KERALA TECHNOLOGICAL UNIVERSITY

Cluster No. 10 for PG Programs

(Engineering Colleges in Kannur, Wayand & Kasaragod Districts)

Curriculum, Scheme of Examinations and Syllabi for M. Tech. Degree Program with effect from Academic Year 2015 - 2016

Computer Science & Engineering

(CSE)

M. Tech.

in

Computer Science and Engineering(Networks and Security)

(CNS)

Preface

Kerala has achieved almost 100% literacy and the General Education facilities are among the top in the country. Technical education in Kerala is going through a phase of rapid change, keeping pace with changes in technology itself. Several technical institutions were setup in the state in the previous decade to provide quality technical education to students in Kerala.

In the field of Post Graduate level education in Engineering and Technology the state has some catching up to do, especially in the area of Computer Science and Engineering / Information Technology. At present, there are more than 130 Engineering Colleges and an NIT in the state. For under graduate level, annual intake is around 9850 for Computer Science / Information Technology disciplines. However for post graduate level, there are below 300 seats including the inter-disciplinary ones in the state. This situation makes the talented and interested students in the state to depend neighboring states for their PG studies. Many students are forced to be satisfied with a B. Tech degree.

Due to the increase in the number of engineering colleges in Kerala around 1100 personnel are required to occupy various teaching positions in the existing engineering colleges in the field. At present most of the faculty members in the subject are fresh recruits having bachelor's degree alone; but, new AICTE norms insists a post graduate degree at the entry level posts in teaching profession. Numerous leading R&D wings of the private and government organizations such as ISRO, CDAC, and DRDO in the state also require post graduate engineers. The present job market demands more number of software, hardware, and IT/CS engineers with specialization in computer networking, image processing, security etc. Tremendous opportunities are open for specialized Engineers in several IT companies including the giants like Infosys, Wipro, TCS, Tata Elxsi, etc. Around 80 IT-based companies are functioning in Technopark campus, Trivandrum and Infopark, Cochin. Many projects such as Smartcity and Technocity which can employ 10000 professionals are coming up in the state. Also, various communication based companies like BSNL, MTNL, Airtel, Reliance Communications etc. are looking for specialist engineers in the area of computer science and engineering.

Eligibility

The eligibility for admissions to the proposed M.Tech. course shall be as per the norms set by the Government of Kerala, related Government orders for admission to Engineering colleges, G.Os issued

by the Government of Kerala for reservation and as recognized by the AICTE. Admission to this course is regulated on the basis of merit as assessed in the GATE.

Academic Objectives

Every institute offering this program may attempt to cover the following program specific objectives also and is provided below to help them(basically, indicative in nature and not mandatory)

1. To provide high quality education opportunity for graduates in Computer Science and specialization in network engineering as the present availability of seats for the same in the state is very limited.
2. To promote academic growth by offering state-of-the-art knowledge.
3. To produce technically qualified and competent post graduates with potential to carry out research works in the field of Computer Science and Engineering with specialization in Networks and Security.
4. To undertake collaborative and socially relevant projects which offer opportunities for long-term interaction with academics and industry.

Areas of Focus

The proposed M.Tech. programme in Computer Science and Engineering(Networks and Security) is devised so as to provide quality post graduate level education to engineering graduates in Computer Science and Engineering / Information Technology. Hence the proposed programme contains advanced courses on both the core subjects and the emerging areas of computer science, network engineering and security.

Program Characterization

1. Program Type: Research Oriented; employability is a concern(employable in industries), but, may be in a full time teaching / research job also.

2. Disciplinary basis: Applications of computing, which means that the course aims to broaden depth of fundamental knowledge and depth and breadth in the areas of networks and security(two separate areas coming under Computer Science and Engineering).

3. Oversight of program quality: Every institute offering this course must implement a mechanism to assure quality of work done by students as part of the academic process depicted here. These mechanisms default to what is specified by NBA-India. Institute must have a plagiarism policy which defaults to UGC guidelines on plagiarism.

4. Professional Mobility : The program strives to achieve this by aligning the topic selection to the knowledge areas recommended by international bodies like IEEE/ACM for UG and PG programs within the structural limitations specified in KTU regulations. It is hoped that the alignment will help a student in studies after this program, inside or outside India.

5. Academic Mobility: Currently, the supported mobility is a vertical mobility as per provisions of clause O-5, part xi of KTU regulation. Horizontal mobility is not implemented by KTU regulations and hence a student joining this program cannot move to a program of higher choice(recorded while seeking admission). However, a student is permitted to move to a higher choice institution offering the same program **on or before entering second semester of study** in this program, subjected to admission conditions and availability of seats.

Program Outcomes[POs & PSOs for accreditation purpose]

To express the concerns of outcome statements, the scale proposed by IEEE/ACM 2013 recommendations for UG curriculum in this area is used. They are named *Familiarity, Correlation, Assessment, Usage and Training* starting roughly from the skill of *knowledge* to higher order skills like

synthesize and *integrate*. The stress on tutorials, laboratories is expressed by the scale *Training*. Basically the hierarchy tells what skills a teacher try to develop in students whereas the existing and widely used hierarchies take it from student perspective.

For any type of skills whether we are improving the *Depth* or *Breadth* (of increasing the level of some skills available with input students) is also stated to make the scope of each statement more clear.

1. Scholarship of Knowledge

Acquire in-depth knowledge of science and engineering fundamentals, including wider and global perspective, in the areas of [networks, security] with an ability to [discriminate, evaluate, analyze, synthesize] existing and new knowledge, and integration of the same for enhancement of knowledge.

[Depth], [Familiarity, Correlation, Assessment, Usage]

2. Critical Thinking

Analyze complex engineering problems in [networks, security] critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in [networks, security] in a wider theoretical, practical and policy context.

[Depth], [Assessment, Usage]

3. Problem Solving

Think laterally and originally, conceptualize and solve engineering problems in [networks, security], design related system components, services or processes after evaluating a wide range of potential solutions for those problems ensuring feasible, optimal solutions after considering public health and safety, cultural, societal and environmental standards in [networks, security]

[Depth, Breadth], [Assessment, Usage, Training]

4. Research Skill

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in [networks, security]

[Depth, Breadth], [Familiarity, Correlation, Assessment, Usage, Training]

5. Usage of modern tools

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations

[Breadth], [Familiarity, Correlation, Usage, Training]

6. Collaborative and Multidisciplinary work

Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

[Breadth], [Familiarity, Assessment, Usage, Training]

7. Project Management and Finance

Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

[Breadth], [Usage, Training]

8. Communication

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

[Breadth, Depth], [Familiarity, Usage, Training]

9. Life-long Learning

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

[Breadth], [Usage, Training]

10. Ethical Practices and Social Responsibility

Acquire professional and intellectual integrity, improve awareness of legal and cultural issues (and consequent responsibilities) relevant to the professional code of conduct in the Indian context, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

[Breadth], [Familiarity, Correlation, Usage, Training]

11. Independent and Reflective Learning

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

[Breadth], [Usage, Training]

12. Improving competency in networks and security

Acquire training and competency along with willingness, to carry out research work in the field of Computer Science and Engineering with specialization in Networks and Security.

[Breadth, Depth], [Familiarity, assessment, usage, training]

13. Helping to realize benefits of taking up community projects

Recognize the need for and ability to take up local community projects which offer opportunities for long-term interaction with academics and industry, helping to understand its implications in sustainable development of Indian society.

[Breadth], [Usage, Training]

Curriculum implementation(providing additional features / rules needed for ***this program*** subjected to provisions of clause O3 of KTU regulations)

As part of curricula implementation plan, the following is provided:

1. Definition of Keywords and Acronyms:

KTU: Kerala Technological University

HoD : Head of Department

CBSS : Credit Based Semester System. This is the one implemented by KTU

Course: Usually referred to as “paper” and is a basic component of CBSS based program.

i) Core : core requirement of course

ii) Elective: a supportive requirement of course

a) Generic: which add “generic” proficiency

b) Discipline centric: which add proficiency in the specialization area of program.

c) Open elective – a course from an unrelated discipline of study

Credit: A unit by which course work is measured and recorded for the purpose of awarding the degree. Credit can be earned only by undergoing the course as per KTU regulations.

Letter Grade: It is an index of performance of a student in a course

Crediting: Refer to the process of undergoing a course to earn the credits. Credits earned will appear in grade cards.

Auditing: Refer to the process of voluntarily undergoing a course without being subjected to assessment procedures in a course. No credits are earned by this method.

Test: Summative assessment method as defined in clause O-8 of KTU regulation

Assignment: Method as defined in clause O-8 of KTU regulation, more details of which is included below.

Open Ended Problems: Often abstract, ill-structured problems where goals or bounds are unspecified, unclear or insufficient in various ways. Also, there are different types of solutions if one dare to solve and attempting such problems are known to develop higher order thinking skills in a student.

Community Problem Solving: Provides students with an opportunity to practice the skills that are needed to participate in finding solutions to the local issues that concern them. This helps to develop the important citizenship objectives of learning for a sustainable future and integrates skills – for both students and teachers – of using experiential and enquiry-based strategies. It also integrates skills in the planning of values clarification and values analysis with the possible solutions so students can take action to help achieve a sustainable future.

2. Types of courses offered:

Core courses, Elective courses, Tutorial courses, Seminars, Laboratories, Mini Project and Project

3. Course structure summary of the program

	Core	**Elective**	**Tutorial**	**Seminar**	**Lab**	**Mini Project**	**Project**
Semester 1	4	1	1	1	1	0	0
Semester 2	3	2	0	0	1	1	0
Semester 3	0	2	0	1	0	0	1
Semester 4	0	0	0	0	0	0	1
Total	**7**	**5**	**1**	**2**	**2**	**1**	**2**

4. Credit structure summary of the program

	Total Contact Hours L-T-P	**Total Credit**
Semester 1	15-5-4	23
Semester 2	15-1-6	19
Semester 3	6-0-16	14
Semester 4	0-0-24	12
	Total	**68**

5. Grading system: Absolute grading based on Total marks obtained by a student as given by clause O-14 of KTU regulation.

6. Type of Assignments: Refer clause O-8 of KTU regulation.

i) Assignments can be home work, projects to improve problem solving skills, group discussions, quiz, literature survey, seminar, course project, software exercises, etc. and represent methods of assessment(summative in nature) which contribute to the Total marks for the course. Formative assessments are permitted subjected to its context and carry **zero** weightage towards Total mark. Faculty is given the freedom to decide the methods, its frequency and weightage while the total of the assessment marks contribute 10% marks of the Total marks, as per provisions of clause O-8 of KTU regulation.

ii) Students may be encouraged to take up additional exercises to improve the problem solving skills / usage skills with **zero** weight towards Total marks. In each module of a course, students may take up "Open ended problems" or “Community problems” related to the contents of the course. Success or failure should be recorded by faculty offering the course and number of students who have taken up such problems and number of successful attempts must be parameters in assessing whether the course is successfully conducted(such an assessment of program is part of the “oversight of quality” policy).

7. Limiting the supplementary chances and grades awarded (KTU clause **O9** amendment)

As such KTU regulation is not specifying the number of supplementary chances. KTU clause **O9** is amended to the extent of limiting the number chances for supplementary examination and the credits earned in supplementary chances, as follows:

Failed candidates in end semester examination, having more than 45% marks in their internals are permitted to write the immediate supplementary examination; however, maximum grade will be limited to **B**. Candidates failing here also shall be awarded **FE** grade and have to register again for the course.

KTU clause **O10-1** last paragraph also need amendment to effect the same change, as follows. The sentence added is shown in italics.

A student should have a minimum of 45% marks in the end semester examination to be eligible for grading in a course. Otherwise he/she will be considered to have failed in the course and an **F** grade will be awarded. *[**F** grade will change to **FE** grade if a student with **F** grade fails again in the next opportunity.]*

8. Minimum credit requirement – Eligibility to continue with programme(KTU clause O-14,iv – implementation)

Semester	**Allotted credits (Min. per semester)**	**Cumulative credits**	**Minimum cumulative credits required to register for courses in higher semesters**
First	23 (15)	23	15
Second	19 (12)	42	27
Third	14 (10)	56	45
Fourth	12	68	

As per the minutes of CGPC dt. 13/6/15, TVPM, it is mandatory for a student to earn all the course credits listed in the first three semesters to appear for the final evaluation of the Project.
As per KTU clause **O6** Maximum credits which can be registered in a semester is **24**.

9. Mini-project (Amendment to KTU clause **O14** to allow this course, say, after sub-clause **v**)

Students have to register for Miniproject in second semester as a preparatory step for Project course offered in subsequent semesters. A pass in this course is mandatory for registering the Project course in subsequent semester. A preparatory work in consultation with project supervisor has to be selected by the student. The complete work has to done internally.

Suggested evaluation procedure:-

A committee containing Miniproject Coordinator, project supervisor and another faculty nominated by HoD forms the evaluation committee. There need to be one interim evaluation and end semester evaluation for the course. Distribution of marks for Mini project is as follows.

Presentation and evaluation by committee: 40 marks

Progress evaluation by supervisor : 30 marks

Report : 30 marks

10. Evaluation committee for Project(Amendment to KTU clause **O-14,vi**)

A committee consisting of Project coordinator, project supervisor and another faculty nominated by HoD forms the evaluation committee. Based on the person nominated by HoD, different valuation committees may be constituted depending on the nature of project work. In the case of multiple evaluation committees, HoD will decide the project to be evaluated by each committee.

There need to be one interim evaluation and end semester evaluation for Project course in third semester which decides the total marks for the work in this semester.

As per clause **O-14,xviii** and as per decision in CGPC meeting dt. 13/06/15, it is mandatory for a student to earn all the course credits listed in the first three semesters to appear for the final evaluation of the Project in fourth semester. Therefore, a pass in Phase 1 is mandatory for registering to Phase 2 of project work.

11. Provisions for providing training, improving professional competency

i) **Teaching assistantship scheme** – subjected to the provisions of orders of Government of Kerala, maximum of 8 hrs. per week, in all semesters.

ii) **Auditing** courses in semester 3 and 4, based on advice of Project supervisor and subjected to approval by HoD offering this program. This contribute courses with **zero** credits in grade cards issued by **institute**. However, faculty offering the course must give a feedback of either "Satisfactory" or "Not satisfactory" subjected to the following conditions:

i) The student has satisfactory attendance in the course.

ii) He has attempted all assignments given to him by faculty.

Grade card issued by **institute** will record this feedback instead of credits. Number of students **Auditing** with status "Satisfactory" need to be recorded by the faculty offering the course and is a parameter in assessing whether course is successfully conducted(as part of quality procedures).

iii) **Participation in a MOOC**(Massive Open Online Courses), based on advice of Project supervisor and subjected to approval by HoD offering this program. This contribute **zero**

credits and also not recorded in grade cards. However, Project supervisor must record either "Satisfactory" or "Not satisfactory" based on whether the student got a pass record in the course. Number of students taking part in such programs and successfully completing it must be recorded and kept as a parameter in assessing the success of remedial procedures(as part of oversight of program quality)

iv) A **collaborating industry/institute** is permitted to offer generic or discipline specific electives(open electives not permitted) against any elective courses based on an MoU which ensures academic integrity and binding the expert offering course with the liability of assessments done as part of the course. Institutions with virtual class room facility may allow virtual presence of the expert for taking classes.

v) **Interdisciplinary studies –** One choice in each elective course may be offered as a Global electives for the programs falling under Electrical engineering and Electronics engineering. A student is allowed to opt Generic elective or Discipline specific elective(decided by HoD) offered by the Electrical/Electronic branches. A student is allowed to opt an open elective offered by Electrical/Electronic branches as part of extra credits only.

Inter-disciplinary Project course is permitted with one student from each participating program and the project supervisor for each such student will be a member of evaluation committee. The evaluations specified will be done in common; however, each student must submit an individual thesis stressing on the specific contribution of that student. Individual technical publications / IPR registration is not insisted. All credits of this work will be shared by the departments participating in the inter-disciplinary work.

vi) **Additional teaching modes** – Any institute with virtual class room facility offering this program may allow virtual presence of any faculty offering courses in program with prior approval of Principal based on recommendation of HoD.

SEMESTER 1

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	10CS6301	Mathematical Foundations(Networks)	3−0−0	40	60	3	3
B	10CS6303	Advanced Algorithms and Analyzes	3−1−0	40	60	3	4
C	10CS6305	Topics in Networking	3−1−0	40	60	3	4
D	10CS6307	Network Design and Performance Evaluation	3−1−0	40	6 60	3	4
E		Elective I	3−0−0	40	60	3	3
F	10GN6001	Research Methodology	0−2−0	100			2
G	10CS6309	Seminar I	0−0−2	100			2
H	10CS6311	Advanced Networking Laboratory	0−0−2	100			1
		TOTAL	**15-5-4**	**500**	**300**	**-**	**23**

Total Contact hours: 24

Total Credit: 23

Electives 1

10CS6313 Advanced Computer Architectures
10CS6315 Applied Probability and Statistics
10CS6317 Ethical Hacking
10CS6319 Wireless Networks
10CS6321 Storage Management and Security
10CS6323 High Performance Networks
10CS6325 Energy Aware Computing
10CS6327 Data Mining and Knowledge Discovery
10CS6329 Virtualization Techniques
10CS6331 Networking in Embedded Systems

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	10CS6302	Mathematical Foundations(Security)	3−0−0	40	60	3	3
B	10CS6304	Path and flow problems in Networks	3−0−0	40	60	3	3
C	10CS6306	Topics in Security	3−1−0	40	60	3	4
D		Elective II	3−0−0	40	60	3	3
E		Elective III	3−0−0	40	60	3	3
G	10CS6308	Mini Project	0−0−4	100			2
H	10CS6312	Secure Computing Laboratory	0−0−2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

Total Contact hours: 22

Total Credit: 19

Electives 2

10CS6314 Laws and Ethics in Computing
10CS6316 Cyber Legislation and Security Policies

Electives 3

10CS6318 Modern Database Systems
10CS6320 Game Theory
10CS6322 Network Forensics
10CS6324 Mobile Computing
10CS6326 Security threats and Management
10CS6328 High Performance Scientific Computing
10CS6330 Managing Big Data
10CS6332 Language Technologies
10CS6334 Cloud Computing
10CS6336 Real Time Systems

SEMESTER 3

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A		Elective IV	3−0−0	40	60	3	3
B		Elective V	3−0−0	40	60	3	3
C	10CS7301	Seminar II	0−0−2	100			2
D	10CS7303	Project(Phase I)	0−0−14	50	6		6
		TOTAL	**6-0-16**	**230**	**120**	**-**	**14**

Total Contact hours: 22

Total Credit: 14

Electives 4

10CS7305 Automated verification
10CS7307 Soft computing techniques
10CS7309 Design of Secured Architectures
10CS7311 Systems Modeling and Simulation
10CS7313 Data visualization techniques

Electives 5

10CS7315 Advanced Operating Systems
10CS7317 Multi Objective Optimization Techniques
10CS7319 Cryptanalysis
10CS7321 Next Generation Networks
10CS7323 Biometric Technologies
10CS7325 Distributed Algorithms
10CS7327 Social Network Analysis
10CS7329 Machine Learning Techniques
10CS7331 Software Defined Networking
10CS7333 Internet of Things

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	10CS7304	Project(Phase II)	0–0–24	70	30		12
		TOTAL	**0-0-24**	**70**	**30**		**12**

Total Contact hours: 24

Total Credit: 12

Total Credits under this program: 23 + 19 + 14 + 12 = 68

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6301	MATHEMATICAL FOUNDATIONS(NETWORKS)	3-0-0-3	2015

Course Prerequisites

Basic courses in Discrete Mathematics, Data structures, Simulation at UG level

Course Objectives

Syllabus

Review of queuing models, important queuing models, Burke's theorem and Jackson's theorem.

Proof Techniques

Review of formal logic concepts, Propositional logic, Predicate Logic, Higher order logic and the incompleteness theorem

Review of Computational logic, Unification, resolution and theorem proving with resolution, logic programming.

Review of graph theoretic concepts, graph isomorphism, Euler's paths, Depth-first and Breadth-First trees on graph, Connected components, articulation points, Networks, flows and cuts.

Expected Outcomes

Texts:

1. Grimaldi P.R, “Discrete & Combinatorial Mathematics”, Addison Wesley
2. James L. Hein, Discrete Structures, Logic,and Computability, Jones and Bartlett Publishers, 3rd Edition
3. Kolman, Busby & Ross “Discrete Mathematical Structures”, PHI.
4. J.P. Tremblay & R. Manohar, “Discrete Mathematical Structure with Application to Computer Science”, TMH, New Delhi (2000).
5. Dimitri P. Bertsekas and Robert G. Gallager, ‘Data Networks’ , 2nd Edition, PHI
6. J. Clark and D.A. Holton, “ A First Look at Graph Theory” , World Scientific.
7. A.O. Allen, “Probability, Statistics and Queueing Theory with Computer

Applications", Elsevier, 2nd edition, 2005.

References:

1. J. Truss, "Discrete Mathematics", Addison Wesley.
2. C.L.Liu, "Elements of Discrete Mathematics", McGraw Hill Book Company.
3. M.Lipson & Lipshutz, "Discrete Mathematics", Schaum's Outline series.
4. Iyengar, Chandrasekaran and Venkatesh, "Discrete Mathematics", Vikas Publication
5. Mordechai Ben-Ari, Mathematical Logic for Computer Science, Springer-Verlag London 3rd Ed.
6. Copi Irving M., *Symbolic logic*, Prentice-Hal, Fifth Edition
7. K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd edition, 2002.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Queuing Models:**- General concepts, Arrival pattern, service pattern, Queue Disciplines, FIFO Queuing systems, M/M/1, M/M/c, M/M/∞, M/G/1, M/M/m/m and other Markov models, non markov models,Network queues, Burke's theorem, Jackson's theorem.	11	25
II	**Proof Techniques:**- Proofs, Techniques for theorem proving, Direct Proof, Proof by Contra position, Proof by exhausting cases and proof by contradiction,	4	10
	First Internal Examination		
III	**Formal Logic**:- Propositional Logic, well formed formula and semantics, logical equivalence, truth functions and normal forms, Validity of arguments, Proof rules and proof, derived rules, Quantifiers, Predicates, Predicate Logic, validity, Prenex Normal form, Higher order logic - Order of Predicates, Quantifiers, WFF and logic, Higher order reasoning. Soundness, Completeness and Gödel's Incompleteness Theorem(without proof)	8	20
IV	**Computational Logic:**- Clauses and clausal form, Skolem's rule and algorithm , Resolution for propositions, Substitution, Composition and unification, Most General Unifier, Robinson unification algorithm, Martelli-Montanari algorithm, General	9	20

	resolution rule and resolving Clauses, Theorem proving with Resolution, Logic programming , Horn clause, SLD resolution**.**		
	Second Internal Examination		
V	**Graph Theory**:- Graphs, Isomorphic graphs, Euler path & hamiltonian circuits, Sub graphs, regular graphs, Euler's formula (proof) five color theorem and four color problem (without proof), Chromatic number and chromatic Polynomial of a graph, Directed graphs, Indegree and out degree, Trees, Depth-first and breadth first search, trees associated with DFS & BFS, Connected components, articulation points, Networks, flows and cuts.	**10**	**25**
	Total	**42**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6303	ADVANCED ALGORITHMS AND ANALYZES	3-1-0-4	2015

Course Prerequisites

Basic courses in Algorithms and Analysis, Number theory at UG level

Course Objectives

Syllabus

Model of Computation, Recurrence Analysis, Amortized Analysis, Case studies with advanced Data structures

Complexity Classes, Randomized Algorithms, Randomized complexity classes

Linear Programming, Number Theoretic Algorithms, Approximation Algorithms, Parallel & Distributed Algorithms.

Expected Outcomes

References:

1. Thomas H Cormen, C E Leiserson, R L Rivest, C Stein Introduction to Algorithms

2. Dexter C Kozen The Design and Analysis of Algorithm

3. Rajeev Motwani and Prabakar Ragavan Randomized Algorithms

4. Jon Kleinberg, Eva Tardos Algorithm Design

5. Prabakar Gupta, Vineet Agarwal, Manish Varshney Design and Analysis of Algorithms

6. Vijay V Vazirani Approximation Algorithms

7. Richard Johnsonbaugh, Marcus Schaefer Algorithms

8. Christos H Papadimitriou, Kenneth Steiglitz Combinatorial Optimization Algorithms and Complexity.

9. Chandra Mohan Design & Analysis of Algorithm

10. Sara Baase, Allen Van Gelder Computer Algorithm

11. Michael Sipser Introduction to Theory of Computation

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Model of Computation**- RAM Model- Notations; **Recurrence Analysis**: Substitution Method, Recursion tree Method, Master Method- Masters Theorem and its Proof; **Amortized Analysis**: Aggregate analysis, The Accounting method, The Potential method-;Case Study with Datastructures: B-Trees, Binomial Heaps;	12	20
II	**Complexity Classes**, NP Hard & NP Complete Problems, Reductions and NP Completeness, Cook's Theorem.	7	15
	First Internal Examination		
III	**Randomized Algorithms**: Las Vegas and Monte Carlo Algorithms, Randomized Divide and conquer Approach, Randomized version of Quick Sort Algorithm, Miller Rabin Randomized Primality Test, De-Randomization; Randomized Complexity Classes; Probabilistic Algorithms.	10	15
IV	**Linear Programming**: Standard and Slack forms, Formulating problems as linear programs, The simplex algorithm, Duality, The initial basic feasible solution;	7	30
	Second Internal Examination		
V	**Number Theoretic Algorithms**: Elementary number theoretic notions, Greatest Common Divisor, Modular Arithmetic, Solving modular linear equations, the Chinese remainder theorem, powers of an element, the RSA Public key crypto system, Primality testing.	7	
	Approximation Algorithms, Polynomial Time and Fully Polynomial Time Approximation Schemes; Randomized	13	20

Approximation Schemes;

Parallel & Distributed Algorithms: Introduction, the parallel random access machine, Sorting networks, Parallel Architectures, Distributed algorithms;

Total	56

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6305	**TOPICS IN NETWORKING**	**3-0-0-3**	**2015**

Course Prerequisites

Basic courses in Data Communication and computer networks at UG level.

Course Objectives

Syllabus

Protocol Design, Specification and Verification, validation

Routing and Addressing, IPv6 addressing, Routing

Congestion, Traffic Management & QoS in IP Networking,

Network Management Tools and Applications, Multimedia Communications in Networks.

Expected Outcomes

References:

1. Pallapa Venkataram and SunilKumar S. Manvi: Communication Protocol Engineering, PHI, 2004

2. Mohammed G. Gouda: Elements of protocol Design, Wiley Student Edition, 2004.

3. High-speed networks and internets: performance and quality of service. Author, William Stallings. Publisher, Pearson Education, 2002

4. Network Routing: Algorithms, Protocols and Architectures Deepankar Medhi and Karthikeyan Ramasamy(Morgan Kaufmann Series in Networking)

5. Larry L Peterson and Bruce S Davie “Computer Networks: A system approach”, 3rd edition,morgan Kauffman publishers.

6. William Stallings “High Speed Networks: TCP/IP and ATM Design Principles” Prentice Hall Upper saddle river new Jersey 07458

7. J.F. Kurose and K.W. Ross, Computer Networking: A Top-Down Approach Featuring

Internet,3/e, Perason Education, 2005.

8. Mani Subramaniam, 'Network Management: Principles and Practices', Pearson Education, 2000

9. Multimedia Communications: protocols and applications, Franklin F Kuo, J. Joaquin Garcia, Wolf gang Effelsberg, Prentice Hall Publications

10. Multimedia Communications: Applications, Networks, Protocols and Standards, Fred Halsall, Pearson Publications.

11. Multimedia Communication Systems: Techniques, standards and Networks' author: K.R. Rao. Zoran.S. Bojkovic, Dragorad A.Milovanovic, PHI,2009.

12. "A practical guide to advanced networking", Third Edition, Jeffrey. S. Beasley and Piyasat Nilkaew, Pearson publication.

13. "Computer Networks: Principles, Technologies and protocols for network design" author: Natalia Olifer and Victor Olifer, Wiley India Edition.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Protocol Specification and Verification:** Communication protocol - Communication protocol development methods, protocol engineering process - Protocol Specification - Components, Communication Service, Protocol Entity, Interface, Multimedia protocol, Internet protocol Specification: Examples - SDL: Examples - Protocol Verification - Verification Using FSMs, Protocol validation, Protocol Design Errors, Protocol validation approaches, SDL based protocol verification, SDL based protocol validation.	11	20
II	**Routing and Addressing:** Address types of TCP/IP stack - IP Address format & assignment order - Mapping IP to local addresses – DNS – DHCP - IP Routing method - Routing using masks - Routing Information Protocol - Network Address Translation - Router architectures, Packet Processing - IPv6 addressing - IPv6 network settings - configuring a router for IPv6 - IPv6 Routing - Troubleshooting IPv6	11	20

connection.

	First Internal Examination		
III	**Congestion, Traffic Management & QoS in IP Networking:** Congestion Control And Resource Allocation - Issues in Resource allocation (Network Model, Taxonomy, Evaluation Criteria), Queuing Disciplines, TCP Congestion Control, Congestion Avoidance Mechanism(DECbit, RED, Source based congestion avoidance), End System traffic management - Link level flow and error control - Transport level traffic control - Network Traffic Management - Internetwork traffic management, Traffic and Congestion Control in ATM Networks - QoS in IP Networks(Integrated and Differentiated services), Protocols for QoS Support, QoS Routing.	11	20
IV	**Network Management Tools and Applications:** Network Management and its infrastructure-Internet standard management framework - SNMPv2 and SNMPv3 - Remote Monitoring - RMON SMI and MIB - Network management tools, Systems and engineering - NMS Design, Network management systems - Network Management applications - Fault & performance management - event correlation technique - Security, accounting, report, service level and policy based managements - Management in IPv6	11	20
	Second Internal Examination		
V	**Multimedia Communications in Networks:** Multimedia Communications - multimedia information representation, multimedia networks, Multimedia applications in networks - application level framing, audio/video conferencing, Video servers, Application requiring reliable multicast, Multimedia applications in WWW, Interactive multiplayer games, application and networking terminology, Standards for multimedia communications, Video transport across generic networks, multimedia transport across ATM networks, The Internet: IPv6, IPv4/IPv6 Interoperability.	12	20
	Total	56	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6307	**NETWORK DESIGN AND PERFORMANCE EVALUATION**	**3-1-0-4**	**2015**

Course Prerequisites

Basic courses in Simulation & Modeling, Computer Networks at UG level

Course Objectives

Syllabus

Introduction to Network Design, Network requirements, Network flows, Network architecture, Network design

Analytical Network modeling and performance evaluation.

Expected Outcomes

Text books:

1. Network Analysis, Architecture, and Design By James D. McCabe, Morgan Kaufmann, Third Edition, 2007.ISBN-13: 978-0123704801

2. Top-down Network Design: [a Systems Analysis Approach to Enterprise Network Design] By Priscilla Oppenheimer, Cisco Press , 3rd Edition, ISBN-13: 978-1-58720- 283-4 ISBN-10: 1-58720-283-2

3. Computer Networks and Systems:Queueing Theory and Performance Evaluation, Thomas G. Robertazzi

References:

1. Simulation Modeling and Analysis, 2nd Ed., by Law and Kelton, McGraw-Hill, 1991.

2. Fundamentals of Queueing Theory , D. Gross and CM Harris, John Wiley and Sons, 1974.

3. Queueing Systems - Vol. I & II, by L. Kleinrock, John Wiley and Sons, 1975.

4. Probability and Statistics with Reliability, Queuing and Computer Science Applications, by Kishor Trivedi.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction to Network Design:** Overview of Analysis, Architecture and Design Process - System Methodology, Service methodology, Service Description - Service characteristics - Performance Characteristics - Network supportability - Requirement analysis - User Requirements - Application Requirements - Device Requirements - Network Requirements - Other Requirements - Requirement specification and map	10	20
II	**Network requirements:** Requirement Analysis Process – Gathering and Listing Requirements- Developing service metrics – Characterizing behavior – Developing RMA requirements – Developing delay Requirements - Developing capacity Requirements - Developing supplemental performance Requirements –Requirements mapping – Developing the requirements specification.	9	15
	First Internal Examination		
III	**Network flows:** introduction - identifying and developing flows - data sources and sinks - flow models - flow prioritization and specification.	21	35

	Network architecture: models-addressing and routing architecture-performance architecture-security and privacy architecture **Network design:** Design Concepts – Design Process - Network Layout – Design Traceability – Design Metrics – Logical Network Design – Topology Design – Bridging, Switching and Routing Protocols - Physical Network Design – Selecting Technologies and Devices for Campus and Enterprise Networks – Optimizing Network Design		
	Second Internal Examination		
IV	**Analytical Network modeling and performance evaluation:** Probability review, Queuing Systems review, Network of queues: The Product Form Solution - Algebraic Topological Interpretation of P.F. Solution - Recursive Solution of Non-Product Form Networks; Numerical Solution of Models; Closed Networks; Convolution Algorithm - Mean Value Analysis - Discrete Time Queuing Systems - Simulation of Communication Networks.	16	30
	Total	56	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6313	ADVANCED COMPUTER ARCHITECTURES	3-0-0-3	2015

Course Prerequisites

Basic course in computer architecture at UG level

Course Objectives

Syllabus

Advanced ILP Exploitation Techniques, High performance computing

Multiprocessor Architecture, Multithreaded processors and Multicore processors,

Simulators in Computer Architecture , Design of High performance architectures

Memory technology optimization, Design of Memory hierarchies

Expected Outcomes

References

1. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, 3rd Edition, Morgan Kaufmann Publishers, 2002.

2. The WWW Computer Architecture page http://arch-www.cs.wisc.edu/tools/ (23/07/2012)

3. David E. Culler, Jaswinder Pal Singh, “Parallel Computing Architecture : A hardware/ software approach” , Morgan Kaufmann / Elsevier, 1997

4. K. Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, McGrawHill, 1984.

5. ACM SIGARCH Computer Architecture News.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Advanced ILP Exploitation Techniques:** Hardware and software techniques for ILP extraction - speculative execution - studies on ILP. Overview and history of computing – Architectural Classification schemes - High performance computing - overview and performance quantification criteria.	**9**	**20**
II	**Multiprocessor Architecture**: Symmetric and distributed shared memory architectures – Cache coherence issues - Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.	**9**	**20**
	First Internal Examination		
III	Multithreaded processors and Multicore processors, methodologies and analysis. Speculative multithreading. Multicore processor design and compilation issues, scheduling. CMPs and Polymorphic processors Concept, Studies and Analysis, Intel Multi-core architecture – SUN CMP architecture	**9**	**20**
	Second Internal Examination		
IV	Simulators in Computer Architecture Introduction – methods, ADLs,traces, dynamic compilation. Multicore simulators. Functional and performance Simulators Design of high performance architecture, parallel vs. pipeline architectures. Pipeline processing. Theory of pipeline scheduling and implementation. Hazards in Pipeline processors. Hazard detection and resolution techniques.	**9**	**20**
V	Memory Technology and Optimizations – Transactional Memory - Optimizations of Cache Performance - Protection:	**9**	**20**

Virtual Memory and Virtual Machines - Design of Memory Hierarchies - Case Studies.	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6315	**APPLIED PROBABILITY AND STATISTICS**	**3-0-0-3**	**2015**

Course Prerequisites

Basic course in elementary statistics and probability at UG level

Course Objectives

Syllabus

One Dimensional Random Variables,

Two Dimensional Random,

Estimation Theory,

Testing of Hypothesis,

Multivariate Analysis

Expected Outcomes

References

1 Jay L. Devore, "Probability and Statistics For Engineering and the Sciences",Thomson and Duxbury, 2002.

2 .Richard Johnson. "Miller & Freund's Probability and Statistics for Engineer",Prentice Hall , Seventh Edition, 2007.

3. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical

Analysis", Pearson Education, Asia, Fifth Edition, 2002.

4. Gupta S.C. and Kapoor V.K."Fundamentals of Mathematical Statistics", Sultan anSons, 2001.

5. Dallas E Johnson , "Applied Multivariate Methods for Data Analysis", Thomson an Duxbury

press,1998.

6. T. Veerarajan- Probability, Statistics and Random Processes(II Edn) (Tata McGraw Hill)

7. Irwin Miller, Marylees Miller- Mathematical Statistics(7th Edn)(Pearson Edn)

8. Douglas.C.Montgomery, George.C.Runger-Applied Statistics & Probability for Engineers -5th Edn(wiley Student Edn)

9. Hogg, Tanis,Tao- Probability & statistical Inference(7th Edn) –Pearson Edn)

10. Vijay. K. Rohagi, A.K. Md.Ehsanes Saleh- An introduction to probability and statistics

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**One Dimensional Random Variables :** Random variables -Probability function — Moments — Moment generating functions and their properties — Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions — Functions of a Random Variable.	**9**	**20**
II	**Two Dimensional Random Variables :** Joint distributions — Marginal and Conditional distributions — Functions of two dimensional random variables — Regression Curve — Correlation	**9**	**20**
	First Internal Examination		
III	**Estimation Theory:** Unbiased Estimators — Method of Moments — Maximum Likelihood Estimation - Curve fitting by Principle of least squares — Regression Lines.	**9**	**20**
IV	**Testing of Hypothesis :** Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions —	**9**	**20**

	Tests for Independence of attributes and Goodness of fit.		
	Second Internal Examination		
V	**Multivariate Analysis:** Random Vectors and Matrices – Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components - Principal components from standardized variables.	**9**	**20**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6317	**ETHICAL HACKING**	3-0-0-3	2015

Course Prerequisites

Basic courses in Computer networks, Wireless networks, Web based services at UG level.

Course Objectives

Syllabus

Introduction to Hacking

Network Hacking

Wireless Hacking

Software Hacking

Expected Outcomes

References

1. Staurt McClure, Joel Scambray and George Kurtz, “Hacking Exposed Network Security Secrets &Solutions”, Tata McGraw-Hill Publishers,2010 (6th Edition)

2. Bensmith and Brian Komer,”Microsoft Windows Security Resource Kit”, Prentice Hall of India,2010

3. Staurt McClure, Joel Scambray and George Kurtz, “Hacking Exposed Network Security Secrets &Solutions”, Tata McGraw-Hill Publishers(2nd Edition).

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction to Hacking:** Casing the Establishment –What are Foot Printing - Internet Foot printing – Scanning – Enumeration - Basic banner grabbing - Enumerating common network services. Case study - Network security monitoring Security permission; Securing file and folder permission - Using the encrypted file system; Securing registry permissions; Securing services - Managing service permission – Default services in windows 2000 and windows XP; UNIX - The Quest for Root – Remote Access vs. Local Access - After hacking root.	**10**	**20**
II	**Network Hacking:** Dial-up, PBX,Voice mail and VPN hacking - preparing to dial-up – War-Dialing - Brute-Force scripting – Network Devices – Discovery - Autonomous System Lookup - Public Newsgroups – Service Detection - Network Vulnerability - Detecting Layer 2 Media.	**10**	**20**
	First Internal Examination		
III	**Wireless Hacking:** Wireless hacking - wireless foot printing - Wireless Scanning and Enumeration - Gaining Access - Tools that exploiting WEP Weakness - Denial of services attacks – Firewalls – Firewalls landscape - Firewall Identification - Scanning through firewalls - Packet filtering -Application Proxy Vulnerabilities - Denial of Service Attacks - Motivation of DoS attacks - Types of DoS attacks - Generic DoS attacks - UNIX and Windows DoS.	**12**	**30**
	Second Internal Examination		
IV	**Software Hacking:** Remote Control Insecurities - Discovering Remote Control Software - Connection Weakness – VNC - MicrosoftTerminal Server and Critrix ICA - Advanced Techniques: Session Hijacking, Back Doors, Trojans – Cryptography - Subverting the systems Environment – Social	**13**	**30**

Engineering - Web hacking - Web server hacking, web application hacking -Hacking the internet User - Malicious Mobile codes' fraud - mail hacking, IRC hacking - Global Counter measures to Internet User hacking.	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6319	WIRELESS NETWORKS	3-0-0-3	2015

Course Prerequisites:

Basic courses in Data Communication, Computer Networks, Wireless networks at UG level

Course Objectives

Syllabus:

Overview of Wireless Networks, Mobile and Adhoc Networks, Wireless Sensor Networks and Special Wireless Sensor Networks.

Different routing protocols used in mobile Adhoc networks, wireless sensor architecture and classification of protocols.

Expected Course outcomes

Text Books:

1. Ian F. Akyildiz and Mehmet Can Vuran, Wirless Sensor Networks, Wiley

2. Siva Ram Murthy C. and Manoj B. S., “Ad Hoc Wireless Networks: Architectures and Protocols”, 2nd Edn. Pearson Education 2005

References:

1. Imielinski T. and Korth H.F., “Mobile Computing”, Kluwer Academic Publishers, 1996.

2. William Stallings, “Wireless Communications and Networks”, Prentice Hall, 2004.

3. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.

4. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific, 2007.

5. Toh C. K., “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR, 2001.

6. Yi-Bing and Imrich Chlamtac, “Wireless and Mobile Networks Architectures”, John Wiley & Sons, 2001.

7. Introduction to Wireless and Mobile System, Dharma Prakash Agrawal, Qing-An Zewg, edition 3, Celengage Learning, 2010

8. From GSM to LTE: An Introduction to Monile Network and Mobile Broadband, Martin Sauter, John Wiley and sons, 2010

9. Fundamental of Wireless Sensor Network Theory and Practical, Waltenegus Dargie and Christian Poollabaner, John Wiley and sons, 2010

10. Wireless Sensor Network: Technology, Protocols and Application by Kazem Sohrahy, Daniel Minoli Tailab Znati, John Wiley and sons, 2007

11. IP for 4G, Dave Wisely, John Wiley and sons, 2009

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	Overview of Wireless Networks: Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer-MAC Management Sublayer- Wireless ATM - HIPERLAN - HIPERLAN 2, WiMax, Wireless Local Loop (WLL). Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, CDMA2000 overview- Radio and Network components, Network structure. 4G features and challenges, Technology path, IMS Architecture, Convergent Devices, 4G technologies, Advanced Broadband Wireless Access and Services.	**11**	**25**
II	Mobile and Adhoc Networks: Introduction to Mobile Networks, Heterogeneity in Mobile Devices, Types of	**10**	**25**

	Mobile Communications, Types of Mobile Host Movements, Challenges Facing Mobile Networks, Introduction to Ad-hoc Wireless Networks, Overview, MAC Protocols. Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, DSDV, WRP, AODV, DSR, TORA.		
	First Internal Examination		
III	Wireless Sensor Networks: Introduction to Wireless Sensor Networks, Overview, Characteristics, Network Applications, Design Objectives, Technological Background, Wireless Sensor Networks Architecture, Classification, Protocol stack, MAC Protocols. Routing Protocols – Flat – Architectural Protocols – Hierarchical Protocols – Geographic Routing Protocols – QoS Based Protocols. Time Synchronization – Localization and Positioning – Topology Management.	**12**	**25**
	Second Internal Examination		
IV	Special Wireless Sensor Networks : Wireless Sensor and Actor Networks – Network Architecture – Sensor Actor Coordination – Actor Actor Coordination. Wireless Multimedia Sensor Networks – Network Architecture. Wireless Underwater Sensor Networks – Network components – Communication Architecture – Basics of Acoustic Propagation. Wireless Underground Sensor Networks – Applications – Network Architecture – Communication.	**12**	**25**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6321	STORAGE MANAGEMENT AND SECURITY	3-0-0-3	2015

Course Prerequisites:

Basic course in Information Storage Management at UG level

Course Objectives:

Syllabus:

Introduction to Information Storage Management, Various storage networks, Distributed Storage systems

Storage System Environments, components

Large and distributed storage systems

Storage Security and management

Expected Course outcomes:

References:

1. EMC Education Services" Information Storage and Management: Storing, Managing and Protecting Digital Information", John Wiley & Sons, 2010.

2. lohn Chirillo, ScottB]aul " Storage Security: Protecting SANs, NAS and DAS", Wiley, 2003.

3. David Alexander, Amanda French, Dave Sutton"Information Security Management Principles" BCS, The Chartered Institute 2008.

4. Gerald J.Kowalski, Mark T.Maybury" Information Storage and Retrieval Systems: Theory And Implementation ", Springer, 2000.

5. Foster Stockwell , "A history *or* information storage and retrieval" McFarland, 2001.

6. R. Kelly Rainer, Casey G. Cegielski ,"Introduction to Information Systems: Enabling and

Transforming Business, John Wiley & Sons, 2010.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	Introduction to Information Storage and Management: Introduction, History: computing, networking, storage, Need for storage networking - SAN, NAS, SAN/NAS Convergence, Distributed Storage Systems. Mainframe/proprietary vs. open storage – Storage Industry Organizations and Major Vendors Market – Storage networking strategy (SAN/NAS) Technology.	**10**	**25**
II	Storage System Environment: Storage Components; Data organization: File vs. Block, Object, Data store; Searchable models: Storage Devices (including fixed content storage devices) – File Systems - Volume Managers - RAID systems – Caches – Prefetching; Error Management: Disk error Management – RAID Error Management - Distributed Systems Error Management.	**12**	**25**
	First Internal Examination		
III	Large Storage Systems: Google FS/Big Table, Cloud/Web - based systems (Amazon S3) - FS÷DB convergence; Programming models: Hadoop - Archive 1 5Ssiems' - Content addressable storage; Backup: server less, LAN free, LAN Replication issues – Storage Security; Storage Management:- Device Management – NAS Management - Virtualization - Virtualization solutions; SAN Management: Storage Provisioning, Storage Migration.	**15**	**30**
	Second Internal Examination		
IV	Storage Security and Management: Securing the	**8**	**20**

storage infrastructure - Storage Security framework - Risk Triad – Storage Security Domains - Security Implementation in Storage Networking - Managing the Storage Infrastructure - Monitoring the Storage Infrastructure - Storage Management Activities - Developing an Ideal Solution - Concepts in Practice.	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6323	HIGH PERFORMANCE NETWORKS	3-0-0-3	2015

Course Prerequisites:

Basic courses in Data Communication, Computer Networks at UG level

Course Objectives:

Syllabus:

Introduction, QoS in high performance networks, Design issues

Gigabit Ethernet Architecture, standards, applications

ATM Architecture and protocols, ADSL and DSL Technologies

Introduction to MPLS, QoS, basic working, Storage networking

SAN topologies, Fiber Channel products, SAN software

Expected Course outcomes:

References:

1. Storage Networks Explained – Uif Troppens, Raiver Erkens and Wolfgang Muller, John Wiley & Sons, 2003.

2. Alex Goldman, “Storage Area Networks Fundamentals”, Cisco Press 2002

3. Storage Area Network Essentials: a Complete Guide to understanding and implementing SANs- Richard Barker and Paul Massiglia, John Wiley India

4. William Stallings: ISDN And BISDN

5. William Stallings: High Speed Networks

6. M Shwartz: Telecommunication Network Protocol Modeling And Analysis: Addison Wesley

7. Gallangar: Data Networks: Prentice Hall

8. Fred Halsall: Data Communication Computer Networks, And Open Systems: Addison Wesley

9. Kershanbaum : Telecommunication Network Design Algorithms: MGH

10. Jochetl Schiller: Mobile Communication: Addison Wesley.

11. Tanenbaum: Computer Networks: PHI

12. Johnson: Fast Ethernet

13. Tom Clark, “Designing Storage Area Networks”, Addison-Wesley Professional, 1st edition, 1999

14. Storage Networks: The Complete Reference – Robert Sparding, Tata Mcgraw Hills, 2003.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Network Performance analysis :** Objectives and requirements for Quality of Service (QoS) in high performance networks; Architecture of high performance networks (HPN) – design issues - protocols for HPN - VHF backbone networks - virtual interface architectures - virtual interface for networking - High-speed switching and routing - internet and PSTN IP switching techniques - SRP protocols – SRP authentication and key exchange - comparison of TCP/IP, FTP, TELNET, queuing systems - network modeling as a graph.	**9**	**20**
II	**Gigabit Ethernet:** Architecture, standards, interface, applications, network design **Frame relay:** Frame relay protocols and services, frame relay congestion Control **ATM:** Architecture, protocol, switching, traffic and congestion control, flow control ATM service categories, ATM in LAN environment, classical IP over ATM	**9**	**20**

	ADSL and DSL Technologies : Background and technological capabilities, Standards and associations, Architecture. Fiber Optics Communication: GPON (Gigabit capable Passive Optical Network), SONET/SDH and comparison with other available standards.		
	First Internal Examination		
III	Introduction to MPLS and QOS - Network Components of MPLS -working RSVP protocol - MPLS network Components - MPLS basic working – Applications – IETF approach - RSVP protocol - Integrated & differential Services Framework. Storage and networking concepts – SCSI bus architecture – Networking in front of the server – Networking behind the server – Network-attached Storage – Fibre channel internals – Layers – Data encoding – Framing protocol – class of service – flow control – Name and addressing conventions.	**13**	**30**
	Second Internal Examination		
IV	SAN topologies – Point-to Point – Arbitrated Loop – Loop Addressing-Loop Initialization- Port Login-Loop port state machine – Design considerations for Arbitrated Loop –Fabrics – Fabric login – Simple Name Server – State Change Notification – Private Loop Support – Fabric Zoning – Building Extended SANs. Fibre Channel Products – Gigabit Interface Converters (GBICs) – host Bus Adapters – Fibre channel RAID – Fibre channel JBODs – Arbitrated Loop Hubs – hub Architecture – Unmanaged Hubs – Managed Hubs – Switching Hubs – Fabric Switches – Fibre Channelto-SCSI Bridges – SAN software Products – Problem isolation in SANs – Isolation Techniques – Fibre channel Analyzers.	**14**	**30**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6325	ENERGY AWARE COMPUTING	3-0-0-3	2015

Course Prerequisites:

Courses in Computer organization, Embedded systems at UG level

Course Objectives:

Syllabus:

Introduction, Energy efficient multi core systems, Low power memory systems
Energy efficient storages, energy saving techniques for disk storages,
Energy efficient algorithms,
Energy minimisation in real time systems, energy aware applications

Expected Course outcomes:

Textbooks:

1. Ishfaq Ah mad, Sanjay Ranka, Handbook of Energy Aware and Green Computing, Chapman and Hall/CRC, 2012
2. Chong-Min Kyung, Sungioo yoo, Energy Aware System Design Algorithm and Architecture, Springer, 2011

Reference:

1. Bob steiger waid, Chris:Luero, Energy Aware Computing, Intel Press 2012

Course plan

Module	Content	Hours	Semester Exam Marks(%)
I	**Introduction:** Energy efficient network on chip architecture for multi core system - Energy efficient MIPS CPU core with fine grained run time power gating - Low power design of emerging memory technology.	8	20
II	**Energy Efficient Storages:** Disk energy management – Power efficient strategy for storage system - Dynamic	7	15

	thermal management for high performance storage system - Energy saving technique for disk storage system.		
	First Internal Examination		
III	**Energy Efficient Algorithms:** Scheduling of parallel tasks - Task level dynamic voltage scaling - Speed scaling -Processor optimization - Memetic algorithms - Online job scheduling algorithms.	**11**	**25**
IV	**Real Time Systems:** Multi-processor systems - Real time tasks - Energy minimization - Energy aware scheduling - Dynamic reconfiguration - Adaptive power management - Energy harvesting embedded system.	**11**	**25**
	Second Internal Examination		
V	Energy Aware Applications: On chip network - Video Codec Design - Surveillance camera - Low power mobile storage.	**8**	**20**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6327	DATA MINING AND KNOWLEDGE DISCOVERY	3-0-0-3	2015

Course Prerequisites:

Basic course in Data mining at the UG level

Course Objectives:

Syllabus:

Introduction to data mining, data mining and knowledge discovery,
Association Rule for data mining, Genetic algorithms for rule discovery,
Issues in classification and prediction,
Cluster analysis and applications, trends in data mining

Expected Course outcomes:

References:

1. Jiawei Han and Micheline Kamber “Data Mining Concepts and Techniques” Second Edition, Elsevier, Reprinted 2008.

2. Alex A. Freitas, “Data Mining and Knowledge Discovery with Evolutionary Algorithms”, Natural Computing Series, Springer International Edition, Springer

3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

4. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition,

Prentice Hall of India, 2006.

5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Data Mining:** Data Mining and Knowledge Discovery – Desirable Properties of Discovered Knowledge – Knowledge representation – Classification – Dependence Modeling Introduction to Data Mining - Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Attribute selection - Data Discretization and Concept Hierarchy Generation – Attribute construction. Evolutionary Algorithms for Data Preparation – Attribute selection – Attribute weighting – Combining selection and weighting	**9**	**20**
II	**Rule discovery:** Association Rule Mining: -Efficient and scalable frequent item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining. Genetic Algorithms for Rule Discovery – Individual representation – Task-specific operators – Task-specific population initialization and seeding – Task-specific rule selection - Fitness evaluation	**11**	**25**
	First Internal Examination		
III	**Classification and Prediction:** Issues Regarding Classification and Prediction –Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section	**13**	**30**
	Second Internal Examination		
IV	**Cluster Analysis and Applications and Trends in Data Mining:** Types of Data in Cluster Analysis – A Categorization of	**12**	**25**

Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis Scaling up Evolutionary Algorithms for Large Datasets – Using data subsets in fitness evaluation – Basics of parallel processing – Parallel EA for data mining - Data Mining Applications – Trends in Data Mining.	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6329	**VIRTUALIZATION TECHNIQUES**	**3-0-0-3**	**2015**

Course Prerequisites:

Basic courses in Operating system, Distributed computing at UG level.

Course Objectives:

Syllabus:

Basics of virtualization, Virtualization types, Taxonomy of virtual machines
Server consolidation,
Network virtualisation,
Virtualizing storage, Virtualizing softwares

Expected Course outcomes:

References:

1. William von Hagen, Professional Xen Virtualization, Wrox Publications, January, 2008.

2. Chris Wolf , Erick M. Halter, Virtualization: From the Desktop to the Enterprise, Apress 2005.

3. Kumar Reddy, Victor Moreno, Network virtualization, Cisco Press, July, 2006.

4. James E. Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.

5. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: Vmware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Basics of Virtualization:** Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization- Virtualization Advantages – Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines –	**10**	**20**

	System Virtual Machines – Hypervisor - Key Concepts.		
II	**Server Consolidation:** Hardware Virtualization – Virtual Hardware Overview - Sever Virtualization – Physical and Logical Partitioning - Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation – Planning for Development – Selecting server Virtualization Platform.	**10**	**20**
	First Internal Examination		
III	**Network virtualization:** Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design – WAN Architecture - WAN Virtualization – Virtual Enterprise Transport Virtualization–VLANs and Scalability theory - Network Device Virtualization Layer 2 - VLANs Layer 3 - VRF Instances Layer 2 - VFIs - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation – Ipsec L2TPv3 Label Switched Paths – Control- Plane Virtualization–Routing Protocols- VRF - Aware Routing Multi-Topology Routing.	**13**	**30**
	Second Internal Examination		
IV	**Virtualizing Storage:** memory management in virtualization, partitioning, reclamation, ballooning; SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual tape libraries. Overview of Hypervisors : Xen Virtual machine monitors- Xen API – VMware – Vmware products – Vmware Features – Microsoft Virtual Server – Features of Microsoft Virtual Server.	**12**	**30**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6331	NETWORKING IN EMBEDDED SYSTEMS	3-0-0-3	2015

Course Prerequisites:

Basic courses in Data Communication, Microprocessor and microcontroller at UG level

Course Objectives:

Syllabus:

Embedded network, Embedded communication protocols,
USB bus and CAN bus,
Embedded ethernet, Element of a network and building a network,
Wireless embedded networking, security of networks

Expected Course outcomes:

References:

1. Frank Vahid, Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley publications

2. Jan Axelson, Parallel Port Complete, Penram publications

3. Dogan Ibrahim, Advanced PIC microcontroller projects in C, Elsevier 2008

4. Jan Axelson, Embedded Ethernet and Internet Complete, Penram publications

5. Bhaskar Krishnamachari, Networking wireless sensors, Cambridge press 2015

6. PIC Microcontroller and Embedded System by Muhammad Ali Mazidi, Rolind D Mekinlay, Danny Causey

7. Introduction to Wireless and Mobile System,Dharma Prakash Agrawal, Qing-An Zewg, 3rd edition, Celengage Learning, 2010

8. Wireless Sensor Network: Technology, Protocol and Application, Kazem Sohraby,Daniel

Minoili Taileb Znati, John Wiley and sons, 2007

9. Serial Port Complete: Com Port, USB Virtual Com Ports and Port for Embedded System, Jan Axelson, Lakeview Research, U.S.; 2nd Revised edition edition (14 November 2007)

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Embedded Communication Protocols:** Embedded network: Introduction - Serial parallel communication – Serial communication protocols – RS232 standard - RS485 standard - Synchronous serial protocols - Serial peripheral interface(SPI) - Inter integrated circuits - PC parallel port programming - ISA/PCI bus protocol – Firmware.	**10**	**20**
II	**USB and CAN BUS:** USB bus – Introduction – Speed identification on the bus - USB state - USB Bus Communication: Packets - Data flow types – Enumeration – Description - PIC Micro controller USB Interface - C Program - CAN Bus- Introduction - Frames - Bit stuffing - Types of errors - Nominal Bit Timing - PIC micro controller CAN Interface - A simple application with CAN.	**13**	**30**
	First Internal Examination		
III	**Embedded Ethernet:** Element of a network - Inside Ethernet - Building a network: Hardware option - Cables - Connections and network speed – Design choices: Selecting components - Ethernet Controllers - Exchanging message using UDP and TCP - Serving web page with dynamic data - Serving web pages that respond to user input - Email for embedded systems - Using FTP - keeping device and network secure.	**11**	**25**
IV	**Wireless Embedded Networking:** Wireless Sensor Networks – Introduction – Application - Network Topology – Localization - Time Synchronization - Energy efficient MAC Protocols – SMAC - Energy Efficient and Robust routing – Data Centric Routing.	**11**	**25**
	Second Internal Examination		
	Total	45	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10GN6001	RESEARCH METHODOLOGY	0-2-0-2	2015

Course Prerequisites

1. Basic skill of analyzing data earned through the project work at UG level;

2. Basic knowledge in technical writing and communication skills earned through seminar at UG level.

Course Objectives

As a tutorial type course, this course is expected to be more learner centric and active involvement from the learners are expected which encourages self-study and group discussions.

The faculty mainly performs a facilitator's role

Syllabus

Overview of research methodology - research process - scientific methods -research problem and design - research design process - formulation of research task, literature review and web as a source - problem solving approaches - experimental research - ex post facto research. Thesis writing - reporting and presentation - interpretation and report writing - principles of thesis writing- format of reporting, oral presentation - seminars and conferences, Research proposals - research paper writing - publications and ethics - considerations in publishing, citation, plagiarism and intellectual property rights. Research methods – modeling and simulation - mathematical modeling – graphs - heuristic optimization - simulation modeling - measurement design – validity – reliability – scaling - sample design - data collection methods and data analysis.

Expected Outcomes

References

1. R Kothari, *Research Methodology : Methods & Techniques*, New Age International Publishers

2. Panneerselvam, *Research Methodology*, Prentice Hall of India, New Delhi, 2012.

3. N. Krishnaswamy, Appa Iyer Sivakumar, and M. Mathirajan, *Management Research Methodology, Integration of Principles*, Pearson Education.
4. Deepak Chawla, and MeenaSondhi, *Research Methodology – Concepts & Cases*, Vikas Publishing House.
5. J.W. Bames, *Statistical Analysis for Engineers and Scientists*, McGraw Hill, New York.

6. Schank Fr., *Theories of Engineering Experiments*, Tata McGraw Hill Publication.

7. Willktnsion K. L, Bhandarkar P. L, *Formulation of Hypothesis*, Himalaya Publication.

8. Douglas C Montgomery, *Design and analysis of experiments*, Wiley International

9. Ranjit Kumar, *Research Methodology : A step by step guide for beginners*, Pearson Education.
10. Donald Cooper, *Business Research Methods*, Tata McGraw Hill, New Delhi.

11. Leedy P D, *Practical Research : Planning and Design*, 4th Edition, N W MacMillan Publishing Co
12. Day R A, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 1989

13. Coley S M and Scheinberg C A, *Proposal Writing*, 1990, Newbury Sage Publications.

14. Sople, *Managing Intellectual Property: The Strategic Imperative*, Prentice Hall of India, New Delhi, 2012

15. Manna, Chakraborti, *Values and Ethics in Business Profession*, Prentice Hall of India, New Delhi, 2012.
16. Vesilind, *Engineering, Ethics and the Environment*, Cambridge University Press.

17. Wadehra, B.L. *Law relating to patents, trademarks, copyright designs and geographical indications*, Universal Law Publishing

Course plan

Module	Content	Hours	Semester Exam Marks (%)

I	**Overview of Research Methodology**: Research concepts, meaning, objectives, motivation, types of research, research process, criteria for good research, problems encountered by Indian researchers, scientific method, research design process.	5	15
II	**Research Problem and Design** : Formulation of research task, literature review, methods, primary and secondary sources, web as a source, browsing tools, formulation of research problems, exploration, hypothesis generation, problem solving approaches, introduction to TRIZ (TIPS), experimental research, principles, laboratory experiment, experimental designs, ex post facto research, qualitative research.	5	15
	First Internal Examination		
III	**Thesis Writing, Reporting and Presentation** : Interpretation and report writing, techniques of interpretation, precautions in interpretation, significance of report writing, principles of thesis writing, format of reporting, different steps in report writing, layout and mechanics of research report, references, tables, figures, conclusions, oral presentation, preparation, making presentation, use of visual aids, effective communication, preparation for presentation in seminars and conferences.	4	15
IV	**Research proposals, Publications, Ethics and IPR** : Research proposals, development and evaluation, research paper writing, layout of a research paper, journals in engineering, considerations in publishing, scientometry, impact factor, other indexing like h-index, citations, open access publication, ethical issues, plagiarism, software for plagiarism checking, intellectual property right (IPR), patenting case studies.	5	15
	Second Internal Examination		

V	**Research Methods - Modeling and Simulation** : Modeling and simulation, concepts of modeling, mathematical modeling, composite modeling, modeling with ordinary differential equations, partial differential equations (PDE), graphs, heuristics and heuristic optimization, simulation modeling.	5	20
VI	**Research Methods - Measurement, Sampling and Data Acquisition** : Measurement design, errors, validity and reliability in measurement, scaling and scale construction, sample design, sample size determination, sampling errors, data collection procedures, sources of data, data collection methods, data preparation and data analysis.	4	20

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6309	**SEMINAR-I**	**0-0-2-2**	**2015**

Course Prerequisites:

Knowledge of technical document preparation systems, Language skills

Course Objectives

Methodology

The student is expected to present a seminar in one of the current topics in the field of specialization and related areas. The student shall prepare a Paper and present a Seminar on any current topic related to the branch of specialization under the guidance of a staff member. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester. The student shall submit typed copy of the paper to the Department. Grades will be awarded on the basis of contents of the paper and the presentation. A common format in (.pdf format) shall be given for reports of Seminar and Project. All reports of Seminar and Project submitted by students shall be in this given format.

Expected Outcomes

Internal work assessment

1. Marks for the report : 30%

2. Presentation & evaluation by the Committee: 40%

3. Ability to answer questions on the topic : 30%

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6311	**ADVANCED NETWORKING LABORATORY**	**0-0-2-2**	**2015**

Course Prerequisites:

Course in Computer networking, Internet programming, Network programming laboratory at UG level

Course Objectives

Syllabus

Experiments Of Network Programming and Security using C/Java,

Network Simulation and performance Evaluation Using Simulator (like NS2)

Expected Outcomes

References

1. W. Richard Stevens, “UNIX Network Programming”, PHI , Eastern Economy Edition

2. J.F. Kurose and K.W. Ross, Computer Networking: A Top-Down Approach Featuring Internet,3/e, Perason Education, 2005.

3. Using Java2 Platform – Weber (AWL)

4. Douglas E.Comer, Hands on Networking with Internet Technologies, Pearson Education.

5. Network And System Security, edited by John R. Vacca

Experiments

Experiments Of Network Programming and Security using C/Java

1) Implementation of ARP and improvisation of protocol by resolving various security problems involved in it.

2) Implementation of Remote Command Execution with the various scenarios such as Remote File copy, Remote Distribution etc.

3) Programs to integrate Link State and Distance Vector Routing Protocols.

4) Implement a protocol which ensures reliable QoS to transfer a file across a network and measure its performance in comparison with TCP.

5) Implementation of network protocol used on the Internet or local area networks to provide a bidirectional interactive communications facility.

6) Implement a protocol for Authenticated Routing in LAN networks.

Network Simulation and performance Evaluation Using Simulator (like NS2)

7) Simulation and Performance Comparison of various Routing Protocols.

8) Simulation of Wireless Networks (Eg. Wifi, Adhoc etc).

9) Simulation and Performance Comparison of different congestion control and avoidance mechanisms which have been proposed for TCP/IP protocols.

Assessment :

1. Practical Records /outputs 40%

2. Regular Class Viva-Voce 20%

3. Final Test (Objective) 40%

Mapping Of Experiments to purpose to show the scope/usage of each experiment

Ex No	N/w Programming	Protocol Design	Network Simulation	Performance Evaluation	Security	Internetworking Experiments	Tracking	Management
1	Y	Y			Y		Y	
2	Y							Y
3	Y	Y				Y		
4	Y	Y						Y
5	Y	Y				Y		
6	Y	Y			Y		Y	
7			Y	Y				
8			Y					
9			Y	Y				

Course No.	Course Name	L-T- P - Credits	Year of Introduction
10CS6302	MATHEMATICAL FOUNDATIONS (SECURITY)	3-0-0-3	2015

Course Prerequisites

Basic course in Number Theory at UG level

Course Objectives

Syllabus

Number Theory,

Quadratic residues

Elliptic curves, Discrete logarithm,

Groups, Rings, Fields, Polynomial GCD,

Linear codes, Hamming Codes, Irreducible polynomials, BCH Codes

Expected Outcomes

Text Books:

1. C Y Hsuing, ‘Elementary Theory of Numbers’, Allied publishers

2. J. Hoffstein, J. Pipher and J.H. Silverman, “An Introduction to Mathematical Cryptography”, Springer (2008)

3. Grimaldi P.R., “Discrete & Combinatorial Mathematics”, Addison Wesley

4. Norman L. Biggs, ‘Codes: An Introduction to Information Communication and Cryptography’ , Springer 2008

References:

1. Niven I., Zuckerman H.S. and Montgomery H. L.,’ An Introduction to the Theory of

Numbers', John Wiley and Sons.

2. Tom M Apostol, 'Introduction to analytic Number Theory', Springer

3. D. R. Stinson, "Cryptography, Theory and practice", Chapman & Hall (2006)

4. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Number Theory:** The Division algorithm and Extended Euclidean Algorithm, GCD, Fundamental theorem of arithmetic, Primes and properties, Euler function, Solving linear diophantine equations, Congruence in one unknown, Solution of congruences, Modular inverse	5	15
II	Complete residue system, Reduced residue system, Euler's theorem, Fermat's little theorem, Wilson's theorem, The Chinese reminder theorem. Quadratic residues and non-residues, Legendre symbol, Quadratic reciprocity law and generalization(without proof), Jacobi symbo	8	15
	First Internal Examination		
III	**Elliptic Curves**: Elliptic curves over real numbers, Elliptic curve addition algorithm, Elliptic curves over finite fields, The elliptic curve discrete logarithm problem, The Double-and-Add Algorithm	8	15
IV	**Algebra**: Definition of group, monoid & semi group, elementary group theorem-uniqueness of identity and inverses, Subgroups, Cyclic groups, group homomorphism and isomorphism. Cosets,	8	20

Lagranges' theorem.

	Second Internal Examination		
V	Rings, Integral domain and fields, Basic properties, Sub-ring and Ideals, Polynomial rings, Division Algorithm for Polynomials and GCD. Irreducible polynomials, Hamming Distance	**7**	**15**
VI	**Coding:** Linear codes, matrix of linear codes, Check matrix, one error correcting codes, decoding problem, Coset leader, Syndrome, Error correcting code, The hamming sphere packing bound, Hamming codes, Perfect code, , Cyclic codes, Classification and properties, several error correcting, BCH codes, Properties of BCH codes	**9**	**20**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6304	PATH AND FLOW PROBLEMS IN NETWORKS	3-0-0-3	2015

Course Prerequisites

Basic courses in graph theory and computer networks at UG level.

Course Objectives

Syllabus

Network flow problem, Developing polynomial time algorithm,
Shortest path: Label setting algorithm, label correcting algorithm,
Maximum Flows, Minimum Cost Flows,
Minimum Spanning Trees,
Linear programming, LP formulation of matching

Expected Outcomes

Text Books:

1. Ravindra K. Ahuja, Thomas L. Magnanti, James B.Orlin, “Network Flows – Theory, Algorithms and Applications”, 1st Edition, Prentice Hall, 1993.

2. Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali, “Linear Programming and Network Flows”, 4th Edition, John Wiley & Sons, 2009.

References:

1. Gunther Ruhe, Kluwer, “Algorithmic Aspects of Flows in Networks”, Academic Publishers Group, 1991.

2. Michael W. Lucas, “Network Flow Analysis”, No Starch Press, 2010.

3. Alexander Engau, Vdm Verlag Dr. Muller, “Semi-Simultaneous Flows in Multiple Networks”, Aktiengesellschaft & Co. Kg, 2008.

4. Wai-kai Che, “Theory of Nets: Flows In Networks”, John Wiley & Sons, 1990.

5. Jon kleinberg, Eva tardos “Algorithm design”, pearson publication.

6. Christros Papadimitriou, Kennet h Steiglitz, Combinatorial optimization:algorithms and complexity, PHI, 2000

	Course plan		
Module	**Content**	**Hours**	**Semester**

			Exam Marks (%)
I	**Network Flow Problems** - Network Representations - Network Transformations -Complexity Analysis - Developing Polynomial Time Algorithms - Search Algorithms -Flow Decomposition Algorithms	**7**	**15**
II	**Shortest Paths: Label Setting Algorithms** – Dijkstra's Algorithm, Dial's Implementation, HeapImplementation, Radix Heap Implementation **Shortest Paths: Label Correcting Algorithms** – Generic Label Correcting Algorithms,Special Implementations of the Modified Label Correcting Algorithm,Detecting Negative Cycles, All Pairs Shortest Path Problem.	**8**	**20**
First Internal Examination			
III	**Maximum Flows**: Generic Augmenting Path Algorithm - Labeling Algorithm and Max-Flow Min–Cut Theorem -Capacity Scaling Algorithm - Distance Labels and Layered Networks -Generic Pre-Flow Push Algorithm - FIFO Pre-Flow Push Algorithm - Flows in Unit Capacity Networks - Flows in Bipartite Networks - Flows in Planar Undirected Networks.	**7**	**15**
IV	**Minimum Cost Flows**: Optimality Conditions - Cycle Canceling Algorithm and the Integrity Property - Successive Shortest Path Algorithm - Primal–Dual Algorithm – Out–of Kilter Algorithm - Capacity Scaling Algorithm - Cost Scaling Algorithm - Minimum Mean Cycle Canceling Algorithm.	**7**	**15**
Second Internal Examination			
V	**Minimum Spanning Trees** - Kruskal's Algorithm –Prim's Algorithm - Sollin's Algorithm-Convex Cost Flows Pseudo Polynomial Time Algorithm, Polynomial Time Algorithm -Generalized Flows - Augmented Forest Structures - Determining Potentials and Flows for an Augmented Forest Structure - Generalized Network Simplex Algorith**m**	**7**	**15**
VI	**Linear programming and network flows** - Linear programming - modeling, geometric solution - Simplex method and minimum cost network flows	**9**	**20**

	- Representation of a Non-basic Vector in Terms of the Basic Vectors - The Simplex Method for Network Flow Problems - LP formulation of matching		
	Total	**45**	**100**
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
10CS6306	TOPICS IN SECURITY	3-1-0-4	2015

Course Prerequisites

Basic courses in Cryptography, Number theory at UG level

Course Objectives

Syllabus

Security mechanisms

Cryptographic functions and MAC functions

OS security, database security

Block ciphers, Digital signatures, Authentication protocols

Public key encryption, Authentication service

Security in public services based on networks

Expected Outcomes

References:

1. William Stallings Cryptography and Network Security principles and practice Fifth Edition pearson publications.
2. Behrouz A Forouzan, Debdeep Mukhopadhyay Cryptography and Network security Mc Graw Hill publications
3. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-857-networkand-

computer-security-spring-2014/lecture-notes-and-readings/

4. Juels, Ari, and Ronald Rivest. "Honeywords: Making Password-Cracking Detectable." *ACM CCS* (2013): 145–60

5. Charles P. Pfleeger, Shari Lawrence Pfleeger Security in Computing , 4/e Pearson Education.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Security Mechanism and principles; Security Goals and Violations; Security Requirements; Security Services; Honeyword generators, decoy passwords.	**7**	**10**
II	**Cryptographic functions and MAC functions:** Discrete Logs; Encryption/Decryption Functions -Perfect secrecy,One-Time Pad; Cryptographic Hash Functions - definitions, Requirements and Algorithmic Implementation of One-Way Functions; random oracle model, desirable properties,applications; Keccak-SHA-3 overview; MAC Functions - message authentication codes, Requirements for MAC, Security of MAC, Algorithmic Implementation - HMAC, CBC -MAC, PRF - MAC, One Time MAC	**11**	**20**
First Internal Examination			
III	**OS and database security:** OS Security Violations and Techniques to Prevent Them; Access Control Models; Secure Programming Techniques; Intrusion Detection; Malicious Software Detection; Firewalls; Database and Data mining security.	**9**	**15**
IV	**Block ciphers and protocols:** Block Ciphers and	**11**	**25**

	Stream Ciphers; Block Ciphers- DES, AES, Ideal Block Cipher; Modes of Encryption; Modes of operations, ECB (Electronic Code Book), CTR (Counter Mode), CBC (Cipher Block Chaining), CFB(Cipher Feedback); Secret Sharing - Shamir's secret sharing - key management – interpolation – bi-linear maps; Digital signatures – Identity based encryption, 3 way agreement; Authentication Protocols - Nonce and Timestamps - Authenticated Diffie-Hellman Key Establishment Protocols; Group Key Establishment Protocols.		
	Second Internal Examination		
V	**Public key encryption:** Pedersen Commitment - PK Encryption (Public Key Encryption) - El-Gamal PK Encryption - DDH (Decision Diffie-Hellman) - PKI and X.509 Authentication Service – Kerberos	**9**	**15**
VI	**Security in network based services:** E-mail Security; IP Security; Secure Socket Layer and Transport Layer Security; Secure Electronic Transactions; Impacts on Emerging Technologies - RFID, Electronic Voting, VoIP and Skype.	**9**	**15**
	Total	**56**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6308	MINI PROJECT	0-0-4-2	2015

Course Prerequisites

The project topic must be identified and assigned a project supervisor.

Course Objectives

Methodology

Every student eligible to take this course will undertake a work under the supervisor assigned by the department towards the project in third and fourth semesters. The work assigned will be from the identified topic for the project work and to the extent possible, to be conceived as a preparatory step for project course offered in subsequent semesters. The identified work will share the same experimentation framework with that of project work in subsequent semesters. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. There need to be one interim evaluation and end semester evaluation for the course.

The supervisor will continuously assess the work by the student assigned to the supervisor. The project evaluation committee assigned to a project will do the interim evaluation and end semester evaluation, based on a presentation by student about the work done. For interim evaluation, student has to be submit an interim report in the format fixed by department to the committee and then do the presentation in a slot fixed for it. For the end semester evaluation, student has to submit a report on the complete work in the course(in the format fixed by department) to the committee and then do the presentation in a slot fixed for it.

Expected Outcomes

Internal work assessment

Total of 100 marks, based on two evaluations

1. Presentation and evaluation by committee: 40 marks

2. Progress evaluation by supervisor : 30 marks

3. Report : 30 marks

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6312	**SECURE COMPUTING LABORATORY**	**0-0-2-2**	**2015**

Course Prerequisites:

Course in Internet programming, Network programming(Java based) laboratory at UG level

Course Objectives

Syllabus

Experiments in Computer Security using C/Java

Case studies of security issues

Tools for security

Expected Outcomes

References

1. https://www.suse.com/documentation/sles11/book_sle_admin/data/sec_apache2_ssl.html
2. http://linuxconfig.org/apache-web-server-ssl-authentication
3. http://www.tomcatexpert.com/knowledge-base/using-openssl-configure-ssl-certificates-

tomcat

4. http://linuxcommand.org/man_pages/openssl1.html
5. https://www.owasp.org/index.php/Digital_Signature_Implementation_in_Java
6. https://www.openssl.org/docs/apps/smime.html
7. http://fedoraproject.org/wiki/How_to_edit_iptables_rules
8. https://www.frozentux.net/iptables-tutorial/iptables-tutorial.html
9. https://www.frozentux.net/iptables-tutorial/iptables-tutorial.html
10. http://nmap.org/bennieston-tutorial/

Experiments

The experiments included in this syllabus broadly serves the following purpose:

Case studies in Security to understand the following points

1) Using IPTABLES on linux for filtering rules
2) Using NMAP for ports monitoring
3) Understanding Firewalls
4) Ethical hacking
5) Using open ssl for web-browser communication
6) Configuring S/MIME for email communication
7) Distributed denial of service attack

Experiments in Security to gain experience in programming/evaluating/trouble-shooting solutions to problems in security

8) Programs using AES algorithm for 128 bit key
9) Elliptic curve cryptography algorithm

10) Digital signature algorithm

11) RSA algorithm

12) Secure hash algorithm

13) Working with sniffers for monitoring network communication

14) Performance evaluation of various cryptographic algorithms

15) Bluetooth attacks

16) Secure Password storage

Following is the actual list of experiments

1) Java/C Program to calculate MD5 and SHA hash values in java.

2) Java Code Implementation to generate a public key in an elliptic curve algorithm using a given private key.

3) Implementation of digital signature using RSA algorithm

4) Implement a protocol for authenticated delivery of data by Considering the Encryption and decryption using AES 128 bit key.

5) Implementation of web-browser communication using SSL by ensuring strong encryption, authentication and data integrity.

6) Java program to sign messages which confirm to the S/MIME standard and verify its digital signatures based on certificates containing RSA keys.

7) Implementation of sniffer for monitoring network communication.

8) Implement java program to send an encrypted string via Bluetooth from a PC as client to a mobile as server.

9) Java program for secure password storage

10) Java program for distributed Denial of service

11) Implement a technique using Java/C to extract the database information through web application(SQL Injection)

12) Performance Evaluation of Cryptographic Algorithms: AES and DES

13) Using IPTABLES/NETFILTER on linux for

Displaying the status of the firewall

Stop/start/restart the firewall

Delete/insert firewall rules

Drop private network address on public interface

Block incoming port request/IP address

Drop or accept traffic from MAC address

Block or allow ICMP ping request

Block or open common ports

Restrict the no: of parallel connections to a server per client IP.

14) Using NMAP for ports montitoring

Scan ports consecutively.

Scan for specific port

Scan a TCP port

Scan a UDP port

Scan multiple ports

Scan ports by network range

Scan remote host for specific ports with TCP ACK

Scan remote host for specific ports with TCP SYN

Check most commonly used ports with TCP syn

Assessment :

1. Practical Records /outputs 40%

2. Regular Class Viva-Voce 20%

3. Final Test (Objective) 40%

Mapping of experiments to purpose is provided to understand scope/usage/compliance of each experiments listed above

Exp No	IPTABLES	NMAP	Firewalls	Ethical Hacking	Open SSL	S/MIME	DDOS	AES	ECC	Digital Signatures	RSA	Secure Hash	Sniffers	Performance eval.	Bluetooth	Password security
1												Y				
2									Y							
3										Y	Y					
4								Y								
5					Y											
6						Y					Y					
7													Y			
8															Y	
9																Y
10							Y									
11				Y												
12								Y						Y		
13	Y		Y													
14		Y	Y													

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6314	**LAWS AND ETHICS IN COMPUTING**	**3-0-0-3**	**2015**

Course Prerequisites

NIL

Course Objectives

Syllabus

Ethics – philosophy and issues

Professional Ethics, Characterisitcs, Code of conduct

Computing and Intellectual Property rights

Introduction to Computing Contracts

Computer Crime, Computer Forensic

Cyber laws in India

Expected Outcomes

References:

1. Deborah G Johnson, Computer Ethics (Paperback), 3rd edition, Pearson education.

2. D. Bainbridge, Introduction to Computer Law, 5/e, Pearson Education, 2004.

3. P. Duggal, Cyber Law – The Indian Perspective, Saakshar Law Publications, New Delhi, 2009.

4. Bill Nelson, Amelia Phillips, Frank Enfinger, Christofer Steuart Computer Forensics and Investigations, second Indian Reprint 2009, Cengage Learning India.

5. Vivek Sood, Cyber Law Simplified , Tata McGrawHill (Unit V: Chapter 7)

6. Rodney Ryder Guide to Cyber Laws , Wadhwa Publications, Nagpur.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Ethics** – philosophy and issues - Vacuum of policies - conceptual muddles – social context - moral and legal issues - uniqueness of ethical issues - role of analogy - descriptive and normative claims - ethical relativism - utilitarianism, other theories; **Professional Ethics** - Characteristics – the system of professions – computing as a profession – professional relationship – responsibilities – code of ethics and professional conducts.	**8**	**20**
II	**Computing and Intellectual Property rights** - Overview of intellectual property rights - Copyright basics - Computer software and copyright – Copyright in Computer-generated works - The law of confidence - Copyright and electronic publishing - Copyright in the information society - Patent law - Trade marks and passing-off – product designs;	**6**	**25**
First Internal Examination			
	Introduction to Computing Contracts - Fundamentals of computer contracts – Liability for defective hardware and software - Contracts for writing software - Licence agreements for "off-the-shelf" software - Contract between software author and publisher – WEB and Hardware contracts.	**6**	
III	**Computer Crime:** Computer Fraud – Hacking – Unauthorized modification of information – Piracy – Pornography and harassment.	**14**	**28**

	Computer Forensic: Introduction to Computer Forensics, history of computer forensics, understanding case law, developing Computer forensics resources, preparing for computer investigations - understanding law enforcement agency investigations, understanding corporate investigations, maintaining professional conduct, Understanding Computer Investigations - Preparing a computer investigation, taking a systematic approach, procedures for corporate high tech investigations, understanding data recovery workstations and software, conducting an investigation, completing the case - Requirements for forensic lab certification , determining the physical requirements for a computer forensics lab, selecting a basic forensic workstation, building a business case for developing a forensic lab.		
Second Internal Examination			
IV	**Cyber laws in India:** Basic Concepts of Technology and Law; Understanding the Technology of Internet, Scope of Cyber Laws, Cyber Jurisprudence Law of Digital Contracts - Intellectual Property Issues in Cyber Space - Rights of Netizens and E-Governance - Information Technology Act 2000 data protection - Legislation on waste management and green technology – Legislation and Enforcement of usage of green Technology.	**11**	**27**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6316	CYBER LEGISLATION AND SECURITY POLICIES	3-0-0-3	2015

Course Prerequisites

Course Objectives

Syllabus

Introduction to Computer Security

Protecting Programs and Data

Professional Ethics

Information security policies and procedures

Writing The Security Policies.

Expected Outcomes

References:

1. Deborah Russell and Sr. G.T Gangemi, Computer Security Basics (Paperback), 2nd Edition, O' Reilly Media, 2006.

2. Charles P. Pfleeger Security in computing, 4th edition, Printice Hall, 2006

3. Thomas R. Peltier, Information Security policies and procedures: A Practitioner's Reference, 2nd Edition Prentice Hall, 2004.

4. Scott Barman, Writing Information Security Policies, Sams Publishing, 2002.

5. Deborah G Johnson, " Computer Ethics", 4th Edition, Pearson Education Publication, 2008

6. Kenneth J Knapp, Cybersecurity and global information assurance: Threat analysis and Response solutions, IGI Global, 2009

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to Computer Security:** Definition - Threats to security - Government requirements - Information Protection and Access Controls; Computer security efforts - Standards, Computer Security mandates and legislation; Privacy Considerations - International security activity.	10	20
II	**Protecting Programs and Data** – Copyrights – patents - trade secret - Information and the Law - protecting information - Rights of Employees and Employers - Redress for Software Failures - Computer Crime - Ethical Issues in Computer Security - Ethical Decision Making: Types of ethical choices, Making defensible decisions; Case Studies of Ethics.	6	24
First Internal Examination			
	Professional Ethics - Characteristics – the system of professions – computing as a profession – professional relationship – responsibilities – code of ethics and professional conducts.	5	
III	**Corporate policies** - Tier 1, Tier 2 and Tier3 policies - process management - planning and preparation - developing policies - asset classification – policy - developing standards - Employee responsibilities.	10	20
Second Internal Examination			

IV	**Writing The Security Policies** - Computer location and Facility construction – Contingency Planning - Periodic System and Network Configuration Audits - Authentication and Network Security – Addressing and Architecture – Access Control – Login Security – Passwords – User Interface – Telecommuting and Remote Access – Internet Security Policies – Administrative and User Responsibilities – WWW Policies – Application Responsibilities – E-mail Security Policies. Organizational and Human security: Adoption of Information security management standards – Human factors in security, Role of information security professionals.	**14**	**36**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6318	MODERN DATABASE SYSTEMS	3-0-0-3	2015

Course Prerequisites

Basic course in Database management systems at UG level

Course Objectives

Syllabus

Database System Architectures, Distributed database concepts

Concepts for Object Databases, Languages and Design, Relational Systems

Multidimensional Data Structures

Mobile Databases

Expected Outcomes

References:

1. Elmasri, Navathe. Fundamentals of Database Systems, Third Edition, Pearson Education, 2000.

2. Thomas Cannolly and Carolyn Begg, " Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.

3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”,

Fifth Edition, McGraw Hill, 2006.

4. C.J.Date, A.Kannan and S.Swamynathan,”An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006

5. . V.S.Subramanian, “Principles of Multimedia Database Systems”, Harcourt India Pvt

Ltd., 2001.

6. Vijay Kumar, “ Mobile Database Systems”, John Wiley & Sons, 2006

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Revisiting Relational Database Systems, Database System Architectures:** Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Distributed Database Concepts - Distributed Data Storage– Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Three Tier Client Server Architecture- Case Studies	**12**	**25**
	First Internal Examination		
II	**Concepts for Object Databases:** Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, **Languages and Design:** ODMG Model – ODL – OQL – Object Relational and Extended **Relational Systems :** Object Relational features in SQL/Oracle – Case Studies	**12**	**25**
III	**Multidimensional Data Structures** – Image Databases –	**9**	**25**

	Text/Document Databases- Video Databases – Audio Databases – Multimedia Database Design		
	Second Internal Examination		
IV	**Mobile Databases:** Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols- Mobile Database Recovery Schemes.	**12**	**25**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6320	GAME THEORY	3-0-0-3	2015

Course Prerequisites

NIL

Course Objectives

Syllabus

Fundamentals,

Non-cooperative Equilibrium in Normal games,

Cooperative solutions,

Sequential Games, Applications

Expected Outcomes

References:

1. Roger A. McCain, “Game Theory – A Non-Technical Introduction to the Analysis of Strategy”, Thomson South-Western, 2005.

2. Tirole, “Game Theory”, Mit press 2005.

3. Osborne, “An Introduction to Game Theory”, Oxford Press 2006.

4. E. N. Barron, “Game Theory: An Introduction”, Wiley India Pvt Ltd, 2009.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Fundamentals:** Conflict - Strategy and Games - Game theory - The Prisoner's Dilemma - Scientific metaphor - Business case - Games in normal and extensive forms – Representation, Examination, Examples.	**10**	**20**
II	**Non Cooperative Equilibrium in Normal Games:** Dominant Strategies and Social Dilemmas - Nash Equilibrium -	**5**	**20**
	First Internal Examination		
	Classical Cases in Game theory - Three person games - Introduction to Probability and Game theory - N-Person games.	**5**	
III	**Cooperative Solutions:** Elements of Cooperative Games - Credible commitment - A Real Estate Development - Solution Set - Some Political Coalitions - Applications of the Core to Economics – The Market Game - The Core of a Two Person Exchange Game - The Core with More than Two Pairs of Traders - The core of Public Goods Contribution Game - Monopoly and Regulation.	**12**	**30**
	Second Internal Examination		
IV	**Sequential Games:** Strategic Investment to Deter Entry - The Spanish Rebellion game, Embedded Games – Planning Doctoral Study - Centipede Solved - Repeated play - Campers Dilemma - Pressing the shirts - Indefinitely Repeated Play – A Repeated Effort Dilemma - The Discount Factor; Applications: Voting Games - Games and Experiments – Auctions - Evolution and Boundary Rational Learning.	**13**	**30**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6322	**NETWORK FORENSICS**	**3-0-0-3**	**2015**

Course Prerequisites

Basic course in Networks in UG level

Course Objectives

Syllabus

Introduction to Network Forensics, Technical Fundamentals,

Traffic Analysis, Protocol analysis, Packet analysis, Flow analysis, Wireless traffic analysis

Network Devices, Intrusion detection and analysis, Packet logging and analysis, Switches and Firewalls

Advanced Topics, web proxies, Network tunnelling, Malware forensic

Expected Outcomes

Textbook:

1. Sherri Davioff, Jonathan Ham, “Network Forensics: Tracking Hackers through Cyberspace”, Pearson Education, 2012

References:

1. John Vecca, “Computer Forensics: Crime Scene Investigation”, Firewall Media
2. Christopher L.T. Brown, “Computer Evidence: Collection and Preservation”, Firewall Media

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to Network Forensics:** Concepts in digital evidence -Challenges related to network	**9**	**20**

	evidence - Network forensic investigative methodology; **Technical Fundamentals:** Sources of network based evidence - On the wire, In the air, Switches, Routers, DHCP servers, Name servers, Authentication servers, Central log servers; Evidence Acquisition - Physical interception of cable, Radio frequency, Hubs, Switches; Traffic acquisition software - Libpcap and WinPcap, The Berkeley packet filter (BPF) language,Tcpdump, Wireshark,Tshark,Dumpcap; Active acquisition - Common interfaces, Inspection without access, strategy.		
II	**Traffic Analysis:** Protocol Analysis - Protocol analysis tool, Protocol analysis technique; Packet analysis - Packet analysis tool, Packet analysis technique; Flow analysis - Flow analysis tool, Flow analysis technique; Higher-layer traffic analysis - Common higher-layer protocols, Higher-layer analysis tool, Higher layer analysis technique;	**6**	**27**
First Internal Examination			
	Statistical flow analysis - Processor overview – Sensors - sensors types, Sensor software, Sensor placement; Flow record export protocols - Netflow, IPFIX, sFlow - Collection and aggregation; Wireless access point - Type of WAP, WAP evidence; Wireless traffic capture and analysis: Spectrum analysis, Wireless passive evidence acquisition; Common attacks: Sniffing, Rogue wireless access points, Evil twin, WEP cracking, Locating wireless devices.	**6**	
III	**Network Devices:** Intrusion detection and analysis – Typical NIDS/NIPS functionality – sniffing - Higher layer protocol awareness - Alerting on suspicious bits modes of detection - Modes of Detection - Signature based analysis -	**9**	**27**

	Protocol awareness - Behavioural analysis - Type of NIDS/NIPS, NIDS/NIPS evidence acquisition - Comprehensive packet logging - Event log aggregation - Correlation and analysis - Source of logs, Operating system logs, Application logs, Physical device logs, Network equipment logs; Network log architecture - Three type of logging architecture; Remote logging - Common pitfall and strategy, Log aggregation and analysis tool;		
Second Internal Examination			
	Collecting and Analysing Evidence, Switches: Content-addressable memory table - ARP, Switch evidence; Routers - Type of routers, Router evidence; Firewalls - Type of firewalls, Firewall evidence.	**3**	
IV	**Advanced Topics** - Web Proxies - Web proxy functionality: Caching, URI Filtering, Content Filtering; Distributed cache – Squid - Squid configuration, Squid access logfile, Squid Cache; Encrypted web traffic - Transport Layer Security – Gaining access to encrypted content - Commercial TLS/SSL Interception Tools; Network Tunneling - Tunneling for functionality - Inter-switch link(ISL), Generic routing encapsulation(GRE), Tunnelling for confidentiality; Internet protocol security(IPSec) - Transport layer security(TLS) and Secure socket layer(SSL) - Covert tunnelling: Covert tunnelling strategy, TCP sequence number; DNS tunnelling - ICMP tunnels - Malware forensics - Trends in malware evolution, Network behaviour of malware - Propagation, Command and control Communications, Payload behaviour.	**12**	**26**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6324	**MOBILE COMPUTING**	**3-0-0-3**	**2015**

Course Prerequisites

Basic course in mobile communications at UG level.
Course 10CS6305

Course Objectives

Syllabus

Mobile Computing Architecture,
Mobile Communications, GPRS,
Mobility Management & Intelligent Networks,
Mobile Device Operating System, IP Multimedia Subsystems

Expected Outcomes

References:

1. Asoke K. Talukder and Roopa R. Yavagal; Mobile Computing- Technology Application, and service creation; TMH Publication, 2006
2. T Rappaport, “Wireless Communication: Principle and Practice”; Pearson Education.
3. G. S. Rao “Mobile Cellular Communication”, Pearson Learning.
4. Gonzalo camarillo, Miguel-Angel Garcia- Martin “The 3G IP Multimedia Subsystem(IMS)” Merging the internet and the cellular worlds.

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Mobile Computing Architecture:** Internet - The ubiquitous network; Schematic representation of mobile computing environment - The three layer mobile computing architecture - Design considerations of mobile computing - Mobile computing through internet - Making existing	**11**	**25**

	applications mobile-enabled - Mobile Computing through Telephony - Multiple Access Procedures - Satellite Communication Systems - Mobile Computing through telephone - developing an IVR application - Voice XML, Telephony Application Programming Interface; Emerging technologies – RFID, WIMAX, Mobile IP, IPv6, Java Card.		
II	**Mobile Communications:** Introduction - The GSM Architecture - GSM Entities - Call Routing in GSM - PLMN interfaces - GSM Addresses and identifiers - Network Aspects in GSM - Mobility Management - GSM Frequency allocation -	**6**	**25**
First Internal Examination			
	Personal Communications services - Authentications and security - Short message service - Mobile Computing over SMS - Value added services through SMS - Accessing the SMS Bearer; **GPRS:** GPRS and Packet Data Network - GPRS Network Architecture - GPRS Network Operations - Data Services in GPRS - Limitations in GPRS - Applications for GPRS.	**6**	
III	**Mobility Management & Intelligent Networks:** CDMA - Spread Spectrum Technology – DSSS - Walsh Function – IS-95 - Speech and Channel Coding - IS-95 Architecture - Channel Structure - Call Processing - Handoff and Roaming - Channel Capacity - CDMA and Data protocol Stack -	**7**	**30**
Second Internal Examination			
	Intelligent Networks and Internetworking - Fundamentals of call processing - Intelligence in the network - SS#7 Signalling - SS#7 Protocol Stack - SS#7 Signal Unit - IN Conceptual Model, IN services - Virtual Calling Card service - Local Number Portability.	**6**	
IV	**Mobile Device Operating System:** Introduction to Symbian Operating System - Symbian OS Architecture - Applications for Symbian - Controls and Compound Control - Active Objects -	**9**	**20**

	Localization, Security in Symbian OS. **IP Multimedia Subsystems:** Architecture of IMS Networks - Protocols Used in IMS - Building Blocks of IMS networks - Call Session Control Function - Identities in IMS - Call flow in IMS Network - IMS Charging - IMS service Architecture - Security in IMS.		
	Total	**45**	**100**
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6326	SECURITY THREATS AND MANAGEMENT	3-0-0-3	2015

Course Prerequisites

Basic course in Cryptography and Network Security at UG level

Course Objectives

Syllabus

Security threats

Network Threats

Threats to Wireless networks

Security Threat Management

Security Elements

Expected Outcomes

References:

1. Joseph M Kizza, “Computer Network Security”, Springer Verlag, 2005.

2. Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.

3. William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Prentice Hall,2008.

4. Thomas Calabres and Tom Calabrese, “Information Security Intelligence: CryptographicPrinciples & Application”, Thomson Delmar Learning, 2004.

5. Cyrus Peikari and Seth Fogie, "Maximum Wireless Security" Sams, 2002.

6. Stallings William, "Wireless Communications and Networks” Second Edition, Pearson Education Ltd, 2009.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction:** Security threats - Sources of security threats - Motives - Target Assets and vulnerabilities – Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers, Insider threats, Cyber crimes.	8	20
II	**Network Threats:** Active / Passive – Interference – Interception – Impersonation – Worms – Virus – Spam’s – Ad ware - Spy ware – Trojans and covert channels – Backdoors – Bots – IP Spoofing - ARP spoofing - Session Hijacking – Sabotage - Internal threats- Environmental threats - Threats to Server Security	9	20
	First Internal Examination		
III	**Threats to Wireless networks:** ESM - ECM and ECCM - Proliferation of device and technologies - Practical aspects - Wireless availability – Privacy Challenges - Risks: Denial of Service, Insertion Attacks - Interception and monitoring wireless traffic - MIS configuration -	9	20

	Wireless Attacks – Surveillance - War Driving, Client-to-Client Hacking - Rogue Access Points - Jamming and Denial of Service.		
IV	**Security Threat Management:** Risk Assessment - Forensic Analysis - Security threat correlation – Threat awareness - Vulnerability sources and assessment - Vulnerability assessment tools - Threat identification - Threat Analysis - Threat Modeling - Model for Information Security Planning.	**9**	**20**
	Second Internal Examination		
V	**Security Elements:** Authorization and Authentication - types, policies and techniques – Security certification - Security monitoring and Auditing – Security Requirements Specifications - Security Policies and Procedures - Firewalls, IDS, Log Files, Honey Pots - Access control - Trusted Computing and multilevel security - Security models - Trusted Systems - Software security issues - Physical and infrastructure security – Human factors – Security awareness - training - Email and Internet use policies.	**10**	**20**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6328	HIGH PERFORMANCE SCIENTIFIC COMPUTING	3-0-0-3	2015

Course Prerequisites

Basic course in distributed computing at UG level.

Course Objectives

Syllabus

High performance through parallelism, Need for parallel architecture, modern parallel computers,
Introduction to multi core architecture, openMP,
Parallel algorithms and MPI,
Parallel computing with CUDA

Expected Outcomes

Textbook:

1. David E. Culler, J aswinder Pal Singh, “Parallel computing architecture : A hardware/ software approach” , Morgan Kaufmann/Elsevier Publishers, 2004.

2. Michael J Quinn, “Parallel programming in C with MP1 and OpenMP”, Tata McGraw Hill, 2003.

3. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.

4. “Professional Cuda C programming” by John Cheng,Max Grossman,Ty McKercher, Wiley, 2014

References

1. Wesley Petersen and Peter Arbenz, “Introduction to Parallel Computing”, Oxford University Press, 2004.

2. Jason Sanders, Jason Sanders, CUDA by Example: An Introduction to General-Purpose GPU Programming, Pearson, 2010

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**

I	Flynn's taxonomy - Need for parallel architecture -convergence of parallel architectures -fundamental design issues - evolution of super computing - modern parallel computers -parallel architectures - interconnection networks - processor arrays - multiprocessors, multi omputers.	**9**	**20**
II	Introduction to multi core architecture system overview of threading – fundamental oncepts of parallel programming -	**6**	**30**
First Internal Examination			
	threading and parallel programming constructs – openMP, a portable solution for threading - hyper threading technology – multiprocessors and multi-core processors.	**7**	
III	Parallel algorithm design - Task channel model - Foster's design methodology – Boundary value problem - Finding the maximum - Message passing programming-model and interface -	**5**	**30**
Second Internal Examination			
	Circuit satisfiability using MPI,The sieve of Eratosthenes - Data decomposition options parallel algorithm, All pair shortest path problem -point to point communication -Matrix multiplication - Solving linear equations - monte-carlo methods - finite difference methods - vibrating string - Performance analysis – Correctness issues	**8**	
IV	CUDA programming model - Introduction, timing your kernel - CUDA execution model - Nature of wrap execution - Exposing parallelism - Avoiding branch divergence – Dynamic parallelism - CUDA memory model - matrix addition with unified memory - CUDA shared memory - Reducing global memory access - Streams and concurrency.	**10**	**20**
	Total	**45**	**100**
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6330	**MANAGING BIG DATA**	**3-0-0-3**	**2015**

Course Prerequisites

Basic courses in Database management systems, Advanced database management system at UG level

Course Objectives

Syllabus

Understanding BigData, Open Source Technologies

Basics of Hadoop and MapReduce

Hadoop Related Tool like Hbase, Cassandra, Pig, Hive

Introduction to NoSQL

Expected Outcomes

Textbooks:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics:

Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

2. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012

3. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

4. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.

5. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.

6. Alan Gates, "Programming Pig", O'Reilley, 2011.

7. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.

8. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison Wesley Professional, 2012

References:

1. Vignesh Prajapati “Big Data Analytics with R and Hadoop”, Set up an integrated infrastructure of R and Hadoop to turn your data analytics into Big Data analytics

2. “MongoDB vs Hadoop Big Solutions for Big Problems”, Deep Mistry, Open Software Integrators

3. Shashank Tiwari, “Professional NoSQL”, 2011, Wrox press.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Understanding BigData:** What Is Big Data - Why Big Data - Challenges Of Conventional Systems - convergence	**11**	**25**

	Of Key Trends – Structured, Semistructured And Unstructured Data, Industry Examples Of Big Data - Web Analytics - Big Data And Marketing - Fraud And Big Data - Risk And Big Data - Credit Risk Management - Big Data And Algorithmic Trading - Big Data And Healthcare - Big Data In Medicine - Advertising And Big Data - Big Data Technologies - Introduction To Hadoop -		
	Open Source Technologies - Cloud And Big Data - Mobile Business Intelligence – Crowd Sourcing Analytics - Inter And Trans Firewall Analytics		
II	**Basics of Hadoop and MapReduce:** What Is Hadoop – Why Hadoop, Data Format - Comparison With Other Systems - Analysis Data With Hadoop -	**4**	**30**
	First Internal Examination		
	Scaling Out - Hadoop Streaming - Hadoop Pipes - Hadoop Distributed File System(Hdfs) - Hadoop I/O - Devoleping A Mapreduce Application - Mapreduce Working – Yarn - Mapreduce Formats - Resource Management - Map-reduce Scheduler	**12**	
III	**Hadoop Related Tool:** Introduction to Hbase – Data Model And Implementations – Hbase Clients – Hbase Examples – Praxis - Hbase Vs Rdms. Introduction to Cassandra – Cassandra Data Model – Cassandra Examples – Cassandra Clients – Hadoop Integration.	**5**	**25**
	Second Internal Examination		
	Introduction to Pig – Grunt – Pig Data Model – Pig Latin – Developing And Testing Pig Latin Scripts - Sql Vs Pig.Introduction to Hive – Data Types And File Formats – Hive Architecture - Hiveql Data Definition – Hiveql Data Manipulation – Hiveql Queries - Hive vs. Rdbms.	**5**	
IV	**Introduction to NoSQL:** Aggregate Data Models – Aggregates – Key - Value And Document Data Models – Relationships – Graph Databases – Schemaless Databases	**8**	**20**

– Materialized Views – Distribution Models – Sharding – Master-Slave Replication – Peer-Peer Replication – Sharding And Replication – Consistency – Relaxing Consistency – Version Stamps. Case Study: Mongodb	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6332	**LANGUAGE TECHNOLOGIES**	**3-0-0-3**	**2015**

Course Prerequisites

Basic courses in Automata theory, Probability at UG level

Course Objectives

Syllabus

Introduction to Natural Language Processing, Linguistic essentials.
Study of Word Collocations, word sense disambiguation,
Natural Language Grammar
Information retrieval,
Familiarizing Applications of NLP.

Expected Outcomes

Texts:

1. Christopher D. Manning and Hinrich Schutze, " Foundations of statistical Natural Language Processing", MIT Press, 1999

2. Tomek Strzalkowski, "Natural Language Information Retrieval", Kluwer academic publishers,1999.

References:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson, 2008

2. Ron Cole, J.Mariani, et.al "Survey of the state of the art in Human Language Technology", Cambridge University Press,1997

3. Michael W. Berry, "Survey of Text Mining: Clustering, Classification and Retrieval", Springer Verlag,2003

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Introduction to natural Language Processing - Mathematical foundations - Elementary Probability Theory - Essential Information Theory - Linguistic Essentials - Parts of Speech and	**10**	**20**

	Morphology - Phrase Structure Semantics and Pragmatics - Corpus based Work		
II	**Words:** Collocations, Frequency, Mean and Variance, Hypothesis Testing, Mutual Information - Statistical Inference, n-gram models, Statistical Estimators, Combining Estimators -	**5**	**20**
First Internal Examination			
	Word Sense Disambiguation, Methodological Preliminaries - Supervised Disambiguation, Dictionary Based Disambiguation, Unsupervised Disambiguation – Lexical Acquisition	**5**	
III	**Grammar:** Hidden Markov Models, Implementation, Properties, Variants - Parts-of-speech Tagging, Markov Model Taggers, Uses of Taggers – Probabilistic Context free Grammars - Probabilistic Parsing, Parsing for Disambiguation	**10**	**20**
Second Internal Examination			
IV	**Information retrieval:** Information Retrieval Architecture, indexing, storage, Compression Techniques, Retrieval, approaches, evaluation - Search Engines, Commercial search engine features, comparison , Performance measures - Document processing, NLP based information retrieval, Information Extraction	**7**	**20**
V	Categorization, Extraction based categorization - Clustering, Hierarchical clustering - Document Classification and routing - Finding and organizing answers from Text search - Text categorization and efficient summarization using Lexical chains – Machine translation, Transfer metaphor, Interlingua and statistical approaches.	**8**	**20**
	Total	**45**	**100**
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P Credits	Year of Introduction
10CS6334	CLOUD COMPUTING	3-0-0-3	2015

Course Prerequisites

Basic course in programming paradigms, distributed computing at UG level
Course 10CS6305

Course Objectives

Syllabus

Introduction to Cloud Computing,
Introduction to component level virtualization,
Architecture of Cloud Computing,
Parallel and distributed computing, Cloud Infrastructure, Programming Model,
Security in the cloud.

Expected Outcomes

References

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud” O'Reilly, 2009.
5. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6. Katarina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, “Grid and Cloud Computing – A Business Perspective on Technology and Applications”, Springer, 2010.

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction to Cloud Computing:** Evolution of Cloud Computing – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture - Features of Cloud Computing –Cloud Services – IaaS, PaaS,	7	16

	SaaS – Cloud service Providers – Public , Private and Hybrid Clouds.		
II	**Introduction to component virtualization:** Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization of CPU, Memory, I/O Devices - Desktop Virtualization – Server Virtualization- Storage Virtualization – Network Virtualization.	8	18
First Internal Examination			
III	Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.	10	22
IV	Parallel and Distributed Programming Paradigms – Map Reduce, Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments - Eucalyptus, Open Nebula, OpenStack.	10	22
Second Internal Examination			
V	Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.	10	22
	Total	45	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6336	REAL TIME SYSTEMS	3-0-0-3	2015

Course Prerequisites

Basic course in Embedded systems at UG level.

Course Objectives

Syllabus

Introduction

Handling Real Time Tasks, Scheduling RT, Sharing Among RT Tasks

RT tasks in commercial systems, Scheduling RT in Multiprocessor and Distributed System, Commercial RT Operation System

RT Communication and Databases.

Expected Outcomes

Textbook:

1. Rajib Mall, “Real Time System: Theory and Practice”, Pearson 2008

References

1. Jane W Liu, “Real-Time Systems”, Pearson Education, 2001
2. Resource Management in Real-Time System and Network, C.Siva Ram Murthy and G. Maninaram, MIT Press, March 2001
3. Phillip A Laplante, Seppo j Ovask , “Real Time System Design and Analysis: Tools for the Practitioner”, John Wiley and Sons, 2012

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Real time systems - Applications, Basic Model, Characteristics - Safety and reliability - Real time tasks - Timing constraints - Modelling timing constraints	**6**	**10**
II	**Handling Real Time Tasks:** **Scheduling RT:** Concepts - Type of RT task and their characteristics - Task scheduling - Clock driven scheduling - Hybrid schedulers - Event-Driven scheduling - EDF scheduling - RMA, Issue with RMA - Issue in using RMA in practical situation. **Sharing Among RT Tasks:** Resource sharing among RT tasks - Priority inversion - PIP, HLP, PCP - Type of priority inversion under PCP, Feature of PCP - Issue in using resource sharing protocols - Handling task dependencies	**13**	**30**
	First Internal Examination		
III	**RT tasks in commercial systems:** **Scheduling RT in Multiprocessor and Distributed System:** Multi-processor task allocation - Dynamic allocation of task - Fault-tolerance scheduling of task - Clocks in distributed RT systems - Centralized and distributed clock synchronization. **Commercial RT Operation System:** Time services - Features of RT OS - Unix as a RT OS, Unix based RT OS - Windows as a RT OS - POSIX, VRTX, VxWork, QNX, µC/OS-II, RT Linux, Lynx, Window CE - Benching RT	**13**	**30**

system.

	Second Internal Examination		
IV	**RT Communication and Databases:** **RT Communication:** Example of applications requiring RT communication - Basic concepts - RT communication in a LAN - Soft and hard RT communication in a LAN, -Bounded access protocol for LAN - Performance comparison - RT communication over packet switched networks - QoS framework - Routing - Resource reservation - Rate control - QoS Models **RT Database:** Example application of RT database - RT databases - Characteristics of temporal data - Concurrency control in RT database - Commercial RT database	**13**	**30**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7305	AUTOMATED VERIFICATION	3-0-0-3	2015

Course Prerequisites

Basic courses in propositional logic, automata theory at UG level

Course 10CS6301

Course Objectives

Syllabus

Introduction, *Transition System Model* of a System,

Linear Time Properties,

Regular Properties,

Specification Logics, Model Checking, System, Tools, Properties.

Expected Outcomes

References:

1. Christel Baier, Joost-Pieter Katoen: “Principles of Model Checking”, MIT Press, 2008.

2. Michael Huth, Mark Ryan: “Logic in Computer Science: Modelling and Reasoning about Systems”, Cambridge University Press, 2004.

3. Edmund M Clarke, Orna Grumberg, Doron Peld: “Model Checking”, MIT Press,2001.

4. Daniel Kroening, Ofer Strichman : “Decision Procedures-An Algorithmic Point of View”,Springer,2008.

Course plan

Module	Content	Hours	Semester

			Exam Marks (%)
I	**Introduction:** Transition System Model of a System - Model Checking, Characteristics of Model Checking - Model Checking Process, Strength and Weaknesses; Transition Systems – Executions, Modeling Hardware and Software Systems, State-Space Exploration Problem.	**10**	**25**
II	**Linear Time Properties:** Deadlock, Linear-Time Behavior, Safety Properties and Invariants, Liveness Properties, Fairness.	**7**	**15**
	First Internal Examination		
III	**Regular Properties :** Automata on Finite Words - Model Checking Regular Safety Properties – Regular Safety Properties, Verifying Regular Safety Properties - Automata on infinite words - w-Regular Languages and Properties - Nondeterministic, Deterministic and Generalized Buchi Automata - Model Checking w-Regular Properties.	**13**	**30**
	Second Internal Examination		
IV	**Specification Logics**: Propositional and first order logic; Temporal logics(CTL,LTL,CTL*), fix-point logics, mu-calculas. **Model Checking, System, Tools, Properties :** Linear Temporal Logic (LTL) – Syntax, Semantics, Specifying Properties, Automata Based LTL Model Checking – complexity, LTL Satisfiability and Validity Checking, Mutual Exclusion Problem - NuSMV Model Checker, Running NuSMV, Example Problems – Mutual Exclusion, Ferryman, Alternating bit protocol.	**15**	**30**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P - Credits	Year of Introduction
10CS7307	**Soft Computing Techniques**	**3-0-0-3**	**2015**

Course Prerequisites

Basic courses in computing paradigms, problem solving/programming techniques at UG level
Course 10CS6303

Course Objectives

Syllabus

Introduction to problem solving techniques, Basics of Soft Computing - various techniques,
Neural Networks,
Fuzzy Systems,
Genetic Algorithms,
Intelligent Systems.

Expected Outcomes

References

1. Sivanandam S.N, Deepa S.N, “Principles of Soft Computing”, Wiley India Edition
2. Satish Kumar, “Neural Networks- A classroom Approach”, The McGraw-Hill Companies.
3. Simon Haykin , “Neural Networks :A comprehensive foundation” , Pearson Education
4. George J Klir and Bo Yuan, ”Fuzzy sets and Fuzzy logic” Prentice-Hall of India,1995
5. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.
6. David E. Goldberg, Genetic algorithms in search, optimization & Machine Learning, PearsonEducation, 2006
7. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
8. Jang J.S.R., Sun C.T. and Mizutani E, Neuro-Fuzzy and Soft computing, Pearson Education 2003.
9. N.P. Padhy, Artificial Intelligence and Intelligent systems, Oxford Press, New Delhi.

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction and Background:** Problem solving techniques – Hard and soft computing, Introduction to soft computing, Overview of techniques in soft computing – Neural networks, Fuzzy Logic, Genetic Algorithm, Hybrid systems. Properties and advantages of soft computing - Applications of soft computing – soft computing in control, business and finance.	**7**	**16**

II	**Neural Networks:** Introduction to Artificial Neural networks: biological neuron – processing and bias in artificial neuron – sigmoid activation – linear separability. Supervised learning : Perceptron – multilayer perceptron – multilayer feedforward networks – backpropagation learning Unsupervised learning: competitive learning - Counterpropagation – Structure of CPN – CPN learning – Adaptive Resonance Theory network – Structure of ART Associative memory networks: pattern association – training algorithm - Auto and hetero associative memory networks – BAM network – Continuous Hopfield Net - Boltzmann machine.	**8**	**18**
First Internal Examination			
III	**Fuzzy Systems:** Fuzzy membership functions – Fuzzification (with example) - Defuzzification – Lambda cut for fuzzy relations – Methods of defuzzification (basic ideas only) - Max-membership principle, Centroid method, Weighted average method, Mean-max membership, Center of sums, Center of largest area, First of maxima, last of maxima. Fuzzy rules and rule bases – formation, decomposition and aggregation of fuzzy rules –Fuzzy inference system Fuzzy decision making – Individual / multiperson decision making – multiobjective and multiattribute decision making – fuzzy bayesian decision making	**10**	**22**
IV	**Genetic Algorithms:** Introduction to genetic algorithms : A brief history of evolutionary computation-biological terminology - search space - encoding, reproduction, operators - elements of genetic algorithm - comparison of GA and traditional search methods – Genetics Based Machine Learning - GA optimization problems - JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem), Differences & similarities between GA & other traditional methods - Applications of GA.	**10**	**22**
Second Internal Examination			
V	**Intelligent systems:** Swarm intelligent systems : Introduction, ant colony systems, development of ant	**10**	**22**

	colony systems, working of ant colony systems Expert Systems: Introduction, stages in the development of an expert system, probability based expert systems, expert system tools.		
	Total	45	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7309	**DESIGN OF SECURED ARCHITECTURES**	**3-0-0-3**	**2015**

Course Pre-requisites

Basic courses in Software Engineering, Software Project Management at UG level

Course 10CS6302, 10CS6306

Course Objectives

Syllabus

Architecture and Security,

Low-Level security Architecture,

Mid-Level security Architecture,

High-Level security Architecture,

Enterprise security Architecture, Case studies

Expected Outcomes

Text Books:

1. Jay Ramachandran, “Designing Security Architecture Solutions”, Wiley Computer Publishing, 2010.

References:

1. Markus Schumacher, "Security Patterns: Integrating Security and Systems Engineering", Wiley Software Pattern Series, 2010.

2. Eduardo Frenandez, "Security patterns and practice: Designing Secure Architectures using Software Patterns", Wiley Series in software design patterns.

3. John Sherwood, Andrew Clark, "Enterprise Security Architecture: A business- driven approach", CRC Press, 2005.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	Architecture and Security - Architecture Reviews - Software Process Reviews and the Software Development Cycle - Software Process and Architecture Models:Kruchten's 4+1 view model - The reference model for open distributed processing - Rational's unified process - Software Process and Security - Architecture Review of System: Architecture document - introduction section - Sections of the architecture document - Architecture review report - Security Assessments - Five level compliance model – Pre-assessment, post-assessment activities - Security Architecture Basics - Security and software architecture - Security Principles- Authentication – Authorization - Models for Access Control - Architecture Patterns in Security.	**8**	**20**
II	Low-Level Architecture - Code Review - importance of code review - Buffer Overflow Exploits - Countermeasures against Buffer Overflow Attacks - patterns applicable - Security and Perl - Byte code Verification in Java - Good Coding Practices Lead to	**9**	**20**

	Secure Code – Cryptography - Trusted Code - The Java Sandbox - Microsoft Authenticode - Internet Explorer Zones - Netscape Object Signing - Signed, Self-Decrypting, and Self-Extracting Packages - Implementing Trust within the Enterprise - Protecting Digital Intellectual Property - Thompson's Trojan Horse Compiler - Secure Communications - The OSI and TCP/IP Protocol Stacks - The Structure of Secure Communication - The Secure Sockets Layer Protocol		
	First Internal Examination		
III	Mid-Level Architecture - Middleware Security - Middleware and Security - The Assumption of Infallibility - The Common Object Request Broker Architecture - The OMG CORBA Security Standard - CORBA Security Level s- Secure Interoperability - Web security - Web Application Architecture - Web Application Security Options - Securing Web Clients - Connection Security - Securing Web Server Hosts - Securing the Web Server- Application and OS security- Structure of an Operating System - Structure of an Application - Application and Operating System Security - Securing Network Services - Database Security - Architectural Components and Security - Secure Connectivity to the Database - Role-Based Access Control - Database Views - Security Based on Object-Oriented Encapsulation - Procedural Extensions to SQL	**10**	**20**
IV	High-Level Architecture - Security Components - Secure Single Sign-On - Public-Key Infrastructures – Firewalls - Intrusion Detection Systems-	**3**	**20**
	Second Internal Examination		
	LDAP and X.500 Directories – Kerberos - Distributed Computing Environment - The Secure Shell, or SSH - The Distributed Sandbox - Security and Other Architectural Goals - Metrics for Non-Functional Goals - Force Diagrams around Security - High Availability – Robustness - Reconstruction of Events - Ease of Use -	**6**	

	Maintainability, Adaptability, and Evolution - Scalability- Interoperability - Performance- Portability.		
V	Enterprise Security Architecture - Security as a Process - Security Data - Enterprise Security as a Data Management Problem - Tools for Data Management - David Isenberg and the “Stupid Network” - Extensible Markup Language - The XML Security Services Signaling Layer - XML and Security Standards - The Security Pattern Catalog Revisited - XML-Enabled Security Data - HGP: A Case Study in Data Management - Business Cases and Security: Building Business Cases for Security	**9**	**20**
	Total	**45**	

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS7311	SYSTEMS MODELING AND SIMULATION	3-0-0-3	2015

Course Prerequisites

Basic course in Probability at UG level,

Course 10CS6301

Course Objectives

Syllabus

Basic concept of modelling and simulation, steps in a simulation study,

Concepts in discrete-event simulation, Object-oriented simulation,

Modeling complex systems,

Simulation of computer systems, simulation of networks

Expected Outcomes

Text

1. Jerry Banks, John S Carson, Barry L Nelson, and David M Nicol, "Discrete- Event System Simulation", Fifth Edition, Prentice-Hall, 2005

2. Law and Kelton, "Simulation Modeling and Analysis", Third Edition, McGraw Hill, 2000.

3. J.B. Sinclair, "Simulation of Computer Systems and Computer Networks: A Process-Ori-

ented Approach",2004.

4. Banks, J. Handbook of simulation: Principles, methodology, advances, applications and practice. Wiley,1998.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Basic concepts:** Systems, Models, and Simulation - Systems and System Environment, Components of a System, Model of a System - Types of Models - Types of Simulation - Parallel and Distributed Simulation - Internet and Web-Based Simulation. Steps in a Simulation Study.	10	20
II	**Discrete-Event Simulation:** Concepts in Discrete-Event Simulation - Event Scheduling/Time Advance Algorithm,	5	20
	First Internal Examination		
	Manual Simulation Using Event Scheduling - List processing in Simulation - Simulation Software, Classification of Simulation Software - Object-Oriented Simulation.	5	
III	**Modeling Complex systems:** A Simple Simulation Language, simlib - Single -Server Queuing Simulation with simlib - Time - Shared Computer Model - Job-Shop Model - Efficient Event-List Manipulation	12	30
	Second Internal Examination		
IV	**Simulation of Computer Systems:** Simulation Tools - Model Input - High-Level Computer-System Simulation - CPU Simulation - Memory Simulation **Simulation of Computer Networks:** Traffic Modeling - Media Access Control - Data Link Layer - TCP Model Construction	13	30
	Total	45	

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7313	**DATA VISUALIZATION TECHNIQUES**	**3-0-0-3**	**2015**

Course Prerequisites

Course 10CS6305

Course Objectives

Syllabus

Core skill for visual analysis,
Time-series, ranking and deviation analysis,
Distribution, correlation and multivariate analysis,
Information dashboard interface design,
Information dashboard design issues, case studies

Expected Outcomes

References:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", nalytics Press, 2009.

2. Stephen Few, "Information dashboard design: The effective visual communication of data",vO'Reilly, 2006.

3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.

4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

7. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Core Skills For Visual Analysis:** Information	**9**	**20**

	visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and cross-tabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples		
II	**Time-Series, Ranking And Deviation Analysis**: Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns –	**6**	**20**
First Internal Examination			
	part-to-whole and ranking displays – best practices – deviation analysis-deviation analysis displays – deviation analysis best practices	**3**	
III	**Distribution, Correlation and Multivariate Analysis:** Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays - correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices	**9**	**20**
IV	**Information Dashboard interface Design:** Information dashboard – categorizing dashboards – typical dashboard data –	**3**	**20**
Second Internal Examination			
	dashboard design issues and best practices – visual perception – limits of short-term memory – visually encoding data – Gestalt principles – principles of visual perception for dashboard design	**6**	

V	**Information Dashboard Design issues:** Characteristics of dashboards – key goals in visual design process – dashboard display media – designing dashboards for usability – meaningful organization – maintaining consistency aesthetics of dashboards – testing for usability; **Case studies:** sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard	**9**	**20**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7315	Advanced Operating Systems	3-0-0-3	2015

Course Prerequisites

Basic course in Operating systems at UG level

Course Objectives

Syllabus

Uniprocessing operating system,

Multiprocessor Operating System,

Distributed Operating System,

Synchronization distributed systems,

Trends in distributed file systems.

Expected Outcomes

References:

1. A.S.Tanenbaum, “Modern Operating Systems”, PHI Edition, 1992

2. A.S.Tanenbaum, “Distributed Operating systems”, PHI.

3. M. Singhal and N.G.Sivarathri, “Advanced Concepts in Operating Systems”,

M.C.Grawhill Inc. 1994.System Concepts, Wiley, 2000.

4. J.L.Peterson and A. Silberchatz, “Operating System Concepts”

5. M.Maekawa, A.E.Oldehoeft And R.R. Oldehoeft, “Operating systems.”

6. M.Milenkovic, “Operating Systems : Concepts and Design” , McGrawhill Inc Newyork,

1992

7. K.Khawng, “Advanced Computer Archiecture : Parallelism , Scalability,

Programmmability”, M.C.Grawhill Inc, 1993

8. C.Crowley, “Operating Systems – A design Oriented Approach”, Irwin

1997.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Uniprocessing operating system:** Review of Operating system concepts. Process Concept – Threads process Scheduling – process synchronization– Interprocess Communication - semaphores – Messages – Monitors – critical Regions – conditional critical regions – dead Locks. Real and virtual Memory management Schemes.	**10**	**25**
II	**Multiprocessor Operating System:** Multiprocessor UNIX design goals - Master slave UNIX	**4**	**15**
	First Internal Examination		
	Multithreaded UNIX - Multicomputer UNIX extensions.	**4**	
III	**Distributed Operating System:** Introduction - Design Issues. Communication in distributed	**10**	**25**

	systems Layered protocols – ATM - client server model - remote Procedure call – Group communication.		
	Second Internal Examination		
IV	**Synchronization distributed systems:** Clock Synchronization – Mutual Exclusion – Election algorithms – Atomic transactions – Deadlocks in distributed systems. Processes and processors in distributed systems: Threads – system models - Processor allocation -Scheduling in distributed Systems.	**10**	**25**
V	**Distributed file system:** Design and implementation – Trends in distributed file systems. Case study AMOEBA, MACH, Recent trends and developments	**7**	**10**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7317	MULTI OBJECTIVE OPTIMIZATION TECHNIQUES	3-0-0-3	2015

Course Prerequisites

Basic courses in Graph theory, Operations Research at UG level

Course Objectives

Syllabus

Introduction, Classical approaches,

MOP Evolutionary algorithms,

Theoretical Issues,

MOEA Testing, Analysis and Parallelization,

Application and alternative meta-heuristics

Expected Outcomes

References:

1. Carlos A. Coello Coello, Gary B. Lamont, David A. Van Veldhuizen, “Evolutionary

Algorithms for Solving Multi-objective Problems", Second Edition, Springer, 2007.

2. Kalyanmoy Deb, " Multi-Objective Optimization Using Evolutionary Algorithms", John Wiley, 2002.

3. Aimin Zhoua, Bo-Yang Qub, Hui Li c, Shi-Zheng Zhaob, Ponnuthurai Nagaratnam Suganthan b, Qingfu Zhangd, "Multiobjective evolutionary algorithms: A survey of the state of the art", Swarm and Evolutionary Computation (2011) 32–49.

4. E Alba, M Tomassini, "Parallel and evolutionary algorithms", Evolutionary Computation, IEEE Transactions on 6 (5), 443-462.

5. Crina Grosan, Ajith Abraham, "Hybrid Evolutionary Algorithms: Methodologies, Architectures, and Reviews", Studies in Computational Intelligence, Vol. 75, Springer, 2007.

6. Christian Blum and Andrea Roli. 2003. Metaheuristics in combinatorial optimization: Overview and conceptual comparison. *ACM Comput. Surv.* 35, 3 (September 2003), 268-308.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction and Classical Approaches :** Introduction – Multi objective optimization problem - principles – Difference between single and multi objective optimization – Dominance and Pareto Optimality , Classical Methods – Weighted Sum – ε- Constraint method – Weighted Metric methods – Benson's method - Value Function - Goal Programming methods – Interactive Methods	**9**	**20**
II	**MOP Evolutionary Algorithms:** Generic MOEA - Various MOEAs: MOGA, NSGA-II, NPGA, PAES, SPEA2, MOMGA, micro GA;	**6**	**20**
	First Internal Examination		
	Constrained MOEAs: Penalty Function approach - Constrained Tournament – Ray-Tai-Seow's Method.	**3**	
III	**Theoretical Issues:** Fitness Landscapes - Fitness	**9**	**20**

	Functions - Pareto Ranking - Pareto Niching and Fitness Sharing - Recombination Operators - Mailing Restriction - Solution Stability and Robustness - MOEA Complexity - MOEA Scalability - Running Time Analysis - MOEA Computational Cost - No Free Lunch Theorem.		
IV	**MOEA Testing, Analysis and Parallelization:** MOEA Experimental Measurements – MOEA Statistical Testing Approaches – MOEA Test Suites;	**5**	**20**
	Second Internal Examination		
	MOEA Parallelization: Background – Paradigms – Issues - MOEA Local Search Techniques.	**4**	
V	**Distributed file system:** Design and implementation – Trends in distributed file systems. Case study AMOEBA, MACH, Recent trends and developments	**9**	**20**
	Total	**45**	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7319	CRYPTANALYSIS	3-0-0-3	2015

Course Prerequisites

Basic course in Cryptography at UG level

Course Objectives

Syllabus

Cryptanalysis of classical ciphers,

Cryptanalysis of block ciphers,

Algorithm for DLP,

Lattice based cryptanalysis

Expected Outcomes

References:

1. Antoine Joux, “Algorithmic Cryptanalysis”, Chapman & Hall/CRC Cryptography and Series, 2009.

2. Song Y Yang, “Number Theory for Computing”, Second Edition, Springer Verlag, 2010.

3. Gregory V. Bard “Algebraic Cryptanalysis “Springer 2009.

4. Hffstein, Jeffray Piper, Jill and Silverman, “An Introduction to Mathematical Cryptography”, Springer 2010.

5. “Applied Cryptanalysis –Breaking ciphers in the real world”-Mark Stamp and Richard M.Low, Wiley-IEEE press, 2007.

6. Cryptography & Net work security, principles & practices, William Stallings, Fifth Edition, Pearson Education.

7. https://eprint.iacr.org/2009/457.pdf

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**CRYPTANALYSIS OF CLASSICAL CIPHERS:** Vigenere cipher - Affine cipher – Hill-cipher - Linear Shift Register Random bit Generator-Berlekamp-Massey algorithm for the cryptanalysis of LFSR - Correlation attack on LFSR based streamciphers - Cryptanalysis of ORYX - Fast algebraic attack	**12**	**25**
II	**CRYPTANALYSIS OF BLOCK CIPHERS:** Man in the middle attack - Double DES - Linear and Differential cryptanalysis-	**3**	**25**
	First Internal Examination		
	Algorithmic Number theory: Stein’s binary greatest common divisor algorithm - Shanks Tonelli algorithm for square root in Fp - Stein’s greatest common divisor algorithm for polynomials.	**5**	
III	**ALGORITHM FOR DLP:** Pollard Rho method for DLP - Shank’s baby step and Giant step algorithm for DLP - Silver-Pohling-Hellman algorithm for DLP -Index calculus for DLP algorithms: Trial division method - Fermat method - Legendre-convergence method - Continued fraction method - Elliptic curve method - Quadratic sieve method.	**12**	**25**
	Second Internal Examination		
IV	**LATTICE BASED CRYPTANALYSIS:** Direct	**13**	**25**

attacks using lattice reduction -Coppersmith's attacks - Attacks on cryptographic hash functions: Birthday paradox - Birthday paradox for multi collisions - Birthday paradox in two groups - Applications of Birthday paradox in Hash functions – Multi collision attack on hash functions.	
Total	**45**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7321	**NEXT GENERATION NETWORKS**	**3-0-0-3**	**2015**

Course Prerequisites

Basic courses in Computer networks, Mobile networks at UG level

Course 10CS6305

Course Objectives

Syllabus

Introduction,

IMS and convergent managements,

MPLS and VPN,

Multicast,

Next generation networks

Expected Outcomes

Text

1. Thomas Plavyk, ”Next Generation Telecommunication networks,Services and

Management.”, Wiley & IEEE Press Publications,2012.

2. Neill Wilkinson, “Next Generation Network Services”, John Wiley Publications, 2002.

3.Azhar Sayeed, Monique J. Morrow, “MPLS and Next Generation Networks: Foundations for NGN Enterprise Virtualizations”, CISCO Press 2006.

4. Monique J Morrow, “Next Generation Networks”, CISCO Press,2007.

5. Ina Minie, Julian Lucek, “MPLS Enabled Applications- Emerging Developments and

New Technology" 3rd Edition, Wiley,2011.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction**:Evolution of public mobile services - motivations for IP based services, wireless IP network architecture – 3GPP packet data network architecture; Introduction to next generation networks - Changes, Opportunities and challenges, Technologies, Network, and Services, Next generation society, future trends.	8	15
II	**IMS AND CONVERGENT MANAGEMENT**:IMS Architecture - IMS services - QoS Control and Authentication - Network and Service management for NGN - IMS advantages - Next generation OSS Architecture – standards important to OSS Architecture - Information framework - OSS interaction with IMS – NGN OSS function/ information view reference model - DMTF CIM.	11	25
	First Internal Examination		
III	**MPLS AND VPN**[11 Hrs.]: Technology overview – MPLS & QoS - MPLS services and components- layer 2 VPN, layer 2 internetworking - VPN services – Signalling - layer 3 VPN - Technology overview - Remote Access and IPsec integration with MPLS VPN.	10	25
IV	**MULTICAST**:MPLS Multicast VPN overview- Applications, examples, IPV6 and MPLS – Technology overview, Future of MPLS- Integrating IP and optical networks, Future layer 3 services, future layer 2 services.	8	20
	Second Internal Examination		

V	**Next Generation Network Management:** Management and Provisioning - Configuration,Accounting, performance, security – case study for MPLS - Future enhancements - Adaptive self healing networks.	**8**	**15**
	Total	**45**	

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7323	BIOMETRIC TECHNOLOGIES	3-0-0-3	2015

Course Prerequisites

NIL

Course Objectives

Syllabus

Introduction to Biometrics,
Physical Biometric Technologies, Fingerprints, Facial scan, Retina vascular pattern, DNA biometric
Behavioral Biometric Technologies, Hand-print biometrics, Signature and handwriting, Keyboard or keystroke dynamics , Voice
Multi Biometrics.

Expected Outcomes

Textbooks:

1. Samir Nanavathi, Michel Thieme, and Raj Nanavathi, “Biometrics- identity verification in a network”, Wiley Eastern 2002
2. John Chirillo and Scott Blaul, “Implementing Biometric Security”, Wiley Eastern Publication, 2005

References:

1. John Berger, “Biometrics for Network Security”, Prentice Hall, 2004
2. Julian Ashbourn,” Guild to Biometric for Large Scale System: Technological, Operational and User Related Factor”, Springer Data London Limited, 2011

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Biometrics:** Introduction - Benefits of biometrics over traditional authentication systems - Benefits of biometrics	11	20

	in identification system - Selecting a biometric system – Application - Key biometric terms and processes - Biometric matching methods - Accuracy in biometric system.		
II	**Physical Biometric Technologies:** Fingerprints - Technical description - Characteristics - Competing technology - Strengths, Weaknesses, Deployments	**3**	**30**
First Internal Examination			
	Facial scan technical description - Characteristics, Weaknesses, Deployments - Retina vascular pattern Technical description - Characteristics, Strength, Weaknesses, Deployments - DNA biometrics.	**9**	
III	**Behavioral Biometric Technologies:** Handprint biometrics - Signature and handwriting technology - Technical description – Classification - Comprehensive packet logging -	**6**	**30**
Second Internal Examination			
	Keyboard or keystroke dynamics - Voice, Data acquisition, Feature extraction - Characteristics, Strength, Weakness, Deployment.	**6**	
IV	**Multi Biometrics:** Multi biometrics and multi factor biometrics - Two factor authentication with password - Tickets and tokens - Executive decision - Implementation plan - Case study on physiological, Behavioural and multifactor biometrics in identification system.	**10**	**20**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7325	**DISTRIBUTED ALGORITHMS**	**3-0-0-3**	**2015**

Course Prerequisites

Basic course in Distributed Systems at UG level.

Course Objectives

Syllabus

Introduction to model of synchronous distributed computing system, Algorithms
Algorithms in Synchronous Networks, Maximal Independent Set
Introduction to model of asynchronous distributed computing system, Algorithms
Asynchronous System Model, Resource Allocation.

Expected Outcomes

Textbook:

1. Nancy A. Lynch," Distributed Algorithms", Morgan Kaufmann Publishers, Inc, 1996

References

1. Sukumar Ghosh, "Distributed Systems: An Algorithmic Approach ", 2nd Edition, CRC Press, 2014

2. Wolfgang Reisig, W. Reisig, "Elements Of Distributed Algorithms: Modeling And Analysis With Petri Nets", Springer-verlag, 1998

3. Tel Gerard , "Introduction To Distributed Algorithms", 2nd Edition, Cambridge UniversityPress, 2000

4. Sukumar Ghosh, "Distributed Systems: An Algorithmic Approach", Chapman &Hall / CRC Press, 2006

5. Valmir C. Barbosa,"An Introduction To Distributed Algorithms", MIT Press, 2003

6. Randy Chow, Theodore Johnson, "Distributed Opearating Systems and Algorithm Analysis, Pearson Education, 1997

7. Santoro N., Nicola Santoro, “Design And Analysis Of Distributed Algorithms”, Wiley-Interscience, 2006

8. Ajay D. Kshemkalyani, Mukesh Singhal, “Distributed Computing - Principles, Algorithms,And Systems”, Cambridge University Press, 2011

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	Introduction to model of synchronous distributed computing system - Leader election in a General Network - Simple Flooding Algorithm - Basic Breadth-First Search Algorithm – Bellman-Ford algorithm.	**8**	**20**
II	Algorithms in Synchronous Networks - Minimum Spanning Tree - Leader Election in a Synchronous Ring - LCR algorithm - HS algorithm - Time Slice Algorithm - Variable Speeds Algorithm – Lower Bound for Comparison-based Algorithms	**8**	**30**
First Internal Examination			
	Maximal Independent Set - LubyMIS algorithm - Distributed Consensus with Link Failures and Process Failures – Basics	**7**	
III	Introduction to model of asynchronous distributed computing system - Send/Receive systems - Broadcast systems - Multicast systems - Basic algorithms - Peterson Leader - Election Algorithm – Local Synchronizer - Safe Synchronizer.	**9**	**20**
Second Internal Examination			
IV	Asynchronous System Model. Shared Memory Systems - Environment Model - Shared Variable Types, Mutual Exclusion - Asynchronous Shared Memory Model - Dijkstra's Mutual Exclusion Algorithm; Resource Allocation - Nonexistence of Symmetric Dining Philosophers Algorithms – Right-Left Dining Philosophers Algorithm - Mutual exclusion and consensus - Relationship between shared memory and network models Asynchronous networks with failures	**13**	**30**

	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P Credits	Year of Introduction
10CS7327	SOCIAL NETWORK ANALYSIS	3-0-0-3	2015

Course Prerequisites

Basic course in distributed computing at UG level.

Course Objectives

Syllabus

Introduction to the topic, Web and its limitations, Development and key concepts,
Evolution in Social Networks,Models and Algorithms for Social Influence Analysis,
Visualizing Online Social Networks-Use of Hadoop and MapReduce,
Mining Communities,Text and Opinion Mining

Expected Outcomes

Textbook:

1. Charu C. Aggarwal Social Network Data Analytics", Springer; 2011

2. Peter Mika , "Social Networks and the Semantic Web", Springer,1st edition2007.

3. BorkoFurht, "Handbook of Social Network Technologies and Applications", Springer, 1stedition, 2010

4. GuandongXu , Yanchun Zhang and Lin Li, " Web Mining and Social Networking– Techniques and applications", Springer, 1stedition, 2011.

5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.

References

1. Panagiotis Karampelas "Techniques and Tools for Designing an Online Social Network Platform", Springer, 2013

2. Bo Pang, Lillian Lee "Opinion Mining and Sentiment Analysis", Now publishers Inc, 2008

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Introduction to Web - Limitations of current Web – Development of Semantic Web	**10**	**24**

	– Emergence of the Social Web – Statistical Properties of Social Networks - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.		
II	**Evolution:** Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities-Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing -	**6**	**24**
First Internal Examination			
	Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - With Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models..	**5**	
III	**Modeling and Visualization:** Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation – Centrality – Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix based Representations - Node-Link Diagrams - Hybrid Representations - Modeling and aggregating social network data – Random Walks and their Applications – Use of Hadoop and MapReduce - Ontological representation of social individuals and relationships.	**11**	**24**
Second Internal Examination			
IV	**Mining Communities:** Aggregating and reasoning with social network data - Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.	**13**	**28**
	Text and Opinion Mining: Text Mining in		

	Social Networks - Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time		
	Total	**45**	**100**
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7329	MACHINE LEARNING TECHNIQUES	3-0-0-3	2015

Course Prerequisites:

Basic course in probability theory and statistics at UG level.

Course Objectives:

Syllabus:
Foundations of Learning, Linear Models and Distance-based Models, Tree and Rule Models, Reinforcement Learning.

Expected Course outcomes:

Text Books:

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.

2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.

3. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice",Easter Economy Edition, Prentice Hall of India, 2006.

4. 8. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition,Prentice Hall, 2009

5. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press,2012.

References:

6. K.P. Soman, R. Loganathan, V. Ajay, "Machine Learning with SVM and Other Kernel Methods", PHI Learning Pvt. Ltd., 02-Feb-2009

7. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.

8. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

9. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.

10. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Foundations of Learning:** Components of learning – learning models – geometric models – probabilistic models – logic models –grouping and grading – learning versus design - binary and multiclass classification – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization tradeoff – bias and variance – learning curve	**10**	**25**
II	**Linear Models and Distance-based Models :** Linear classification – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures - Kernel Methods and the Evolution of SVM - Support Vector Machines - Non Linear SVM and Kernel Trick	**6**	**30**
First Internal Examination			
	Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – kernels to distance – locality sensitive hashing – non-parametric regression – Principal component analysis(PCA) - PCA algorithm - PCA and nearest neighbours - High Dimensional	**8**	

	data - PCA via singular value decomposition(SVD) - ensemble learning – bagging and random forests – boosting – meta learning		
III	**Tree and Rule Models:** Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning	**6**	**25**
Second Internal Examination			
	clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning	**6**	
IV	**Reinforcement Learning:** Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal difference learning – active reinforcement learning – exploration – learning an action-utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in Robot control	**9**	**20**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7331	SOFTWARE DEFINED NETWORKS	3-0-0-3	2015

Course Prerequisites

Basic course in Computer Networks at UG level

Course Objectives

Syllabus

Introduction to the concept of central control, evolution of software defined networks, Applications and emulation platform

Review of various SDN controllers, Introduction to Network Virtualization and emulation of Network Virtualization

Study of programmable data planes, hardware programmability and SDN programming languages.

Analysis configuration verification, control verification, QoS and security aspects in SDN.

Expected Outcomes

References:

1. Paul Goransson, Chunk Black, “Software Defined Networking- A Comprehensive Approach”, Morgan Kauffman

2. Ken Gray, “ Software Defined Networking”, Oreilly

3. Patricia A Morrealle, James M Anderson, “Software Defined Networking-Design and

Deployment", CRC Press

4. Fei Hu, "Network Innovation through OpenFlow and SDN", CRC press

5. Vishal Shukla, "Introduction to Software Defined Networking: OpenFlow & VxLAN", CreateSpace Independent Publishing Platform

6. Course Notes on SDN by Nick Feamster.

7. Mininet.org https://github.com/mininet/mininet/wiki/Documentation

8. Tennenhouse, David L., et. al., " A survey of active network research", Communication Magazine IEEE 35.1 (1997), 80-86

9. Van der Merwe et. al., " The tempest – a practical framework for network programmability", Network, IEEE 12.3, (1998): 20-28

10. Bavier Andy et. al., "In VINI veritas: ralistic and controlled network expertimentation", ACM SIGCOMM Computer Communication Review, Vol 36, No.4, ACM 2006

11. Nick Feamster., et al., "How to lease the internet in your spare time", ACM SIGCOMM Computer Communication Review, 37.1, (2007): 61-64.

12. Feamster et. al. "The case of separating routing from routers", Proceeding os SIGCOMM, ACM 2004

13. Albert Greenberg, " A clean slate 4D approach to network control and a management", ACM SIGCOMM Communication Review 2005.

14. www. noxrepo.org

15. http://osrg.github.io/ryu

16. http://www.projectfloodlight.org/

17. http://opendaylight.org

18. http://www.opennetworking.org

19. Koponen Teemu, "Network virtualization in multi-tenant Data center", NSDI April 2014.

20. Mihai Dobrescu, et. al. "RouteBricks: exploiting the parallelism to scale software routers", 22nd ACM SIGOPS, 2009

21. Foster Nateet. al., "Frenetic: A network programming language", ACM SIGPLAN Notices 46.9 (2011)

22. Mosanto Christphper et. al., "Composing Software defined networks", NSDI 2013.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Basics and History** : Central Control, Programmable Networks, Network Virtualization, Control Plane Evolution, Control and Data Plane Separation, Opportunities in various domains, [6,8,9,10,11] Challenges in Realizing Control and Data Plane Separation, Routing Control Platform (RCP), The 4D Network Architecture[13]. Motivation: SDN/Openflow Applications [2,4], The mininet emulation platform [7]	**10**	**25**
II	Overview of Control Plane, Examples of SDN Controllers (Nox, Pox, Floodlight, Ryu, Open Daylight)[14-18], Customizing the control plane behavior with mininet. [7]	**5**	**25**
	First Internal Examination		
	What is network virtualization and how is it implemented?, Examples of network virtualization and applications, Virtual networking in Mininet, Slicing network control, virtualization in multi-tenant data centers[6,19]	**6**	
III	Programmable Software Data Planes: Click, Making Software Faster: RouteBricks[6,20], Making Hardware Programmable: RMT, Protocol Independent Forwarding: P4 (and POF), Building a Programmable Data Plane: NetASM, Motivation for "Northbound APIs" and SDN Programming Languages, Frenetic: A Programming Language for SDN[6,21]. Composing SDN Control: The Pyretic Programming Language, Event Based SDN Control, Data Centers Internet Exchange Points (IXPs), Wide-Area Backbone Networks, Home Networks,	**11**	**25**
	Second Internal Examination		
IV	Configuration Verification: rcc (pre-SDN), Data-Plane Verification: Veriflow, Header Space Analysis,	**11**	**25**

Control-Plane Verification: Kinetic [6].	
Quality of Service : QoS issues in SDN, QoS oriented design of SDN – Multimedia on SDN -Traffic Cl assification – SDN in Optical Networks – Security issues -Anycast Implementation [4,2]	
Total	**42**

Cluster Level End Semester Examination

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7333	INTERNET OF THINGS	3-0-0-3	2015

Course Prerequisites

Basic knowledge in Networks in UG level

Course Objectives

Syllabus

Introduction to Internet of Things

Components in internet of things

Programming the Microcontroller for IoT, Communication

Resource Management in the Internet of Things

Business Models for the Internet of Things

Internet of Things, Web of Things

Expected Outcomes

References:

1. Charalampos Doukas, Building Internet of Things with the Arduino, Create space, April 2002

2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011

3. Luigi Atzor et.al, The Internet of Things: A survey, Journal on Networks, Elsevier

Publications, October, 2010

4. http://postscapes.com/

5. http://www.theinternetofthings.eu/what-is-the-internet-of-things

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to Internet of Things:** Introduction – Definition - phases – Foundations – Policy - Challenges and Issues – identification - security – privacy; **Components in internet of things:** Control Units -Sensors -Communication modules - Power Sources - Communication Technologies - RFID - Bluetooth – Zigbee – Wifi – RF links - Mobile Internet - Wired Communication.	**7**	**16**
II	**Programming the Microcontroller for IoT:** Basics of Sensors and actuators - examples and working principles of sensors and actuators - Cloud computing and lOT - Arduino/Equivalent Microcontroller platform- Setting up the board - Programming for lOT- Reading from Sensors; **Communication:** Connecting microcontroller with mobile devices – communication through Bluetooth and USB - connection with the internet using wifi / Ethernet.	**8**	**18**
First Internal Examination			
III	**Resource Management in the Internet of Things:** Introduction - Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines - Software Agents for Object - Data Synchronization - Types of Network Architectures -	**10**	**22**

	Fundamental Concepts of Agility and Autonomy - Enabling Autonomy and Agility by the Internet of Things -23 Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behavior of Objects.		
IV	**Business Models for the Internet of Things:** The Meaning of DiY in the Network Society - Sensor-actuator technologies and Middleware as a basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things - Semantic Interoperability as a Requirement for DiY Creation –	**5**	**22**
Second Internal Examination			
	Ontology - Value Creation in the Internet of Things - Application of Ontology Engineering in the Internet of Things - Semantic Web-Ontology - The Internet of Things in Context of EURIDICE Business Impact.	**5**	
V	**Internet of Things, Web of Things:** Resource-oriented Architecture and Best Practices - Designing REST ful Smart Things - Web-enabling Constrained Devices - The Future Web of Things - Setting up cloud environment - send data from microcontroller to cloud - Case studies - Open Source e-Health sensor platform - **BeClose,** a monitoring based Safety System for Elderly people - Other recent projects.	**10**	**22**
	Total	**45**	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7301	SEMINAR-II	0-0-2-2	2015

Course Prerequisites

Course 10GN6001 Research Methodology

Course 10CS6309 Seminar 1

Familiarity with journals and conferences in the areas of networks, security

Course Objectives

Methodology

The student is expected to present a seminar on the preliminary findings in the phase I of the project work. The content of the presentation will be such that the usability of the work can be reviewed by the members attending the presentation, any problems remaining unaddressed in the project work can be brought to notice of the presenter, the potential of the work in generating publications in journals and conferences can be identified by faculty attending the presentation, any conceptual errors can be exposed by the discussion happening after the presentation, sufficiency of literature survey can be assessed by faculty attending the presentation etc...

The student shall prepare the presentation taking help and approval of the assigned project supervisor. The student shall prepare a report (seminar report) considering the contents of presentation, in a format fixed by the department, to the evaluation committee.

Grades will be awarded on the basis of contents of the seminar report, the presentation and the ability to defend the questions raised. A common format in (.pdf format) shall be given for re-

ports of Seminar. All reports of Seminar submitted by students shall be in this given format.

The student shall prepare a final version of the seminar report considering the reviews obtained on the report with approval of the project supervisor. The student shall prepare an abstract (project review report) of the preliminary findings of phase I of the project, along with the reviews obtained during the presentation in each type of checkpoints shown above for project monitoring purpose(in the format fixed by the department).

The student shall submit typed copies of the two report to the department for record purpose.

Expected Outcomes

Internal work assessment

1. Marks for the report : 30%

2. Presentation & evaluation by the Committee: 40%

3. Ability to answer questions on the topic : 30%

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7303	PROJECT(Phase I)	0-0-14-6	2015

Course Prerequisites

Course 10CS6308 Mini project

Course Objectives

Methodology

Every student eligible take this course will undertake a project work under a supervisor assigned by the department. The work is spread over third and fourth semesters, where the work under this course precedes the work under course 10CS7304 Project(Phase II). There will be one interim evaluation and and end-semester evaluation for this course. No grades is awarded by this course; however, marks awarded will be carried over to Project(Phase II) where, after evaluations in second phase, a grade is given to student.

Project supervisor will continuously assess the work by the student assigned to the supervisor. The project evaluation committee assigned to a project will do the interim evaluation and end semester evaluation, based on a presentation by student about the work done. Student has to submit a work-done report in the format fixed by department to the committee and then do the presentation in a slot fixed for it, during each evaluation.

A typed copy of this work-done reports and contents of presentations submitted to interim evaluation and end semester evaluation, along with the reviews obtained during evaluations will be submitted to the department(Project progress report) by each student after the end-semester evaluation.

Expected Outcomes

Internal work assessment

Total of 50 marks, based on two evaluations

1. Progress evaluation by project supervisor : 20 marks

2. Presentation & evaluation by the Committee: 30 marks

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7304	PROJECT(Phase II)	0-0-24-12	2015

Course Prerequisites

Course 10CS7301
Course 10CS7303 PROJECT(Phase I)

Course Objectives

Methodology

Every student eligible to take this course will complete the project work assigned to them under the supervisor assigned by the department. There will be one interim evaluation and and end-semester evaluation for this course. Grade is awarded to this course, considering the marks awarded in Project(Phase I) and Project(Phase II).

Project supervisor will continuously assess the work by the student assigned to the supervisor. The project evaluation committee assigned to a project will do the interim evaluation and end semester evaluation, based on a presentation by student about the work done. Student has to submit a work-done report in the format fixed by department to the committee and then do the presentation in a slot fixed for it, during each evaluation.

Each student has to submit the Project review report(from Seminar II) and Project progress report(from Project(Phase I)) to the committee during interim evaluation as an additional requirement, besides the work-done report in Project(phase II). Interim evaluation committee will check the implementation of the reviews and recommendations given in these documents while awarding marks, besides considering the work in Project(Phase II).

There will be an end semester evaluation of the project by a committee including an external expert. Each student has to prepare a thesis in the format fixed by department and submit it for evaluation. Besides, the student has to prepare a work-done report for the entire project in the format fixed by department and submit for the end semester evaluation. Technical publications resulting from project work also is to be submitted for end-semester evaluation. **It is mandatory for a student to earn all the course credits listed in the first three semesters to appear for**

the final evaluation of the Project in fourth semester. The student shall prepare a final version of the thesis considering the reviews obtained during evaluation, with approval of the project supervisor. Typed copy of this report need to be submitted to department for record purpose.
Expected Outcomes
Work assessment **Total of 100 marks, based on two evaluations** 1. Progress evaluation by project supervisor(s) : 30 marks 2. Presentation & evaluation by the Committee: 40 marks 3. Evaluation by the external expert : 30 marks