd 2002

BDS-304 Probability & Statistics

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of the course the students will be able to

1. Cast Probability & statistics problems into application part.
2. Learn efficient Probability & statistics procedures to solve real life problem
3. To implement Large Sample Tests of Hypothesis methods in solving the various problems.

SECTION-A (15L)

Introduction: Probability and Probability Distribution: Events and the Sample Space,Calculating Probabilities using Simple events, Useful counting rules, Probability rules: Addition rule, Conditional probability and multiplication rule, Bayes' rule.

SECTION-B (15L)

Probability Distributions: Random Variable, Discrete random variable, Mean and Standard deviation of discrete random variable, Discrete Probability Distributions:Binomial, Poisson and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution.

SECTION-C (15L)

Sampling Distribution: sampling plans and experimental designs, Sampling distribution of a statistic, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation: Point estimation, Interval estimation, Confidence interval of population mean, Population proportion, difference between two population means, difference between two population proportions.

SECTION-D (15L)

Large Sample Tests of Hypothesis: Test of a Population mean, Test of difference of two population means, Test of hypothesis for a binomial proportion, Test of hypothesis for the difference between two binomial proportions.

Inference from Small Samples: Student's t Distribution, Small Sample inferences concerning a population mean and difference between two population means,Inferences concerning a population variance and difference between two population variances.

Recommended Books:

1. William Mendenhall, Robert J. Beaver, Barbara M. Beaver, "Probability and statistics" 14/e, CENGAGE Learning.
2. W. W. Hines, D.C. Montgomery, D.M. Goldsman, & C.M. Borror, "Probability & statistics in Engineering"
3. Probability & statistics,A.K.P.C Swain

BDS305 – Object Oriented Programming

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Learn the concepts of data, abstraction and encapsulation
2. Be able to write programs using classes and objects, packages.
3. Understand conceptually principles of Inheritance and Polymorphism and their use and program level implementation.
4. Learn exception and basic event handling mechanisms in a program
5. To learn typical object-oriented constructs of specific object oriented programming language

UNIT I. basics: Introduction to Object Oriented Programming and its Basic Features, Basic Components of C++, Characteristics of Object -Oriented Language, Structure of a C++ Program, Flow Control Statements in C++, Functions - Scope of Variables, Inline Functions, Recursive Functions, Pointers to Functions, C++ Pointers, Arrays, Dynamic Memory Allocation and De-Allocation

UNIT II. Differences Between Object Oriented and Procedure Oriented Programming, Abstraction, Overview of Object-Oriented Programming Principles, Encapsulation, C++ Classes, Objects, User Defined Types, Constructors and destructors, this Pointer, Friend Functions, Data Abstraction, Operator Overloading, Type Conversion

UNIT III. Class Inheritance, Base and Derived Classes, Virtual Base Class, Virtual Functions, Polymorphism, Static and Dynamic Bindings, Base and Derived Class Virtual Functions, Dynamic Binding through Virtual Functions, Pur e Virtual Functions, Abstract Classes, Virtual Destructors

UNIT IV. Stream Classes Hierarchy, Stream I/O, File Streams, Overloading the Extraction and Insertion Operators, Error Handling during File Operations, Formatted I/O.

UNIT V. Exception Handling- Benefits of Exception Handling, Throwing an Exception,

the Try Block, Catching an Exception, Exception Objects, Exception Specifications, Re-throwing an Exception, Uncaught Exceptions

TEXT BOOKS

1. Problem solving with C++: The Object of Programming, Walter Savitch, 4th Edition, Pearson Education.
2. C++: The Complete Reference, Herbert Schildt, 4th Edition

REFERENCE BOOKS

1. Object Oriented Programming with C++, Sourav Sahay, 2nd Edition, Oxford
2. The C++ Programming Language, B. Stroutstrup, 3rd Edition, Pearson Education
3. Programming in C++, Ashok N Kamthane. Pearson 2nd Edition

BDS306 - Algorithms Lab

4-Hours/Week **2 Credits**

The student shall develop programs in a chosen language to solve problems using algorithm design techniques such asDivide and Conquer, Greedy, Dynamic programming and Backtracking. Some of the problems to be solved are indicated below.

1. Write a test program to implement Divide and Conquer Strategy . Eg: Quick sort algorithm for sorting list of integers in ascending order
2. Write a program to implement Merge sort algorithm for sorting a list of integers in ascending order.
3. Write program to implement the DFS and BFS algorithm for a graph.
4. Write program to implement backtracking algorithm for solving problems like N-queens ..
5. Write a program to implement the backtracking algorithm for the sum of subsets problem
6. Write program to implement greedy algorithm for job sequencing with deadlines.
7. Write a program to implement Dijkstra's algorithm for the Single source shortest path problem.
8. Write a program that implements Prim's algorithm to generate minimum cost spanning tree.
9. Write a program that implements Kruskal's algorithm to generate minimum cost spanning tree
10. Write program to implement Dynamic Programming algorithm for the 0/1 Knapsack problem.
11. Write program to implement Dynamic Programming algorithm for the Optimal Binary Search Tree Problem.

BDS307 – Object Oriented Programming Lab

4-Hours/Week **2 credits**

Students are required to understand the object-oriented concepts using C++. They are required to practice the concepts learnt in the theory . Some of the programs to be implemented are listed as follows:

Part A

1. Number of vowels and number of characters in a string.

2. Write a function called zeros smaller () that is passed with two introduce arguments by reference and set the smaller of the number to zero. Write a man() program to access this function.
3. Demonstration of array of object.
4. Using this pointer to return a value (return by reference).
5. Demonstration of virtual function.
6. Demonstration of static function.
7. Accessing a particular record in a student's file.
8. Demonstration of operator overloading.

Part B

9. Write a program to create a database for students that contains Name, Enrolment no, Department, Programme using Constructors, destructor, input and output functions ; input and output for 10 people using different methods.

10. Create a class holding information of the salaries of all the family members (husband, wife, son, daughter). Using friend functions give the total salary of the family.

SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-IV

(Session 2019-22/2020-23)

BDS401 - Software Engineering

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Basic knowledge and understanding of the analysis and design of complex systems.
2. Ability to apply software engineering principles and techniques.
3. To produce efficient, reliable, robust and cost-effective software solutions.
4. Ability to work as an effective member or leader of software engineering teams.
5. To manage time, processes and resources effectively by prioritising competing demands to achieve personal and team goals Identify and analyzes the common threats in each domain.

UNIT I. Software Development Approaches: Introduction; Evolving Role of Software; Software Characteristics; Software Applications. Software Design Processes: Introduction; What is Meant by Software Engineering?, Definitions of Software Engineering; The Serial or Linear Sequential Development Model; Iterative Development Model; The incremental Development Model

UNIT II. Software Design Principles: Introduction, System Models: Data -flow Models, Semantic Data Models, Object Models, Inheritance Models, Object Aggregation, Service Usage Models, Data Dictionaries; Software Design: The Design Process, Design Methods, Design description, Design Strategies, Design Quality; Architectural Design: System Structuring, The Repository Model, The Client–Server Model, The Abstract Machine Model, Control Models, Modular Decomposition, Domain-Specific Architectures.

UNIT III. Object Oriented Design: Introduction; Object Oriented Design: Objects, Object Classes & Inheritance, Inheritance, Object Identification, An Object -Oriented Design Example, Object Aggregation; Service Usage; Object Interface Design: Design Evolution, Function Oriented Design, Data–Flow Design; Structural Decomposition: Detailed Design.

UNIT IV. An Assessment of Process Life-Cycle Models: Introduction; Overview of the Assessment of Process; The Dimension of Time; The Need for a Business Model in Software Engineering; Classic Invalid Assumptions: First Assumption: Internal or External Drivers, Second Assumption: Software or Business Processes, Third Assumption: Processes or Projects, Fourth Assumption: Process Centered or Architecture Centered; Implications of the New Business Model; Role of the Problem - Solving Process in this Approach: Data, Problem Definition, Tools and Capabilities; Redefining the Software Engineering Process: Round -Trip Problem-Solving Approach, Activities, Goals, Interdisciplinary Resources, Time.

UNIT V. Software Reliability: Introduction; Software Reliability MetriDS; Programming for Reliability: Fault Avoidance, Fault Tolerance, Software Reuse.

UNIT VI. Software Testing Techniques: Introduction; Software Testing Fundamental; Testing Principles; White Box Testing; Control Structure Testing; Black Box Testing; Boundary Value Analysis; Testing GUIs; Testing Documentation and Help Facilities; Software Testing Strategies: Introduction; Organizing for Software Testing;

Software Testing Strategy, Unit Testing: Unit Test Considerations, Top -Down Integration, Bottom-Up Integration.

REFERENCE BOOKS

1. R. G. Pressman – Software Engineering, TMH
2. Sommerville, Ian, Software Engineering, Pearson Education
3. Pankaj Jalote – An Integrated Approach to Software Engineering, Narosa
4. Publications.
5. Pfleeger, Shari Lawrence, Software Engineering Theory and Practice, second edition. Prentice- Hall 2001.
6. Object Oriented & Classical Software Engineering (Fifth Edition), SCHACH,TMH

BDS402 – Data Base Management System

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Gain knowledge of database systems and database management systems software.
2. Ability to model data in applications using conceptual modelling tools such as ER Diagrams and design data base schema based on the model.
3. Formulate, using SQL, solutions to a broad range of query and data update problems.
4. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
5. Be acquainted with the basics of transaction processing and concurrency control.
6. Familiarity with database storage structures and access techniques.
7. Compare, contrast and analyze the various emerging technologies for database systems such as NoSQL.
8. analyze strengths and weaknesses of the applications of database technologies to various subject areas.

UNIT I. Basic Database Concepts, Terminology, and Architecture; Types of Database Management Systems. Differences between Relational and other Database Models. Data Modelling: Relations, Schema, Constraints, Queries, and Updates; Conceptual vs. Physical Modeling; Entity Types, attributes, ER Diagrams.

UNIT II. SQL Data Definition: Specifying Tables, Data Types, Constraints; Simple SELECT, INSERT, UPDATE, DELETE Statements; Complex SELECT Queries, including Joins and Nested Queries; Actions and Triggers; Views; Altering Schemas.

UNIT III. Relational Algebra: Definition of Algebra; Relations as Sets; Operations: SELECT, PROJECT, JOIN, etc. Normalization Theory and Functional Dependencies, 2NF, 3NF, BCNF, 4NF, 5NF;

UNIT IV. Indexing: Files, Blocks, and Records, Hashing; RAID; Replication; Single-Level and Multi-Level Indexes; B-Trees and B+-Trees. Query Processing Translation of SQL into Query Plans; basics of Transactions, Concurrency and Recovery.

UNIT V. DAT ABASE PROGRAMMING: Embedded SQL; Dynamic SQL, JDBC; Avoiding Injection Attacks; Stored Procedures; Lightweight Data Access Layers for Python and JavaScript Applications; PHP and MySQL, Object Relational Modeling: Hibernate for Java, Active Record for Rails.

UNIT VI. BIG DATA: Motivations; OLAP vs. OLTP; Batch Processing; MapReduce and Hadoop; Spark; Other Systems: HBase. Working with POSTGRES, REDIS, MONGO, and NEO: Setting up the same Database on Four Platforms; Basic Queries and Reporting.

TEXTBOOKS

1. Elmasri's and Navathe's *Fundamentals of Database Systems*. Addison-Wesley

REFERENCE BOOK

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education
2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education

BDS403 - Programming in Java

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 3**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: Upon successful completion of this course, students should be able to:

1. Knowledge of the structure and model of the Java programming language,
2. Use the Java programming language for various programming technologies
3. Develop software in the Java programming language,
4. Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements

UNIT I. Introduction: Java Essentials, Its Characteristics, Execution and Compilation, Data types, Variables, Control Statements, Standard Input/ Output.

UNIT II. Constructors, Object Oriented Concepts: Encapsulation, Abstraction, Inheritance, polymorphism, JAVA Packages.

UNIT III. Exception Handling, Wrapper Classes, Auto-boxing, Multi -thread Programming.

UNIT IV. Applets, Event Handling, AWT, Database Handling using JDBC.

TEXT BOOKS

1. E Balaguruswamy, Programming with JAVA, A Primer (5e), Kindle Edition

REFERENCE BOOKS

1. Bruce Eckel, Thinking in Java (4e)
2. Herbert Schildt, Java: The Complete Reference (9e)
3. Y. Daniel Liang, Introduction to Java Programming (10e)
4. Paul Deitel, Harvey Deitel, Java: How To Program (10e)
5. Cay S. Horsttnann, Core Java Volume I –Fundamentals (10e)

BDS-404 Optimization Techniques

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of the course the students will be able to

3. Cast engineering minima/maxima problems into optimization framework.
4. Learn efficient computational procedures to solve optimization problems.
5. To implement important optimization methods in solving the various problems.

SECTION-A (15L)

Basics of idea of optimization of a function: Extremizer of function of single variable, and several variables, local minimizer and global minimizer of functions. Concept of critical points. feasible regions, convex region. Constrained optimization, unconstrained optimization. Introduction to linear programming problem(lpp). Formulation of lpp. Basic feasible solution of set of linear constraints. Determination feasible solutions of lpp with two variables by graphical method, use of iso-profit line. Different forms of lpp, standard form and canonical form.

SECTION-B (15L)

Solution of linear programming problem : Solution of lpp by simplex method, use of artificial variable in solving lpp. Identifying initial basic feasible solution, solution of lpp by Big-M method, and by two phase method. Duality in lpp , general rule for converting primal lpp to its dual. Dual simplex method is solving special types of lpp. Duality theorems (discussions on statements only), duality techniques in solving lpp.

SECTION-C (15L)

Special types of lpp : Introduction to transportation problem(TP) as an lpp. Solution of transportation problem: searching initial basic feasible solution of transportation problem by Vogel's method, test for optimality in TP, improving feasible solution for optimality, optimal solution of TP by MODI method. Degeneracy in TP. Introduction to assignment problem as special type of TP, solution of assignment problem by Konig's algorithm. Special type of assignment problem prohibited assignment and traveling sales man problem.

Network Scheduling Problem: Introduction to network scheduling problem, Network and basic components, rules of network construction. Network scheduling by Critical Path Method (CPM) and Program Evaluation and Review method, distinction between CPM and PERT method.

SECTION-D (15L)

Non Linear Programming : One dimensional optimization, unimodal functions and its minimizer, optimization of unimodular functions by function comparison methods-two point equal search method, bisection method, golden section method; polynomial interpolation methods- quadratic interpretation, cubic interpretation; iterative methods- Newton's method, secant method. Unconstrained gradient based optimizations; method of steepest descent method, conjugate gradient method, Newton type method. Constrained optimization of non linear functions in function of several variables- Lagrange multipliers method, optimization by using Khun-Tucker conditions.

Recommended Books:

1.Operations Research, K. Swarup, P. K. Gupta, M. Mohan, Sultan Chand & sons, New Delhi, 1990.
2. Optimization : Theory and Practice, M. C. Joshi, K. M. Moudgalya, Narosa Publishing House.
3.Optimization Techniques: An Introduction,L. R. Foulds,Springer-Verlag.
4. Optimization Techniques,Chander Mohan and Kusum Deep,New Age Science.
5. Operation Research : An Introduction, H. A Taha, Mc Millan Publishing Co, New York, 1986.

BDS405- Web Programming

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of the course the students will be able to:

1. To understand basics of the Internet and World Wide Web
2. To acquire knowledge and skills for creation of web site considering both client and server-side programming
3. To learn basic skill to develop responsive web applications
4. To understand different web extensions and web services standards
5. To understand basic concepts of Search Engine basics.
6. To learn Web Service Essentials.
7. To learn Rich Internet Application Technologies.
8. To understand and get acquainted with Web Analytics 2.0

UNIT I. (Introduction to World Wide Web) -Internet Standards, Introduction to WWW and WWW Architecture, Internet Protocols, Overview of HTTP, HTTP request – response, Generations of dynamic web pages

UNIT II. (User Interface Design) Introduction to HTML and HTML5, TML Tags, Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms. The need for CSS, Introduction to CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style, Backgrounds, Manipulating Text, Margins and Padding, Positioning using CSS.

UNIT III. (Java Programming) Java Script, Introduction, Core features, Data types and Variables, Operators, Expressions, Functions, Objects, Array, Date and Math related Objects. JAVA Networking classes, TCP/IP Protocol Suite, File Transfer Protocol (FTP), Java Environment |Setup for Web Applications, Java Bean, Application Builder Tool, Bean

Developer Kit (BDK), The Java Beans API, Introduction to EJB

UNIT IV. (Database) Database basics, SQL, MySQL, PostgreSQL, JDBC API, Driver Types, Two-tier and Three-tier Models, Connection Overview, Transactions, Driver Manager Overview, Statement Overview, Result Set Overview, Types of Result Sets, Concurrency Types, Prepared Statement Overview

UNIT V. (Java Applet and JSP) Java Web Programs and Applets, Web Application, Servlet, Servlet Life Cycle, Servlet Programming, Introduction to JSP, Life Cycle of a JSP Page, Translation and Compilation, Creating Static Content, Response and Page Encoding, Creating Dynamic Content, Using Objects within JSP Pages, JSP Programming

UNIT VI. (Dot Net Framework) Introduction to Dot Net, Dot Net framework and its architecture, CLR, Assembly, Components of Assembly, DLL hell and Assembly Versioning, Overview to C#, Introduction to ASP.net, Asp.net Programming

REFERENCE BOOKS

1. J2EE: The complete Reference by James Keogh.
2. Java EE and HTML5 Enterprise Application Development (Oracle Press) by John Brock, Arun Gupta, Geertjan Wielenga
3. Struts: The Complete Reference, 2nd Edition by James Holmes
4. ASP.NET Unleashed by Stephen Walther, Kevin Scott Hoffman, Nate Dudek
5. Microsoft Visual C# 2013 Step by Step by John Sharp

BDS406 – Data Base Management System Lab

4-Hours/Week **2 credits**

Students are required to practice the concepts learnt in the theory by designing and querying a database for a chosen organization (Like Library, Transport etc). The teacher may devise appropriate weekly lab assignments to help students practice the designing , querying a database in the context of example database. Some indicative list of experiments is given below.

Experiment 1: E-R Model

Analyze the organization and identify the entities , attributes and relationships in it.

Identify the primary keys for all the entities. Identify the other keys like candidate keys, partial keys, if any.

Experiment 2: Concept design with E-R Model

Relate the entities appropriately. Apply cardinalities for each relationship. Identify strong entities and weak entities (if any).

Experiment 3: Relational Model

Represent all the entities (Strong, Weak) in tabular fashion. Represent relation ships in a tabular fashion.

Experiment 4: Normalization

Apply the First, Second and Third Normalization levels on the database designed for the organization

Experiment 5: Installation of Mysql and practicing DDL commands

Installation of MySql. Creating databases, How to create tables, altering the database, dropping tables and databases if not required. Try truncate, rename commands etc.

Experiment 6: Practicing DML commands on the Database created for the example

organization

DML commands are used to for managing data within schema objects. Some examples:

- SELECT - retrieve data from the a database
- INSERT - insert data into a table
- UPDATE - updates existing data within a table
- DELETE - deletes all records from a table, the space for the records remain

Experiment 7: Querying

practice queries (along with sub queries) involving ANY, ALL, IN, Exists, NOT EXISTS, UNION, INTERSECT, Constraints etc.

Experiment 8 and Experiment 9: Querying (continued…)

Practice queries using Aggregate functions (COUNT, SUM, AVG, and MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.

Experiment 10: Triggers

Work on Triggers. Creation of, insert trigger, delete trigger, update trigger. Practice triggers using the above database.

BDS407 - Programming in Java Lab

2-Hours/Week **1 Credit**

Students are required to implement object -oriented paradigm using JAVA. Below are the list of some of the experiments.

Part A

1. Program on strings: Check the equality of two strings, Reverse a string.
2. Program using loops: to find the sum of digits of a given number, display a multiplication table, display all prime numbers between 1 to 1000.
3. Program to demonstrate all math class functions.

Part B

1. Program on files : to copy a file to another file using Java to package classes.
2. Program to demonstrate method over-riding and overloading
3. Programs on inheritances.
4. Multi-threaded programming.

SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-V

(Session 2019-22/2020-23)

BDS501- Internet Technologies

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly.

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Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. To understand the terms related to the Internet and how the Internet is changing the world.
2. To understand how computers are connected to the Internet and demonstrate the ability to use the World Wide Web.
3. Demonstrate an understanding of and the ability to use electronic mail and other internet based services
4. Understand the design principles of Web pages and how they are created
5. To develop an ability to create basic Web pages with HTML.

UNIT I. Introduction: Overview, Network of Networks, Intranet, Extranet and Internet. World Wide Web, Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP: Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control,

UNIT II. IP Data-gram, IPv4 and IPv6. IP Sub-netting and addressing: Classful and Classless Addressing, Sub-netting. NAT, IP masquerading, IP tables. Internet Routing Protocol: Routing -Intra and Inter Domain Routing, Unicast and Multi-cast Routing, Broadcast. Electronic Mail: POP3, SMTP.

UNIT III. HTML: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, I frame, Colors, Color name, Color value. Image Maps: map, area, attributes of image area. Extensible Markup Language (XML): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts: Introduction, Environment Variable, GET and POST Methods.

UNIT IV. PERL: Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling. JavaScript: basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object - string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies: Definition of cookies, Create and Store a cookie with example. Java Applets: Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.

UNIT V. Client-Server programming In Java: Java Socket, Java RMI. Threats: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT VI. Internet Telephony: Introduction, VoIP. Multimedia Applications: Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV. mywbut.com Search Engine and Web Crawler: Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

REFERENCE BOOKS

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI, Learning, Delhi, 2013.
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.

BDS502- Artificial Intelligence

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Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Explain what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.
2. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
3. Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, a s a constraint satisfaction problem, as a planning problem, etc).
4. Implement basic AI algorithms (e.g., standard search or constraint propagation algorithms).
5. Design and perform an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
6. Explain the limitations of current Artificial Intelligence techniques.

UNIT I. Introduction to Artificial Intelligence: Definition of AI; Turing Test; Brief History of AI. Problem Solving and Search: Problem Formulation; Search Space; States vs. Nodes; Tree Search: Breadth-First, Uniform Cost, Depth-First, Depth-Limited, Iterative Deepening; Graph Search.

UNIT II. Informed Search: Greedy Search; A* Search; Heuristic Function; Admissibility and Consistency; Deriving Heuristics via Problem Relaxation. Local Search: Hill - Climbing; Simulated Annealing; Genetic Algorithms; Local Search in Continuous Spaces.

UNIT III. Playing Games: Game Tree; Utility Function; Optimal Strategies; Minimax Algorithm; Alpha-Beta Pruning; Games with an Element of Chance. Beyond Classical Search: Searching with Non-deterministic Actions; Searching with Partial Observations; Online Search Agents; Dealing with Unknown Environments.

UNIT IV. Knowledge Representation and Reasoning: Ontologies, Foundations of Knowledge Representation and Reasoning, Representing and Reasoning about Objects, Relations, Events, Actions, Time, and Space; Predicate Logic, Situation Calculus, Description LogiDS, Reasoning with Defaults, Reasoning about Knowledge, Sample Applications.

UNIT V. Representing and Reasoning with Uncertain Knowledge: Probability, Connection to Logic, Independence, Bayes Rule, Bayesian Networks, Probabilistic

Inference, and Sample Applications.

UNIT VI. Planning: The STRIPS Language; Forward Planning; Backward Planning; Planning Heuristics; Partial-Order Planning; Planning using Propositional Logic; Planning vs. Scheduling.

UNIT VII. Constraint Satisfaction Problems (DSPs): Basic Definitions; Finite vs. Infinite vs.

Continuous Domains; Constraint Graphs; Relationship With Propositional Satisfiability, Conjunctive Queries, Linear Integer Programming, and Diophantine Equations; NP - Completeness of DSP; Extension to Quantified Constraint Satisfaction (QDSP). Constraint Satisfaction as a Search Problem; Backtracking Search; Variable and Value Ordering Heuristic; Degree Heuristic; Least-Constraining Value Heuristic; Forward Checking; Constraint Propagation; Dependency-Directed Backtracking;

TEXT BOOKS

1. Elaine Rich, Kevin Knight, Shivashankar B Nair, Artificial Intelligence, Third Edition, McGraw Hill Edition.

REFERENCE BOOKS

1. Russell Stuart Jonathan and Norvig Peter, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2010

BDS503- Data Analytics

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to support decision making.
2. To gather sufficient relevant data, conduct data analytics using scientific methods, and understand appropriate connections between quantitative analysis and real - world problems.
3. Understand the exact scopes and possible limitations of each method to provide constructive guidance in decision making.
4. To Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
5. To make better decisions by using advanced techniques in data analytics.

UNIT I. Data Definitions and Analysis Techniques: Elements, Variables, and Data Categorization, Levels of Measurement, Data Management and Indexing

UNIT II. Descriptive Statistics: Measures of Central Tendency, Measures of Location of Dispersions, Error Estimation and Presentation (Standard Deviation, Variance),

Introduction to Probability

UNIT III. Basic Analysis Techniques: Statistical Hypothesis Generation and Testing, Chi-Square Test, T -Test, Analysis of Variance, Correlation Analysis, Maximum Likelihood Test

UNIT IV. Data Analysis Techniques-I: Regression Analysis, Classification Techniques, Clustering Techniques (K-Means, K-Nearest Neighborhood)

UNIT V. Data Analysis Techniques-II: Association Rules Analysis, Decision Tree

UNIT VI. Introduction to R Programming: Introduction to R Software Tool, Statistical Computations using R (Mean, Standard Deviation, Variance, Regression, Correlation etc.)

UNIT VII. Practice and Analysis with R and Python Programming, Sensitivity Analysis

REFERENCE BOOKS

- Probability and statistics for Engineers and Scientists (9 Edn.), Ronald E Walppole, Raymond H Myres, Sharon L. Myres and Leying Ye, Prentice Hall Inc
- The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.) Travor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
- Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer

BDS504- Theory of Computation

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1(COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. To provide a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical (abstract) view towards algorithmic design and in general computation itself.
2. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part as well.
3. Become proficient in key topics of theory of computation, and to have the opportunity to explore the current topics in this area

UNIT I. Automata: Introduction to Formal Proof, Additional Forms of Proof,

Inductive Proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Finite Automata with Epsilon Transitions

UNIT II. Regular Expressions and Languages: Regular Expression, FA and Regular Expressions, Proving Languages not to be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata

UNIT III. Context Free Grammars and Languages: Context Free Grammar (CFG), Parse Trees , Ambiguity in Grammars and Languages, Definition of The Push down Automata, Languages of a Push down Automata, Equivalence of Push down Automata and CFG Deterministic Push down Automata.

UNIT IV. Properties of Context Free Languages: Normal Forms for CFG, Pumping Lemma for CFL, Closure Properties of CFL, Turing Machines, Programming Techniques for TM, Variations of TM, Non Universal TM, Universal TM.

UNIT V. Undecidability: A Language that is not Recursively Enumerable (RE), an Undecidable Problem that is RE, Undecidable Problems about Turing Machine, Post's Correspondence Problem, The Classes P and NP.

REFERENCE BOOKS

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education, 2007.
2. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Second Edition, Pearson Education, 2003.
3. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education., 2007.
4. J. Martin, "Introduction to Languages and the Theory of computation, Third Edition, Tata Mc Graw Hill, 2007.

BDS505- Artificial Intelligence Lab

4-Hours/Week **2 credits**

The students are expected to explore the foundational skills on AI techniques acquired in theory in solving problems and using sample data sets and various tools prepare themselves for careers in AI industry. The following is an indicative list of assignments for the semester. However students should be encouraged to take-up mini-project using the techniques and tools explored in the lab to understand the true potential

1. Using simple Hill-climbing compute an approximate solution to the travelling salesperson problem.
2. Using Naïve bayes method learn a text classifier using training data and using test set evaluate the quality of the classifier.
3. Implement gradient descent and back-propagation in Python.
4. Using Scikit learn for Logistic regression, Support Vector Machines, Building Neural Networks.
5. Using inbuilt TensorFlow functionality to build a Neural Network and train on MNIST

Dataset for classification.

6. Installation of Prolog and practicing queries using Prolog.

BDS506- Theory of Computation Lab

4-Hours/Week **2 credits**

The students are expected to understand the Hierarchy of formal languages with reference to their varying degrees of complexity in recognizing them. Programs can be designed after designing suitable automata to recognize the following formal languages. Given an input the recognizer shall output a Yes/No answer depending on whether the string is part of the language or not.

1. Language of Binary strings which ends with the pattern 101.
2. Language of Binary strings such that the third symbol from the end is a Zero
3. Language of parenthesised expressions with matching left and right parenthesis
4. Language of Binary strings with equal number of Zeros and Ones
5. Language generated by the grammar $\{a^n b^n c^n \mid n^3 1\}$
6. Language $\{ a^p \mid p \text{ is prime}\}$

SRI SRI UNIVERSITY

Faculty of Science

Syllabus

B.Sc. (Hons.) Data Science

Semester-VI

(Session 2019-22/2020-23)

BDS601- Computer Graphics

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1 (COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment : 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 4** **Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Acquire familiarity with the concepts and relevant mathematics of computer Graphics.
2. Ability to implement various algorithms to scan, convert the basic geometrical primitives, transformations, area filling, clipping.
3. Describe the importance of viewing and projections.
4. Ability to design basic Graphics application programs.
5. Familiarize with fundamentals of animation and Virtual reality technologies
6. Be able to design applications that display graphic images to given specifications.
7. To understand a typical Graphics pipeline.

UNIT I. Application Areas of Computer Graphics, Overview of Graphics Systems and Devices. Points and Lines, Line Drawing Algorithms, Mid -Point Circle and Ellipse Algorithms. Filled Area Primitives, Polygon Filling Algorithms. Curve Generation: Bezier and B-Spline Curves.

UNIT II. 2-D Geometrical Transforms: Translation, Scaling, Rotation, Reflection and Shear Transformations Composite Transforms, Transformations between Coordinate Systems. 2-D Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-port Coordinate Transformation, Viewing Functions.

UNIT III. Line Clipping Algorithms- Cohen-Sutherland and Cyrus Beck Line Clipping Algorithms, Sutherland–Hodgeman Polygon Clipping Algorithm. 3-D Object Representation: Polygon Surfaces, Quadric Surfaces, Spline Representation

UNIT IV. 3-D Geometric Transformations: Translation, Rotation, Scaling, Reflection and Shear Transformations, Composite Transformations, 3-D Viewing: Viewing Pipeline, Viewing Coordinates, View Volume, General Projection Transforms and Clipping.

UNIT V. Visible Surface Detection Methods: Classification, Back -Face Detection, Depth- Buffer, Scan line, Depth Sorting, BSP-Tree Methods, Area Sub-Division and Octree Methods Illumination Models and Surface Rendering Methods: Basic Illumination Models, Polygon Rendering Methods Computer Animation: Design of Animation Sequence, General Computer Animation Functions Key Frame Animation, Animation Sequence, Motion Control Methods, Morphing, Warping (Only Mesh Warping)

UNIT VI. Virtual Reality : Basic Concepts, Classical Components of VR System, Types of VR Systems, Three Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces. Input Devices, Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL Rendering Pipeline. Applications of Virtual Reality.**TEXTBOOKS**

1. Donald Hearn and M. Pauline Baker, "Computer Graphics with Open GL", Prentice Hall.
2. R. K Maurya, "Computer Graphics with Virtual Reality", Wiley

REFERENCE BOOKS

1. "Computer Graphics Principles & practice", Foley, Van Dam, Feiner and Hughes, Pearson Education.

BDS602- Machine Learning

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1 (COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks **Min. Pass Marks : 50%**	**Internal Assessment : 40 Marks** **Min. Pass Marks : 50%**	**Credits:- 6** **Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Differentiate between supervised, unsupervised machine learning approaches
2. Ability to choose appropriate machine learning algorithm for solving a problem
3. Design and adapt existing machine learning algorithms to suit applications
4. Understand the underlying mathematical relationships across various machine learning algorithms
5. Design and implement machine learning algorithms to real world applications

UNIT I. Introduction: Concept of Machine Learning, Applications of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Statistical Learning: Bayesian Method, The Naive Bayes Classifier

UNIT II. Software's for Machine Learning and Linear Algebra Overview: Plotting of Data, Vectorization, Matrices and Vectors: Addition, Multiplication, Transpose and Inverse using Available Tool such as MATLAB.

UNIT III. Linear Regression: Prediction using Linear Regression, Gradient Descent, Linear Regression with one Variable, Linear Regression with Multiple Variables, Polynomial Regression, Feature Scaling/Selection.

UNIT IV. Logistic Regression: Classification using Logistic Regression, Logistic

Regression vs. Linear Regression, Logistic Regression with one Variable and with Multiple Variables.

UNIT V. Regularization: Regularization and its Utility: The problem of Overfitting, Application of Regularization in Linear and Logistic Regression, Regularization and Bias/Variance.

UNIT VI. Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multi-layer Perceptrons, Multiclass Representation, Back Propagation Algorithm.

TEXT BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.
2. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by Springer, 2007.
4. Mevin P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.

BDS603 -Computational Intelligence

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1 (COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 6**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Provide a basic exposition to the goals and methods of Computational Intelligence.
2. Study of the design of intelligent computational techniques.
3. Apply the Intelligent techniques for problem solving.
4. Improve problem solving skills using the acquired knowledge in the areas of, reasoning, natural language understanding, computer vision, automatic programming and machine learning.

SECTION-A (10L)

Artificial Neural Network(ANN) : Difference between Artificial and Biological Neuron, Models of an artificial Neuron, Neural Network Architecture, Terminologies of ANN, Hebb Network, Learning methods

SECTION-B (10L)

Supervised Learning Networks: Single Layer Perceptron model, Multi Layer Perceptron Model, Architecture and study of Back Propagation Networks(BPN) , Effect of Tunning the parameters of the Back propagation, Adaline, Multiple Adaline

Associative memory: Auto, hetero and linear associative memory networks, Applications of ANN

SECTION-C (10L)

Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations,

Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods, Fuzzy rule based reasoning, Applications of Fuzzy Logic in Real life Problems.

SECTION-D (10L)

Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction.
Genetic Modeling : Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Applications of Genetic Algorithms in Real life Problems.

SECTION-E (10L)

Fundamentals of Expert system: Introduction to expert system. Structure of an Expert system, Applications of Expert Systems.

Recommended Books:

1. Principles of Soft Computing- S.N.Sivanandan and S.N.Deepa, Wiley India, 2 nd Edition,2011
2. S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI
3. Neuro Fuzzy and Soft Computing, J. S. R. JANG,C.T. Sun, E. Mitzutani, PHI
4. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application)

BDS604 - Cloud Computing

Note: Total **9 Questions** are to be set by the examiner covering the entire syllabus uniformly. **Question No. 1 (COMPULSORY)** having **Short Answer Questions** from entire syllabus. Rest of the **Eight** questions are from **Section A, B, C & D** of **Syllabus.** In question paper, each question of **Section B** having internal choice. A candidate is required to attempt Four **questions** out of **Section B** of question paper. All questions shall carry equal marks.		
Total Marks : 100		**Max. Time : 3 Hrs.**
End Sem Exam : 60 Marks	**Internal Assessment : 40 Marks**	**Credits:- 4**
Min. Pass Marks : 50%	**Min. Pass Marks : 50%**	**Lectures:- 60**

Learning Outcomes: After successful completion of this course the students are able to:

1. Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
2. Compare the advantages and disadvantages of various cloud computing platforms.
3. Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google AppEngine.
4. Program data intensive parallel applications in the cloud.
5. Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
6. Identify security and privacy issues in cloud computing.
7. Explain recent research results in cloud computing and identify their pr os and cons.
8. Solve a real-world problem using cloud computing through group collaboration.

Unit I. Introduction to cloud computing

Definition, Characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multi-tenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

Unit II. Virtualization

Virtualization concepts , Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their

features.

Unit III. Data in cloud computing

Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map -Reduce, Enterprise batch processing using Map-Reduce.

Unit IV. Cloud security

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security, Security challenges : Virtualization security management - virtual threats, VM Security Recommendations, VM - Specific Security techniques, Secure Execution Environments and Communications in cloud.

Unit V. Issues in cloud computing

Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud.

TEXT BOOK:

1. Enterprise Cloud Computing by Gautam Shroff,Cambridge publication

REFERENCE BOOK:

1. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley -India
2.. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication

BDS605- Computer Graphics Lab

4-Hours/Week **2 credits**

The students are required to create interactive Graphics applications in C using Graphics application programming interfaces and demonstrate geometrical transformations. The lab material includes implementation of line drawings, circle drawing, ellipse drawing as well as different geometrical transformations.

Experiment 1: Line Drawing Using DDA and Bresenham
Experiment 2: Circle Drawing Using Midpoint Algorithm
Experiment 3: Ellipse Drawing Using Mipoint Algorithm.
Experiment 4: Performing the basic 2D transformations such as translation, Scaling, Rotation, shearing and reflection for a given 2D object.

BDS606 - Cloud Computing Lab

4-Hours/Week **2 Credits**

The students shall explore development of web applications in cloud. Practically Design and develop processes involved in creating a cloud based application and programming using Hadoop

Indicative List of Experiments

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS with virtualization support
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Experiment a procedure to transfer the files from one virtual machine to another virtual machine.
6. Experiment a procedure to launch virtual machine using try stack (Online Openstack Demo Version)
7. Install Hadoop single node cluster and run simple applications like word count.

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Syllabus for Elective papers

Computer Science COURSE DETAILS AS General Elective Course FOR B.Sc.(HONS) in OTHER SUBJECT

SEM	Generic Elective Courses (GEC) each with 06 credit. 4 Courses	
I	GEC-I	Programming Methodology
II	GEC-II	Data Structure OR Discrete Structures

III	GEC-III	Operating System OR Algorithms OR Computer Networks
IV	GEC- IV	Software Engineering OR DBMS OR Object Oriented Programming

Skill Enhancement Course(SEC)-1

1. MATLAB PROGRAMMING

1. Understand the fundaments of procedural and functional programming;
2. Understand Matlab data types and structures;
3. Be able to set up simple real-life numerical problems such that they can be solved and visualized using basic codes in Matlab;
4. Be ready to use advanced coding in Matlab in their subsequent studies

SYLLABUS **4 Credits**

UNIT 1. Introduction to MATLAB Programming- basics of MATLAB programming, Array operations in MATLAB, Loops and execution control, Working with files: Scripts and Functions, Plotting and program output

UNIT 2. Approximations and Errors- Defining errors and precision in numerical methods, Truncation and round-off errors, Error propagation, Global and local truncation errors

UNIT 3. Linear Equations- Linear algebra in MATLAB, Gauss Elimination, LU decomposition and partial pivoting, Iterative methods: Gauss Siedel Method

UNIT 4. Regression and Interpolation- Introduction, Linear least squares regression(including lsqcurvefit function), Functional and nonlinear regression (including *lsqnonlin* function), Interpolation in MATLAB using spline and *pchip*

UNIT 5. Nonlinear Equations- Nonlinear equations in single variable, MATLAB function fzero in single variable, Fixed-point iteration in single variable, Newton- Raphson in single variable, MATLAB function *fsolve* in single and multiple variables, Newton-Raphson in multiple variables

TEXT BOOKS

1. Fausett L.V.(2007) Applied NumericalAnalysis Using MATLAB, 2nd Ed.,Pearson Education
2. Essential MATLAB for Engineers and Scientists, 6th Edition, Brian Hahn; Daniel T. Valentine, Academic Press, Web ISBN-13: 978-0-12-805271-6,

2. PROGRAMMING IN JAVA

1. Knowledge of the structure and model of the Java programming language,
2. Use the Java programming language for various programming technologies
3. Develop software in the Java programming language,
4. Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements

SYLLABUS **4 credits**

A. Theory

UNIT I. Introduction: Java Essentials, Its Characteristics, Execution and Compilation, Data types, Variables, Control Statements, Standard Input/ Output.

UNIT II. Constructors, Object Oriented Concepts: Encapsulation, Abstraction, Inheritance, polymorphism, JAVA Packages.

UNIT III. Exception Handling, Wrapper Classes, Auto-boxing, Multi -thread Programming. UNIT IV. Applets, Event Handling, AWT, Database Handling using JDBC.

TEXT BOOKS

- E Balaguruswamy, Programming with JAVA, A Primer (5e), Kindle Edition

REFERENCE BOOKS

- Bruce Eckel, Thinking in Java (4e)
- Herbert Schildt, Java: The Complete Reference (9e)
- Y. Daniel Liang, Introduction to Java Programming (10e)
- Paul Deitel, Harvey Deitel, Java: How To Program (10e)
- Cay S. Horsttnann, Core Java Volume I –Fundamentals (10e)

B. Practicum

Students are required to implement object -oriented paradigm using JAVA. Below are the list of some of the experiments.

Part A

1. Program on strings: Check the equality of two strings, Reverse a string.
2. Program using loops: to find the sum of digits of a given number, display a multiplication table, display all prime numbers between 1 to 1000.
3. Program to demonstrate all math class functions.

Part B

4. Program on files : to copy a file to another file using Java to package classes.
5. Program to demonstrate method over-riding and overloading
6. Programs on inheritances.
7. Multi-threaded programming.

3. PYTHON PROGRAMMING

1. Develop and Execute simple Python programs.
2. Structure a Python program into functions.
3. Using Python lists, tuples to represent compound data
4. Develop Python Programs for file processing

SYLLABUS

A Theory **4**
Credits

UNIT I. Introduction to Python, Python, Features of Python, Execution of a Python, Program, Writing Our First Python Program, Data types in Python. Python Interpreter and Interactive Mode; Values and Types: int, float, boolean, string, and list; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules and Functions, Function Definition and use, Flow of Execution, Parameters and Arguments

UNIT II. Operators in Python, Input and Output, Control Statements. Boolean Values and operators, Conditional (if), Alternative (if-else), Chained Conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion

UNIT III. Arrays in Python, Strings and Characters. Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Illustrative Programs: Square Root, gcd, Exponentiation, Sum an Array of Numbers, Linear Search, Binary Search.

UNIT IV. Functions, Lists and Tuples. List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return Value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Illustrative Programs: Selection Sort, Insertion Sort, Merge sort, Histogram.

UNIT V. 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.

TEXT BOOKS

- Mark Lutz, Learning Python
- Tony Gaddis, Starting Out With Python
- Kenneth A. Lambert, Fundamentals of Python
- James Payne, Beginning Python using Python 2.6 and Python 3

B. Practical **2 Credits**

The students are required to verify their ablility to use core programming basics and program design with functions using Python programming language. The teacher shall programs to strengthen the practical expertise of the students. The following is an indicative list of programs that can be practiced

1. Write a program to demonstrate different number data types in Python.

2. Write a program to perform different Arithmetic Operations on numbers in Python.

3. Write a program to create, concatenate and print a string and accessing sub-string from a given string.

4. Write a python script to print the current date in the following format "Fri Oct 11 02:26:23
IST 2019"

5. Write a program to create, append, and remove lists in python.

6. Write a program to demonstrate working with tuples in python.

7. Write a program to demonstrate working with dictionaries in python.

8. Write a python program to find largest of three numbers.

9. Write a Python program to construct the following pattern, using a nested for loop

```
*
* *
* * *
* * * *
* * * * *
* * * *
* * *
* *
*
```

10. Write a Python script that prints prime numbers less than 20.

11. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.

12. Write a python program to define a module and import a specific function in that module to another program.

13. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

14. Write a Python class to convert an integer to a roman numeral.

15. Write a Python class to reverse a string word by word.

Skill Enhancement Course(SEC)-2

1. MOBILE APPLICATION DEVELOPMENT

1. To understand Android platform and its architecture.
2. To learn about mobile devices types and different modern mobile operating systems.
3. To learn activity creation and Android User Interface designing.
4. To learn basics of Intent, Broadcast and Internet services.
5. To learn about different wireless mobile data transmission standards.
6. To understand and learn how to integrate basic phone features, multimedia, camera and Location based services in Android Application.
7. To learn about different systems for mobile application development, deployment and distribution in Mobile market place (Android, IoS).
8. To understand and carry out functional test strategies for mobile applications.

SYLLABUS **4 credits**

UNIT I. (Introduction) What is Android, Android Versions and its Feature Set, Various Android Devices on the Market, Android Market Application Store, Android Development Environment System Requirements, Android SDK, Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE), Creating Android Virtual Devices (AVDs)

UNIT II. (Android Architecture Overview and Application) Android Software Stack, The Linux Kernel, Android Runtime - Dalvik Virtual Machine, Android Runtime – Core Libraries, Dalvik VM Specific Libraries, Java Interoperability Libraries, Android Libraries, Application Framework, Creating a New Android Project ,Defining the Project Name and SDK Settings, Project Configuration Settings, Configuring the Launcher Icon, Creating an Activity, Running the Application in the AVD, Stopping a Running Application, Modifying the Example Application, Reviewing the Layout and Resource Files,

UNIT III. (Android Software Development Platform and Framework) Understanding Java SE and the Dalvik Virtual Machine, The Directory Structure of an Android Project,

Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes , Launching Mobile Application: The AndroidManifest.xml File, Android Application Components, Android Activities: Defining the UI, Android Service s: Processing in the Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components

UNIT IV. (Understanding Android User Interfaces, Views and Layouts) Designing for Different Android Devices, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool Displaying Text with TextView, Retrieving Data from Users, Using Buttons, Check Boxes and Radio Groups, Getting Dates and Times from Users, Using Indicators to Display Data to Users, Adjusting Progress with Seek Bar, Working with Menus using views, Gallery, Image Switcher, Grid View, and Image View views to display images, Creating Animation

UNIT V. (Databases, Intents, Location-based Services) Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers Intents and Intent Filters: Intent Overview, Implicit Intents, Creating the Implicit Intent Example Project, Explicit Intents, Creating the Explicit Intent Example Application, Intents with Activities, Intents with Broadcast Receivers

UNIT VI. Sending SMS Messages Programmatically, Getting Feedback after Sending the Message Sending SMS Messages Using Intent Receiving, sending email, Introduction to location-based service, configuring the Android Emulator for Location -Based Services, Geocoding and Map-Based Activities Multimedia: Audio, Video, Camera: Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

REFERENCE BOOKS

- Android Programming Unleashed (1st Edition) by Harwani.
- Beginning Mobile Application Development in the Cloud (2011), Richard Rodger.

2. WEB PROGRAMMING

1. To understand basics of the Internet and World Wide Web
2. To acquire knowledge and skills for creation of web site considering both client and server-side programming
3. To learn basic skill to develop responsive web applications
4. To understand different web extensions and web services standards
5. To understand basic concepts of Search Engine basics.
6. To learn Web Service Essentials.
7. To learn Rich Internet Application Technologies.
8. To understand and get acquainted with Web Analytics 2.0

SYLLABUS **4 credits**

UNIT I. (Introduction to World Wide Web) -Internet Standards, Introduction to WWW

and WWW Architecture, Internet Protocols, Overview of HTTP, HTTP request – response, Generations of dynamic web pages

UNIT II. (User Interface Design) Introduction to HTML and HTML5, TML Tags, Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms. The need for CSS, Introduction to CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style, Backgrounds, Manipulating Text, Margins and Padding, Positioning using CSS.

UNIT III. (Java Programming) Java Script, Introduction, Core features, Data types and Variables, Operators, Expressions, Functions, Objects, Array, Date and Math related Objects. JAVA Networking classes, TCP/IP Protocol Suite, File Transfer Protocol (FTP), Java Environment |Setup for Web Applications, JavaBean, Application Builder Tool, Bean Developer Kit (BDK), The Java Beans API, Introduction to EJB

UNIT IV. (Database) Database basics, SQL, MySQL, PostgreSQL, JDBC API, Driver Types, Two-tier and Three-tier Models, Connection Overview, Transactions, Driver Manager Overview, Statement Overview, Result Set Overview, Types of Result Sets, Concurrency Types, Prepared Statement Overview

UNIT V. (Java Applet and JSP) Java Web Programs and Applets, Web Application, Servlet, Servlet Life Cycle, Servlet Programming, Introduction to JSP, Life Cycle of a JSP Page, Translation and Compilation, Creating Static Content, Response and Page Encoding, Creating Dynamic Content, Using Objects within JSP Pages, JSP Programming

UNIT VI. (Dot Net Framework) Introduction to Dot Net, Dot Net framework and its architecture, CLR, Assembly, Components of Assembly, DLL hell and Ass embly Versioning, Overview to C#, Introduction to ASP.net, Asp.net Programming

REFERENCE BOOKS

- J2EE: The complete Reference by James Keogh.
- Java EE and HTML5 Enterprise Application Development (Oracle Press) by John Brock, Arun Gupta, Geertjan Wielenga
- Struts: The Complete Reference, 2nd Edition by James Holmes
- ASP.NET Unleashed by Stephen Walther, Kevin Scott Hoffman, Nate Dudek
- Microsoft Visual C# 2013 Step by Step by John Sharp

3. GNU IMAGE MANIPULATION PROGRAMME

1. To familiarize the students with the underlying concepts of digital images.
2. To make the students know how to enhance images and prepare them for printing and publishing.

SYLLABUS **4 credits**

A. Theory

UNIT I Imaging Concepts and Graphic Formats: Pixel, Resolution, File Size, Image Compression, Raster & Vector Images, Color Model.

UNIT II Capturing and Creating Images: Saving Images, Scanning Images, Familiarization with GIMP Interface.

UNIT III Settings: Foreground and Background Colors, Grid Properties.

UNIT IV Image Manipulations: Resizing images, Cropping images, Moving and Copying images, Rotating and flipping images.

UNIT V Working with Text: Creating and editing text, Formatting Text, Applying text wraps.

UNIT VI Tools: Drawing tools, Painting tools.

REFERENCE BOOKS

- Kay Richter, GIMP 2.8- Buch (e-book)
- Olivier Lecarme and Karine Delvare, The Book of GIMP, A complete Guide to Nearly Everything, Kindle Edition

B. Practicum

Students are required to implement a project based on learned concepts.

Domain Specific Elective Course (DSEC)

IMAGE PROCESSING

1. To familiarize the students with the image fundamentals and mat hematical transforms necessary for image processing.
2. To make the students understand the image enhancement techniques
3. To make the students understand the image restoration and reconstruction procedures.
4. To familiarize the students with the image segmentation procedures.

SYLLABUS **6 credits**

UNIT I Digital Image Fundamentals: Elements of Visual Perception, Light, Brightness Adaption and Discrimination, Image Sensing and Acquisition, Image Sampling and Quantization, Pixels, Some Basic Relationships between Pixels, Coordinate Conventions, Imaging Geometry, Perspective Projection, Linear and Nonlinear Op erations

UNIT II Image Enhancement in the Spatial Domain: Intensity transformations, Contrast Stretching, Histogram Equalization, Correlation and Convolution, basics of Spatial Filtering, Smoothing Filters, Sharpening Filters, Gradient and Laplacian.

UNIT III Filtering in the Frequency domain: Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2 -D sampling, Discrete Cosine Transform, Frequency domain filtering.

UNIT IV Image Restoration and Reconstruction: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradation, Estimation of Degradation functions, Restoration from projections.

UNIT V Color Image Processing, Color Fundamentals, Color Models, Pseudocolor Image Processing, basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing, Dilation and Erosion, Opening and Closing., Extensions to Gray -Scale Images.

UNIT VI Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds.

TEXT BOOKS

- Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, Prentice

Hall.

REFERENCE BOOKS

- Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall.
  Stan Birchfield, Image Processing and Analysis, Cengage Learning.

DATA ANALYTICS

1. This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to support decision making.
2. To gather sufficient relevant data, conduct data Analytics using scientific methods, and understand appropriate connections between quantitative analysis and real - world problems.
3. Understand the exact scopes and possible limitations of each method to provide constructive guidance in decision making.
4. To Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
5. To make better decisions by using advanced techniques in data Analytics.

SYLLABUS **6 credits**

UNIT I. Data Definitions and Analysis Techniques: Elements, Variables, and Data Categorization, Levels of Measurement, Data Management and Indexing

UNIT II. Descriptive statistics: Measures of Central Tendency, Measures of Location of Dispersions, Error Estimation and Presentation (Standard Deviation, Variance), Introduction to Probability

UNIT III. Basic Analysis Techniques: Statistical Hypothesis Generation and Testing, Chi-Square Test, T -Test, Analysis of Variance, Correlation Analysis, Maximum Likelihood Test

UNIT IV. Data Analysis Techniques-I: Regression Analysis, Classification Techniques, Clustering Techniques (K-Means, K-Nearest Neighborhood)

UNIT V. Data Analysis Techniques-II: Association Rules Analysis, Decision Tree

UNIT I. Introduction to R Programming: Introduction to R Software Tool, Statistical Computations using R (Mean, Standard Deviation, Variance, Regression, Correlation etc.)

UNIT VII. Practice and Analysis with R and Python Programming, Sensitivity Analysis

REFERENCE BOOKS

- Probability and statistics for Engineers and Scientists (9 Edn.), Ronald E Walppole, Raymond H Myres, Sharon L. Myres and Leying Ye, Prentice Hall Inc
- The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.) Travor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
- Software for Data Analysis: Programming with R (statistics and Computing), John M. Chambers, Springer

COMPUTER ETHICS

1. The student will be able to describe and distinguish between the various ethical theories which can be used to form the basis of solutions to moral dilemmas in computing.
2. Identify traditional and current Issues related to Computers, Information Systems, ethics, Society and Human Values;
3. The student will be able to identify and define the components of a structured plan for solving ethical problems and, in the process, will be able to understand the basis for her/his own ethical system.
4. Given several examples of professional codes of ethics related to computing, the student will be able to compare and contrast these examples, discussing their commonalties, differences, and implications.
5. Develop skills of critical analysis and applying ethical principles to situations and dialectical thinking

SYLLABUS **6 credits**

UNIT I. The Need for Computer ethics Training and Historical Milestones

UNIT II. Defining the Field of Computer ethics, Computer ethics codes, Sample topics in Computer ethics

i. Computer crime and computer security
ii. Software theft and intellectual property rights
iii. Computer hacking and the creation of viruses
iv. Computer and information system failure
v. Invasion of privacy. Privacy in the Workplace and on the Internet vi. Social implications of artificial intelligence and expert systems vii. The information technology salesman issues

UNIT III. Transparency and Virtual ethics, Free Speech, Democracy, Information Access

UNIT IV. Developing the Ethical Analysis Skills and Professional Values, Privacy, Accountability, Government Surveillance

UNIT V. Boundaries of Trust, Trust Management, Wikipedia, Virtual Trust, Plagiarism in Online Environment, Intellectual Property, Net neutrality

REFERENCE BOOKS

- Deborah, J, Nissenbaun, H, Computing, ethics & Social Values, Englewwod Cliffs, New Jersey, Prentice Hall, 1995.
- Spinello, R, Tavani, H, T, Readings in Cyberethics, Sudbury, MA, Jones and Bartlett Publishers, 2001.
- Bynum, T, W; Rogerson, S, Computer ethics and Professional Responsibility, Blackwell, 2004

SYSTEM SECURITY

1. Develop an understanding of information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
2. Gain familiarity with prevalent network and distributed system attacks, defenses against them, and forensiDS to investigate the aftermath.
3. Develop a basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
4. Develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

SYLLABUS **6 Credits**

UNIT 1. Cryptographic Tools- Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudo-random Numbers, Practical Application: Encryption of Stored Data

UNIT 2. User Authentication- Means of Authentication, Password-Based Authentication, Token-Based Authentication, Bio-metric Authentication, Remote User Authentication, Security Issues for User Authentication, Practical Application: An Iris Bio-metric System, Case Study: Security Problems for ATM Systems

UNIT 3. Access Control- Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, Example: UNIX File Access Control, Role - Based Access Control, Case Study: RBAC System for a Bank

UNIT 4. Database Security-The Need for Database Security, Database Management Systems, Relational Databases, Database Access Control, Inference, Statistical Databases, Database Encryption, Cloud Security

UNIT 5. Malicious Software-Types of Malicious Software (Malware), Propagation–Infected Content–Viruses, Propagation–Vulnerability Exploit–Worms, Propagation–Social Engineering–SPAM E-mail, Trojans, Payload–System Corruption, Payload–Attack Agent–Zombie, Bots, Payload–Information Theft–Keyloggers, Phishing, Spyware, Pa yload–Stealthing–Backdoors, Rootkits,, Countermeasures

UNIT 6. Denial-of-Service Attacks- Denial-of-Service Attacks, Flooding Attacks, Distributed Denial-of-Service Attacks, Application-Based Bandwidth Attacks, Reflector and Amplifier Attacks, Defenses Against Denial -of-Service Attacks, Responding to a Denial-of-Service Attack.

TEXT BOOKS

- M. Stamp, “Information Security: Principles and Practice,” 2 st Edition, Wiley, ISBN: 0470626399, 2011.
- M. E. Whitman and H. J. Mattord, “Principles of Information Security,” 4 st Edition, Course Technology, ISBN: 1111138214, 2011.
- M. Bishop, “Computer Security: Art and Science,” Addison Wesley, ISBN: 0 -201-44099-7, 2002.
- G. McGraw, “Software Security: Building Security In,” Addison Wesley, ISBN: 0321356705, 2006.

HUMAN COMPUTER INTERFACE

1. Provide an overview of the concepts relating to the design of human - computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
2. Understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces.
3. Understand the important aspects of implementation of human-computer interfaces.
4. Identify the various tools and techniques for interface analysis, design, and evaluation.
5. Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.

SYLLABUS **6 credits**

UNIT I. Introduction: Historical Evolution of HCI, Interactive System Design: Concept of Usability- Definition and Elaboration, HCI and Software Engineering, GUI Design and AesthetiDS, Prototyping Techniques

UNIT II. Model-Based Design and Evaluation: Basic Idea, Introduction to Different Types of Models, GOMS Family of Models (KLM And CMN -GOMS), Fitts' Law and Hickhyman's Law,

UNIT III. General Development Guidelines and Principles: Shneiderman's Eight Golden Rules, Norman's Seven Principles, Norman's Model of Interaction, Nielsen's Ten Heuristics with Example of its use, Contextual Inquiry

UNIT IV. Dialog Design: Introduction to Formalism in Dialog Design, Design using FSM (Finite State Machines), State Charts and (Classical) Petri Nets in Dialog Design

UNIT V. Task Modeling and Analysis: Hierarchical Task Analysis (HT A), Engineering Task Models and Concur Task Tree (CTT)

UNIT VI. Object Oriented Modelling: Object Oriented Principles, Definition of Class and Object and their Interactions, Object Oriented Modelling for User Interface Design, Case Study Related to Mobile Application Development

REFERENCE BOOKS

- Dix A., Finlay J.,Abowd G. D. and Beale R. Human Computer Interaction, 3 rd edition, Pearson Education, 2005.
- Preece J., Rogers Y.,Sharp H.,Baniyon D., Holland S. and Carey T. Human Computer Interaction,Addison-Wesley, 1994.
- B.Shneiderman; Designing the User Interface,Addison Wesley 2000 (Indian Reprint).

MODELLING AND SIMULATIONS

1. Characterize systems in terms of their essential elements, purpose, parameters, constraints, performance requirements, sub-systems, interconnections and environmental context.
2. Understand the technical underpinning of modern computer simulation software.
3. System problem modelling and solving through the relationship between theoretical, mathematical, and computational modelling for predicting and optimizing performance and objective.
4. Mathematical modelling real world situations related to information systems development, prediction and evaluation of outcomes against design criteria.
5. Develop solutions and extract results from the information generated in the context of the information systems
6. Interpret the model and apply the results to resolve critical issues in a real world environment.
7. Develop different models to suit special Characteristics of the system being model led.

SYLLABUS **6 credits**

UNIT 1. Systems and environment: Concept of model and model building, model classification and representation, Use of simulation as a tool, steps in simulation study.

UNIT 2. Continuous-time and Discrete-time systems: Laplace transform, transfer functions, state-space models, order of systems, z-transform, feedback systems, stability, observability, controllability. Statistical Models in Simulation: Common discrete and continuous distributions, Poisson process, empirical distributions

UNIT 3. Random Numbers: Properties of random numbers, generation of pseudo random numbers, techniques of random number generation, tests for randomness, random variate generation using inverse transformation, direct transformation, convolution method, acceptance-rejection

UNIT 4. Design and Analysis of simulation experiments: Data collection, identifying distributions with data, parameter estimation, goodness of fit tests, selecting input models without data, multivariate an time series input models, verification and validation of models, static and dynamic simulation output analysis, steady -state simulation, terminating simulation, confidence interval estimation, Output analysis for steady state simulation, variance reduction techniques

UNIT 5. Queuing Models: Characteristics of queuing systems, notation, transient and steady state behavior, performance, network of queues

UNIT 6. Large Scale systems: Model reduction, hierarchical control, decentralized control, structural properties of large-scale systems

REFERENCE BOOKS

- Shailendra Jain, Modeling and Simulation using MATLAB - Simulink, 2ed, Kindle edition

DATA ANALYTICS

1. This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to support decision making.
2. To gather sufficient relevant data, conduct data analytics using scientific methods, and understand appropriate connections between quantitative analysis and real - world problems.
3. Understand the exact scopes and possible limitations of each method to provide constructive guidance in decision making.
4. To Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
5. To make better decisions by using advanced techniques in data analytics.

SYLLABUS **6 credits**

UNIT I. Data Definitions and Analysis Techniques: Elements, Variables, and Data Categorization, Levels of Measurement, Data Management and Indexing

UNIT II. Descriptive Statistics: Measures of Central Tendency, Measures of Location of Dispersions, Error Estimation and Presentation (Standard Deviation, Variance), Introduction to Probability

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Decision Tree

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- The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.) Travor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014

- Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer

THEORY OF COMPUTATION

1. To provide a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical (abstract) view towards algorithmic design and in general computation itself.

2. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part as well.

3. Become proficient in key topics of theory of computation, and to have the opportunity to explore the current topics in this area

PREREQUISITE

Students should have a background in discrete mathematics, data structures, and programming languages.

SYLLABUS

A THEORY **4 Credits**

UNIT I. Automata: Introduction to Formal Proof, Additional Forms of Proof, Inductive Proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Finite Automata with Epsilon Transitions

UNIT II. Regular Expressions and Languages: Regular Expression, FA and Regular Expressions, Proving Languages not to be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata

UNIT III. Context Free Grammars and Languages: Context Free Grammar (CFG), Parse Trees , Ambiguity in Grammars and Languages, Definition of The Pushdown Automata, Languages of a Pushdown Automata, Equivalence of Pushdown Automata and CFG Deterministic Pushdown Automata.

UNIT IV. Properties of Context Free Languages: Normal Forms for CFG, Pumping Lemma for CFL, Closure Properties of CFL, Turing Machines, Programming Techniques for TM, Variations of TM, Non Universal TM, Universal TM.

UNIT V. Undecidability: A Language that is not Recursively Enumerable (RE), an Undecidable Problem that is RE, Undecidable Problems about Turing Machine, Post's Correspondence Problem, The Classes P and NP.

REFERENCE BOOKS

- J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education, 2007.

• H.R. Lewis and C.H. Papadimitriou, “Elements of the theory of Computation”, Second
Edition, Pearson Education, 2003.

- Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education., 2007.
- J. Martin, "Introduction to Languages and the Theory of computation, Third Edition, Tata Mc Graw Hill, 2007.

B. Practicum **2 credits**

The students are expected to understand the Hierarchy of formal languages with reference to their varying degrees of complexity in recognising them. Programs can be designed after designing suitable automata to recognize the following formal languages. Given an input the recognizer shall output a Yes/No answer depending on whether the string is part of the language or not.

1. Language of Binary strings which ends with the pattern 101.
2. Language of Binary strings such that the third symbol from the end is a Zero
3. Language of parenthesised expressions with matching left and right parenthesis
4. Language of Binary strings with equal number of Zeros and Ones
5. Language generated by the grammar $\{a^n b^n c^n \mid n^3 1\}$
6. Language $\{ a^p \mid p \text{ is prime}\}$

DATA MINING

1. Demonstrate advanced knowledge of data mining concepts and techniques.
2. Apply the techniques of clustering, classification, association finding, feature selection and visualisation on real world data
3. Determine whether a real world problem has a data mining solution
4. Apply data mining software and toolkits in a range of applications
5. Set up a data mining process for an application, including data preparation, modelling and evaluation
6. Demonstrate knowledge of the ethical considerations involved in data mining.

SYLLABUS **6 credits**

UNIT I. Introduction to Data Mining, Understanding Data, Relations to Database, statistics, Machine Learning

UNIT II. Association Rule Mining, Level-wise Method, FP-Tree Method, Other Variants

UNIT III. Classification, Decision Tree Algorithm, CART, PUBLIC, Pruning Classification Tree

UNIT IV. Clustering Techniques, Clustering of Numeric Data, of Ordinal Data, Efficiency of Clustering, Consensus Clustering, Spectral Clustering

UNIT V. Rough Set Theory and its Application to Data Mining

UNIT VI. ROC Analysis

UNIT VII. Data Mining Trends, Big Data, Data Analytics

TEXT BOOKS

- Data Mining Techniques (4e) Universities Press Arun K Pujari

CLOUD COMPUTING

1. Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
2. Compare the advantages and disadvantages of various cloud computing platforms.
3. Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google AppEngine.
4. Program data intensive parallel applications in the cloud.
5. Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
6. Identify security and privacy issues in cloud computing.
7. Explain recent research results in cloud computing and identify their pr os and cons.
8. Solve a real-world problem using cloud computing through group collaboration.

SYLLABUS

A. **Theory** **4 Credits**

Unit I. Introduction to cloud computing

Definition, Characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multi tenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

Unit II. Virtualization

Virtualization concepts , Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features.

Unit III. Data in cloud computing

Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of MapReduce, Relational operations using Map -Reduce, Enterprise batch processing using MapReduce.

Unit IV. Cloud security

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security, Security challenges : Virtualization security management - virtual threats, VM Security Recommendations, VM - Specific Security techniques, Secure Execution Environments and Communications in cloud.

Unit V. Issues in cloud computing

Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud.

TEXT BOOK:

1. Enterprise Cloud Computing by Gautam Shroff,Cambridge publication

REFERENCE BOOK:

1. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley -India
2.. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication

B. **Practicum** **2 Credits**

The students shall explore development of web applications in cloud. Practically Design and develop processes involved in creating a cloud based application and programming using Hadoop

Indicative List of Experiments

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS with virtualization support
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Experiment a procedure to transfer the files from one virtual machine to another virtual machine.
6. Experiment a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
7. Install Hadoop single node cluster and run simple applications like word count.

INTERNET OF THINGS

1. To learn the concepts of Sensors, Wireless Network and Internet
2. To learn and implement use of Devices in IoT technology.
3. To learn the different IoT Technologies like Micro -controller, Wireless communication like Blue Tooth, GPRS, Wi-Fi and Storage and embedded systems
4. To understand how to program on embedded and mobile platforms including different Microcontrollers like ESP8266, Raspberry Pi, Arduino and Android programming
5. To understand how to make sensor data available on the Internet (data acquisition) and understand how to analyze and visualize sensor data
6. To understand, analysis and evaluate different protocols used in IoT.
7. To learn basic python programming for IoT applications
8. To learn and design different applications in IoT.
9. To design, develop and test different prototypes in IoT.

SYLLABUS **6 credits**

UNIT I. (Introduction to IoT, Sensors and Actuators) Introduction to IoT: Definition, Characteristics, Applications, Evolution, Enablers, Connectivity Layers, Addressing, Networking and Connectivity Issues, Network Configurations, Multi -Homing, Sensing: Sensors and Transducers, Classification, Different Types of Sensors, Errors, Actuation: basics, Actuator Types- Electrical, Mechanical Soft Actuators

UNIT II. (Introduction to Networking, Communication Protocols and Machine-to-Machine Communication) basics of Networking, Communication Protocols, Sensor Network, Machine to Machine Communication (IoT Components, Inter-Dependencies, SoA, Gateways, Comparison Between IoT & Web, Difference Protocols, Complexity of Networks, Wireless Networks, Scalability, Protocol Classification, MQTT & SMQTT, IEEE 802.15.4, Zigbee)

UNIT III. (Arduino Programming) Interoperability in IoT, Introduction To Arduino Programming, Integration Of Sensors And Actuators With Arduino

UNIT IV. (Python Programming and Raspberry Pi) Introduction to Python Programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Implementation of IoT with Raspberry Pi

UNIT V. (Data Analytics and Cloud Computing) Data Handling and Analytics, Cloud Computing Fundamentals, Cloud Computing Service Model, Cloud Computing Service Management and Security, Sensor-Cloud Architecture, View and Dataflow

UNIT VI. (FOG Computing and Case Studies) FOG Computing: Introduction, Architecture, Need, Applications and Challenges

UNIT VII. Industrial IoT, Case Studies: Agriculture, Healthcare, Activity Monitoring

REFERENCE BOOKS

- The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).
- Internet of Things: A Hands-on Approach", by A Bahga and Vijay Madisetti **(Universities Press)**

Eligibility for admission to B.Sc(Hons)Computer Science :

10+2 Science with mathematics as a subject With 50% marks

Examinations: As per University norms for
B.Sc(Hons)Computer Science Courses.