Program Educational Objective(s)	
After graduation and few years of graduation, the Computer Science & Engineering graduates would	
PEO I	**Technical Expertise: Implement fundamental domainknowledge of core courses for developing effective computing solutions by incorporating creativity and logical reasoning.**
PEO II	**Successful Career: Deliver professional services with updated technologies in computer science based career.**
PEO III	**Soft Skills:Develop leadership skills and incorporate ethics, team work with effective communication & time management in the profession.**
PEO IV	**Life Long Learning: Conduct research among computing professionalas per market needs.**

Program Outcome(s)

Students will be able to

PO1: Apply knowledge of mathematics, science and algorithm in solving complex Computer engineering problems.
PO2: Generate solutions by conducting experiments and applying techniques to analyze and interpret data
PO3: Design component, or processes to meet the needs within realistic constraints.
PO4: Identify, formulate, and solve Software Engineering, Networking and Data Mining problems.
PO5: Comprehend professional and ethical responsibility in computing profession.
PO6: Express effective communication skills.
PO7: Participate in global, economic, environmental, and societal context.
PO8: Recognize the need for, and an ability to engage in life-long learning.
PO9: Knowledge of contemporary issues and emerging developments in computing profession.
PO10: Utilize the techniques, skills and modern computer Engineering tools, Software and techniques necessary for Engineering practice.

PO11: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO12: Design research problems and conduct research in computing environment.

Mapping of PEO & PO

Programme Educational Objective(s)	Program Outcome(s)	
PEO I	**Technical Expertise: Implement fundamental domain knowledge of core courses for developing effective computing solutions by incorporating creativity and logical reasoning.**	1,2,4,7,8,10
PEO II	**Successful Career: Deliver professional services with updated technologies in computer science based career.**	3,5,6,11
PEO III	**Soft Skills: Develop leadership skills and incorporate ethics, team work with effective communication & time management in the profession.**	3,9
PEO IV	**Life Long Learning: Conduct research among computing professionalas per market needs.**	**12**

Department of Computer Science & Engineering

Proposed Teaching and Evaluation Scheme (2015-16)

B.E.(Full-Time) in Computer Science &Engineering

SEMESTER-I

THEORY COURSES														
S. No.	**Course Code**	**Subject**	**PO**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**						
								Theory			**Term Work**	**Practical/ Viva-voce**	**Total**
				L	**T**	**P**		**Test**	**TA**	**ESE**			
1	CS441	Advanced Algorithms	1,2,5,7,9,10,12	03	-	-	03	20	20	60	-	-	100
2	CS442	Cryptography & Network security	1,2,3,4,10,12	03	-	-	03	20	20	60	-	-	100
3	CS443	Software Testing and Quality assurances	3,4,10,11	03	01	-	04	20	20	60	-	-	100
4	CS444 - CS446	Elective 1		03	01	-	04	20	20	60	-	-	100
5	CS447 - CS449	Elective-2		04	-	-	04	20	20	60	-	-	100
LABORATORY COURSES													
1	CS450	Lab Advanced Algorithm	1,2,3,4,10,12	-	-	02	01	-	-	-	25	25	50
2	CS451	Lab Cryptography & Network security	1,2,3,4,5,8,10,12	-	-	02	01	-	-	-	25	25	50
3	CS452	Lab Software Testing and Quality assurance	1,2,3,4,6,10,11	-	-	02	01	-	-	-	25	25	50
4	CS453	Seminar	6,8,9,11	-	-	02	01	-	-	-	25	-	25
5	CS454	Project-I	4,6,8,9,10,11,12	-	-	04	02	-	-	-	75	-	75
(A) Total of Semester – I				**16**	**02**	**12**	**24**	**100**	**100**	**300**	**175**	**75**	**750**

SEMESTER-II

THEORY COURSES													
S. No.	**Course Code**	**Subject**		**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**					
								Theory			**Term Work**	**Practical/Viva-voce**	**Total**
				L	**T**	**P**		**Test**	**TA**	**ESE**			
1	CS455	Parallel Computing	2,3,9, 12	03	1	-	**04**	20	20	60	-	-	100
2	CS456	Distributed Databases	1,2,3, 4,10	04	-	-	**04**	20	20	60	-	-	100
3	CS457	Wireless & Mobile Computing	2,3,8	04	-	-	**04**	20	20	60	-	-	100
4	CS458 - CS460	Elective-3		03	1	-	**04**	20	20	60	-	-	100
LABORATORY COURSES													
1	CS461	Lab Parallel Computing &	2,9,1 2	-	-	02	01	-	-	-	-	25	25
2	CS462	Lab Distributed Databases	1,2,3, 10			02	01				-	25	25
3	CS463	Lab Wireless & Mobile Computing	2,3,1 2	-	-	02	01	-			-	25	25
4	CS464 - CS466	Lab Elective-3		-	-	02	01	-	-	-	25		25
5	CS467	Research Lab	2,3,4, 5,6,8, 10,11 ,12	-	-	02	01				25	25	50
6	CS468	Project-II	2,3,5, 6,10, 11,12	-	-	06	03	-	-	-	100	100	200
(B) Total of Semester- II				**14**	**02**	**16**	**24**	**80**	**80**	**240**	**150**	**200**	**750**
Grand Total = (A) + (B)				**30**	**04**	**28**	**48**	**180**	**180**	**540**	**325**	**275**	**1500**

	Elective1		Elective 2		Elective -3
CS444	Design of Linux Operating System	CS447	Artificial Intelligence	CS458	Adv. Compiler Design
PO	2,3,9,11	PO	1,2,8,9	PO	3,9,10,11
CS445	Information	CS448	Cloud Computing	CS459	Data Analytics

	Retrieval System				
PO	1,2,10,11	PO	1,2,5,10	PO	1,2,3,4,8,9,10
CS446	Embedded System Design	CS449	Computer Vision	CS460	Multimedia Computing
PO	2,3,9,11,12	PO	1,2,4,10,12	PO	1,2,3,4,10

CS464	Lab Adv. Compiler Design	2,4,9,10,11,12
CS465	Lab Data Analytics	1,2,3,4,9,10
CS466	Lab Multimedia Computing	1,2,3,4,9,10,11

CS441 Advanced Algorithms

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
		Teacher Assessment	20 Marks
Total Credits	3	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: Discrete mathematics,Datastructures,Programminglanguages,Design and analysis of algorithms, Theory of computation

Course Description: This course introduces different design paradigms for designing efficient and optimal solutions to real world problems. The course will identify the computational issues in choosing an suitable algorithm for applying to solve complex problems. In addition to introducing the concept of NP Hard and NP Complete problems the course also exposes to geometrical algorithms and algorithms for big data sets.

Course Objectives:

- To identify issues related to the definition, creation and usage of classes, objects and methods.
- To discuss the principles of inheritance and polymorphism and demonstrate through problem analysis assignments how they relate to the design of methods, abstract classes and interfaces.
- To provide the foundation of good programming skills by discussing key issues to the design of object-oriented software, including programming design patterns.

Course Outcomes :

After completion of this course students will be able to:

CO1:Analyze the pros and cons of applying the different design paradigms in different Contexts.

CO2:Exposure to randomization as a tool for developing algorithms.

CO3:Relevance of analysis to the design of efficient computer algorithms.

CO4 :Identify the computational issues and apply suitable algorithms to solve it effectively

CO5:Conceptualize and design efficient and effective algorithmic solutions for different real-world problems.

Detailed Syllabus:

UNIT 1	**Theory of NP- Hard and NP-Complete Problems** P, NP and NP-Complete complexity classes; Introduction to a few NP-Completeness proofs; Other complexity classes	
Unit 2	**Approximation Algorithms** Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, A few examples of approximation algorithms, Analysis of the expected time complexity of the algorithms.	
Unit 3	**Probabilistic Algorithms & Randomized Algorithms** Numerical probabilistic algorithms, Las Vegas and Monte Carlo algorithms, min-cut, markov and hidden markov models	
Unit 4	**Computational Geometry** Range Trees, Prority Search Trees, Quadtrees and k-d Trees, Convex Hulls	
Unit 5	**Algorithms for large data sets** Streaming algorithms,nearestneighbour search algorithms	

TEXT BOOKS:

1. Introduction to Algorithms : T.H. Cormen, C.E.Leiserson and R.L. Rivest
2. Fundamentals of Algorithmics : G.Brassard and P.Bratley

REFERENCE BOOK:

1. Approximation Algorithms: Vijay V.Vazirani
2. Randomized Algorithms: R. Motwani and P.Raghavan

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	M		
CO5					M		M					

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on thefollowing :-

1) Assignment
2) PowerpointPresentation
3) Quiz/Multiple choice questions test
4) Programmming/Design Experiments

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember			
K2	Understand	15	05	25
K3	Apply	00	05	25
K4	Analyze	05	05	10
K5	Evaluate	00	05	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K3	K4	K5
	CO1,CO2	CO4	CO3,CO4	CO5
Class Test (20 Marks)	15	05		
Teachers Assessment (20 Marks)			10	10
ESE Assessment (60 Marks)	25	25	10	

Special Instructions if any: Nil

Designed by

- Mrs. Meghana B. Nagori
- Mr. Sudhir G. Shikalpure
- Mrs. Pallavi V. Kulkarni

CS 442: Cryptography and Network Security	
Teaching Scheme **Lectures: 4 Hrs/Week** **Credits: 4**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Theory of Computation

Course description:This course will introducethe concepts of theCryptography 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 practicals.

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

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Attendance
2) Cryptographic Example Solving
3) Power point presentation of case studies
4) Question & answer / Numerical solution

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	10	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00

K6	Create	00	00	00
	Total Marks 100	20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K2
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	05	10	00	05	00
Teachers Assessment (20 Marks)	00	00	05	10	05
ESE Assessment (60 Marks)	15	20	10	15	00

Special Instructions if any: Nil

Designed by

- Mr. Prashant D. Pathak
- Mr. Vivek Kshirsagar
- Mr. sudhirShikaplure

CS 443: Software Testing & Quality Assurance

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: 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

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Attendance
2) Testing Example Solving
3) Power point presentation of case studies
4) Question & answer / Numerical solution

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	00	00	00
K2	Understand	20	00	40
K3	Apply	00	15	20
K4	Analyze	00	05	00

K5	Evaluate	00	00	00
K6	Create	00	00	00
	Total Marks 100	20	20	60

Assessment table

Assessment Tool	K2	K3	K4	K5	K4
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	10	10	00	00	00
Teachers Assessment (20 Marks)	00	05	05	05	05
ESE Assessment (60 Marks)	12	12	12	12	12

Special Instructions if any: Nil

Designed by

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

CS 444: Elective 1:Design of Linux Operating System

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 45 Hours.

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.

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 .(k2)
CO6: debate various case studies . (K4).
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
UNIT-4	**Virtual file system and Memory Management:-** Pages, Zones, Slab layer and Slab allocator interface, Virtual file system, Ext2 filesystem ,Ext3 filesystem, Procfilesystem.
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. Case studies :- Embedded Linux, Real time linux,Linux with Android

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

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			

High-H Medium-M Low-L

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Attendance
2) Testing Example Solving
3) Power point presentation of case studies
4) Question & answer / Numerical solution

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	10	05	40
K3	Apply	05	10	10
K4	Analyze	05	05	20
K5	Evaluate	00	05	00
K6	Create	00	00	00
	Total Marks 100	20	20	60

Assessment table

Assessment Tool	K3	K2	K2	K4	K2	K4
	CO1	CO2	CO3	CO4	CO5	CO6
Class Test (20 Marks)	5	10		5		
Teachers Assessment (20 Marks)	5	5		5		5
ESE Assessment (60 Marks)	10	10	10	10	10	10

Special Instructions if any: Nil

Designed by

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

CS 445: Elective 1: Information Retrieval

Teaching Scheme		Evaluation Scheme	
Lectures	4 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: Mathematics, Programming language.

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 retrival.
- 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	I**ntroduction:** 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

Teacher's Assessment: Teachers Assessment of 20 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 any topic from syllabus.
4) Quiz
5) Developing Small applications.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	10	05	20
K2	Understand	10	05	20
K3	Apply	00	05	20
K4	Analyze	00	05	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K4	K2
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	10	00	00	00
Teachers Assessment (20 Marks)	00	05	05	05	05
ESE Assessment (60 Marks)	20	20	10	10	00

Special Instructions if any: Nil

Designed by

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

CS 446: Elective 1: Embedded System Design

Teaching Scheme			Evaluation Scheme	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorials	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: Digital Electronics, Microprocessor, Microcontroller & Peripherals

Course description: After completing this course, students will have a broad and fundamental understanding of Embedded System. Topics range from an overview of Basics of Embedded System, ARM processor's introduction, programs based on ARM processor using Embedded C, Overview of Real Time Embedded System.

Course Educational Objectives:

1. To discuss about real-time and quality of service system principles
2. To discuss real-time operating systems and the resource management and quality of service issues that arise.

3. To construct sample applications on representative platforms .Platforms range from handheld and Mobile computers to media and real-time server systems.

Course Outcomes Expected:

After completing the course, students will able to:

CO1: Design real time embedded systems using the concepts of RTOS.
CO2: Describe the embedded system architecture and instruction set of ARM7.
CO3: Write structured, well-commented, understandable programs in assembly language.
CO4: Use interrupts types of filters in ARM7 processor
CO5: Interface I/O devices and memory to ARM processors.

UNIT-1	ARM Embedded Systems The RISC Design Philosophy ARM Design Philosophy Embedded System Hardware Embedded System Software 2 ARM Processor Fundamentals Registers Current Program Status Register Pipeline Exceptions, Interrupts, and the Vector Table Core Extensions Architecture Revisions ARM Processor Families
UNIT-2	Introduction to the ARM Instruction Set, Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instructio, Program Status Register Instructions, Loading Constants, Introduction to the Thumb Instruction Set, Thumb Register Usage ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction
UNIT-3	Efficient C Programming, Overview of C Compilers, and Optimization Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing Structure, Floating Point Inline Functions and Inline Assembly Portability Issues
UNIT-4	Writing and Optimizing ARM Assembly Code Writing Assembly Code Profiling and Cycle Counting Instruction Scheduling Register Allocation Conditional Execution Looping Constructs Bit Manipulation Efficient Switches Handling Unaligned Data Summary Optimized Primitives Double-Precision Integer Multiplication Integer Normalization and Count Leading Zeros Division Square Roots Transcendental Functions: log, exp, sin, cos Endian Reversal and Bit
UNIT-5	Digital Signal Processing Representing a Digital Signal Introduction to DSP on the ARM FIR filters IIR Filters The Discrete Fourier Transform Exception and Interruput Handling Exception Handling Interrupts Interrupt Handling Schemes Firmware Firmware and Bootloader Example: Sandstone Embedded Operating Systems Fundamental Components Example: Simple Little Operating System Caches, The Memory Hierarchy and Cache Memory Cache Architecture Cache Policy Coprocessor Caches and Software Performance Memory Protection Units

TEXT AND REFERENCE BOOKS

1. Raj Kamal , "Embedded systems, architecture, programming and design" , Tata McGrawhill 2003
2. Philip A Laplaute, "Real Time Systems Design & Analysis", PHI
3. Dr.K.V.K.K. Prasad,"Embedded/Real-time Systems",Dreamtech Publication
4. Frank Vahid/Tony Givargis,"Embedded System Design", Wiley Student Edition
5. REFERENCE BOOKS: 1. Sloss, Symes, Right , "ARM System Developers' Guide

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 20 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 any topic from syllabus.
4) Quiz
5) Developing Small applications.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	20		40
K3	Apply			5
K4	Analyze		10	5
K5	Evaluate		10	10
K6	Create			
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3,K4	K2	K5
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	10			
Teachers Assessment (20 Marks)			10		10
ESE Assessment (60 Marks)	20	20	10	10	

Special Instructions if any: Nil

Designed by

- Mrs.Vijayshri A. Injamuri
- Mr. Sudhir G. Shikalpure
- Mr. Vivek P. Kshirsagar

CS 447: Elective 2: Artificial Intelligence

Teaching Scheme			**Evaluation Scheme**	
Lectures	4 Hrs/Week		Test	20 Marks
			Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prequisites: Discrete Maths,Discrete mathematics, basic probability theory and Statistics Knowledge of any programming language and data structures

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) **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

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) " Think More Write Less" Based (observation based) Assignment
3) Power point presentation of Topic which is related but out of syllabus
4) Class room Question & answer
5) Overall approach towards learning, creativity.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	05	15
K2	Understand	05	05	25
K3	Apply	05	05	20
K4	Analyze	00	05	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

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

Special Instructions if any: Nil

Designed by

- Mrs. Madhuri A. Aher
- Mr. Sudhir G. Shikalpure
- Mrs. Meghana Nagori

CS 448: Elective 2: Cloud Computing

Teaching Scheme			**Evaluation Scheme**	
Lectures	4 Hrs/Week		Test	20 Marks
			Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: Database Management System , Computer Network

Course description: This course provides a comprehensive study of Cloud concepts and capabilities across thevarious 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:

After completing the course, students will 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, Characteristics, Components, deployment model, service model, Applications, Benefits of cloud computing, Limitations of	

	cloud computing. Grid Computing, Grid vs Cloud Computing.	
UNIT-2	**Cloud architecture, Services and Applications** Exploring cloud computing stack – Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Defining Infrastructure as a Service (IaaS), Defining Software as a Service (SaaS), Defining Platform as a Service (PaaS), Defining Identity as a Service (IDaaS), Defining Compliance as a Service (CaaS).	
UNIT-3	**Cloud Infrastructure and Virtualization** Hardware and Infrastructure – Clients, Security, Network and Services., use of Virtualization technology, Load Balancing and Virtualization, virtualization benefits, Hypervisors, porting application, Defining cloud capacity by defining baselines and Metrics.	
UNIT-4	**Exploring cloud services** Software as a Service – Overview, advantages, limits, virtualization benefits, examples. Platform as a Service – overview, advantages and functionalities, PaaS application frameworks – Drupal, Long Jump. Case study – Google Apps and Web Services.	
UNIT-5	**Cloud Administration and Security Management** Management responsibilities, lifecycle management, cloud management products, Cloud management standards. Cloud security, data security, Identity and presence protocol standards, Availability management in SaaS, IaaS, PaaS, Access Control, Security Vulnerability, Patch and Configuration Management, Security as a Service of cloud, Future of Security in Cloud computing.	

TEXT AND REFERENCE BOOKS

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Edition.
2. Anthony Velte, tobyVelte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw-Hill Edition.

Mapping of Course outcome with Program Outcomes

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

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Power point presentation of case studies
2) Question & answer
3) Study of Industry processes and its presentation

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	00	00	00
K2	Understand	20	00	40
K3	Apply	00	10	10
K4	Analyze	00	10	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K4	K2
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	10			
Teachers Assessment (20 Marks)			10	10	
ESE Assessment (60 Marks)	15	15	10	10	10

Special Instructions if any: Nil

Designed by

- Mr. Nouman Pathan
- Mr. Vivek Kshirsagar
- Mr. Prashant D. Pathak

CS 449: Elective 2: Computer Vision

Teaching Scheme		**Evaluation Scheme**	
Lectures	4 Hrs/Week	Test	20 Marks
Tutorials	00	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: Mathematics, Programming language.

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 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:

1) Digital image processing, by Gonzales Woods 3rd Edition, Pearson Education

2) 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 20 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 .

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	05	20
K2	Understand	10	05	20
K3	Apply	00	05	10
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K3	K4
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	10	00	00	00
Teachers Assessment (20 Marks)	00	05	05	05	05
ESE Assessment (60 Marks)	20	20	10	10	00

Special Instructions if any: Nil

Designed by

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

CS450: LabAdvanced Algorithms

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:labs- Programming languages, Programming in Java,design and analysis of algorithms,data structures.++

Course Outcome:

After completion of this course student will be able to:-

CO1:Identify Data Structures, Design paradigms and Computational complexity in the design of simple tools
CO2:Demonstrate relationships among NP-Complete Problems
CO3: Implement the approximate algorithms approach to solve some NP-Complete Problems.
CO4: Demonstraterandomness by solving some examples
CO5: Implement algorithms for geometry and large data-sets.

Suggestive list of experiments:-

1) Design of simple tool of choice for revising of basic concepts.
2) Implement program to show relationship between clique,vertex-cover and independent set.
3) Implement Approximate algorithm technique for vertex cover/steiner tree.
4) Implement approximate algorithms on various variants of Travelling Salesman problem.
5) Demonstrate randomness by implementing Quicksort algorithm.
6) Demonstrate randomness by implementing min-cut algorithm.
7) Demonstrate with a Program the Markov property and stationery markov chain
8) Implementing the Viterbi algorithm
9) Implementing the forward algorithm
10) Implementing algorithms from geometry problems and large data sets.

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							H		
CO3		M								H		
CO4		M								H		
CO5										H		L

H – High M – Medium L - Low

Assessment Table

Assessment Tool	S2	S3	S4	S5
	CO2	CO1,CO4	CO3	CO5
Term Work (25 Marks)	5	10	5	5
Practical Examination & Viva Voce (25 Marks)		15	10	

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation		
S2	Manipulation	05	05
S3	Precision	15	15
S4	Articulation	05	05
S5	Naturalization	00	00
Total		25	25

Preparation (S1)	00	00
Conduct of Experiment (S2)	10	08
Observation and Analysis of Results (S3)	10	05
Record (S3)	05	02
Mini-Project / Presentation/ Viva-Voce (S3)	00	10
Total	**25**	**25**

Special Instructions if any: Nil

Designed by

- Mrs. Meghana B. Nagori
- Mr. Sudhir G. Shikalpure
- Mrs. Pallavi V. Kulkarni

CS451 : Lab -Cryptography & Network Security

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

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	07	07	05	03	03
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	Skill Level	Term Work	Practical Examination & viva voce
S1	Imitation	05	05
S2	Manipulation	08	10
S3	Precision	12	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	05

Conduct of Experiment (S2)	04	07
Observation and Analysis of Results (S3)	08	05
Record (S2)	03	03
Mini-Project / Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

Special Instructions if any: Nil

Designed by

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

CS-452: Lab: Software Testing & Quality Assurance

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

Prerequisite Subject: Theory-Software Testing and Quality Assurance
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 Automation Testing Tool.
4. Examine the Winrunner Testing tool.
5. Recording test cases in Context sensitive mode.
6. Recording test cases in Analog mode.
7. Design and construct the test cases through Synchronizing testing.
8. Design and construct the test cases for Checking GUI Objects.

9. Design and construct the test cases for Checking Bitmap Objects.
10. Design and construct the test cases for testing program using TSL.
11. Load Testing of software.

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

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	08	10
S3	Precision	12	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

Preparation (S1)	05	05
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	05	05
Record (S2)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Special Instructions if any: Nil

Designed by

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

CS453: Seminar

Teaching Scheme			Evaluation Scheme	
Practical	2 Hrs/Week			
			Term Work	25 Marks
Total Credits	1			

Total Hours required for this practical course: 30 Hours.

Lab Outcomes:

After completing this course, students will able to:
CO1**:** Collect , Organize & Analyze information about emerging technologies /market demands/current trends.

CO2: Exhibit effective communication skills, stage courage, and confidence.

CO3: Demonstrate intrapersonal skils,

CO4: Awareness&in keeping with new innovations and inventions.

Guidelines for presenting a seminar:

- The seminar will consist of a typewritten report covering the topic related to his area of final year project.
- If more number of students are working on same project then they should separate the seminar topics from the project area which is relevant and which will contribute for completion of project.
- Weekly report of students work for finalization of his area of work and topic of seminar should be submitted to the faculty during designated hours meant for seminar
- 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 seminar topics by 4th week

  Literature/Field Study Mechanism identified sources and strategy by 5th week

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

  Presentation Format contents & Trial Presentations to student groups 9th,10th week

- It is expected that the candidate prepares a report based on outcomes of literature studies, field visits, observation schedules, focus group meetings etc related to a problem in relevant technology area.
- The report shall be tested for any plagiarism out of books, journals and internet based articles and reports by appropriate web based tool.
- The candidate shall deliver seminar on the topic on first two occasions to students of his class for peer assessment.
- Format for peer group assessment should be designed by the faculty with approval of department. Peer assessment should not be given more than 15% weightage
- Final presentation for term work should be attended by minimum TWO faculty members. Each candidate may be given time minimum of 8 to 10 minutes.
- 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 as per the norm stated above.
- 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			
CO2						H						
CO3											H	
CO4								H				

H – High M – Medium L - Low

Assessment Table

Assessment Tool	S2	S2	A3	S3
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	10	10	2	3

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**

S1	Imitation	
S2	Manipulation	20
S3	Precision	03
A3	Valuing	02
S5	Naturalization	
Total		25

Preparation (S1)	
Conduct of Experiment (S2)	
Observation and Analysis of Results (S3)	
Record (S2)	05
Mini-Project / Presentation/ Viva-Voce (S3)	20
Total	**25**

Special Instructions if any: Nil

Designed by
All Faculty

CS454: Project-I

Teaching Scheme			Evaluation Scheme	
Practical	4 Hrs/Week			
			Term Work	75 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
- 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 9^{th} to 11^{th} 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

Assessment Table

Assessment Tool	K4	K2	A3	S3
	CO1	CO2	CO3	CO4
Term Work (75 Marks)	20	20	15	20

Assessment Pattern

Assessment Pattern	**Skill Level**	**Term**

Level No.		Work
K2	Understand	20
K4	Analyze	20
S3	Precision	20
A3	Valuing	15
Total		75

Preparation (S1)	
Conduct of Experiment (S2)	
Observation and Analysis of Results (S3)	
Record (S2)	20
Mini-Project / Presentation/ Viva-Voce (S3),K2,K4	55
Total	**75**

Special Instructions if any: Nil

Designed by
All Faculty

SEMESTER II

CS455 Parallel Computing

Teaching Scheme		Evaluation Scheme	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: CS244:Programming Language

Course Description: This course introduces you to the foundations of parallel computing including the principles of parallel algorithm design, analytical modeling of parallel programs, programming models for shared- and distributed-memory systems, parallel computer architectures, along with numerical and non-numerical algorithms for parallel systems. The course will include material on emerging multicore hardware, shared-memory programming models, message passing programming models used for cluster computing, data-parallel programming models for GPUs, and problem-solving on large-scale clusters using MapReduce. A key aim of the course is for you to gain a hands-on knowledge of the fundamentals of parallel programming by writing efficient parallel programs using some of the programming models that you learn in class.

Course Objectives:

To impart the knowledge to the students so that they will be able to
1. Increase GPU awareness.
2. Know GPU computing platforms.

Course Outcomes :

After completing this course, students will able to:
CO1: Awareness of the GPU architecture and its programming.
CO2: Design parallel programs for GPU.
CO3: Design & develop OpenMP and CUDA programs.
CO4: Analyze and apply various parallel algorithms.
CO5: Capable to optimize algorithms for better performance.

Detailed Syllabus:

UNIT 1	**Introduction to Parallel Computing** Thinking in Parallel, Parallelism Vs. Concurrency, Types and levels of parallelism, Different grains of parallelism, Introduction to parallelization and vectorization: Data dependencies, SIMD technology, Definition of thread and process, Parallel programming models, Decomposition methodologies for parallel program development, The message passing paradigm,load balancing issues for parallel programs,PRAM computational model, Flynn's Taxonomy,current issues in parallel processing, Parallel Processing speedup issues: including Amdahl's and Gustafason's Laws.	
Unit 2	**Heterogeneous Architectures**	

	Motivation for Heterogeneous Computing, Introduction to heterogeneous architectures- GPU in particular Modern GPU architecture. Introduction to GPU computing (general purpose computation on GPU), GPU architecture case studies: NVIDIA Fermi Tesla C2050/Kepler K20, languages for parallel computing, including:MPI and OpenMP Parallel Programming	
Unit 3	**Introduction to CUDA programming Compute Unified Device Architecture (CUDA):** CUDA Architecture, CUDA programming model, execution model, thread organization: Concept of grid, block and thread, thread index generation, warp; memory model: Introduction to global, shared, local memories, usage of cache, texture cache, constant memory, memory banks and bank conflicts. CUDA structure, API and library (CUDPP, CUBALS, FFT etc.) details. CUDA example programs (Vector dot product, Matrix multiplication (with the usage of tiling and shared memory) etc.).	
Unit 4	**Multicore Programming with OpenMP** Fundamentals of Shared Memory Programming, Basic OpenMP concepts, PARALLEL directive, data scoping rules, basic OpenMP constructs/directives/calls, examples, parallelizing an existing code using OpenMP, More advanced OpenMP directives and functions, OpenMP performance issues	
Unit 5	**Problem solving using GPUs:-**Single vs double precision, solving problems that involves Vectors, Matrices, Binomial coefficients, Bernstein coefficients and etc. Instructor will choose the problems from several domains with which students are already aware. **Optimizations and Tools:** Memory coalescing, Reduction operation using prefix sum example. Usage of shared memory optimally, Performance issues in algorithms-deciding parallelization of a part of algorithm and selecting the highest parallelism, Need of profilers and analyzers, Introduction to CUDA Tools: MemCheck, Command line & Visual Profilers.	

TEXT BOOKS

2. AnanthGrama, Anshal Gupta, GreogeKarypis, Vipin Kumar, "Introduction to Parallel Computing",Second Edition,(Pearson Publication)
3. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-On Approach", Second Edition(MK-Morgan Kaufmann Publication)
4. Parallel Programming in C with MPI and OpenMP by Michael J. Quinn, Tata McGrawHill Edition
5. Advanced computer architecture by Kai Hwong, Tata McGraw-Hill Edition, 2001

REFERENCE BOOKS

5. Jason Sanders and Edward Kandrot,"CUDA by Example: An Introduction to General-Purpose GPU Programming",2010.
6. http://developer.nvidia.com/

Mapping of Course outcome with Program Outcomes

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

CO3		M	M									
CO4		M	M									
CO5									H			H

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) " Think More Write Less" Based (observation based) Assignment
3) Power point presentation of Topic which is related but out of syllabus
4) Class room Question & answer
5) Overall approach towards learning, creativity.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	05	15
K2	Understand	05	05	25
K3	Apply	05	05	20
K4	Analyze	00	05	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

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

Special Instructions if any: Nil

Designed by

- Mrs. Madhuri A. Aher
- Mr. Sudhir G. Shikalpure
- Mr Vikul Pawar

CS 456: Distributed Databases

Teaching Scheme			**Evaluation Scheme**	
Lectures	4 Hrs/Week		Test	20 Marks
			Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisite: 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

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) Case Study
3) Power point presentation of Topic which is related but out of syllabus
4) Class room Question & answer
5) Overall approach towards learning, creativity.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	05	00	12
K3	Apply	10	10	24
K4	Analyze	00	05	12
K5	Evaluate	00	05	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1K2	K3	K3	K2	K4
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	10	10	00	00	00
Teachers Assessment (20 Marks)	00	05	05	05	05
ESE Assessment (60 Marks)	12	12	12	12	12

Special Instructions if any: Nil

Designed by

- Mr. Vikul J. Pawar
- Mr. Sudhir G. Shikalpure
- Mrs. Madhuri Aher

CS457 Wireless& Mobile Computing			
Teaching Scheme		**Evaluation Scheme**	
Lectures	4 Hrs/Week	Test	20 Marks
		Teacher Assessment	20 Marks

Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisites: CS345:Operating System, CS350:Computer Networks.

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 Objectives:

To impart the knowledge to the students so that they will be able to

- To learn about the concepts and principles of mobile computing;
- To explore both theoretical and practical issues of mobile computing;
- To develop skills of finding solutions and building software for mobile computing applications.

Course Outcomes :

After completing this course, students will able to:

CO1: Understand and identify the GSM, GPRS and Bluetooth software model for mobile computing.**CO2:**The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.

CO3: Understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities

CO4: Analyze QoS over wire and wireless channels

CO5: Able to promote the awareness of the life-long learning,business ethics, professional ethics and currentmarketing scenarios.

Detailed Syllabus:

UNIT1	**Introduction:** Short history of wireless communication, Applications, Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread Spectrum, Cellular systems (DSSS & FHSS). Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals; Multiple access with collision avoidance, Polling, Inhibit sense multiple access; CDMA: Spread Aloha multiple access.	
Unit 2	**Telecommunication Systems I:** PCS Architecture, Cellular Telephony: Advanced Mobile Phone Service(AMPS); Global System for Mobile Communication (GSM); EIA/TIA IS-136 Digital Cellular System; EIA/TIA IS-95 Digital Cellular System, Cordless Telephony and Low-Tier PCS: Cordless Telephone, Second Generation (CT2); Digital European Cordless Telephone (DECT); UMTS, Personal Handy Phone System (PHS); Personal Access Communications System (PACS) ; Unlicensed Systems, 3G Wireless systems. Mobility Management: Handoff (Inter-BS, Intersystem), Roaming Management, Handoff Management - Detection and Assignment: Strategies for Handoff Detection, Channel Assignment, Handoff Management – Radio Link Transfer: Hard and Soft Handoff, Network Signaling : Signaling System No.7, Interconnection and Message Routing, Mobility Management.	
Unit 3	**Telecommunication Systems II:**	

	GSM: Mobile services, System Architecture, Radio interface, Protocols, Localization and Calling, Handover, Security, New data services, GSM Short Message Service, VOIP service for Mobile Networks : GSM on the Net, The iGSM Wireless VoIP Solution, The H.323 Network, iGSM Architecture, iGSM Procedures and Message Flows: Registration, Deregistration, Call Delivery to the IP Network: Implementation Issues; International Roaming for GSM, GSM Operations, Administration, & Maintenance, Mobile Number Portability. **GPRS**: Functional Groups, GPRS Architecture, GPRS Network Nodes:18.3.1 Mobile Station; Base Station System; GPRS Support Node; HLR and VLR, GPRS Interfaces: Um Interface; EDGE;Gb Interface; Gn and Gp Interfaces; Gs Interface; Gi Interface, GPRS Procedures.	
Unit 4	**Wireless LAN:** Infrared vs. Radio transmission, Infrastructure and Ad hoc Networks, IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium Access Control layer, MAC management, Future development; HIPERLAN: Protocol architecture, Physical layer, Channel access control sublayer, Medium Access Control sublayer, Information bases and Networking. **Bluetooth:** User Scenarios, Physical Layer, MAC layer, Networking. Security, link management, Enterprise PCS: Office Level , Local Area Wireless: An Example of WPBX, Capacity Planning for WPBX, IrDA ZigBee, RFID, Wireless Broadband (WiMax)	
Unit 5	**Support for Mobility:** **Mobile Computing Architecture**: Three Tier Architecture for mobile computing, Design considerations, Mobile Computing through Internet. **File systems:** Consistency, Examples; World Wide Web: Hypertext transfer protocol, Mobile File System, Mobile databases. **Language Support:** Hypertext markup language (XHTML)-MP, Wireless markup language; WML script,Mobile Application Languages-XML, Voice XML. Java, J2ME and JavaCard. **Wireless application protocol:** Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, WAP UAProf and Caching , User Agent Profile , Caching Model , Wireless Bearers for WAP , WAP Developer Toolkits and application environment, Wireless telephony application, Mobile agents, Application Server, Gateways, Portals, Service Discovery, Device Management **Wireless devices and their Operating System :** PalmOS; Windows CE; EPOC; Symbian OS; Linux for Mobile Devices. Mobile Agents **Threats and Security Issues in Mobile Computing**	

Text Books:

1. Jochen Schiller, *"Mobile communications",* Addison wisely, Pearson Education
2. Wireless and Mobile Network Architecture : Yi Bang Lin and ImrichChlamtech (Wiley).
3. Mobile Computing by RajKamal (Oxford).

Reference Book:

1. Rappaort, *"Wireless Communications Principals and Practices'*
2. YI Bing Lin*, "Wireless and Mobile Network Architectures',* John Wiley
3. P. Nicopolitidis, *"Wireless Networks',* John Wiley
4. K. Pahlavan, P. Krishnamurthy, *"Principles of Wireless Networks"*
5. Uwe Hansmann, LotharMerk, Martin S. Nicklous, Thomas Stober, *" Principles of Mobile Computing*, Springer

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) " Think More Write Less" Based (observation based) Assignment
3) Power point presentation of Topic which is related but out of syllabus
4) Class room Question & answer
5) Overall approach towards learning, creativity.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	05	15
K2	Understand	05	05	25
K3	Apply	05	05	20
K4	Analyze	00	05	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

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

Special Instructions if any: Nil

Designed by

- Mrs. Madhuri A. Aher
- Mr. Sudhir G. Shikalpure
- Mr.Prashant Pathak

CS 458: Elective 3: Advanced Compiler Design

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorial	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Prerequisite: Theory of Computation, Design & Analysis Algorithm, System Programming & Compiler Construction.

Course Description: In this course students will learn about the fundamentals of *program analysis* as well as algorithms for constructing advanced *intermediate program representations*. The above techniques and representations will be used to develop a suite of *machine independent code optimizations* (redundancy elimination, dead code elimination etc.). This course also consider*machine dependent optimizations* (e.g., instruction scheduling, register allocation) for modern processors.

Course Educational Objectives:

1. To discuss the techniques of scanning , parsing & semantic elaboration well enough to build or modify front end.
2. To expose the critical issues in modern compilers & provide them with the background to tackle those problems.

Course Outcomes Expected:

After completing this course, students will able to:

CO1: Identify all essential steps for automatically converting source code into object code.(Understand)

CO2: Generate the low-level code for calling functions/methods in modern languages. (Apply)

CO3: Discuss opportunities for optimization introduced by naïve translation and approaches for achieving optimization such as instruction selection, instruction scheduling , register allocation, and peephole optimization.(Apply)

CO4: Interpret benefits and limitations of automatic memory management. (Understand)

CO5:Explain advantages, disadvantages and difficulties of just in time and dynamic recompilation. (Understand)

UNIT-1	**Source Program Analysis:** Analysis of source program, Phases of compiler, Grouping of Phases, Compiler construction Tools, Lexical Analysis, Language for Lexical Analyzer, Role of parser, Context free Grammars, Writing a grammars, Predictive Parser-LR Parser
UNIT-2	**Intermediate Code Generation:** Intermediate Language, Declarations, Assignment statements, Boolean Expressions, Case Statements, Back Patching, Procedure calls
UNIT-3	**Basic Optimization:**Advanced Issues in elementary topics, The importance of optimizations, Structure of optimizing compilers, Constant Expression Evaluation, Scalar Replacement of Aggregates,Algebraic simplifications and Re-association, Value Number, Copy Propagation, Common Sub-expression Elimination, Loop invariant Code motion, Partial Redundancy Elimination, Redundancy Elimination and Re- association, Code Hoisting, Induction Variable optimization, Unnecessary Bounds Checking Elimination
UNIT-4	**Procedure Optimization :**Tail-call optimization and Tail-Recursion Elimination, Procedure Integration, Inline Expansion, Leaf Routine optimization and shrink wrapping, Register allocation and assignment, Graph coloring, Unreachable Code Elimination, Straightening- If simplifications, Loop Simplifications, Loop inversion, Un-switching, Branch optimizations, Tail merging or cross jumping, Conditional moves, Dead code Elimination, Branch Prediction, Machine Idioms and Instruction

	combining
UNIT-5	**Code Generation:** Procedure calls and method dispatching, Separate Compilation & Linking, Instruction selection, Instruction Scheduling, Register allocation, Peehole optimization Dynamic memory management approaches and techniques: malloc/free, garbage collection(mark-sweep, copying, reference counting),regions Data layout for objects and activation records , just in time compilation & dynamic recompilation

TEXT BOOKS:

1. A.Aho, M. Lam, R. Sethi and J.Ullman ,"Compilers: Principles, Techniques and Tools" Addison-Wesley 2nd edition ISBN-13: 978-0321547989 Year 2007.
2. S. Muchnick"Advanced Compiler Design & Implementation", Morgan-Kaufmann Publishers ISBN: 1-558600-320-4.

REFERENCE BOOKS:

1. Keith Cooper and Linda Torczon, "Engineering a Compiler", Morgan-Kaufmann Publishers ISBN: 1-558600-698-X Year 2010.

2. Building an Optimizing Compiler" by Morgan

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Question answer based Theoretical Assignment
2) " Think More Write Less" Based (observation based) Assignment
3) Power point presentation of Topic which is related but out of syllabus
4) Class room Question & answer
5) Overall approach towards learning, creativity.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	05	10	35

K3	Apply	15	10	25
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K3	K3	K2	K2
	C01	C02	C03	CO4	CO5
Class Test 20 Marks	05	05	10		
Teachers Assessment 20 Marks		05	05	05	05
ESE Assesment 60 Marks	15	15	10	10	10

Special Instructions if any: Nil

Designed by

- Mrs. Pallavi. V. Kulkarni
- Mr. Vikul J. Pawar
- Mrs. Arjumand M. Khan

CS 459: Elective 3: Data Analytics

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorials	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		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-reduceand different other components such as Pig, Hive, HBase and ZooKeper.

Course Educational Objectives:

1. **To provide students with the fundamentals and essentials of Big Data and Hadoop.**
2. **Demonstrate various challenges in processing Big Data.**
3. **Demonstrate various concepts of Big Data and Hadoop.**
4. **Understand Hadoop MapReduce Framework.**

Course Outcomes Expected:

After completing this course, students will able to:

1. **Understand the concepts of Big data and challenges in processing Big Data**
2. **Understand Hadoop architecture and eco-system.**
3. **Gain conceptual understanding of Hadoop Distributed File System.**
4. **Understand the concepts of map and reduce and functional programming**
5. **Identify appropriate techniques and tools to solve actual Big Data problems.**

UNIT-1	**Introduction to Big Data and Hadoop:** What is Big Data, What are Challenges in processing Big data? What is hadoop, Data Storage and Analysis, Comparison with Other Systems: RDBMS, Grid Computing, Volunteer Computing; A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem.
UNIT-2	**HDFS: Hadoop Distributed File System:** Significance of HDFS in Hadoop, Features of HDFS, The Design of HDFS, HDFS Concepts: Blocks, Data replication, Namenodes and Datanodes; Accessing HDFS: CLI (Command line interface), Java based Approach.
UNIT-3	**Map Reduce:** Map Reduce Architecture, How map reduce works:Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion. Failures, Job Scheduling.
UNIT-4	**Pig:** Introduction to Apache Pig, Map-Reduce vs Pig, Pig Latin, Data Processing Operators. **Hive:** Hive introduction, Architecture, Comparison with Traditional Databases, HiveQL, Tables.
UNIT-5	**HBase:**HBasics, Concepts, HBase Versus RDBMS. **ZooKeeper:** The ZooKeeper Service. **Case Studies:** Hadoop and Hive at Facebook, Log Processing at Rackspace.

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. **VigneshPrajapati, "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				2				1	1			
CO2	3			3				1	1			
CO3								2	1			
CO4	1								1	2		
CO5	2	2	2	2				2		1		

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	10	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K3
	C01,CO2	CO1,C02	C03	CO4	CO5
Class Test (20 Marks)	05	10	00	05	00
Teachers Assessment (20 Marks)	00	00	05	10	05
ESE Assessment (60 Marks)	15	20	10	15	00

Special Instructions if any: Nil

Designed by

- Mr. Nouman Pathan
- Mrs. Meghana B. Nagori
- Mrs. Pallavi V. Kulkarni

CS 460: Elective 3: Multimedia Computing

Teaching Scheme			Evaluation Scheme	
Lectures	3Hrs/Week		Test	20 Marks
Tutorials	1 Hrs/Week		Teacher Assessment	20 Marks
Total Credits	4		End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Course Description: Multimedia computing is a study on presentation, integration and computation of various media using computing techniques. This programme encompasses theory and application in multimediainteraction.Thisprogramme also focuses on multimodal interaction techniques to create multimedia applications.

Course Educational Objectives:

1. Introduce to the students the characteristics and design methodologies of Multimedia

2. Expose students to theoretical and fundamental concepts of multimedia, its applications and the techniques involved
3. Help students learn the issues involved in capturing, processing, manipulating, storing, and retrieving various kinds of continuous media.

Course Outcomes Expected:

After completing this course, students will able to:

CO1: Identify different media; representations of different multimedia data and data formats.
CO2: Analyze various compression techniques.
CO3: Compare various audio and video file formats.
CO4: Apply different coding technique for solving real world problems.
CO5: Choose optical storage media suitable for multimedia applications.

UNIT-1	**MM Introduction:** Overview of multimedia, Multimedia building blocks, Digital representation, Interaction techniques and devices. **Multimedia architecture:** Introduction to multimedia architectures, User interfaces, Windows multimedia support, Windows API for Multimedia, Multimedia Database Systems, Media streaming, Multimedia authoring tools, Multimedia OS. Programming aspects of using Windows/Open-source API for developing applications, Design & programming aspects of application for audio/video streaming.
UNIT-2	Introduction to Image Processing and Compression applications, **Image Processing:** Basic Image fundamentals, Image data types, image file formats (GIF, BMP, TIFF, JPEG), Image acquisition, Image enhancement: Enhancement by point processing, Spatial filtering, Color image processing. **Image compression**: Types of compression: Lossy& lossless, symmetrical & asymmetrical, intraframe&interframe Hybrid, Loss less: RLE, Shannon- Fano algorithm, Arithmetic coding. Lossy: Vector quantization, fractal compression technique, transform coding, psycho-analysis, interframe correlation. Hybrid: JPEG-DCT Programs considerations for image enhancement using point processing and image compression.
UNIT-3	**Multimedia Audio:** Data structures used in audio files, Characteristics of sound waves, psycho, digital audio, MIDI and MIDI File format, CD and DVD formats. **Audio file formats:** WAV, VOC, AVI, MPEG Audio

	Audio compression: Compression in audio PCM,DM, DPCM Study of different audio file formats and compression techniques Programming considerations for audio compression.
UNIT-4	Study of different text formats and video formats. **Text :**Visual representation of text, Digital representation of text, Text compression: Huffman coding, LZ & LZW, **Text file formats:** TXT, DOC, RTF, PDF. **Video**: Digitization of video, Video capturing , Video transmission standards; EDTV, CCER, CIF, SIF, HDTV, Video formats: H-26I, H-263. MPEG Video compression. Video streaming. Study and analysis of video formats, compression and streaming .
UNIT-5	Animation and Multimedia Languages**,** Learn to use OpenGL **Animation:** Basics of animation, types of animation, principles of animation, techniques of animation, Creating animation. **OpenGL:** Open GL over windows/Linux, Extension, programming languages, SDK, shadowing techniques, rendering, Programming aspects in creating simple animation using OpenGL

TEXT BOOKS

1. Ralf Steinmetz and KlaraNahrstedt "Multimedia Computing, Communication andApplications", Pearson Education.
2. K.R. Rao, ‖ Multimedia Communication Systems: Techniques, Standards, and Networks‖, TMH.
3. Ranjan Parekh, "Principles of Multimedia",TMH.

REFERENCE BOOKS

1. Gonzalez, Woods, "Digital Image Processing" Addison Wesley
2. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education.
3. Edward Angel, ‖OpenGL: A Primer‖, Addison-Wesley.
4. “DeMustified Video”
5. Parag Havaldar, Gerard Medioni, ‖Multimedia Systems‖, Cengage Learning.

Mapping of Course outcome with Program Outcomes

Course	***Programme Outcomes***

Outcomes	*PO1*	*PO2*	*PO3*	*PO4*	*PO10*
CO1	M				
CO2	M	M			
CO3			M		
CO4				M	M
CO5	M				

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Power point presentation of case studies
2. Question & answer
3. Quiz

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	20	10	40
K3	Apply	00	00	20
K4	Analyze	00	10	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K4	K2	K3	K2
	C01	C02	C03	CO4	CO5
Class Test (20 Marks)	10	00	10	00	00
Teachers Assessment (20 Marks)	00	10	00	00	10
ESE Assessment (60 Marks)	15	20	15	20	10

Special Instructions if any: Nil

Designed by

- Mr. Nitin Dhutraj
- Mrs. Madhuri Aher
- Mrs. Arjumand M. Khan

CS461 Lab: Parallel Computing

Teaching Scheme
Practical 2 Hrs/Week
Credits 1

Evaluation Scheme
Practical /Viva-voce 25 Marks

Total Hours required for this practical course: 30 Hours.

Prerequisites:CS247: Lab Programming Language
Laboratory Course Outcome:
After completion of this course student will be able to
CO1: Design, implement, test and debug a parallel application program using
CO2: MPI Design, implement, test and debug a parallel application program using OpenMP
CO3: Parallelize an existing application using an appropriate parallel programming paradigm
CO4: Explain, in writing, the tradeoffs that result from using a specific programming paradigm for a given problem class
CO5: Develop and analyze a parallel algorithm using the PRAM model.

Suggestive list of programs.

1. Demonstrate a program which creates child process and prints its process Ids.

Shared Memory Programming

2. Implement a program to copy the contents of one array to another.
3. Design &develop a program to do sum of numbers from 1 to 10, by dividing the job into two processes, one parent and one child.
4. Develop a program to do sum of elements of the array using self-scheduling.
5. Design &develop a program to do sum of the elements of the array by loop splitting; Each process adds its partial sum to the final sum (The overhead on the parent is removed.)
6. Create a program to find factorial of a given number using self-scheduling.

Thread Based Implementation

7. Design & develop a program to solve the producer consumer problem using thread.
8. Create a program to create singly linked list of numbers using thread.
9. Implement a program to find minimum and maximum elements from an array of N elements using thread.

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

CO2		H							H			H
CO3		H							H			H
CO4		H							H			H
CO5		H							H			H

H – High M – Medium L - Low

Assessment Table

Assessment Tool	**S2**	**S3**	**S3**	**S2**
	CO1,CO2	CO3	CO4	CO5
Practical Examination & Viva Voce (25 Marks)	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Practical Examination & viva voce**
S1	Imitation	00
S2	Manipulation	10
S3	Precision	10
S4	Articulation	05
S5	Naturalization	00
Total		25

Preparation (S1)	00
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	07
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

Special Instructions if any: Nil

Designed by

- Mrs. Madhuri A. Aher
- Mr. Sudhir G. Shikalpure
- Mr. Vikul Pawar

CS-462: Lab : Distributed Databases

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

Prerequisite subject: 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 implementmaterialized 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

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Practical Examination & viva voce**
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10

S4	Articulation	00
S5	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	07
Observation and Analysis of Results (S3)	05
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

Special Instructions if any: Nil

Designed by

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

CS463 Lab: Wireless and Mobile Computing

Teaching Scheme
Practical 2 Hrs/Week
Credits 1

Evaluation Scheme
Practical /Viva-voce 25 Marks

Total Hours required for this practical course: 30 Hours.

Prerequisites:CS247: Lab Programming Language
Course Outcome:
After completion of this course student will be able to
CO1: To design successful mobile and pervasive computing applications and services.
CO2: To use contemporary development environment and languages (e.g., C#, Java) to develop mobile applications.
CO3: To program the typical functionalities of modern smartphones (e.g., light sensor, gyro, accelerometer, cameras, microphones, GPS, barometer).
CO4: To work effectively as a member of a team to complete a large programming project.

Suggestive list of programs.
1. Design & develop a program for text formatting , character formatting & display data in tabular format using wml programming.

2. Design & develop a program for user input & navigation between cards using wml.

3. Design & develop a program to handle different events using wml.

4. Introduction to WML script.

5. Design & develop a program to convert currency in wml script.

6. Create "Hello World" application that will display "Hello World" in the middle of the

screen with the use of android.

7.Create Activity, Intent modules using android

8. Using android develop a sample application for login module.

9. Create an application that will display "Toast Message" on specific interval of time using android

10. Mini Project based on Android.

Practical Examination will consist of Performance and Viva-voice Examination
The assessment will be based on the following –

1. Performance in the practical examination
2. Record of programs submitted by the candidate
3. Setting goals higher than expected from problem statement
4. Innovation & Creativity
5. Team building skills
6. Technical writing skills

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Assessment Table

Assessment Tool	**S2**	**S3**	**S3**	**S2**
	CO1	CO2	CO3	CO4
Practical Examination & Viva Voce (25 Marks)	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Practical Examination & viva voce**
S1	Imitation	00
S2	Manipulation	10
S3	Precision	10
S4	Articulation	05
S5	Naturalization	00
Total		25

Preparation (S1)	00
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	07
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	05
Total	**25**

Special Instructions if any: Nil

Designed by

- Mrs. Madhuri A. Aher
- Mr. Sudhir G. Shikalpure
- Mrs. Vijayshree A. Injamuri

CS464 : Lab Elective3: Adv Compiler Design

Teaching Scheme			**Evaluation Scheme**	
Practical	2 Hrs/Week		Term Work	25 Marks
Credits	1			

Total Hours required for this practical course: 30 Hours.

Prerequisite: Lab Programming Language, Lab Java programming.

Course Outcome:
After completing this course, students will able to:

CO1: Familiarize with freely available compiler infrastructure like Soot, JikesRVM, Wala, LLVM, Scala, gcc, Eclipse, abc, SUIF.
CO2: Implement the techniques of Lexical Analysis andSyntaxAnalysis .
CO3: Generate Intermediate code for High level Language.
CO4: Use Optimization techniques and generate machine level code.
CO5: Design a compiler for a subset of any High level language.

The term work shall consist of following practical/assignments/mini-project/visit*

Tentative List of Experiments

1. Study of UNIX tools(like lex/flex) for Lexical Analyzer generator.
2. Study of UNIX tools(like yacc/bison) for Syntactic Analyzer generator.
3. Declaration Analysis, Type Checking
4. Storage Allocation & Instruction Scheduling.
5. Code Generation with Register Allocation.
6. Peephole optimization
7. Mini project

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		H										
CO5				H						H	H	L

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S2	S3	S3	S3	S4
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	00
S2	Manipulation	05
S3	Precision	15
S4	Articulation	05
55	Naturalization	00
Total		25

Preparation (S1)	00
Conduct of Experiment (S2)	04
Observation and Analysis of Results (S3)	08
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	06
Total	**25**

Special Instructions if any: Nil

Designed by

- Mrs. Pallavi. V. Kulkarni
- Mr. Vikul J. Pawar
- Mrs. Arjumand M. Khan

CS465: Lab Elective3: Data Analytics

Teaching Scheme			**Evaluation Scheme**	
Practical	2 Hrs/Week		Term Work	25 Marks
Credits	1			

Total Hours required for this practical course: 30 Hours.

Lab Educational Objectives:

1. **Understand Hadoop core components (HDFS &MapReduce).**
2. **Learn and understand different platforms such as Pig, Hive and Zookeeper.**

Lab Outcomes Expected:

After completing this course, students will able to:

CO1: Install and use Hadoop framework.

CO2: Use Map Reduce API and write common algorithms

CO3: Manage and Monitor Hadoop Cluster.

CO4: Use Hive & Pig for analysis.

Suggestive List of Laboratory Practice:

1. Installing Hadoop.
2. Running MapReduce Jobs.
    a. Complie java File
    b. Create a Jar File
    c. Run MapReduce Job
3. Writing a MapReduce Program
    a. Implement a Unit Tests for the WordCount code.
4. Creating a Hadoop cluster using virtual machines.
5. Managing Hadoop clusters.
    a. Managing jobs.
    b. Managing scheduler.
6. Installing and running pig.
7. Installing and running Hive.
8. Installing HBase, HBase Shell.
9. Manipulating data with HBase.
10. Installing and Running ZooKeeper.
11. Importing data with Sqoop.
12. Integration of Apache Hive and HBase.

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3
	CO1,CO3,CO4	CO2	CO3,CO4	CO2,CO3,CO4
Term Work (25 Marks)	07	07	05	03

Assessment Pattern

Assessment Pattern	Skill Level	Term

Level No.		Work
S1	Imitation	05
S2	Manipulation	08
S3	Precision	12
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	00
Conduct of Experiment (S2)	04
Observation and Analysis of Results (S3)	08
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	06
Total	**25**

Special Instructions if any: Nil

Designed by

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

CS466 : Lab Elective3: Multimedia Computing

Teaching Scheme			**Evaluation Scheme**	
Practical	2 Hrs/Week		Term Work	25 Marks
Credits	1			

Total Hours required for this practical course: 30 Hours.

Prerequisite: Computer Graphics

Course Outcomes

After completing this course, students will able to:

CO1: Use different tools for multimedia processing to formulate computing requirements
CO2: Implement the mathematical principles of digital image enhancement
CO3: Experiment with audio and video signals to interpret data in different forms
CO4: Select and use appropriate image compression techniques necessary for practice
CO5: Demonstrate practical applications animations to continue professional development

The term work shall consist of following practical/assignments/mini-project/visit*
Suggestive list of programs –

1. Design & Develop a program for data compression techniques
2. Design & Develop VRML program of creation of table and chair
3. Design & Develop VRML program of bouncing ball
4. Design & Develop VRML program of creation of cube
5. Design & Develop VRML program of switching on and off of bulb
6. Design & Develop VRML program of flight simulation system
7. Write assignment on MIDI
8. Write assignment on basic compression techniques
9. Design & Develop a program for interpret a file type and convert the file into another format

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						H		
CO4									H	H		
CO5			H						L		H	

H – High M – Medium L - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3	S3
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	07	07	05	03	03

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	05
S2	Manipulation	08
S3	Precision	12
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	00
Conduct of Experiment (S2)	04
Observation and Analysis of Results (S3)	08
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	06
Total	**25**

Special Instructions if any: Nil

Designed by

- Mr. Nitin Dhutraj
- Mrs. MadhuriAher
- Mrs. Arjumand M. Khan

CS467: Research Lab

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

Total Hours required for this practical course: 30 Hours.

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

CO1: Identify area of interest / problem domain.

CO2:Collect related latest standard research papers and analyze them.

CO2: Use required Toolbox .

CO3: Apply the functions to solve problem / implement algorithm.

CO5: Develop solution and test it

Study of various MatLab/SciLab Tool Boxes related to Computer Science & Engineering

Suggestive List is

1. **Computer Vision System Toolbox**
2. **Image Processing Toolbox**
3. **DSP System Toolbox**
4. **Parallel Computing Toolbox**
5. **Neural Network Toolbox**
6. **Bioinformatics Toolbox**

A miniproject in a group of 2 to 3 students based on required tool boxes should be completed and a record for the same shall be submitted.

Internal Practical examination will consist of an oral examination.

1. The assessment in the oral examination
2. Record of programs/ projects submitted by the candidate.

Practical Examination will consist of Performance and Viva-voice Examination

The assessment will be based on the following –

1. Performance in the practical examination
2. Record of programs submitted by the candidate
3. Setting goals higher than expected from problem statement
4. Innovation & Creativity
5. Team building skills
6. Technical writing skills

Mapping of Course outcome with Program Outcomes

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

H – High M – Medium L - Low

Assessment Table

Assessment Tool	A3	K3	K2	S3	K4,S4
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	20	30	20	15	25
Practical Examination & Viva Voce (25 Marks)	10	50	20	10	10

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
A3	Valuing	20	10
K3	Apply	20	10
K2	Understand	20	10
S3	Precision	20	50
K4, S4	Evaluate, Articulation	20	20
Total		100	100

Preparation (S1)		
Conduct of Experiment (S2)		
Observation and Analysis of Results (S3)		
Record (S2)		
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	**100**	**100**

Special Instructions if any: Nil

Designed by
All Faculty

CS468: Project-II

Teaching Scheme			Evaluation Scheme	
Practical	6 Hrs/Week		Term Work	100 Marks
Total Credits	3		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

Assessment Table

Assessment Tool	K2	K3	K3	S3	K4
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	20	30	20	15	25
Practical Examination & Viva Voce (25 Marks)	10	50	20	10	10

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
K2	Understand	20	15
K3	Apply	50	20
S3	Precision	15	40
K4	Analyze	25	20
S5	Naturalization		5
Total		100	100

Preparation (S1)		
Conduct of Experiment (S2)		
Observation and Analysis of Results (S3)		
Record (S2)		
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	**100**	**100**

Special Instructions if any: Nil

Designed by
All Faculty