UNIVERSITY OF MUMBAI

Revised Syllabus for the

M. E. (Computer Engineering):
Program: M.E.
Course: Computer Engineering

(As per Credit Based Semester and Grading System with effect from the academic year 2012–2013)

Program Structure for
ME Computer Engineering
Mumbai University

(With Effect From 2012-2013)

Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC101	Advanced Algorithms and Complexity	04	--	--	04	--	--	04
CSC102	Parallel Computing	04	--	--	04	--	--	04
CSC103	Network Design and Management *	04	--	--	04	--	--	04
CSE101X	Elective I	04	--	--	04	--	--	04
CSE102X	Elective II	04	--	--	04	--	--	04
CSL101	Laboratory I –Open Source #	--	02	--	--	02	--	01
CSL102	Laboratory II – Advanced Algorithm and Network Lab	--	02	--	--	02	--	01
	Total	**20**	**04**	**--**	**20**	**04**	**--**	**22**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem.Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
CSC101	Advanced Algorthm and Complexity	20	20	20	80	03	--	--	100
CSC102	Parallel Computing	20	20	20	80	03	--	--	100
CSC103	Network Design and Management *	20	20	20	80	03	--	--	100
CSE101X	Elective I	20	20	20	80	03	--	--	100
CSE102X	Elective II	20	20	20	80	03	--	--	100
CSL101	Laboratory I –Open Source #	--	--	--	--	--	25	25	50
CSL102	Laboratory II – Advanced Algorithm and Network Lab	--	--	--	--	--	25	25	50
	Total	**100**	**100**	**100**	**400**	**--**	**50**	**50**	**600**

* Common for Computer and IT

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC201	Advanced Operating System	04	--	--	04	--	--	04
CSC202	Cyber Security	04	--	--	04	--	--	04
CSC203	Decision Making and Adaptive Business Intelligence	04	--	--	04	--	--	04
CSE201X	Elective III	04	--	--	04	--	--	04
CSE202X	Elective IV	04	--	--	04	--	--	04
CSL201	Laboratory I –Open Source #	--	02	--	--	02	--	01
CSL202	Laboratory II –Cyber Security and Decision Making and Adaptive Business Intelligence	--	02	--	--	02	--	01
Total		**20**	**04**	**--**	**20**	**04**	**--**	**22**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem.Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
CSC201	Advanced Operating System	20	20	20	80	03	--	--	100
CSC202	Cyber Security	20	20	20	80	03	--	--	100
CSC203	Decision Making and Adaptive Business Intelligence	20	20	20	80	03	--	--	100
CSE201X	Elective III	20	20	20	80	03	--	--	100
CSE202X	Elective IV	20	20	20	80	03	--	--	100
CSL201	Laboratory I –Open Source	--	--	--	--	--	25	25	50
CSL202	Laboratory II –Cyber Security and Decision Making and Adaptive Business Intelligence	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**	**--**	**50**	**50**	**600**

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSS301	Seminar	--	06	--	--	03	--	03
CSD301	Dissertation I	--	24	--	--	12	--	12
Total		**--**	**30**	**--**	**--**	**15**	**--**	**15**

Subject Code	Subject Name	Examination Scheme						
		Theory				Term Work	Pract. / Oral	Total
		Internal Assessment			End Sem.Exam.			
		Test1	Test 2	Avg.				
CSS301	Seminar	--	--	--	--	50	--	50
CSD301	Dissertation I	--	--	--	--	100	--	100
Total		**--**	**--**	**--**	**--**	**150**	**--**	**150**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MDD401	DissertationII	--	30	--	--	15	--	15
Total		**--**	**30**	**--**	**--**	**15**	**--**	**15**

Subject Code	Subject Name	Examination Scheme						
		Theory				Term Work	Pract. / Oral	Total
		Internal Assessment			End Sem.Exam.			
		Test1	Test 2	Avg.				
MDD401	DissertationII	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	**100**	**100**	**200**

Note:
- o In case of Seminar, 01 Hour / week / student should be considered for the calculation of load of a teacher
- o In case of Dissertation I, 02 Hour / week / student should be considered for the calculation of load of a teacher
- o In case of Dissertation II, 02 Hour / week / student should be considered for the calculation of load of a teacher

Subject Code	Elective I	Subject Code	Elective II
CSE1011	Operation Research*	CSE1021	Bioinformatics *
CSE1012	Software Testing	CSE1022	High Performance Computing
CSE1013	Machine Learning	CSE1023	Service Oriented Architecture
CSE1014	Advanced Data Base Design	CSE1024	E-Business Technology *

* Common for Computer and IT

Subject Code	Elective III	Subject Code	Elective IV
CSE2011	Advance Computer Graphics	CSE2021	Advanced Compiler Design
CSE2012	Information Retrieval	CSE2022	Semantic Web Technology
CSE2013	Storage Area Network	CSE2023	Ubiquitous Computing *
CSE2014	Soft Computing *	CSE2024	Emerging wireless Technologies and Future Mobile Internet

* Common for Computer and IT
 # There will be one mini project for Lab I. One student per project based on either core or elective courses which are not covered in Lab II in semester I and II both.

Subject Code	Subject Name	Credits
CSC101	**Advanced Algorithms and Complexity**	**04**

Module	Detailed content	Hours
1	**Introduction to analysis of Algorithms** Design and Analysis Fundamentals, Performance analysis, space and time complexity, Growth of a function Big Oh Omega theta notation, Mathematical Background for algorithm analysis, Randomized and recursive algorithms Master's theorem , Substitution and Recursive	04
2	**Divide and Conquer** Searching and Sorting algorithms, Median, FFT DFT IFFT Interpolation	04
3	**Flow N/W Maximum Flow** Shortest Path, The Flyod - Warshall Algorithm, Johnson's Algorithm for sparsegraphs, Flow Networks, The Ford-Fulkerson method, Maximum bipartite matching, Push relabel algorithms, The relabel-to-front algorithm, Shortest Path, The Flyod - Warshall Algorithm	06
4	**Online algorithms** The online paging problem, Adversary models, Paging against an oblivious adversary, Relating the adversaries, The adaptive online adversary, The k-Server Problem	05
5	**Linear Programming** An Introduction to linear programming, Flows in networks, Bipartite matching, Duality, Zero- sum games, The simplex algorithm, Post script: circuit evaluation	04
6	**Greedy and Dynamic Algorithms** Travelling Sales parsing, Knapsack, Matrix Chain Multiplication	04
7	**String Matching** The naïve string matching algorithm, Rabin Karp algorithm, Longest common subsequence (LCS), String matching with finite automata	05
8	**Approximation Algorithms** The vertex - cover problem, The travelling salesman problem, The set-covering problem, Randomization and linear programming, The subset-sum problem	04
9	**Optimization Algorithms** Genetic Algorithm, K- means Algorithm	04

TEXT BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to ALGORITHMS, PHI, India Second Edition.
2. Dan Gusfield, "Algorithms on Strings, Trees, and Sequences", Cambridge University Press.
3. Rajeev Motwani, Prabhakar Raghavan, " Randomized Algorithm", Cambridge University Press.
4. Michael Goodrich, Roberto Tamassia, " Algorithm Design" Wiley Student Edition.

Reference Books

1. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI
2. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.

Practical:

For Every module implement any 1 algorithm. Minimum 6 Algorithms from 6 different modules to be implemented.

Subject Code	Subject Name	Credits
CSC102	**PARALLEL COMPUTING**	**04**

Module	Detailed content	Hours
1	INTRODUCTION: Parallel computing, scope of parallel computing, Abstract model of serial & parallel computation, pipelining, data parallelism, control parallelism, scalability , topologies in processor organization, parallel computing design consideration , parallel algorithms & parallel architectures, applications of parallel computing .	06
2	SYSTEM ARCHITECTURES Shared memory multiprocessors(UMA-Uniform memory Access), Distributed memory multiprocessors(NUMA- Non Uniform memory Access),SIMD, Systolic processor ,Cluster computing, Grid computing, Multicore Systems .	07
3	PARALLEL ALGORITHMS Introduction to parallel algorithms, parallel algorithm models, Decomposition Techniques, characteristics of tasks & interactions ,mapping techniques for load balancing, methods for containing interaction overheads.	06
4	PARALLEL ALGORITHMS & APPLICATIONS Matrix multiplication, parallel reduction ,parallel sorting : bubble, quick sort, Graph algorithm: Minimum spanning tree(prim's algorithm),Fast Fourier transform: serial algorithm, transpose algorithm .	10
5	PARALLEL PROGRAMMING Paradigms, parallel programming models, shared memory programming , message passing programming , MPI , PVM ,Threads.	07
6	ANALYATICAL MODELLING OF PARALLEL PROGRAMS Sources of overhead in parallel programs , performance metrics for parallel systems , effect of granularity &data mapping on performance , scalability of parallel systems ,analysis of parallel programs .	04
7	CASE STUDY High performance FORTRAN, High performance JAVA , OpenMP	02

References:

1)" **Introduction to Parallel Computing**" (2nd Edition) Ananth Grama ,George Karypis, Vipin Kumar , Anshul Gupta.

2) "**Algorithms and Parallel Computing** "(Wiley Series) Fayez Gebali .

3) " **Scalable Parallel Computers**" Kai Hwang, Zhiwei Xu .

4) "**Introduction to parallel processing** " M.Sasikumar , Dinesh shikhare, P. Ravi Prakash .

5) "**Principles of Grid computing** " P. Venkata Krishna, Ane's Student Edition .

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSC103	**Network Design and Management**	**04**

Module	**Detailed content**	**Hours**
1	Requirements Planning and Choosing Technology: User Requirements, documentation and planning, traffic sizing, tuning data size across the network, traffic characteristics, time and delay consideration.	4
2.	Traffic Engineering and Capacity Planning: Poisson Arrivals, Markov processes, Voice traffic modeling, Queuing system models, Markovian queuing system models M/D/1, M/M/1, Bernoulli process, Erlang formulas and M/M/c/e system priority queue system, LAN Traffic Modeling, Availability and Reliability.	6
3	Network Design: Designing the network topology and solutions-Top down Approach – Network Design Layers--Application Layer, Premises Architecture or Local Enterprise, Architecture Layer, Access Layer, Backbone Layer, Access Layer Design, Backbone Network Design.	6
4.	Enterprise LAN Design: Ethernet Design Rule. 100 Mbps Fast Ethernet Design rules, Gigabit Ethernet Design Rules, 10 Gigabit Ethernet Design rules, 10GE Media types.	6
5.	Network Management—Challenges of Information Technology Managers, Goals, Network Provisioning, Installation and Maintenance.	5
6.	Network Management Protocols: SNMP v1,v2,v3, RMON1, RMON2, Netflow, Syslog. Network Management Standards, ASN.1, encoding structure, Macros, Functional Model.	6
7.	Telecommunication Network management--Terminology, functional architecture, information architecture, TMN Cube, TMN & OSI.	5
8.	Functional Areas of Network Operations and Management: Configuration Management, Performance Management, Fault Management, Accounting Management, Security Management, Policy Based Management.	5
9.	Network Management Tools: Basic software tools, SNMP MIB tools, Protocol Analyzer.	5

References:

1. Data Network Design, Darren L. Spohn, Tata McGraw Hill Edition.
2. Network Management Principles and Practice, Mani Subramanian, Pearson Education.
3. Network Analysis, Architecture, and Design 3rd Edition, James D, Morgan Kaufman.
4. Wide Area Network Design: Robert S Kahn, Morgan Kaufman.
5. Fundamentals of Telecommunication Network Management --Lakshmi Raman IEEE Communication Society, Prentice Hall of India Edition 1999.
6. Cisco press CCDA official Guide.
7. Telecommunication Network Modeling, Planning & Design-- by Sharon Evans (BT Comm.Tech.) 2009.
8. High Speed Networks and Internets: Performance and Quality of Service, William Stallings, Prentice Hall.
9. Computer Networks – A Systems Approach, Larry L. Peterson and Bruce S. David, 4th Edition, Elsevier, 2007.
10. Computer Networking, A Top-Down Approach Featuring the Internet", James F. Kurose, Keith W. Ross, Third Edition, Addison Wesley, 2004.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are: six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1011	**Operation Research**	**04**

Module	Detailed content	Hours
1	Overview of Operation Research and Modelling Approach	02
2	Linear Programming: Introduction to Linear Programming , Formulation of LP Model,Graphical solution ,Assumptions , Simplex Method,Duality theory and Sensitivity Analysis , Transportation and Assignment Problems, Network Optimization Models	10
3	Dynamic Programming	03
4	Non-linear Programming One variable and Multi-variable unconstrained optimization, Quadratic Programming , Seperable Programming, Convex Programming,	05
5	Decision Analysis Decision Trees, Utility Theory, Application of Decision Analysis	06
6	Queueing Theory Queueing Models,Notations and Little's law, Role of exponential Destribution , Birth and Death Process,Markovian Queues – Single and Multi Server Models, Queueing Models involving non-exponential destribution, Queueing Networks	08
7	Inventory Model Continuous Review Model , Deterministic Periodic Review Model , Stochastic Continuous Review Model	07
8	Simulation Discrete Event Simulation and Applications , Generation of Random Numbers , Generation of Random Observation from a probability Distribution	07

References:

1. Introduction to Operations Research – Concepts and Cases ; 8th Edition , Fredrick S. Hillier , Gerald J. Lieberman ; SIE – McGraw Hill.
2. Operation Research – An Introduction – Hamdy A. Taha , Pearson Education

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1012	Sem-I, Elective-I, Software Testing	04

Module	Detailed content	Hours
1	**Fundamentals of Testing** Human and errors, Testing and Debugging, Software Quality, Requirement Behavior and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, The Tester's Role in a Software Development Organization, Origins of Defects, Defect Classes, The Defect Repository and Test Design, Defect Examples.	04
2	**Levels of Testing** The Need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests. The Class as a Testable Unit, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, System Test – The Different Types, Regression Testing, Alpha, Beta and Acceptance Tests	06
3	**Test Case Design** Introduction to Testing Design Strategies, Test Case Design Strategies, Using Black Box Approach to Test Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis, Other Black-box Test Design Approaches, Using White-Box Approach to Test design, Coverage and Control Flow Graphs, Covering Code Logic, Additional White Box Test Design.	08
4	**Testing Object Oriented Software** Introduction to OO testing concepts, Differences in OO testing, Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing, State Based Testing.	05
5	**Metrics and Models in Software Testing** Software Metrics, Categories of Metrics, Object Oriented Metrics Used in Testing, What should we Measure during Testing? Software Quality attributes Predication Models.	07
6	**Automated Testing** Automated Testing and Test Tools ,The Benefits of Automation and Tools, The V model –Tool support for life-cycle testing, Software Test Automation, Common problems of test automation – The limitations of automating software testing. Testing Web Applications.	12
7	**Testing Standards and Documentation**. ISO ,CMMI and PCMMI, Six Sigma, Types of software documentation, The importance of documentation testing, Factors for reviewing documentation, The realities of documentation Testing	05

Text Books:
1) Ron Patton, "Software Testing", Pearson publication.
2) Yogesh Singh, "Software Testing", Cambridge University Press.

References Books:
1) William E. Perry, "Effective Methods for Software Testing" Wiley India Publication, 3rd Edition.
2) Roger S Pressman, "Software Engineering: A Practitioner's Approach" 6th Edition, McGraw Hill, 2005.
3) Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, New Delhi,
4) Elfriede Dustin, "Effective Software Testing", Pearson Education, New Delhi, 2003
5) Renu Rajani and Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw-Hill, New Delhi, 2003

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:
Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1013	**SEM-II, Elective-III,** **MACHINE LEARNING**	**04**

Module	Detailed content	Hours
1	INTRODUCTION Definition of learning systems. Goals and applications of machine learning. designing a learning system: training data, concept representation, function approximation. well posed learning problems, perspective & issues in machine learning	06
2	CONCEPT LEARNING The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypothesis. FIND-S , candidate elimination algorithm	04
3	DECISION TREE LEARNING Introduction, Decision tree representation, appropriate problems for decision tree learning, basic decision tree algorithm, hyper space search in decision tree learning, issues in decision tree learning .	06
4	BAYESIAN LEARNING Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.	06
5	INSTANCE BASED LEANING Introduction, K-nearest neighbour learning, case based learning, radial basis functions	04
6	CLUSTERING & UNSUPERVISED LEARNING Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabelled data.	06
7	ARTIFICIAL NEURAL NETWORK Introduction, neural network representation , problems for neural network learning, perceptrons ,multilayer network & Back propagation Algorithm.	05
8	GENETIC ALGORITHMS Introduction, genetic operators, genetic programming, models of evolution & learning, parallelizing genetic algorithm	05

References:

1. Tom M. Mitchell. **"Machine Learning"** McGraw-Hill, 1997.

2. P. Langley. **"Elements of Machine Learning"** Morgan Kaufmann Publishers, Inc. 1996.

3. Ethem Alpaydin **"Introduction to machine learning "**.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02
Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1014	**SEM-I, Elective – I , Advanced Databases Design**	**04**

Module	Detailed content	Hours
1	**DATABASE DESIGN ISSUES** ER Model – Normalization – Security – Integrity – Consistency – Database Tuning – Optimization and Research Issues – Design of Temporal Databases – Design of Spatial Databases.	06 hrs

2	**DISTRIBUTED DATABASES**
	
	Distributed Databases Vs Conventional Databases
	– Architecture
	– Advantages
	– Disadvantages
	– Fragmentation
	   – horizontal, vertical, hybrid Replication Top-up design
	   – the allocation problem Bottom-down design
	– Data Replication
	– Data Fragmentation
	– Transparently Naming & Autonomy
	– Distributed Query Processing
	– Recovery
	– Concurrency Control
	– Deadlock Handling
		10 hrs

3	**OBJECT ORIENTED & OBJECT RELATIONAL DATABASES** Introduction to Object Oriented Data Bases – Approaches – Modeling and Design – Persistence – Query Languages – Transaction – Concurrency – Multi Version Locks – Recovery.	08hrs
4	**EMERGING SYSTEMS** Enhanced Data Models – Client/Server Model – Data Warehousing and Data Mining – Web Databases – Mobile Databases.	10hrs
5	**CURRENT TRENDS** Rules Knowledge Bases – Active and Deductive Databases – Parallel Databases – Multimedia Databases	10hrs

– Image Databases
– Text Database.
– Unstructured Databases
– Cloud Computing
– Data streaming

References:

1. R. Elmasri S.B. Navathe, "Fundamentals of Database PearsonEducation, 2004.
2. F.Henry Korth, Abraham Silberschatz, S.Sudharshan, System Concepts", Fourth Ediion, Tata Mcgraw Hill, 2002.
3. Elisa Bertino, Barbara Catania, Gian Piero Zarri, "Intelligent Database Systems", Addison-Wesley, 2001.
4. Carlo Zaniolo, Stefano Ceri, Christos Faloustsos, R.T.Snodgrass, V.S.Subrahmanian, "Advanced Database Systems", Morgan Kaufman, 1997.
5. N.Tamer Ozsu, Patrick Valduriez, "Principles Of Distributed Database Systems", Prentice Hall International Inc., 1999.
6. Abdullah Uz Tansel Et Al, "Temporal Databases:"Theory, Design And Principles", Benjamin Cummings Publishers, 1993.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:
Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1021	**BioInformatics**	**04**

Module	Detailed content	Hours
1	**Introdcution:** History of Bioinformatics, Biological information resources and retrieval system, Knowledge Discovery and data mining, data characteristics and presentation	3
2	**Protein Information Resources:** Biological databases, Primary sequence databases, protein sequence databases, Secondary databases, protein pattern databases, and structure classification databases.	8
3	**Genome Information Resources :** Computational methods: Gene identification methods; data mining (Genome databases) and phylogenetic analysis; Predictive methods using nucleic acids and protein sequences.DNA sequence databases, specialized genomic resources. Gene identification methods Genomics and Human genome project; Strategy of genome sequencing	12
4	**Bioinformatics Software :** Molecular structure drawing tool (Chemdraw); VMD/Rasmol/Insight-II; Clustal X1.8; OLIGO; Molecular modelling/ Docking(CAChe);	8
5	**Biological Data Bases And Their Management:**Introduction to SQL (Sequence Query Language) Concept on data base in Protein and nucleic acids, Various programmes for sequence comparison and analysis, Database searching, Alphabets and complexity, Algorithm programs. Comparing two sequences, sub sequences, identity and similarity, The Dotplot, Local and global similarity, different alignment techniques. Dynamic programming , pair wise searching, importance and need of secondary database searching. secondary database structure and building a sequence search protocol	12
6	**Various Development In Bioinformatics:** Genome projects (human, Rice), Molecular modeling and structure function relationship, Proteomics, Molecular Dynamics Analysis package structure, commercial software, comprehensive, current trends and future prospects of bioinformatics.	5

Text Books:

1. Cynthia Gibas ,Per Jambeck "Developing Bioinformatics Computer Skills". Publisher: O'Reilly,First Edition April 2001

2. T.K.Attwood And D J Parry-Smith Addison" Introduction To Bioinformatics" Wesley longman

3. Jean –Michel, Clavreriw, cerdric notredame, "Bioinformatics-A Beginnr's Guide" Willy dreamlech india pvt. Ltd.

Reference Books

1. Introduction to Bioinformatics, Arthur M. lesk, OXFORD publishers (Indian edition)

2. Baxevanis AD, Ouellette BFF (eds): "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins"

3. Higgins D, Taylor W (eds): "Bioinformatics: Sequence, Structure and Databanks".

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE1022	**SEM-II, Elective-II, High Performance Computing**	**04**

Module	Detailed content	Hours

1   **Introduction to Grid Architecture**
- a. Characterization of Grid.
- b. Grid related standard bodies.
- c. Grid types, Topologies, Components and Layers.
- d. Comparison with other approaches.

2   **2. System Infrastructure**
- a. Traditional paradigms for distributed computing
- b. Web Services
- c. Grid standards : OGSA & WSRF
- d. Introduction to Globus Toolkit 3 & GT 4

3   **Semantic Grid & Autonomic Computing**
- a. Metadata & Ontology in semantic Web
- b. Semantic Web Services
- c. Layered Structure of Semantic Grid
- d. Semantic Grid Activities
- e. Autonomic Computing

4   **Basic Services**
- a. Grid Security
- b. Grid Monitoring
- c. GMA, Review criteria overview of Grid Monitoring system – Autopilot.
- d. Computational grids, Data grids, architecture of Grid systems, Grid security infrastructure.

5   **Grid Scheduling & Resource Management**
- a. Scheduling Paradigms
- b. How Scheduling Works

Review of Condor

6   **Introduction to Cloud Computing**

Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS / HAAS
and Others, Organizational scenarios of clouds, Administering & Monitoring cloud
services, benefits and limitations

7   **Virtualization & Cloud**

Virtualization characteristics, Managing virtualization, Virtualization in cloud,
Virtualization desktop and managing desktops in the cloud and security issues

8   **Cloud Storage and Data Security**

Storage basics, Storage as a service providers, security, aspects of data security, data
security mitigation, provider data and it's security.

List of Books

1. The Grid Core Technologies, by Maozhen Li, Mark Baker, John Wiley & Sons.

2. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, Wiley India Edition.

3. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif, SPD, O'REILLY.

4. A networking Approach To Grid Computing by Daniel Minoli, John Wiley & Sons, INC Publication.

5. Cloud Computing: A Practical Approach by J.Vette, Toby J. Vette, Robert Elsenpeter, Tata McGraw Hill.

Practicals:

1. Use of Globus Tool Kits – GT3/GT4

2. Assignment on Web Services call two separate components on a s ingle framework

3. Assignment on services of Cloud (SAAS / PAAS / IAAS / HAAS)

Subject Code	Subject Name	Credits
CSE1023	**SEM-II, Elective-II, Service-Oriented Architecture**	**04**

Module   **Detailed content**   **Hours**

Pre-requisite:- Software Engineering, OOSE, OOAD, WE, Design Patterns**.**

Objective: Service Oriented Architecture (SOA) has quickly become the industry standard for building next generation software. This course begins with a look at the architectural principles needed to create successful applications and then goes on to examine the process for designing services and SOA implementations.

1   **Introduction:** Introduction to Middleware Technology, General Middleware, Service Specific Middleware, Client Server Building blocks, Promises and Challenges of SOA, Reference Architecture, Common Semantics, Governance, Business Process Modeling, Design-Time Service Discovery, Model-Based Development, Best Practices in SOA Analysis and Design.
Overview of SOA Implementation Methodology, SOA Reference Architecture, Business Architecture, Business Processes, Information Design, Service Identification, Service Specification, Services Realization, Service Life Cycle, and the Service Design Process.

2   **Modelling:** Understanding the Business Motivation Model, Business Process Management and Modeling, Use Cases, Conditional Business Process Models.
a) Types of Modeling:- Service modeling, Service guideline classify service model logic, Contrasting service modeling approaches , SOA programming models , SCA, WCF.

3   **Design Patterns:** Services, Design Guidelines, Interface Design Illustrated, and Solution Model.

4   **SOAD:** Need for models, Principals of service design, Design of activity services, Design of data services, Design of client services, Design of business services.

5   **Implimentation of SOA**: Implementing interface layer, implementing Business layer, Implementing Resource Layer, Implementation Design Illustrated.

6   **Integration and Security :**Integration in SOA, Special Considerations for Implementing of Integration. Security Goals and Fundamentals, Web Service Security Standards and Specifications, SOA Security Blueprints.

List of Books

1. "Service-Oriented Architecture Thomas Erl Concepts, Technology, and Design", Pearson Education.
2. "Service- Oriented Architecture for Enterprise Applications", Shankar Kambhampaty, Wiley publication.
3. "SOA Principles of Service Design" by Thomas Erl, Prentice Hall
4. "Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap "Norbert Bieberstein, Sanjay Bose, Marc Fiammante, Keith Jones, Rawn Shah, IBM Press.
5. "The New Language of Business: SOA & Web 2.0" Sandy Carter, IBM Press.
6. "Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WSAddressing, WS-BPEL, WS-Reliable Messaging, and More" Sanjiva Weerawarana, Francisco Curbera, Frank Leymann, Tony Storey, Donald F.Ferguson,, Prentice Hall Publication.
7. "Understanding SOA with Web Services", Eric Newcomer, Greg Lomow, Addison Wesley Publication,
8. "Enterprise Service Bus", Dave Chappell, O'Reilly Publications.
9. "Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services", Thomas Erl, Prentice Hall Publication.

Practicals

Case study implementations
   a. Based on Java Platform
   b. Based on Cross Platform
   c. Based on any open source

Subject Code	Subject Name		Credits
CSE1024	**E-Business Technology**		**4**

Module	Detailed content	Hours
1.	Defining E-business, Framework for understanding e-business, Fundamental model of e-business, Preparing e-business plan	**04**
2.	Environmental forces affecting Planning and Practice	**04**
3.	Ethical Legal and Social concerns	**04**
4.	Developing e-business model: Characteristic of Internet based software and E-business solutions	**04**
5	A Multilevel Organizational approach, Strategic planning and value chain, building online presence of existing business.	**04**
6	Researching and analyzing Opportunities for growth. E-business research process, method of research, benefit of research.	**04**
7	Understanding online Communication and behavior. Soruces of influences on Buyer Behavior and Decision-Making	**03**
8	Organizational and Managerial Issues	**03**
9	Financial planning and working with investor	**03**
10	Implementation and control of e-business plan	**03**
11	E-business Revenue model	**03**
12	Virtual community, social network	**03**
13	Technology: Web Hosting and E-business software	**03**
14	Technology: Online Security and Online payment system	**03**

Reference book
1. E-business Theory and Practice : Brahm Canzer, Cengage
2. E-commerce: Ninth edition, Gary Schneider, cengage
3. Effortless E-commerce: Pearson education

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSL101	**Open Source Lab 1**	**02**

Module	Detailed content	Lab. Sessions
1	Installation of Linux OS in Dual boot Environment Basic Linux Command Practice	01
2	Basic Linux Networking commands Multiple IP address to Single LAN Adding Static Route in Routing table Configure Linux Server as a Router and configure IP Forwarding	01
3	Configuration of Linux as FTP and Web server	01
4	Configuration of Linux as DNS Server	01
5	Configuration of Linux as a Firewall, SNAT and DNAT	01
6	IT Infrastructure monitoring using NEGIOS	01
7.	Virtualization on Linux	01
8.	Working With LaTeX	01
9.	Mini Project	04

Assessment:

End Semester Examination:
Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CSL102	**Advanced Algorithm & Complexity Lab 2**	**02**

Module	Detailed content	Lab. Sessions
1	For Every module implement any one algorithm. Minimum 6 Algorithms from 6 different modules to be implemented.	

Assessment:

End Semester Examination:
    Practical/Oral examination is to be conducted by pair of internal and external examiners

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theor	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC201	Advanced Operating System	04	--	--	04	--	--	04
CSC202	Cyber Security	04	--	--	04	--	--	04
CSC203	Decision Making and Adaptive	04	--	--	04	--	--	04
CSE201X	Elective III	04	--	--	04	--	-	04
CSE202X	Elective IV	04	--	--	04	--	-	04
CSL201	Lab1-Open Source System #	--	02	--	--	02	--	01
CSL201	Lab2-Cyber Security and Decision Making and Adaptive Business Intelligence	--	02	--	--	02	--	01
T		**2**	**0**	**-**	**2**	**0**	**-**	**2**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem.Ex am.	Exam. Duratio n (in			
		Test1	Test 2	Avg.					
CSC201	Advanced Operating System	20	20	20	80	03	--	--	100
CSC202	Cyber Security	20	20	20	80	03	--	--	100
CSC203	Decision Making and Adaptive Business	20	20	20	80	03	--	--	100
CSE201X	Elective III	20	20	20	80	03	--	--	100
CSE202X	Elective IV	20	20	20	80	03	--	--	100
CSL201	Lab1-Open Source System	--	--	--	--	--	25	25	50
CSL201	Lab2-Cyber Security	--	--	--	--	--	25	25	50
T		**100**	**100**	**100**	**400**	**--**	**50**	**50**	**600**

Subject	Elective	Subject	Elective
CSE2011	Advanced Computer Graphics	CSE2021	Advanced Complier Design
CSE2012	Information Retrieval	CSE2022	Semantic Web Technologies
CSE2013	Storage Area Network	CSE2023	Ubiquitous Computing

CSE2014	Soft Computing	CSE2024	Emerging Wireless Technologies and the Future Mobile Internet
CSC201	**ADVANCED OPERATING SYSTEMS**	**04**	

Module	Detailed content	Hours
1	**Introduction** Functions of operating systems, Design approaches: layered ,kernel based and virtual machine approach, why advanced operating systems, types of advanced operating systems	4
2	**Distributed Operating Systems** Architecture of distributed operating systems, system architecture types, issues in distributed operating systems, inherent limitation of distribute systems, distributed mutual exclusion: classification of mutual exclusion algorithms, Lamport's ,token based algorithm, Suzuki-Kasami's Broadcast algorithm, Raymond's Tree based algorithm, Distributed deadlock detection, Distributed file systems, Distributed shared memory, Distributed scheduling	8
3	**Multiprocessor Operating Systems** Introduction, structure of multiprocessor operating system, operating system design issues, threads, the test and set instruction, the swap instruction, implementation of the process wait , processor scheduling, reliability and fault tolerance.	6
4	**Real Time Operating System** Introduction to Real time systems and Real Time Operating Systems, Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Services, structure, goal and feature of RTOS, architecture of RTOS, micro kernels and monolithic kernels, tasks in RTOS, Performance measures, estimating program runtimes, task assignment, scheduling in RTOS, rate monotonic scheduling, priority inversion, task management, inter task communication, applications of various RTOS.	10

5	**Data base operating Systems** Introduction to database operating systems, concurrency control: theoretical aspect, distributed database system, concurrency control algorithms	6
6	**Mobile Operating System** Symbian O.S.: introduction, kernel design in Symbian OS, scheduling in Symbian OS, File systems on mobile phones, I/O in Symbian OS, Application development using Android. Introduction to cloud OS.	6

TEXT BOOK

1. M Singhal and NG Sivaratri, Advanced Concepts in Operating Systems, Tata McGraw Hill Inc., 2001
2. A.S. Tanenbaum, Distributed Operating system, Pearson Education Asia, 2001.
3. A.S. Tanenbaum, Modern Operating system, Prentice Hall, 3rd edition.
4. Real Time Operating System, Barr M.
5. Real-Time Systems, Jane Liu, Pearson Ed. Asia
6. Real -Time Systems, Krishna and Shin, McGraw Hill International.
7. Smart phone operating system concepts with Symbian O.S. A tutorial guide by Michael J. Jipping. Symbian Press, Wiley.
8. Application development using Android, Hello, Android, mobile development platform 3rd Edition by Ed Burnette

REFERENCE BOOK

1. SILBERSCHATZ and P. GALVIN, Operating System Concepts, VI **edition**, Addison Wesley 2004.

Suggested Laboratory Exercises :

Case studies on Open source software, LINUX, Open SOLARIS, PalmOS, Symbian OS, Mach OS, Android OS, Linux for Mobile Devices, various RTOS.

Subject Code	Subject Name	Credits
CSC202	**Cyber Security**	**4**

Module	Detailed content	Hours
1	**Introduction to Cybercrime** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
2	**Cyberoffenses & Cybercrime** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafe and Cybercrimes, Botnets, Attack vector, Cloud computing,Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	12
3	**Tools and Methods Used in Cyberline** Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
4	**Cybercrimes and Cybersecurity: The Legal Perspectives** Why do we need Cyberlaw: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario	4
5	**Understanding Computer Forensics** Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidance, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting of a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of	

	the OSI 7 Layer Model to the Computer Forensics and Social Networking Sites: The Security/Privacy Threats, Forensics Auditing, Anti Forensics.	8
6	**Cybersecurity: Organizational Implications** Cost of Cybercrimes and IPR Issues:Lesson for Organizations, Web Treats for Organizations: The Evils and Perils, Security and Privacy Implications from Cloud Computing, Social Media Marketing:Security Risk and Perils for Organization, Social Computing and the Associated Challenges for Organizations, Protecting People's Privacy in the Organization, Organizational Guidelines for Internet Usage, Safe Computing Guidelines and Computer Usage Policy, Incident Handling: An Essential Component, Intellectual Property in the Cyberspace of Cybersecurity, Importance of Endpoint Security in Organizations.	6

Text Book:

Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi

References:

3. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
4. Kennetch J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
5. William Stallings*, Cryptography and Network Security,* Pearson Publication

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSC203	**Decision Making and Adaptive Business Intelligence**	**04**

Module	Detailed content	Hours
	AIM : To understand the techniques and application of numerous prediction and optimization techniques as well as how these concepts can be used to develop computerized adaptive decision-making systems. To study the computational technologies for gathering, providing access to, and analyzing data for the purpose of helping enterprise users make better business decisions. **Objectives :** • To introduce the idea of decision making in complex industrial and service environments • To understand the science behind better predictions and decisions • To generate an ability to design, analyze and perform experiments on real life problems using various Decision making methodologies.	
1	**Introduction** Introduction to decision making methods, AHP, SAW,VIKOR,WPM MCDM,MADM methods and examples.	05
2	**Characteristics of Complex Business Problems** Number of Possible Solutions, Time-Changing Environment , Problem-Specific Constraints , Multi-objective Problems , Modeling the Problem, A Real-World Example	05
3	**Adaptive Business Intelligence** Data Mining, Prediction, Optimization ,Adaptability, he Structure of anAdaptive Business Intelligence System	04
4	**Prediction Methods and Models** Data Preparation, Different Prediction Methods, Mathematical Methods, Distance Methods: Logic Methods, Modern Heuristic Methods ,Additional Considerations, Evaluation of Models	07
5	**Modern Optimization Techniques** Local Optimization Techniques, Stochastic Hill Climber, Simulated Annealing, Tabu Search, Evolutionary Algorithms, Constraint Handling	06
6	**Computational Intelligence and Expert Techniques in Decision making** Design of an expert system for decision making using Neural network, fuzzy logic and genetic algorithm, Classifiers, Evolutionary Compuation : Ant colony optimization,Particle	10
7	**Hybrid Systems and Adaptability** Hybrid Systems for Prediction, Hybrid Systems for Optimization, Adaptability	04
8	**Applying Adaptive Business Intelligence** Marketing Campaigns , Manufacturing, Investment Strategies, Emergency Response Services, Credit Card Fraud	07

Text Books

1. **Adaptive Business Intelligence by** Zbigniew Michalewicz, Martin Schmidt, Matthew Michalewicz, Constantin Chiriac "Adaptive Business Intelligence" by Springer Publication
2. **Decision Making in the Manufacturing Environment:**Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods by Venkata Rao ,Springer publications
3. **Computational Intelligence in Complex Decision Systems by** Da Ruan ,Atlantis Press, Amsterdam Press, World Scientific.
4. **Fuzzy sets, decision making and expert system by** Hans- Jurgen Zimmermann ,Kluwer Academic Publishers, Boston
5. **Business Intelligence: Data Mining and Optimization for Decision Making by** Carlo Vercellis ,Wiley Publications

TERM WORK

Term work will be based on Seminar/ Written Assignments/ Tutorial covering the topics of the syllabus.

Practical work should consists of design of an expert system from the topic mentioned in the syllabus.

Subject Code	Subject Name	Credits
CSE2011	**SEM-II, Elective-III,** **Advanced Computer Graphics**	**04**

Module	Detailed content	Hours
1	**Basic Background** Two Dimensional Geometric Transformations. Clipping: Point clipping, Line clipping, Polygon clipping, Text clipping, Logical Classification of input devices, Different input modes, Interactive picture-construction techniques, Three Dimensional Geometric Transformations	08
2	**3D Viewing** Viewing pipeline, Viewing coordinates, Parallel and Perspective Projections, View volumes and Projection transformations, Clipping.	05
3	**Representing Curves, Surfaces and Fractals** Polygon Meshes: Representing polygon Meshes, Consistency of polygon-mesh representations, Plane equations. Parametric Cubic Curves: Hermite curves, Bezier curves, Uniform nonrational B-splines, Subdividing Curves, Drawing curves, Comparison of the cubic curves, Parametric Bicubic Surfaces, Fractal curves.	10
4	**Solid Modeling** Representation of Solids, Primitive Instancing, Sweep representations, Boundary representations, Spatial-partitioning representations, Constructive solid geometry methods, Octrees, Binary, Space Partitioning trees.	06
5	**Visual Surface Determination** Introduction, Techniques for efficient visible-surface algorithms, Coherence, The Perspective Transformation, Extents and bounding volumes, Back-face culling, Algorithms for visible-line determination: Appel's Algorithm, Z-Buffer Algorithm, Depth-sort Algorithm, Binary Space Partitioning Trees, Representing 3D data using Octrees, Boolean Operations on Octrees, Visible Surface ray tracing.	10
6	**Achromatic and color Light** Achromatic light, selection of intensities, halftone approximation, chromatic color, CIE chromaticity diagram, color models	05
7	**Introduction to Animation** Introduction, Methods of controlling Animation, basic rules of Animation, Problems peculiar to animation, Raster animations, Computer-Animation languages, Key-frame systems, Motion specifications, Warping Techniques, Graphics and Multimedia.	08

Text Books:
1. James D. Foley, Andries Van dam, Steven K. Feiner & John F. Hughes, "Computer Graphics – Principles and Practices", 2nd Edition in C, 2005
2. Donald Hearn and M Pauline Baker, "Computer Graphics", 2nd Edition, 2003, Prentice Hall of India.

References Books:
1. Rajesh K Maurya "Computer Graphics" wiely India
2. Woo, Neider, Davis, Shreiner, "Open GL Programming Guide", 3rd edition, 2000, Pearson Education.
3. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata-McGraw Hill.
4. Zhigang Xiang and Roy Plastock, "Computer Graphics", 2nd Edition, 2002, Tata McGraw-Hill Edition.
5. C. S. Verma, "Computer Graphics", Ane's Book Pvt ltd.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:
Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2012	**SEM-II, Elective-III,** **INFORMATION RETRIEVAL**	**04**

Module	Detailed content	Hours
1	**Introduction to Information Retrieval Systems** Definition of Information Retrieval System - Objectives of Information Retrieval Systems - Functional Overview - Relationship to Database Management Systems - Digital Libraries and Data Warehouses , Information versus Data Retrieval, A Taxonomy of Information Retrieval Models. The Retrieval Process- Ad Hoc and Filtering. Classic Information Retrieval :Basic Concepts, Boolean Model ,Vector Model, Probabilistic Model, Brief Comparison of Classic Models ,Alternative Set Theoretic Models :Fuzzy Set Model, Extended Boolean Model, Alternative Algebraic Models :Generalized Vector Space Model ,Latent Semantic Indexing Model	8
2	**Information Retrieval System Functions and Indexing** Search Capabilities - Browse Capabilities - Miscellaneous Capabilities - Indexing Process –Automatic Indexing-Statistical Indexing – Natural Language – Concept Indexing - Hypertext Linkages-Information Extraction	8
3	**Data Structure in IR System** Stemming Algorithms - Inverted File Structure - N-Gram Data Structures - PAT Data Structure - Signature File Structure - Hypertext and XML Data Structures - Hidden Markov Models	6
4	**Document and Term Clustering** Introduction to Clustering - Thesaurus Generation - Item Clustering - Hierarchy of Clusters	4
5	**Search Techniques** Search Statements and Binding - Similarity Measures and Ranking - Relevance Feedback - Selective Dissemination of Information Search - Weighted Searches of Boolean Systems - Searching the INTERNET and Hypertext – Introduction to Text Search Techniques - Software Text Search Algorithms	8
6	**Visualization& Multimedia Information Retrieval** Introduction to Information Visualization - Cognition and Perception - Information Visualization Technologies .Spoken Language Audio Retrieval –Non-Speech Audio Retrieval - Graph Retrieval - Imagery Retrieval - Video Retrieval	6

TEXT BOOKS:
1. Gerald J. Kowalski and Mark.T.Maybury, "Information Storage and Retrieval Systems: Theory and Implementation", Springer/BSP Books, 2nd Edition.
2. D. Grossman and O. Frieder.,Information Retrieval: Algorithms and Heuristics, Kluwer Academic Press.
3. Michael W. Berry " Survey of Text Mining: Culstering, Classification and Retrieval", Springer Verlag, 2003.
4.Introduction to Information Retrievalby Christopher D. Manning, Prabhakar Raghavanand HinrichSchütze, Cambridge University Press

REFERENCES:
1.Introduction to Information Retrieval. C.D. Manning, P. Raghavan, H. Schütze. Cambridge UP, 2008.
2. Modern Information Retrieval. R. Baeza-Yates, B. Ribeiro-Neto. Addison-Wesley, 1999.
3. Managing Gigabytes. I.H. Witten, A. Moffat, T.C. Bell. Morgan Kaufmann, 1999.
4.TREC: Experiment and Evaluation in Information Retrieval. E.M. Voorhees, D.K. Harman. MIT Press, 2005.
5.Language Modeling for Information Retrieval. W.B. Croft, J. Lafferty. Springer, 2003.
6.The Geometry of Information Retrieval. C.J.VanRisjbergen. Cambridge UP, 2004.
7. Introduction to Modern Information Retrieval. G.G. Chowdhury. Neal-Schuman, 2003..
8.Text Information Retrieval Systems. C.T. Meadow, B.R. Boyce, D.H. Kraft, C.L. Barry.

Subject Code	Subject Name	Credits
CSE2013	**SEM-II, Elective-III,** **Storage Area Networks**	**04**

Module	Detailed content	Hours
1	**Concepts of storage networks:** The data storage and data access problem, the battle of size and access, decoupling the storage component: putting storage on the network, creating a network for storage. Introduction to SAN, Benefits of SAN	4
2	**Storage area network :** fiber channels, components of SAN,FC connectivity, ports, FC architecture ,zoning, FC login types, topologies	4
3	**Network Attached Storage:** benefits, NAS file I/O , components, implementations, sharing protocols, NAS I/O operations , factors affecting NAS performance and availability, IP SAN**:** Iscsi, fcip	6
4	**Content-addressed storage:** fixed content and archives, types of archives, features and benefits of CAS,CAS architecture, example	2
5	**Storage virtualization:** forms of virtualization, Storage Virtualization Configuration and Challenges, Types of Storage Virtualization.	2
6	**Basic software for storage networking :** Software For SANs, Shared access data Managers, Volumes: Resilience, performance, and Flexibility, File Systems and Application performance	3
7	**Killer Applications for SAN:** Backup, Highly available data, Disaster Recoverability, Clusters, Data Replication	5
8	**Enterprise backup software for SAN:** Backup Management, Enterprise data Protection, Backup architecture, Backup policies, Minimizing impact of Backup	3
9	**SAN management and Security:** Managing SANs, SAN management, Basics, an ideal environment, quality of online storage service, backup cost backup impact, allocation availability, assets utilization, management tools.	7
10	**Securing storage infrastructure:** Storage security framework, risk triad, storage security domains, security implementations in storage networking	4

References

1. Richard Barker, Paul Massiglia, "Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs", Wiley India
2. G. Somasundaram, Alok Shrivastava, "Information Storage and Management", EMC Education services", Wiley Publication
3. Ulf Troppen, Rainer Erkens, Wolfgang Muller, "Storage Networks Explained", Wiley publication
4. Robert R. Korfhage, "Information Storage and Retrieval", Wiley Publication
5. John R. Vacca, Michael Erbschloe, "The Essential Guide to Storage Area Networks," Prentice Hall.
6. Tom Clark, "IP SANS: An Introduction to iSCSI, iFCP, and FCIP Protocols for Storage Area Networks," Addison-Wesley.
7. Alan F. Benner, "Fibre Channel for SANs," McGraw-Hill.
8. Ralph H. Thornburgh, Barry J. Schoenborn, "Storage Area Networks: Designing and Implementing a Mass Storage System," Prentice Hall.
9. Marc Farley, "Building Storage Networks," McGraw-Hill.
1. Thomas Clark, "Designing Storage Area Networks," Addison-Wesley.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2014	**Soft Computing**	**04**

Module	Detailed content	Hours
1	Introduction to soft Computing: Introduction, Fuzzy Computing, Neural Computing, Genetic Algorithms, associative Memory, adaptive Resonance Theory, applications.	06
2	Fundamentals of neural Network: Model of artificial neuron, Architectures, Learning Methods, Taxonomy of NN Systems, single-Layer NN system, applications	08
3	Back propagation Network	06
4	Associative Memory: Description, Auto-associative Memory, bi-directional hetero-associative memory	06
5	Adaptive Resonance Theory: Supervised, unsupervised, backprop algorithms,competitive Learning; SPD, ART Netowrks, Iterative Clustering, Unsupervised ART Clustering	06
6	Fuzzy Set Theory: Fuzzy set: Membership, operations, properties; Fuzzy relations	04
7	Fuzzy Systems: Fuzzy logic, Fuzzification, Fuzzy inference, fuzzy rule based system, defuzzification	04
8	Hybrid System: Genetic algorithm, GA Based Back Propagation, Networks, Fuzzy Associative Memories, simplified Fuzzy ARTMAP	08

References:
1)Principle of Soft computing:, sivanandam, wiley
2) Neural Netowrk, fuzzy logic, and genetic algorithm, Rajasekaran, Printice hall
3) Soft computing and Intelligent Systems- theory and application by Naresh sinha, Addison wesley

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2021	**SEM-II, Elective-IV, Advanced Compiler Design**	

Module	Detailed content	Hours
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	9
2	**Intermediate Code Generation** Intermediate Language, Declarations, Assignment statements, Boolean Expressions, Case Statements, Back Patching, Procedure calls	7
3	**Basic Optimization** 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	8
4	**Procedure Optimization and Register Allocation** 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	8
5	**Code Generation** Issues in the Design of code generator, The Target Machine, Runtime Storage management , Next-use information, A simple code generator, DAG Representation of Basic Blocks, Peephole Optimization, Generating code from DAG's	8

Text Book:

1. Alferd V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compliers Principles, Techniques and Tools", Pearson Education.
2. Steven S. Muchnick, "Advanced Complier Design Implimentation", Academic Press.

References:

1. D. M. Dhamdhere, "Compiler Construction" (2/e), Macmillan.43 44.
2. Cooper & Torczon, "Engineering a Compiler" Elsevier.
3. K C. Louden, "Compiler Construction: Principles and Practice" Cengage.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students.Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2022	**SEM-II, Elective-IV,** **Semantic Web Technologies**	**4**

Module	Detailed content	Hours
1.	**Introduction:** Semantic Web Technologies, The Goal of the Semantic Web, Ontologies and Ontology Languages, Creating and Managing Ontologies, Using Ontologies, Applications, Developing the Semantic Web.	2
2.	**Knowledge Discovery for Ontology Construction**: Knowledge Discovery, Ontology, Methodology for Semi-automatic Ontology Construction, Ontology Learning Scenarios, Using Knowledge Discovery for Ontology Learning	4
3.	**Semantic Annotation and Human Language Technology:** Information Extraction, Semantic Annotation, Applying 2018Traditional IE in Semantic Web Applications, Ontology-based IE, Deterministic Ontology Authoring using Controlled Language IE.	6
4.	**Ontology Evolution:** Ontology Evolution: State-of-the-art, Logical Architecture, Data-driven Ontology Changes, Usage-driven Ontology Changes.	4
5.	**Reasoning With Inconsistent Ontologies:** Framework, Prototype, and Experiment: Brief Survey of Approaches to Reasoning with Inconsistency, Brief Survey of Causes for Inconsistency in the Semantic WEB, Reasoning with Inconsistent Ontologies, Selection Functions, Strategies for Selection Functions, Syntactic Relevance-Based Selection Functions, Prototype of Pion.	4
6.	**Ontology Mediation, Merging, and Aligning:** Approaches in Ontology Mediation, Mapping and Querying Disparate Knowledge Bases.	4
7.	**Ontologies for Knowledge Management:** Ontology usage Scenario, Terminology, Ontologies as RDBMS Schema, Topic-ontologies versus Schema-ontologies, Proton Ontology.	4

8.	**Semantic Information Access:** Knowledge Access and the Semantic WEB, Natural Language Generation from Ontologies, Device Independence: Information Anywhere, SEKTAgent.	4
9.	**Ontology Engineering Methodologies:** The Methodology Focus, Diligent Methodology, First Lessons Learned.	4
10.	**Semantic Web Services--Approaches and Perspectives:** Semantic Web Services--A Short Overview, The WSMO Approach, The OWL-S Approach, The SWSF Approach, The IRS-III Approach, The WSDL-S Approach, Semantic Web Services Grounding: The Link Between The SWS and Existing Web Services Standards.	4

References:

1. John Davies, Rudi Studer, Paul Warren, "Semantic Web Technologies: Trendz and Research in Ontology-Based Systems", Wiley India.
2. Grigoris Antoniou, Frank Van Harmelen, "A Semantic Web Primer", PHI Learning.
3. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", Wiley India.
4. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, "Fundamentals of Semantic Web Technologies", Chapman & Hall / CRC Press.
5. Liyang Yu, "Introduction to the Semantic Web and Semantic Web Services", Chapman and Hall / CRC Press.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2023	Ubiquitous computing	04

Module	Detailed content	Hours
1	Ubiquitous Computing: Basics and Vision. Living in a Digital World. Modelling the Key Ubiquitous Computing Properties. Ubiquitous System Environment Interaction. Architectural Design for UbiCom Systems: Smart DEI Model.	04
2	Applications and Requirements. Introduction. Example Early UbiCom Research Projects. Everyday Applications in the Virtual, Human and Physical World.	04
3	Smart Devices and Services. Introduction.Service Architecture Models. Service Provision Life-Cycle. Virtual Machines and Operating Systems.	04
4	Smart Mobiles, Cards and Device Networks. Introduction. Smart Mobile Devices, Users, esources and Code. Operating Systems for Mobile Computers and Communicator Devices. Smart Card Devices. Device Networks.	04
5	Human–Computer Interaction. Introduction. User Interfaces and Interaction for Four Widely Used Devices. Hidden UI Via Basic Smart Devices. Hidden UI Via Wearable and Implanted Devices. Human-Centred Design (HCD). User Models: Acquisition and Representation. iHCI Desi	06
6	Tagging, Sensing and Controlling. Introduction. Tagging the Physical World. Sensors and Sensor Networks. Micro Actuation and Sensing: MEMS. Embedded Systems and Real-Time Systems. Control Systems (for Physical World Tasks). Robots	06
7	Context-Aware Systems. Introduction. Modelling Context-Aware Systems. Mobility Awareness. Spatial Awareness. Temporal Awareness: Coordinating and Scheduling. ICT System Awareness.	06
8	Intelligent Systems (IS). Introduction. Basic Concepts. IS Architectures. Semantic KB IS. Classical Logic IS. Soft Computing IS Models. IS System Operations. Intelligent System Interaction. Introduction. Interaction Multiplicity. Is Interaction Design. Some Generic Intelligent Interaction Applications.	06

| 9 | Autonomous Systems and Artificial Life.

Introduction. Basic Autonomous Intra-Acting Systems. Reflective and Self-Aware Systems. Self-Management and Autonomic Computing. Complex Systems. Artificial Life | 04 |
|---|---|---|
| 10 | Ubiquitous Communication.

Introduction. Audio Networks. Data Networks. Wireless Data Networks. Universal and Transparent Audio, Video and Alphanumeric Data. Ubiquitous Networks. Further Network Design Issues. Ubiquitous System: Challenges and Outlook.

Introduction. Overview of Challenges. Smart Devices. Smart Interaction. Smart Physical Environment Device Interaction. Smart Human–Device Interaction. Human Intelligence Versus Machine Intelligence. Social Issues: Promise Versus Peril. | 04 |

Reference books

1. Ubiquitous Computing: Smart Devices, Environments and Interactions, Stefan Poslad, Wiley Publication
2. Ubiquitous Computing Fundamentals, John Krumm, CRC Press.
3. Everyware The Drawing age of Ubiquitous Computing, Adam Greenfield.
4. Ubiquitous Computing: Design, Implementation, and Usability, Yin-Leng Theng; Henry B. L. Duh, IGI Global

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
CSE2024	**SEM-II, Elective-IV,** **Emerging Wireless Technologies and the Future Mobile Internet**	
	Elective	

Module	Detailed content	Hours
1	Next-Generation Wireless Standards and Their Integration with the Internet	3
2	Ad Hoc and Mesh Network Protocols and Their Integration with the Internet	3
3	Opportunistic Delivery Services and Delay-Tolerant Networks	4
4	Sensor Networks Architectures and Protocols	3
5	Network Services for Mobile Participatory Sensing	3
6	Supporting Cognitive Radio Network Protocols on Software-Defined Radios	3
7	Vehicular Networks: Applications, Protocols, and Testbeds	4
8	Opening Up the Last Frontiers for Securing the Future Wireless Internet	3
9	Experimental Systems for Next-Generation Wireless Networking	3
10	Long-Term Evolution of 3GPP	5
11	Ultra Mobile Broadband of 3GPP 2	6

Text Book:-
1. Emerging Wireless Technologies and the Future Mobile Internet, Dipankar Raychaudhuri, Mario Gerla, Cambridge.

Reference Book:-

2. Mobile Broadband Including Wi Max and LTE, Mustafe Ergen, Springer.
3. Advanced Wireless Comm & Internet, Savoy G.Glisic, Wiely Publication (3rd Edition)

Subject Code	Subject Name	Credits
CSL201	**Open Source Lab 1**	**02**

Module	Detailed content	Lab. Sessions
1	- Working With Wireshark in Hub Environment for Packet Sniffing - Packet sniffing in Switch Environment	01
2	- Vulnerability Scanning technique using NESSUS	01
3	- REST Architecture :Web Mash up using PHP	01
4	- Vesrion Control – Software Configuration Management in Linux	01
5	- Customization of Linux Live CD	01
6	- Working with LVM in Linux	01
7.	- Exploring atleast two linux based web designing tools (Bluefish, Komodo etc.)	01
8.	- Exploring Content Management system on Linux	01
9.	- Mini Project	04

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CSL202	**CYBER SECURITY Lab 2**	02

Module	Detailed content	Lab. Sessions
1	Install and study chkrootkit security audit tool	1
2	Install and study Nessus network vulnerability audit tool	1
3	Use Nmap port scanner to scan remote machine	1
4	Install a proxy server and scan the user activities.	1
5	Simulate DOS attack using your favorite programming language.	1
6	Simulate IP spoofing attack	1
7	Simulate Buffer overflow problem	1
8	Write a program to hide text data in image file(Steganography)	1
9	Write a program to implement RSA algorithm	1
10	Install wireless Intrusion Detection System (WIDZ) and detect attacks on Wireless network 802.11	1
11	Create VPN using IPSEC tool	1
12	Install and study PGP using Mozilla Thunderbird	1
13	Install SNORT and study its different security features.	2

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
CSCS301	**Seminar**	**03**

Guidelines for Seminar

o Seminar should be based on thrust areas in Computer Engineering
o Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the topic and compile the report in standard format and present infront of Panel of Examiners appointed by the Head of the Department/Institute of respective Programme.
o Seminar should be assessed based on following points
  ƒ Quality of Literature survey and Novelty in the topic
  ƒ Relevance to the specialization
  ƒ Understanding of the topic
  ƒ Quality of Written and Oral Presentation

Subject Code	Subject Name	Credits
CSP302 / CSP401	**Dissertation (I and II)**	**12 + 15**

Guidelines for Dissertation

- o Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- o Dissertation I should be assessed based on following points
  - ƒ Quality of Literature survey and Novelty in the problem
  - ƒ Clarity of Problemdefinition and Feasibility of problem solution
  - ƒ Relevance to the specialization
  - ƒ Clarity of objective and scope
- o Dissertation I should be assessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

- o Dissertation II should be assessed based on following points
  - ƒ Quality of Literature survey and Novelty in the problem
  - ƒ Clarity of Problemdefinition and Feasibility of problem solution
  - ƒ Relevance to the specialization or current Research / Industrial trends
  - ƒ Clarity of objective and scope
  - ƒ Quality of work attempted
  - ƒ Validation of results
  - ƒ Quality of Written and Oral Presentation
- o Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai

Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Refereed Journal)