Structure & Syllabus for Final Year Engineering (CSE) from Academic Year 2019- 20 (CBCS Pattern)

Semester- I

Sr. No	Code	Subject	Contact Period (Hrs.)			Credits	Continuous Evaluation in terms of Marks						
			L	T	P		Class Test I	Class Test II	TA	ESE	TW	PR	Total
1	CS4001	Big Data Analytics	3	-	-	3	15	15	10	60	-	-	100
2	HSXXXX	Humanity & Social Science	2	-	-	2	-	-	20	30	-	-	50
3		Professional Elective I	3	1	-	4	15	15	10	60	-	-	100
4		Professional Elective II	3	1	-	4	15	15	10	60	-	-	100
5		Open Elective III	3	-		3	15	15	10	60	-	-	100
6		Lab Professional Elective I	-	-	2	1	-	-	-	-	25	25	50
7		Lab Professional Elective II			2	1					25	25	50
8	CS4002	Project I	-	-	4	2	-	-	-	-	50	-	50
		Total	**14**	**2**	**8**	**20**	**60**	**60**	**60**	**270**	**100**	**50**	**600**

Semester- II

Sr. No	Code	Subject	Contact Period (Hrs.)			Credits	Continuous Evaluation in terms of Marks						
			L	T	P		Class Test I	Class test II	TA	ESE	TW	PR	Total
1	HSXXXX	Humanity & Social Science	3	-	-	3	15	15	10	60	-	-	100
2		Professional Elective III	3	1	-	4	15	15	10	60	-	-	100
3		Professional Elective IV	3	1	-	4	15	15	10	60	-	-	100
4	CS4005	Open Elective IV	3	-	-	3	15	15	10	60	-	-	100
5		Lab Professional Elective III	-	-	2	1	-	-	-	-	25	25	50
6		Lab Professional Elective IV	-	-	2	1	-	-	-	-	25	25	50
7	CS4003	Project II	-	-	12	6	-	-	-	-		100	100
		Total	**12**	**2**	**14**	**22**	**60**	**60**	**40**	**240**	**50**	**150**	**700**
		Grand Total	**26**	**4**	**22**	**42**	**120**	**120**	**100**	**510**	**150**	**200**	**1300**

L = Lecturer, **T** = Tutorial, **P** = Practical, **TA** = Teacher Assessment, **ESE** = End Semester Examination

Professional Elective I
CS4006:Computer Graphics
CS4007:Image Processing
CS4008: Cloud Computing

Professional Elective II
CS4009:Software Testing & Quality Assurance
CS4010:Natural Language Processing
CS4011:Artificial Intelligence

Professional Elective –III
CS4018: Computer Vision
CS4019:Neural Network and Deep Learning
CS4020:Design of Linux Operating System

Professional Elective -IV:
CS4021:Information Retrieval
CS4022:Cryptography & Network Security
CS4023:Distributed Databases

Approved in XVII th Academic Council, dated 10/01/2018

CS 4001: Big Data Analytics

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test 1	15 Marks
			Test 2	15 Marks
			Teacher Assessment	10 Marks
Total Credits	3		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Pre-requisites: None

Course Description:

This course will introduce the concept of big data and challenges in managing and processing of big data. The course will introduce the component of hadoop framework like, managing big data on HDFS, processing data using Map-reduce and different other components such as Pig, Hive, HBase and ZooKeper.

Course Educational Objectives:

1. To learn about basic concepts, technical challenges, and opportunities in big data
2. To learn about data analysis tools such as Hadoop Map Reduce, Pig, Hive and others
3. To learn about different types of scenarios and applications in big data analysis
4. To learn about common algorithms used to perform big data analysis
5. To understand high performance computing using map reduce, hadoop and nosql

Course Outcomes Expected:

After completing this course, students will able to:

CO1: Find meaningful pattern in data

CO2: Graphically interpret data

CO3: Implement the analytic algorithms

CO4: Handle large scale analytics projects from various domains

CO5: Develop intelligent decision support systems

UNIT-1	Introduction to Big Data Analytics Big Data Infrastructure and Systems-Hbase and Hadoopdb, Hadoop distributed File system-HDFS, MapReduce, Pig, Hive, Mahout
UNIT-2	Text Processing in MapReduce, Language Models and Machine Translation , Inverted Indexing and Search Learning for scalable text analysis,

UNIT-3	Algorithms for Big Data: Finding Similar Items and Frequent Itemsets
UNIT-4	Analyzing Relational Data SQL on Hadoop, Relational Data Processing with Spark
UNIT-5	Analyzing Graphs Graph Representations, Page Rank and Random Walks

TEXT AND REFERENCE BOOKS

1. **Tom White, "Hadoop: The Definitive Guide", Second Edition, O'Reilly Yahoo Press.**
2. **Robert D. Schneider, "Hadoop for Dummies", Wiley.**
3. **Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing.**

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				M				H	H			
CO2	L			L				H	H			
CO3								M	H			
CO4	H								H	M		
CO5	M	M	M	M				M		H		

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1. Simulation
2. Application development
3. Power point presentation of case studies
4. Question & answer
5. Quiz

Special Instructions if any: Nil

Designed by

- Mrs. Meghana B. Nagori
- Mrs. Pallavi V. Kulkarni

Approved in XVIIth Academic Council, dated 10/01/2018

Professional Elective I

CS4006: Computer Graphics

Teaching Scheme		Evaluation Scheme	
Lectures	3 Hrs/Week	Test 1	15 Marks
		Test 2	15 Marks
Tutorial	1 Hrs/Week	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: NIL

Course Description: Overview of different hardware devices used for Graphical interface is give in this course. This course contains derivation of basic graphics formulae and complex functions like transformations and clipping. Introduction of 3D concepts , animation and Multimedia is also given in this course.

Course Educational Objectives:

- To familiarize with the graphics techniques and algorithms.
- To make aware of the multimedia concepts and various I/O technologies.
- To elaborate different graphics command s/functions and algorithms for programming & animation.
- To make students able to develop their creativity & imagination in graphics designing.
- To evaluate mathematical concepts of graphics functions and methods.

Course Outcomes Expected:

After completion of this course students will be able to:
CO1: Apply computer programming to computer graphics, applications and problem solutions.(K1)
CO2: Apply graphics functions to create animation as games, cartoons etc.(K2)
CO3: Ready to work in virtual reality environment. (K2)
CO4: Match graphics objects with real world application.(K3)
CO5: Develop advanced application in image processing, scientific, research & various fields.(K3)

UNIT 1 **Computer Graphics System**

Overview of Computer Graphics, Computer Graphics Application and Software, Video display devices :- Color CRT Monitors, Raster scan & Random Scan Display Systems, DVST, Flat Panel Display :- LCD ,LED, Plasma display. 3D Viewing devices, Input & Output Devices.

Unit 2 **Graphics Output Primitives**

Scan Conversion, Rasterization, Line drawing algorithms, Circle drawing algorithms, Ellipse drawing algorithms, Character generation, Color Models & color application, Filled area algorithms, Aliasing & anti-aliasing.

Unit 3 **Two Dimensional Transformations, Clipping and windowing**

Basic transformations: Translation, Rotation, Scaling, Matrix representation and Homogeneous

Coordinates, Composite transformations, Other Transformations: Reflection & Shear, Line Clipping algorithm, Viewing transformation, Polygon clipping algorithm, Interior/Exterior clipping, Text clipping.

Unit 4 **Basic 3D concepts and Computer Animation**
Different 3D display methods: Parallel projection, Perspective projection and Depth cueing, Basic 3D transformations, Spline representation, B-Spline curves & surfaces, Bezier curves & surfaces, Fractal geometry methods, classification of fractals, Design of animation sequences, animation functions, morphing, simulation, Virtual reality environments.

Unit 5 **Introduction to Shader based Open GL programming**
Structure of OpenGL applications, new revisions of OpenGL, comparison with other APIs. mobile devices and OpenGL ES ,basics of OpenGL Shader Language and basic shaders

TEXT BOOKS:

1. A. P. Godse ,"Computer Graphics & Multimedia Techniques", – Technical Publications, Pune
2. OpenGL Programming Guide: The Official Guide to Learning OpenGL by Dave Shreiner8th edition
3. OpenGL: A Primer (2nd Edition) by Edward Angel, 3rd edition

REFERENCE BOOKS:

1. Computer Graphics, " Donald Hearn and M", Pauline Baker, PHI
2. http://www.cs.rit.edu/~ncs/Courses/570.shtml
3. Rajesh K.Maurya, "Computer Graphics",Wiley
4. HarshalArolkar&, " Sonal Jain Simplifying C",DreamTech
5. Wolff:OpenGL 4 Cookbook

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3			H									
CO4											L	
CO5											L	

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mrs. Arjumand M. Khan
- Mrs. Vrushali A. Chakkarwar
- Mr. Vikul J. Pawar

Approved in XVII th Academic Council, dated 10/01/2018

CS4007: Image Processing

Teaching Scheme		Evaluation Scheme	
Lectures	3 Hrs/Week	Test 1	15 Marks
		Test2	15 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: MA2001: Engineering Mathematics-III, CS1001: Basics of Computer & Information Technology.

Course Description: Images and visual information are integral parts of our daily lives. Digital image processing plays an important role in various practical applications among them: television, medical imaging modalities such as X-ray or ultrasound, photography, security, astronomy and remote sensing. This subject will introduce the fundamentals of image processing and manipulation. While image applications will be used for illustrations, the subject emphasizes general principles of image processing rather than specific applications. To know and understand how computers can process digital images. To know some of the basic operations (their basis, implementation and consequences) in image processing

Course Educational Objectives:

- Introduce the scope of field of image processing and basic concepts in digital image processing.
- Demonstrate different of image enhancement techniques.
- Describe different segmentation & compression techniques.
- Analyze different morphological techniques.
- Construct a model for object recognition.

Course Outcomes Expected:

After completion of this course student will be able to

CO1: Describe the theory and algorithms that are widely used in digital image processing K2
CO2: Apply a proper image enhancement technique for given a set of noisy images. K3
CO3: Compare different image segmentation and compression techniques. K3
CO4: Formulate solutions using morphological concepts. K3
CO5: Develop any application using different image processing techniques. K4

Detailed Syllabus:

UNIT-1 **Digital Image Fundamentals** Different fields of DIP, The digitized image and its properties – Image sampling and quantization ,image types, spatial Intensity and resolution, basic relationship between pixels, Mathematical tools used in DIP

UNIT-2 **Image Enhancement** – Basic Intensity transformation functions, Histogram processing, smoothing and sharpening filters in spatial and frequency domain , Periodic noise.
Image Restoration and reconstruction- A model of Image Degradation/ restoration Process, Noise Models, Mean filters, order statistics filters, Adaptive filters, and Notch filters.

UNIT-3 **Morphological Image Processing** – Erosion & Dilation, Opening & Closing , Hit or Miss Transformation, Boundary Extraction, Thinning, Thickening, Skeletons ,Pruning, Textural segmentation, morphological smoothing.

UNIT-4 **Image Segmentation** – Fundamentals, Point, line & Edge Detection, Thresholding, basic thresholding, global thresholding, multivariable thresholding, region growing, region splitting and merging.
Image Compression- Coding redundancy, measuring image information, fidelity criteria, image compression models, Huffman coding, Arithmetic coding, run length coding, symbol

based coding, bit plane coding, digital image watermarking.

UNIT-5 **Object recognition** –Need for object recognition system, automated object recognition system, patterns and pattern class, representation of pattern class, selection of measurement parameters, relationship between image processing and object recognition, approaches to object recognition, Bayes' parametric classification, Structural method-shape numbers, string matching, Face recognition.

TEXT BOOK :

1) Digital image processing, by Gonzales Woods 3rd Edition, Pearson Education
2) Digital Image Processing, by S Jayaraman, S Esakkirajan, T Veerakumar TMH Publication

REFERENCE BOOK:

1) Fundamental of Digital Image Processing by Anil K. Jain, PHI Pub.
2) Image Processing, Analysis and Machine Vision , by Milan Sonka ,Vaclav Hlavac , Roger Boyle Cengage Learning 3rd Edi

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										
CO2	H	H										
CO3	H	H		M								
CO4	H	H		H						M		
CO5	H	H		H		M				M		M

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mrs. Vrushali A. Chakkarwar
- Mr. Vikul J. Pawar
- Mr. Prashant D. Pathak

Approved in XVII th Academic Council, dated 10/01/2018

CS 4008: Cloud Computing

Teaching Scheme			Evaluation Scheme	
Lectures	3 Hrs/Week		Test 1	15 Marks
			Test 2	15 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	10 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: CS2002: Database Management System, **CS3010:**Computer Network

Course description: This course provides a comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS),Software as a Service (SaaS). It consists of topics like cloud service models, virtualization and cloud infrastructure, and security and management of cloud.

Course Educational Objectives:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
3. Understand the importance of protocols and standards in computing.

Course Outcomes Expected:

At the end of the course the student will be able to

1. Identify the appropriate cloud services for a given application.
2. Assess the comparative advantages and disadvantages of Virtualization technology.
3. Analyze authentication, confidentiality and privacy issues in cloud computing.
4. Identify security implications in cloud computing.
5. Understand the importance of protocols and standards in management for cloud services.

UNIT-1	**Introduction to Cloud Computing** Defining Cloud computing,Cloud architecture Characteristics, Components, Deployment Models: Public, Private, Hybrid, Service models: IaaS, PaaS, SaaS, Applications, Benefits & Limitations, Grid vs Cloud Computing.	
UNIT-2	**Cloud Infrastructure and Virtualization** Understanding Abstraction and virtualization: understanding virtualization technologies, Load Balancing and Virtualization, Understanding Hypervisors, Capacity Planning	
UNIT-3	**Cloud Administration and Security Management** Management responsibilities, lifecycle management, cloud management products, Cloud management standards. Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and	

	business consideration	
UNIT-4	**Case Studies** Amazon Cloud, Microsoft Azure Cloud, IBM Bluemix, Rackspace, Google Cloud	
UNIT-5	Introduction to Kubernets, Docker, CloudSIM, OpenStack, OpenNebula, Aneka Cloud	

TEXT AND REFERENCE BOOKS

1. RajkumarBuyya, "Cloud computing principles and paradigms", Wiley
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Edition.
3. Anthony Velte, tobyVelte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw-Hill Edition. Assessment Table (Terminology as per Blooms Taxonomy)

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	15	5	25
K2	Understand	15	00	20
K3	Apply	00	5	15
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
Total Marks 100		30	10	60

Assessment table

Assessment Tool	K1	K2	K3	K1	K3
	C01	C02	C03	CO4	CO5
Class Test (30 Marks)	15	15	00	00	00
Teachers Assessment (10 Marks)	05	00	00	05	00
ESE Assessment (60 Marks)	15	20	10	10	05

Special Instructions if any: Nil

Designed by

- Mr. Prashant D. Pathak

Approved in XVIIth Academic Council, dated 10/01/2018

Professional Elective II

CS 4009: Software Testing & Quality Assurance

Teaching Scheme			Evaluation Scheme	
Lectures	3 Hrs/Week		Test 1	15 Marks
			Test 2	15 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	10 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: CS3004: Software Engineering

Course Description: This course presents the knowledge about Testing background such introduction of Bug , cause of Bug, how it effect on cost of project, role of STLC cycle realities of software testing. This subject also gives the knowledge software testing fundamentals, under the study of types of testing this subject enlighten the Configuration testing, Compatibility testing, Foreign language testing, Usability testing, Testing the documentation, Testing for software security, Web site testing and more. At the end this subject focuses on the test planning and quality assurance.

Course Educational Objectives:

1. To discuss software testing background.
2. To introduce software testing techniques.
3. To explain different types of testing to understand realistic problem.
4. To develop analyzing techniques through automation testing tool.
5. To create awareness about the process part as per as software testing is concern.

Course Outcomes Expected:

After completing the course, students will able to:

1. Formulate problem by following Software Testing Life Cycle.
2. Design Manual Test cases for Software Project.
3. Identify the realistic problem for different category of software.
4. Use automation testing tool students will be able test the software.
5. Follow the process related activity and testing techniques to work as team member.

UNIT-1	**Introduction** – s/w testing background - What is a bug? Why do bugs occur? The cost of bugs. Goals of a software tester. Characteristics of s/w tester. Software development process- product component, software project staff, software development lifecycle model. The realities of s/w testing – testing axioms, s/w testing terms and definitions, Software Testing Life Cycle(STLC)
UNIT-2	**S/w testing fundamentals-** Examining the specifications - Black box and white box testing, Static and dynamic testing, Static black box testing, Performing a high level review of the specification, low level specification test techniques. Testing the s/w with blinders on – Dynamic black box testing, Test to pass and test to fail, Equivalence partitioning, data testing, State testing, Other black box test techniques. Examining the code – Static white box testing, Formal review, Coding standards and guidelines, Generic code review checklist. Testing the software with X-ray glasses – Dynamic white box testing, Dynamic white box testing, verses debugging testing the pieces
UNIT-3	**Types of testing-I-** Configuration testing, Compatibility testing, Foreign language testing, Usability testing, Testing the documentation, Testing for software security
UNIT-4	**Types of testing-II-** Web site testing, Automated testing and test tools-

	Benefits of automation and tools, various test tools, Software test automation, Random testing. Bug bashes and beta testing – Having other people test your s/w, Test sharing, Beta testing, Outsourcing your testing. Performance Testing – Introduction, Benefits of performance testing. Types of performance testing Tools for performance Testing, Process for performance testing, challenges.
UNIT-5	**Test planning and quality assurance** –Planning the test – Goal of test planning, Various test planning topics, Writing and tracking test cases- Goal of test case planning, Test case planning overview, Test case organization and tracking, Reporting what you find - Getting the bug fixed, Isolating and replacing bugs, Bug's lifecycle, Bug tracking system, Measuring the success, Software quality assurance- Quality is free, Testing and quality assurance in the work place, Test management and organizational structures, capability maturity model (CMM), ISO 9000 Test Metrics and Measurement – Test Defect Metrics – Defect find rate, Defect fix rate, outstanding defects rate, priority outstanding rate, Defect trends, Defect classification trend, weighted defects trend, Defect cause distribution. Productivity Metrics – Defect per 100 hours of testing, Test Cases Educated per 100 Test Cases, Defects per 100 failed test cases, Test phase Effectiveness, Closed Defect Distribution

TEXT BOOKS:

1. Ron Patton, "Software Testing" SAMS Publishing
2. Marnei L. Hutcheson – "Software Testing Fundamentals: Methods and Metrics" WILEY Pub.

REFERENCE BOOKS:

1. Pressman "Software Engineering" McGraw-Hill publications
2. StrinivasanDesikan and GopalswamiRamesh,"Software Testing – Principles and Practices" Pearsons

Mapping of Course outcome with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				H								
CO2			H									
CO3			M									
CO4										H		
CO5										M	M	

High-H Medium-M Low-L

Special Instructions if any: Nil

Designed by

- Mr. Vikul J.Pawar
- Mrs. Vrushali A. Chakkarwar
- Mr. Prashant D. Pathak

Approved in XVIIth Academic Council, dated 10/01/2018

CS4010: Natural Language Processing

Teaching Scheme		Evaluation Scheme	
Lectures	3 Hrs/Week	Test 1	15 Marks
		Test 2	15 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisite:CS3011: System Programming & Compiler Construction

Course Educational Objectives:

1. Teach students the leading trends and systems in natural language processing
2. Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language
3. Make them capable to describe the application based on natural language processing and to show the points of syntactic, semantic processing

Course Outcomes Expected:

After Completing the course student will be able to

CO1: Describe the mathematical and linguistic foundations underlying approaches to the areas in NLP. (Measured by problem sets and quizzes).

CO2: Design, implement and test algorithms for NLP problems (measured by problem sets).

CO3: Apply basic algorithms in the field, Morphology syntax semantics and pragmatics as well as the resources of natural language data corpora.

CO4: Grape basics of knowledge representations, inference and relations to the artificial intelligence.

CO5: Find opportunities for research and prepare to conduct research in NLP or related fields.

UNIT 1	Motivation for studying NLP; Natural Language Processing as the forcing function of AI; Classical approaches to NLP with knowledge bases and linguistic rules; Data Driven and Machine Learning Approaches to NLP; Efficient, Robust and Scalable NLP	**[6]**
UNIT 2	Classical NLP: Linguistics Fundamentals: Syntax and Parsing: Meaning:	**[6]**
UNIT 3	Empirical or Statistical NLP: Probabilistic Methods on Introductory Graphical Models for NLP: Shallow Parsing: Probabilistic Parsing	**[6]**
UNIT 4	Applications: Machine Translation, Information Retrieval, Question Answering, Summarization, Information Extraction	**[6]**
UNIT 5	Biology and Sociology of NLP: Neurolinguistics, Child Language Acquisition	**[6]**

TEXT BOOKS:

1. Jurafsky, Daniel, and James H. Martin, Speech and Language

Processing:An Introduction to Natural Language Processing, Speech Recognition,and Computational Linguistics, PrenticeHall, 2000.
2. Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing. Cambridge, MIT Press, 1999.

REFERENCE BOOKS:

1. James Allen, Natural Language Understanding, Benjamin/Cummings, 2ed, 1995.
2. Eugene Charniak, Statistical Language Learning, MIT Press, 1996.
3. Martin Atkinson, David Britain, Harald Clahsen, Andrew Redford, Linguistics, Cambridge University Press, 1999.
4. P. Lieberman, Toward an evolutionary biology of language, Harvard university Press, 2006.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	H									M		
CO3	H	H								M		
CO4	H	H								M		M
CO5	H	H								M		M

H – High M – Medium L - Low

Special Instructions if any: Nil

CS 4011: Artificial Intelligence

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test 1	15 Marks
Tutorial	1 Hrs/Week		Test 2	15 Marks
			Teacher Assessment	10 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Perquisites:CS2003: Discrete Mathematical Structures ,Cs2008:Data Structures,CS2001: Object Oriented Programming

Approved in XVIIth Academic Council, dated 10/01/2018

Course Description: This course will examine the area of wireless networking and mobile computing, looking at the unique network protocol challenges and opportunities presented by wireless communications and host or router mobility. The course will give a brief overview of fundamental concepts in mobile wireless systems and mobile computing, it will then cover system and standards issues including wireless LANs, mobile IP, ad-hoc networks, sensor networks, as well as issues associated with small handheld portable devices and new applications that can exploit mobility and location information. This is followed by several topical studies around recent research publications in mobile computing and wireless networking field.

Course Educational Objectives:

1. To introduce to the basic concepts of Artificial Intelligence, with illustrations of current state of the art research and applications.
2. To recognize the characteristics of AI that make it useful to real-world problems.
3. To identify the type of an AI problem(search inference, decision making under uncertainty, game theory,etc.)
4. To describe the strengths and limitations of various state-space search algorithms, and choose the appropriate algorithm.

Course Outcomes Expected:

After completing the course, students will able to:

1. Exhibit strong familiarity with a number of important AI techniques, including in particular search, knowledge representation, planning and constraint management.
2. Interpret the modern view of AI as the study of agents that receive percepts from the environment and perform actions.
3. Build awareness of AI facing major challenges and the complexity of typical problems within the field.
4. Assess critically the techniques presented and apply them to real world problems.
5. Develop self-learning and research skills to tackle a topic of interest on his/her own or as part of a team.

Detailed Syllabus:

UNIT-1	**Introduction:** Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I. **Intelligent Agents**: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.
UNIT-2	Solving Problems by Searching, Study and analysis of Various searching algorithms. Implementation of Depth-first search Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search Informed (Heuristic) Search Strategies: Greedy bestfirst search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating, admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience **Beyond Classical Search**

	Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic Actions: AND-OR search trees, Searching with Partial Observations
UNIT-3	Adversarial Search and Constraint Satisfaction Problems, Study of minimax algorithm **Adversarial Search:** Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha--Beta Pruning, Move ordering , Imperfect Real-Time Decisions, Evaluation functions, Cutting off search, Forward pruning, Search versus lookup, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Alpha-beta pruning and CSP, Implementation aspects of minimax algorithm and CSP.
UNIT-4	**Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees **Learning from Examples:** Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, Inducing decision trees from examples.
UNIT-5	**Logical Agents:** Knowledge representation structures: Frames, semantic net, Scripts, Logic: Prepositional Logic, Prepositional Theorem Proving, Inference and proofs, Proof by resolution, Conjunctive normal form, Horn clauses and definite clauses, Forward and backward chaining, A complete backtracking algorithm, Syntax and Semantics of First-Order Logic, Symbols and interpretations, Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG) Natural language processing and Expert systems, **Natural Language Processing:** Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic Processing, Implementation aspects of Syntactic Analysis (Parsing)

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	Expert Systems: What is Expert system, Components of Expert System, Case studies on Expert System

Text Books:

1. Artificial Intelligence: A Modern Approach by Peter and Norvig ISBN-0-13- 1038052

Reference Books:

1. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0-07- 008770-5, TMH,
2. Prolog Programming for A.I. by Bratko, TMH
3. Artificial Intelligence by SarojKausik ISBN:- 978-81-315-1099-5, Cengage Learning
4. Artificial Intelligence and Intelligent Systems by Padhy, Oxforfd University Press,

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M							H			
CO2	M	M							H			
CO3	M	M							H			
CO4	M	M							H			
CO5								H				

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mrs. Meghana Nagori
- Mr. Sudhir G. Shikalpure

Lab Professional Elective I

CS 4012: Lab Computer Graphics

Teaching Scheme		**Evaluation Scheme**	
Practical	2 Hrs/Week	Team Work	25 Marks
Credits	1	Practical/Viva-voce	25 Marks

Total Hours required for this practical course: 30 Hours.
Prerequisites: NIL

Course Educational Objectives:
- To elaborate basic graphics functions/commands and algorithms for programming and animation.
- To elaborate multimedia concepts in programming related to audio and video.
- To enable the students to develop their programming creativity and imagination.
- To implement mapping of various functions related to real world applications

Course Outcomes:
After completion of this course students will be able to:
CO1: Apply different graphics functions and design GUI Platforms.
CO2: Create animations used in computer based games.
CO3:Apply different algorithms to create graphical application.
CO4: Ready to work in virtual reality environment.
CO5: develop advanced application in image processing , scientific, research & various fields.

Suggestive List of Programs –

1] To demonstrate basic graphics functions.
2] To illustrate DDA Line drawing Algorithm
3] To demonstrate Bresenhams Line drawing Algorithm
4] To perform Circle drawing Algorithm
5] To demonstrate Ellipse drawing algorithm
6] To perform program on Character generation.
7] To illustrate filled area algorithm.
8] To evaluate program for 2 D transformations.
9] To demonstrate Line clipping Algorithm
10] To perform program for Polygon clipping algorithm.

Miscellaneous

1. Program to make fish.
2. Program to make fish.
3. Open GL programs to draw a line .
4. Open GL programs to draw a sunrise & fall .

Program for simple gaming as bouncing ball ,tic tac toe.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H									

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CO2		H	H									
CO3		M	M									

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mrs. Arjumand M. Khan
- Mrs. Vrushali A. Chakkarwar
- Mr. Vikul J. Pawar

CS 4013: Lab Image Processing

Teaching Scheme
Practical 2 Hrs/Week
Credit 1

Evaluation Scheme
Term Work : 25 Marks
Practical/Viva-voce: 25 Marks

Total Hours required for this practical course: 30 Hours.

Prerequisite: CS1001: Basics of Computer & Information Technology

Course Outcomes Expected:
After completion of this course student will be able to
- CO1: Perform image related operations. K2
- CO2: Apply a proper filter for given a set of noisy images. K3
- CO3: Analyse different image segmentation and compression techniques. K3
- CO4: Demonstrate different morphological operations. K4
- CO5: Develop any application using different image processing techniques. K4

Suggestive list of practical is

Sr. No.	TITLE
1	To study Mat lab toolbox.
2	To perform simple arithmetic operations on images.
3	To implement program for image enhancement using histogram equalization.
4.1	To study and implement the program addition of different type of noise's to images.
4.2	To study and implement program of low pass and high pass filter using Gaussian filter.
5	To implement program of the edge detection using different type of method
6	To implement program to perform different morphological operations on images and reduce noise using morphological operations in images.
7	To study and implement program of the different type of texture effect on images.
8	To study and implement a program to detect a cell using image segmentation.
9	To study and implement the program of bit plane coding.
10	To study and implementation of wavelet-based watermarking.

The list is indicative only. Scope of the subject should not be limited to the same.

Reference Book:

1. Rafael C. Gonzalez , Richard E. Woods, Steven L. Ed ,Digital Image Processing Using MATLAB, 2nd ed, Gatesmark publishing.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H		M								
CO2	H	H		M								

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CO3	H	H		M								
CO4	H	H		M								
CO5	H	H		M								M

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mrs. Vrushali A. Chakkarwar
- Mr. Vikul J. Pawar
- Mr. Prashant D. Pathak

CS 4014: Lab Cloud Computing

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credit:	1	**Pract. Exam**	:	25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

List of Experiments

1. Study Cloud Architecture and its service models

2.To implement the service model of "Software as a Service".

3.To implement the service model of "Platform as a Service". Deploy an application on Google App Engine or anyother open source platformproviders.

4.Implement the service model of "Infrastructure as a Service". Use IBMBlueMix cloud or any other open sourceframework for IaaS.

5. Tocreate virtual machines using virtual box or Vmware on windows or Linux platform and know its various features (Virtualization Concept)

6. Implement encryption algorithm for securing data on cloud

7. Study and prepare a SLA Document between Cloud service provider and User

8. Migrate a Virtual Machine from one node to another node.

9. Implementation procedure for configuring OpenStack

10. Compare major cloud service providers

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Lab Professional Elective II

CS4015: Lab: Software Testing & Quality Assurance

Teaching Scheme			Evaluation Scheme	
Lectures	2 Hrs/Week		Term Work	25 Marks
			Practical Exam	25 Marks
Total Credits	1		Total Mark	50 Marks

Prerequisite:
Laboratory Course Outcome:
After completion of this course student will be able to

CO1: Design and construct the manual test cases for different software module.
CO2: Construct the test cases in automation testing tool.
CO3: Record the test cases in different mode.
CO4: Design and construct the test cases for checking GUI objects and checking bitmap objects
CO5: Design and construct the test cases for testing program using TSL.

Minimum of 8 programs should be completed which will be based on the subject and record for the same shall be submitted.

Suggestive list of programs –

1. Examine the SDLC with software development models.
2. Design and construct the test cases through manual testing.
3. Examine the UFT Testing tool.
4. Design and construct the test cases in Context sensitive mode.
5. Design and construct the test cases in Analog mode.
6. Design and construct the test cases through Synchronizing testing.
7. Design and construct the test cases for Checking Bitmap Objects.
8. Construct Excel sheet and insert data in to it using UFT.
9. Design and construct the test cases using Selenium.
10. Examine the Automation Testing Tool.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H	H		L					L	
CO2			H			L				M		
CO3		H										
CO4			H									
CO5			H									

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mr. Vikul J.Pawar
- Mrs. Vrushali A. Chakkarwar
- Mr. Prashant D. Pathak

CS4016: Lab Natural Language Processing

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credit :	1	**Pract. Exam**	:	25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

The objective of Natural Language Processing lab is to introduce the students with the basics of NLP which will empower them for developing advanced NLP tools and solving practical problems in the field.

1. **Word Analysis**
2. **Word Generation**
3. **Morphology**
4. **N-Grams**
5. **N-Grams Smoothing**
6. **POS Tagging: Hidden Markov Model**
7. **POS Tagging: Viterbi Decoding**
8. **Building POS Tagger**
9. **Chunking**
10. **Building Chunker**

References :

1. Jurafsky and Martin: "Speech and Langugage Procesing", Prentice Hall, 2000.
2.Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: A Paninian Perspective", Prentice-Hall of Indiaa , New Delhi, 1995.

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CS4017: Lab Artificial Intelligence

Teaching Scheme:

Practical : 2 Hrs/Week

Credit : 1

Examination Scheme:

Term Work : 25 Marks

Pract. Exam : 25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

CS4003: Project I

Teaching Scheme			**Evaluation Scheme**	
Practical	4 Hrs/Week			
			Term Work	50 Marks
Total Credits	2			

Course Outcomes:

After completing this course, students will able to:
CO1: Identify and Finalize problem statement by surveying variety of domains.
CO2: Perform requirement analysis and identify design methodologies
CO3: Apply advanced programming techniques
CO4: Present technical report by applying different visualization tools and Evaluation metrics..

The project will consist of the work on the topic selected for the project .The project must be done in a group not exceeding four students. .

The candidate is expected to select the project, do the requirements analysis, and carry out the necessary design procedure.

Term Work:

The assessments of the term work should be done by two internal examiners, one of which will be the guide and the other will be HOD or senior staff member from the department.

Guidelines for completing the Project I:

- Weekly report of students work for finalization of his area of work and topic of project should be submitted to the faculty during designated hours meant for seminar

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- Format of weekly report should be finalized by the department with sufficient inputs received from the students. It should have following stage wise reports:

  Project Area and Project Groups by 3rd week

  Tentative project problem statements by 5th week

  Literature/Field Study Mechanism identified sources and strategy by 6th week

  Weekly report on Literature/Field Study 6th, 7th& 8th week

  Trial design sheets, SRS, ER diagrams, compilation of field data, trial database design and normalization, Hardware design documents, prototype software or hardware modules designed/developed 9th to 11th week

  Journal on above stages and Final Presentation Report 12th week

- It is expected that the group of candidates prepare a report based on outcomes of literature studies, field visits, observation schedules, focus group meetings etc related to the problem statement. It shall include trial design documents, SRS, Hardware and software prototypes, Testing strategy
- The report shall be tested for any plagiarism out of books, journals and internet based articles and reports by appropriate web based tool.
- Assessment criteria for term work assessment should be viva voce examination by two examiners appointed by the department
- Assessment criteria for seminar delivery for term work should be designed by the faculty with inputs received from students of the class. It should include provision for peer group assessment if possible.
- Assessment Criteria so designed will be displayed on the department notice board with the approval from department along with these guidelines.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				H							H	L
CO2										H	H	
CO3								H	H		H	
CO4						H					H	

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by
All Faculty

Professional Elective III
CS4018: Computer Vision

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test 1	15 Marks
		Test 2	15 Marks
Tutorials	1	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: MA2001:Engineering Mathematics-III, CS1001:Basics of Computer & Information Technology, CS2003:Discrete Mathematical Structures

Course Description: This course is designed for undergraduate students interested in vision, graphics, artificial intelligence, and machine learning. It offers a broad introduction to common vision problems, theories, and algorithms. The course is also aimed at developing critical thinking and understanding when and how these algorithms can be applied to particular applications. This course is an introduction to fundamental vision concepts, including: image formation; color; key point and edge detection; segmentation; perceptual grouping; object/activity recognition; and 3D scene reconstruction.

Course Educational Objectives:

- To review image processing techniques for computer vision
- To illustrate shape and region analysis
- To describe Hough Transform and its applications to detect lines, circles, ellipses
- To discuss three-dimensional image analysis techniques
- To discuss motion analysis
- To explore some applications of computer vision algorithms

Course Outcomes Expected:
After completing the course, students will able to:
CO1: Describe different image representation, their mathematical representation and different their data structures used. K2
CO2: Classify different segmentation algorithm for given input K2
CO3: Create a 3D object from given set of images K3
CO4: Detect a moving object in video using the concept of motion analysis K3
CO5: Recognize the object using the concept of computer vision K4

Detailed Syllabus:

UNIT-1 **The image, its representations and properties –** image representations a few concepts, Image digitization, Digital image properties, Color images, Cameras : an overview.
Mathematical and physical background – Linear integral transforms, Images as stochastic processes, Image formation physics.

UNIT-2 **Data structures for image analysis-** levels of image data representation, traditional image data structures, and Hierarchical data structures. Image understanding-fitting via random sample consensus, point distribution model

UNIT-3 **Segmentation II –** Mean Shift Segmentation , Active contour models – snakes, Geometric deformable model – level sets and geodesic active contours, Fuzzy connectivity, Towards 3D

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graph – based image segmentation, Graph cut segmentation

UNIT-4 **3 D Vision Geometry** – 3 D Vision tasks, basics of projective geometry, A Single perspective camera, Scene reconstruction from multiple views, two camera stereopsis, **Use of 3D vision** Shape from X, Full 3D objects, 3D model-based vision, 2D view-based representations of a 3D scene

UNIT-5 **Motion Analysis**- Different Motion Analysis methods, Optical flow, analysis based on correspondence of interest points, Detection of specific motion patterns, video tracking

TEXT BOOK :

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Digital Image Processing and Computer Vision" Cengage Learning, 1st Edition, 2008

REFERENCE BOOK:

3) Digital image processing, by Gonzales Woods 3rd Edition, Pearson Education
4) Fundamental of Digital Image Processing by Anil K. Jain, PHI Pub.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H									H		
CO2	H	H		H						H		
CO3	H	H		H						H		
CO4	H	H		H						H		
CO5	H	H		H						H		H

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) Surprise Test
3) Power point presentation of any IEEE paper in field of image processing
4) Quiz
5) Developing Small applications .

Special Instructions if any: Nil

Designed by

- Mrs. Vrushali A. Chakkarwar
- Mrs. A. M. Khan
- Mr. Vikul J. Pawar

CS4019 : Neural Network & Deep Learning

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test 1	15Marks
		Test 2	15Marks
Tutorials	1 Hrs/Week	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisite: Nil

Course Description: This course examine the history of neural networks and state-of-the-art approaches to deep learning. Students will learn to design neural network architectures and training procedures via hands-on assignments. Students will read current research articles to appreciate state-of-the-art approaches as well as to question some of the hype that comes with the resurgence of popularity.

Course Educational Objectives:

Course Outcomes Expected:

After Completing the course student will be able to

CO1: Differentiate between Neural network & deep Learning

CO2:Identify real Time problems where deep learning is applicable

CO3: Describe Deep learning Model to solve real time problem.

CO4:Analyze & Evaluate Deep Learning Model

CO5: Find opportunities for research and prepare to conduct research in Deep Learning or related fields.

UNIT 1	History Perceptrons (classification) linear models (regression) Hebbian learning LMS activation functions error functions back propagation local and distributed representations	**[6]**
UNIT 2	Deep learning Recent developments in deep neural networks (esp. min 26-40) ,Overview of ways to improve generalization ,Limiting the size of the weights ,Using noise as a regularizer The ups and downs of back propagation ,Dropout , Introduction to the full Bayesian approach ,The Bayesian interpretation of weight decay	**[6]**
UNIT 3	Recurrent networks Modeling sequences: A brief overview ,Training RNs with back propagation , A toy example of training an RNN ,Why is it difficult to train an RNN? ,Long short-term memory ,Echo state networks , Hessian free optimization ,Learning to predict the next character	**[6]**
UNIT 4	Probabilistic neural nets ,Boltzmann machines ,RBMs ,sigmoid belief nets Generative models Application domains: object recognition , language, speech recognition	**[6]**
UNIT 5	Eliana Colunga on concept/word learning, Limitations of deep learning	**[6]**

TEXT BOOKS:

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1. Neural Networks and Deep Learning by Michael Nielsen

REFERENCE BOOKS/Articles:

1. Deep Learning Neural Networks: Design and Case Studies **By** Daniel Graupe
2. Bengio, Learning deep architectures for AI (section 1)
   Chronicle of Higher Education article on Deep Learning
3. Manjunath: Visualizing and understanding convolutional neural networks (2013)

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	H									M		
CO3	H	H								M		
CO4	H	H								M		M
CO5	H	H								M		M

H – High M – Medium L - Low

Special Instructions if any: Nil

CS 4020: Design of Linux Operating System

Teaching Scheme			Evaluation Scheme	
Lectures	3 Hrs/Week		Test 1	15 Marks
			Test 2	15 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	10 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 45 Hours.

Prerequisites: CS3002: Operating System, CS2011: Lab Open Source Software Technology

Course Outcome: This course covers design principles of Linux Operating System, algorithms for process management, memory management. Structure of File system and virtual file system is also elaborated. This course contains details of shell programming and introduces system administration.

Course Educational Objectives:

1. To Classify Linux kernel mode with user mode and differentiate Kernel structuring methods.
2. To Describe Process management and Thread management strategies.
3. To Demonstrate internal file system structure with device drivers and file operations using system calls.
4. To Summarize the principles of Virtual memory as applied to paging & caching techniques.
5. To Contruct shell scripts with different programming syntax
6. To prepare for various OS case studies.
7. To implement R programming in Linux OS(platform)

Course Outcomes Expected:

After completing the course, students will able to:

CO1: Classify Linux Kernel mode with user mode & contrast between Kernel structures. (K3)

CO2: Identify and estimate process management & thread management strategies along with their different operations (Process creation) (K2)

CO3: Implement different system calls for various file handling operations. (K2).

CO4: determine paging and Caching techniques related to Virtual Memory. (k2,K4).

CO5: construct shell scripts. (k3,k6)

CO6: debate various case studies. (K4).

CO7 :Implement R commands & create some Basic programs of R in Linux(k5,k6)

Sample Assessment Table (Terminology as per Blooms Taxonomy)

UNIT-1	**Introduction to Linux operating and Kernel:-** Overview of operating system and kernel, Features of linux, Obtaining the Kernel source ,Building & configuring the kernel, Types of kernels , Kernel modules, Design principles of Linux system.
UNIT-2	**Process Management** :-Process management: The Process Descriptor and task structure, Process creation, , process termination.Thread definition, Motivation for Threads,Thread States: Life Cycle of a,Thread,Thread Operations Threading Models -User-Level Threads *Kernel-Level Threads.Process scheduling-Policy,* preemption and context switching
UNIT-3	**Filesystem /IO and system calls:** Inodes, directories, Device drivers ,CharacterDevices,Blockdevices,Network device. System calls & their implementation: Open, create, read, write, fseek, pipe, dup, chair, chown, change, mode, state & stat

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UNIT-4	**Virtual file system and Memory Management:-** Pages, Zones, Slab layer and Slab allocator interface, Virtual file system, Ext2 filesystem ,Ext3 filesystem, Procfilesystem. Case studies :- Embedded Linux, Real time linux,Linux with Android
UNIT-5	**Shell Programming and System Administration:** Writing simple shell scripts , command line arguments, if then else, case, do while, for loop, until loop, operators, advanced shell programming, requirements of system administration. Installation of R on linux,study of basic R commands as ls,rnorm,cd,rm etc in linux terminal,study of datastructure,variables & functions in linux terminal/editor.

TEXT AND REFERENCE BOOKS

1. Maurice Bach , "The Design of Unix Operating System", Pearson Education
2.Robert Love, "Linux Kernel Development ", Person Education
3.StephanPrata, "Advance Unix-Programmers Guide", SAMS Publication

4.TomAdelstein and Bill Lubanovic, "Linux System Administration", O'Reilly Media, Inc., 1st Edition, 2007.ISBN-10: 0596009526 | ISBN-13: 978-0596009526
5.Harvey M. Deitel, "Operating Systems", Prentice Hall, 3rd Edition,2003, ISBN-10: 0131828274 | ISBN-13: 978-0131828278
6.ABRAHAM SILBERSCHATZ ,PETER BAER GALVIN GREG GAGNE

, "Operating System Concepts", 7th edition by

URL for R(linux):-

https://linuxconfig.org/running-gnu-r-on-linux-operating-system

https://cran.r-project.org/mirrors.html

https://www.rstudio.com/products/rstudio/download/

http://www.jason-french.com/blog/2013/03/11/installing-r-in-linux/

https://www.tutorialspoint.com/r/

http://www.tutorialspoint.com/r/r_tutorial.pdf

Mapping of Course outcome with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H	H						M			
CO2		H	H									
CO3		M										
CO4		M										
CO5		M	H								L	
CO6									H			
CO7		M							H			H

High-H Medium-M Low-L

Special Instructions if any: Nil

Designed by

- Mrs. Arjumand M. Khan
- Mrs. Pallavi V. Kulkarni
- Mr.Vivek K. Kshirsagar

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Professional Elective IV

CS 4021: Information Retrieval

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test 1	15 Marks
		Test 2	15 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	10 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: MA2001:Engineering Mathematics-III, CS1001: Basics of Computer & Information Technology , CS2003:Discrete Mathematical Structures

Course Description: This is an introductory course for students covering the practices, issues, and theoretical foundations of organizing and analyzing information and information content for the purpose of providing intellectual access to textual and non-textual information resources. This course will introduce students to the principles of information retrieval systems and models, query expansion, queries, web crawling, taxonomy and ontology. Students will learn how effective information search and retrieval is interrelated with the organization and description of information to be retrieved. Students will also learn to use a set of tools and procedures for organizing information, will become familiar with the techniques involved in conducting effective searches.

Educational Objectives:

- To review informational retrieval system.
- To illustrate retrieval metric and query expansion.
- To describe query languages and properties.
- To discuss concepts of web crawling and web retrieval.
- To introduce taxonomy and ontology concepts

Course Outcomes Expected:

After completing the course, students will able to:

CO1: Illustrate the different query properties K2
CO2: Compare different search engine ranking techniques. K2
CO3: Analyze the different retrieval metrics for retrieval evaluation. K3
CO4: Construct a search engine. K4
CO5: Describe different ontology and taxonomy architectures and processes. K2

Detailed Syllabus:

UNIT-1 **Introduction:**
Information Retrieval Early Developments, Information Retrieval in Libraries and Digital Libraries, IR at the Center of the Stage, The IR Problem, The IR System, The Web
Modeling:
IR Models, Classic Information Retrieval, Other Models

UNIT-2 **Retrieval Evaluation and Query Expansion:**
Introduction, Retrieval Metrics, Implicit Feedback Through Global Analysis, Query Expansion based on a Similarity Thesaurus, Query Expansion based on a Statistical Thesaurus

UNIT-3 **Queries: Languages and Properties**
Query Languages, Keyword-Based Querying, Beyond Keywords, Structural Queries, Query Protocols
Query Properties, Characterizing Web Queries, User Search Behavior, Query Intent Query Topic, Query Sessions and Missions, Query Difficulty

UNIT-4 **Web Retrieval and Web Crawling**
Introduction, The Web, Search Engine Architectures, Search Engine Ranking, Managing Web Data, Search Engine User Interaction, Browsing, Beyond Browsing, Web Crawling

UNIT-5 **Taxonomy and Ontology:** Creating domain specific ontology, Ontology life cycle
Distributed and Parallel IR: Relationships between documents, Identify appropriate networked collections, Multiple distributed collections simultaneously, Parallel IR - MIMD Architectures, Distributed IR – Collection Partitioning, Source Selection, Query Processing

Text Books:
1. Modern Information Retrieval, The Concepts and Technology behind Search
Ricardo Baeza-Yates ,Berthier Ribeiro-Neto , Second edition Addison Wesley Publication

Reference Books:
1. Information Retrieval : Implementing and Evaluating Search Engines Buttcher, larke, Cormak
2. Information Retrieval : Data Structures and Algorithms William Frakes

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	H									M		
CO3	H	H								M		
CO4	H	H								M		M
CO5	H	H								M		M

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by
- Mrs. Vrushali A. Chakkarwar
- Mrs. Meghana Nagori
- Mrs. Pallavi Kulkarni

Approved in XVIIth Academic Council, dated 10/01/2018

CS 4022: Cryptography and Network Security

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs/Week	Test 1	: 15Marks
Tutorials: 1 Hrs/Week	Test 2	: 15 Marks
Credits: 4	Teachers Assessment	: 10 Marks
	End Semester Exam	: 60 Marks

Prerequisites: Nil

Course description: This course will introduce the concepts of the Cryptography and Network Security. It consists of topics on various cryptographic models available, Mail Protocols Standards, IP Security Architecture; Firewall Design Principles. Students will also learn implementation of some of the mechanisms through practical.

Course Objectives:

- To provide introduction to the concept of Network Security Model and Cryptography systems.
- To give the knowledge of Digital Signature and other Security Measures available.
- To familiarize with the various techniques like PGP and S/MIME.
- To showcase IP Security Architecture & Transport Layer Security to identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks.
- To explain the firewall design principles and various intrusion detection system.

Course Outcomes
After completing the course, students will able to:

CO1	Illustrate the concepts of Network Security and Compare Various Symmetric and Asymmetric Cryptographic methods used for Network Security.
CO2	Classify various Algorithms to be used at various TCP/IP Layers & to operate Digital Signature in Real World Situation
CO3	Summarize different Authentication Techniques & Describe programs like PGP & S/MIME
CO4	Implement IP Security Architecture &Transport Layer Security to identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply them to design and evaluate counter-measure tools
CO5	Implement Firewall design principles and identify various intrusion detection systems and be able to achieve highest system security

Detailed Syllabus:

Unit 1	Overview: Computer Security Concepts, Security Attacks, Security Services, Security Mechanism, A Model for Network Security, Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Ciphers and the Data Encryption, Euclid's Algorithm, Placement of Encryption Function, Traffic Confidentiality, key distribution.
Unit 2	Public Key Crypto System and RSA: Prime Numbers, Fermat's and Euler's Theorems, Principles of Public-Key Cryptography, the RSA Algorithm, Key Management, Diffie- Hellman

	Key Exchange,Cryptographic Hash Function: Applications, Requirements & Security, SHA-3, Authentication Requirements, Authentication Functions
Unit 3	Digital Signatures, Digital Signature Standards.Authentication Application & Electronic Mail Security: Kerberos, X.509 Authentication Service,Pretty Good Privacy, S/MIME.
Unit 4	IP Security and Web Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Transport Level Security, Wireless Network Security
Unit 5	System Security: Intruders, Intrusion Detection, Firewalls, Cloud Security: Threats, Cloud Security Controls, Mobile Security: Challenges, Attacks based on Communication, vulnerabilities in Software application, Countermeasures

Text Books

1. Cryptography and Network Security: Principals & Practice: by William Stallings
2. Cryptography and Network Security: Atulkahate

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2		2					2		3
CO2	1	1	2		2					2		2
CO3	3	2	3	3								1
CO4	3	2	3									
CO5	3	2	3	2				2		2		1

1 – High 2 – Medium 3 - Low

Special Instructions if any: Nil

Designed by

- Mr. Prashant D. Pathak
- Mr. Vivek Kshirsagar
- Mr. Sudhir Shikaplure

Approved in XVIIth Academic Council, dated 10/01/2018

CS 4023: Distributed Databases

Teaching Scheme			Evaluation Scheme	
Lectures	3 Hrs/Week		Test 1	15 Marks
			Test 2	15 Marks
Tutorials	1 Hr/Week		Teacher Assessment	10 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisite: CS2002: Database Management System

Course Description: This course presents the fundamentals of Distributed Database systems; this course also gives the knowledge of how to use the different techniques ofdistributedquery processing. This course gives the idea over how to set the rules for management of transaction and concurrency control, student will get knowledge of parallel database system architecture. At the last subject will apprehend the knowledge on Machine Learning Algorithms.

Course Objectives:

- Enhanced the knowledge in the area of Distributed Database system.
- Comprehend the Distributed query processing
- The subject explores the ideas of Transaction management and concurrency control.
- Know the parallel database system architecture.
- Become conscious about current trends.

Course Outcomes:

After completing this course, students will able to:

CO1: Aware of fundamentals of Distributed Database systems.
CO2: Use the different techniques of Distributed query processing.
CO3: Set the rules over management of transaction and concurrency control.
CO4: Familiar with parallel database system architecture.
CO5: Apprehend Machine Learning Algorithms.

UNIT-1	**Introductory concepts and design of Distributed Database Systems** Distributed DBMS architecture, Distributed database design, Alternative design strategies, Design Issues, Data Fragmentation, Replication, and allocation techniques for DDBMS, Semantic data control: View management, Data security; client server architecture.
UNIT-2	**Distributed query processing and Data Replication** Overview of query processing: Query processing problems, Objectives, Complexity, Characterization query processing, Layers of query processing, Optimization of distributed queries:Join ordering in fragment queries, Semi join; Data Replication: Consistency of Replicated Databases, Update Management Strategies, Replication Protocols.
UNIT-3	**Transaction Management and Concurrency Control** One-tier and two-tier models; three-tier model, Introduction to transaction management: Defining a transaction, properties of transaction, types transaction, transaction monitor; services provided by a transaction monitor; Deadlock Management, RELAXEDConcurrency control.
UNIT-4	**Parallel database systems and Database Interoperability** Parallel database systems: Database servers, parallel- architectures; parallel DBMS techniques: DataPlacement, query parallelism, parallel data processing; Database Interoperability: Database Integration, Query Processing, Transaction management, Object orientation and Interoperability.
UNIT-5	**Current Trends** Introduction to Big Data and hadoop; Introduction: Why Look Beyond Hadoop Map-Reduce?, Berkeley Data Analytics Stack (BDAS); Realizing Machine Learning Algorithms with Spark. Case Study: a survey of Data Center : Typical components, Networking, Fire safety, Backup provision.

TEXT BOOKS

1. M. Tamer Ozsu, M. and Valduriez, P. - Principles of Distributed Database Systems, (2nd Edition) Prentice Hall International Inc. 1999 ISBN 0-13-607938-5
2. Vijay Srinivas Agneeswaran - Big Data Analytics Beyond Hadoop *Pearson Education, Inc.*

REFERENCE BOOK:

3. Orfali, R., Harkey Dan and Edwards, J. The essential Distributed Objects-Survival guide. John Wiley & Sons, Inc. 1996 ISBN 0-471-12993-3

Mapping of Course outcome with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2				H								
CO3										H		
CO4			H									
CO5		H										

High-H Medium-M Low-L

Special Instructions if any: Nil

Approved in XVIIth Academic Council, dated 10/01/2018

CS4024: Lab Computer Vision

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credit :	1	**Pract. Exam**	:	25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

CS4025: Lab Neural Network and Deep Learning

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credits :	1	**Pract. Exam**	:	25 Marks

Execute Programs based on following concepts

1. Parallel and distributed processing - I: Interactive activation and competition models
2. Parallel and distributed processing - II: Constraint satisfaction neural network models
3. Perceptron learning
4. Multilayer feedforward neural networks
5. Hopfield model for pattern storage task
6. Hopfield model with stochastic update
7. Competitive learning neural networks for pattern clustering
8. Solution to travelling salesman problem using self organizing maps
9. Solution to optimization problems using Hopfield models
10. Weighted matching problem: Deterministic, stochastic and mean-field annealing of an Hopfield model

Give solution using Deep Learning for any three of the following

1. Colorization of Black and White Images.
2. Adding Sounds To Silent Movies.
3. Automatic Machine Translation.
4. Object Classification in Photographs.
5. Automatic Handwriting Generation.
6. Character Text Generation.
7. Image Caption Generation.
8. Automatic Game Playing.

CS4026: Lab Design of Linux Operating System

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credits:	1	**Pract. Exam**	:	25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

1. Demonstration of various text editors in Linux.

   i vi,
   ii gedit,
   iii nano,
   iv Emacs etc.

2. Implementation to Basic commands in Linux.

   i Simple commands
   ii Directory commands
   iii File commands

3. Exploring the Gnome & KDE desktop.
4. Implementation of file system directory hierarchy, I/O redirection and fire permission in Linux.
5. Implementing programs on Process management using ps & kill system call.
6. Implementation of program using fork(), vfork() system calls & run in all five states.
7. Develop a program using a file handling signals as read(), write(), open(), creat(), close,lseek(),etc.
8. Demonstrating & working on office application in Linux (Libra or Open office).
9. Implementing shell scripts using while loop, for loop, it then else, case statement.
10. Implementing different R commands & programs .

CS4027: Lab Information Retrieval

Teaching Scheme:		**Examination Scheme:**		
Practical:	2 Hrs/Week	**Term Work**	:	25 Marks
Credit:	1	**Pract. Exam**	:	25 Marks

Minimum of 8 Programs should be completed which will be based on the subject and record for the same shall be submitted

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CS4028: Lab Cryptography & Network Security

Teaching Scheme:

Practical: 2 Hrs/Week

Credits: 1

Examination Scheme:

Term Work : 25 Marks

Pract. Exam : 25 Marks

Course Outcomes

After completing the course, students will able to:

CO1	Identify Vulnerabilities in a Network
CO2	Solve Problems using various Algorithms
CO3	Identify Various Attacks and Formulate Defense Mechanism
CO4	Understand Wireless Security
CO5	Understand Web And DNS Security

List of Experiments

Sr. No.	Details
1	Network/Vulnerability scanner (case study: nmap and nessus)
2	Numerical Problems on DES, IDEA Algorithms
3	Numerical Problems on MD5, Diffie Hellman algorithms
4	DoS and other Network Attacks
5	Intrusion Detection/Prevention Systems (case study: snort IDS)
6	Firewalls - Case Study
7	Wireless network security – Case Study
8	Packet Sniffers: Tcpdump, Ettercap, Dsniff.
9	Web and DNS security Techniques
10	Using PGP Mail freeware to encrypt and sign email messages and individual files

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M		M					M		L
CO2	H	H	M		M					M		M
CO3	L	M	L	L								H
CO4	L	M	L									
CO5	L	M	L	M				M		M		H

H – High M – Medium L - Low

Special Instructions if any: Nil

Designed by

- Mr. Prashant D. Pathak
- Mr. Vivek Kshirsagar
- Mr. Sudhir Shikalpure

CS4029: Lab Distributed Database

Teaching Scheme:

Practical: 2 Hrs/Week

Credits: 1

Examination Scheme:

Term Work : 25 Marks

Pract. Exam : 25 Marks

Prerequisite subject: CS2004: Lab Database Management System

Laboratory Course Outcome:

After completion of this course student will be able to

CO1: Implement fragmentation and its types in distributed database system.
CO2: Implement materialized view.
CO3: Implement heterogeneous databases.
CO4: Implement of replication in distributed database system.
CO5: Design Hadoop basics-Creating an map reduce program

1	Examine and implement of Basic database management operations and SQL queries
2	Examine and implement fragmentation and its types in distributed database system
3	Examine and implement materialized view
4	Implement different types of joins
5	Implement heterogeneous databases
6	Examine and implement of replication in distributed database system
7	Hadoop Installation
8	Hadoop: Basic Program
9	Hadoop basics-Creating an map reduce program
10	A mini project based on Distributed Databases

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H										
CO2	H	M										
CO3										H		
CO4				M						M		
CO5			H									

H – High M – Medium L - Low

Approved in XVIIth Academic Council, dated 10/01/2018

Special Instructions if any: Nil

Designed by

- Mr. Vikul J.Pawar
- Mr. Sudhir G. Shikalpure
- Mr. Prashant D. Pathak

CS4003: Project-II

Teaching Scheme			Evaluation Scheme	
Practical	12 Hrs/Week			
Total Credits	6		Practical/Viva-voce	100 Marks

Course Outcomes:

After completing this course, students will able to:
CO1: Review the literature and develop solutions for framed problem statement.
CO2: Implement hardware and/or software techniques for identified problems.
CO3: Test and analyze the modules of planned project.
CO4: Write technical report and deliver presentation.
CO5: Apply engineering and management principles to achieve project goal.

The project will consist of the work on the topic selected for the project .The project must be done in a group not exceeding four students.

The candidate is required to complete the implementation of the project work which was started in Project I of last semester.

The candidate will submit project report in triplicate to head of the department.

Term Work:

The assessments of the term work should be done by two internal examiners, one of which will be the guide and the other will be HOD or senior staff member from the department. Guidelines for the term work and assessment shall be as described in the Project I of the same program.

Practical Examination:

Practical Examination will consist of a presentation along with actual demonstration of the project. The said examination will be conducted by a panel of two examiners (one internal guide and one external examiner).

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H										
CO2			H								H	M
CO3		H										
CO4					H	H						
CO5										H		

H – High M – Medium L - Low

Approved in XVII[th] Academic Council, dated 10/01/2018

Special Instructions if any: Nil

Designed by
All Faculty