Department of Computer Science.

1.	MAN-001	Mathematics-1	BSC	4
2.	PHN-005	Electrodynamics and Optics	BSC	4
3.	CEN-105	Introduction to Environmental Studies	GSC	3
4.	HS-001A	Communication Skills (Basic)	HSSC	2
5.	HS-001B	Communication Skills (Advance)	HSSC	2
6.	HSN-002	Ethics and General Awareness	HSSC	2
7.	CSN-101	Introduction to Computer Science & Engineering	DCC	2
8.	CSN-103	Fundamentals of Object Oriented Programming	ESC	4
9.	MAN-010	Optimization Techniques	BSC	4
10.	PHN-006	Quantum Mechanics and Statistical Mechanics	BSC	4
11.	ECN-104	Digital Logic Design	DCC	4
12.	CSN-102	Data Structures	DCC	4
13.	CSN-106	Discrete Structures	DCC	4
14.	ECN-102	Fundamentals of Electronics	ESC	4
15.	MIN-106	Engineering Thermodynamics	DCC/ESC	4
16.	ECN-203	Signals and Systems	DCC	4
17.	CSN-221	Computer Architecture and Microprocessors	DCC	4
18.	CSN-261	Data Structures Laboratory	DCC	2
19.	CSN-291	Object Oriented Analysis and Design	DCC	4
20.	MTN-105*			
21.	CSN-212	Design and Analysis of Algorithms	DCC	4
22.	CSN-252	System Software	DCC	3
23.	CSN-254	Software Engineering	DCC	4
24.	CSN-232	Operating Systems	DCC	4
25.	ECN-252	Digital Electronic Circuits Laboratory	DCC	2
26.	CSN-341	Computer Networks	DCC	4
27.	CSN-351	Database Manaement Systems	DCC	4
28.	CSN-353	Theory of Computation	DCC	4

29.	CSN-361	Computer Networks Laboratory	DCC	2
30.	CSN-312	Principles of Programming Languages	DCC	3
31.	CSN-352	Compiler Design	DCC	4
32.	CSN-362	Compiler Laboratory	DCC	2
33.	CSN-371	Artificial Intelligence	DEC	4
34.	CSN-372	Computer Graphics	DEC	4
35.	CSN-373	Probability Theory for Computer Engineering	DEC	4
36.	CSN-381	Information Retrieval	DEC	4
37.	CSN-382	Machine Learning	DEC	4
38.	CSN-521	Mobile and Pervasive Computing and	DEC	4
39.	CSN-510	Network Programming	MSC	3
40.	CSN-471	Computer Vision	DEC	4
41.	CSN-475	Parallel and Distributed Algorithms	DEC	4
42.	CSN-476	Software Project Management	DEC	4
43.	CSN-481	Bioinformatics	DEC	4
44.	CSN-483	Intrusion Detection Systems	DEC	4
45.	CSN-484	Multimedia	DEC	4
46.	CSN-485	Quantum Computing, and	DEC	4
47.	CSN-513	Information Network Security	DEC	4
48.	CSN-515	Datamining and Warehousing,	DEC	4
49.	CSN-516	Modeling and Simulation	MSC/DHC	4
50.	CSN-519	Social Network Analysis	DCC	4
51.	CSN-520	Cloud Computing	DEC	4
52.	CSN-254	Software Engineering	DCC	4
53.	CSN-491	Structure of Information Networks	MSC/DHC	4
54.	CSN-492	High Performance Computing	MSC/DHC	4
55.	CSN-493	Advanced Data Mining	MSC/DHC	4
56.	CSN-494	Big Data Analytics	MSC/DHC	4
57.	CSN-495	Distributed Systems	MSC/DHC	4

58.	CSN-501	Advanced Algorithms	MSC/DHC	4
59.	CSN-503	Advanced Computer Networks	MSC/DHC	4
60.	CSN-506	Advanced Computer Architecture	MSC/DHC	4
61.	CSN-511	Advanced Database Management Systems	MSC/DHC	4
62.	CSN-512	Formal Methods and Software Verification	MSC/DHC	4
63.	CSN-514	Advanced Automata Theory	MSC/DHC	4
64.	CSN-517	Advanced topics in Software Engineering	MSC/DHC	4
65.	CSN-518	Logic and Automated Reasoning	MSC/DHC	4
66.	CSN-522	Advanced Graph Theory	MSC/DHC	4
67.	CSN-523	Computational Geometry	MSC/DHC	4

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-101** Course Title: **Introduction to Computer Science & Engineering**

2. Contact Hours: **L: 2** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory** **2** **Practical** **0**

4. Relative Weightage**:** **CWS** **15** **PRS** **0** **MTE** **35** **ETE** **50** **PRE** **0**

5. Credits**:** **2** 6. Semester**: Autumn** 7. Subject Area**: DCC**

8. Pre-requisite**:** **NIL**

9. Objective: To introduce the discipline of Computer Science & Engineering.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Evolution of Computer Hardware and Moore's Law	**2**
2.	Problem solving using Computers; Flow charting technique and writing algorithms	**6**
3.	Introduction to Computer Structure: CPU, 8085 Assembly Language.	**8**
4.	Basics of Computer Networks, Client Server Computing, Web Technology.	**6**
5.	Emerging trends and applications of Computers Science and Engineering, impact of Computer in Science and Engineering.	**6**
	Total	**28**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Mano M.M., "Computer System Architecture", Prentice-Hall of India, 3rd Edition.	**2004**

2.	Sahni S., "Data Structures, Algorithms and Applications in C++", WCB/McGraw-Hill.	**2001**
3.	Hall D.V., "Microprocessors and Interfacing", Tata McGraw-Hill, 2nd Edition.	**2006**
4.	Tanenbaum A.S, "Computer Networks", Pearson Education, 6th Edition.	**2012**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-102** Course Title: **Data Structures**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **CSN-103**

9. Objective: To provide basic data structure concepts in an object-oriented setting for design, implementation, testing and maintenance of software systems.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Complexity A nalysis:** Time and Space com plexity of algorithms, asymptotic a nalysis, bi g O and ot her not ations, i mportance of efficient al gorithms, program pe rformance m easurement, data structures and algorithms.	3
2.	**Linear L ists:** Abstract da ta t ype, s equential a nd l inked representations, c omparison of i nsertion, de letion and search operations f or s equential a nd l inked l ists, l ist and c hain c lasses, exception a nd i terator c lasses f or l ists, doubl y l inked l ists, c ircular lists, linked lists thr ough simulated pointers, lists in STL, skip lists, applications of lists in bin sort, radix sort, sparse tables.	8
3.	**Stacks an d Q ueues: A** bstract d ata t ypes, s equential and linked implementations, e xception ha ndling i n c lasses, r epresentative applications s uch as p arenthesis m atching, t owers of H anoi, w ire routing i n a c ircuit, f inding pa th i n a m aze, s imulation of que uing systems, equivalence problem.	6
4.	**Hashing:** Search efficiency in lists and skip lists, hashing as a search structure, ha sh t able, collision a voidance, l inear ope n a ddressing, chains, uses of hash tables in text compression, LZW algorithm.	4
5.	**Trees:** Binary trees and their properties, terminology, sequential and linked implementations, tree traversal methods and algorithms, heaps as pr iority que ues, he ap i mplementation, i nsertion a nd de letion operations, heapsort, h eaps i n H uffman coding, l eftist t rees, tournament t rees, use o f w inner t rees i n mergesort as an external	8

	sorting algorithm, bin packing.	
6.	**Search T rees**: Binary s earch t rees, search efficiency, insertion and deletion ope rations, i mportance of ba lancing, AVL t rees, searching insertion a nd d eletions in A VL t rees, red-black t rees, com parison with AVL trees, search insert and delete operations.	**4**
7.	**Multiway Trees:** Issues in large dictionaries, m-way search trees, B-trees, search insert and delete operations, height of B-tree, 2-3 trees, sets and multisets in STL.	**5**
8.	**Graphs:** Definition, t erminology, di rected and undi rected graphs, properties, c onnectivity i n g raphs, a pplications, i mplementation – adjacency m atrix and linked adjacency ch ains, g raph traversal – breadth first and depth first, spanning trees.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.	2001
2.	Sahni, S., "Data Structures, Algorithms, and Applications in Java", WCB/McGraw-Hill.	2001
3.	Drozdek, A ., " Data S tructures a nd Algorithms i n C ++", V ikas Publishing House.	2002
4.	Wirth, N ., " Algorithms a nd D ata S tructures", P rentice-Hall of India.	1985
5.	Lafore, R ., " Data S tructures a nd A lgorithms i n J ava", 2 nd Ed., Dorling Kindersley.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-103** Course Title: **Fundamentals of Object Oriented Programming**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**

4. Relative Weightage**:** **CWS** **15** **PRS** **15** **MTE** **30** **ETE** **40** **PRE** **0**

5. Credits**:** **4** 6. Semester**: Autumn** 7. Subject Area**: ESC**

8. Pre-requisite**:** **NIL**

9. Objective: To introduce the concepts of Object Oriented Programming through Java.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to computer systems, computer as a programmed machine; machine language, assembly language, high level languages; concept of flow chart and algorithms, algorithms to programs, object oriented programming concept, difference in approach from procedural programming,	**3**
2.	**Introduction to Java Programming Environment:** Java compiler and virtual machine, Structure of a Java program, stand-alone programs and applets; concepts of portability.	**3**
3.	**Programming Elements in Java:** Data types, variables and array operators, assignment and selection statements, iterative structures, nested loops, string handling in Java, I/O mechanism, command line arguments.	**6**
4.	**Classes in Java:** General form of a class, creating objects, access control in classes; Constructors, methods, parameters, method overloading, recursive methods, returning objects, static members, finalization, final qualifier, nested and inner classes.	**10**
5.	**Dynamic Memory:** Pointers, references and dynamic memory handling in C ++, Objects as references in Java, dynamic memory allocation and garbage collection in Java	**5**

6.	**Inheritance:** Basics, super cl asses and subclasses, the keyword extends, multilevel hi erarchy, method overriding; r un time polymorphism, abstract classes, final in inheritance, the object class.	**5**
7.	**Packages an d I nterfaces:** Defining pa ckage, a ccess pr otection, importing classes and packages, defining and implementing interfaces, nested interfaces, use of interfaces, variables in interfaces.	**3**
8.	**Exception H andling:** Fundamentals, t ypes o f e xceptions, c atching exceptions, m ultiple c atching, ne sted t ry s tatements, unc aught exceptions, throw and throws, finally mechanism, built-in exceptions, creating exception subclasses, using exceptions.	**4**
9.	**Applets:** Applet f undamentals, na tive m ethods, s tatic i mport, t he applet c lass, a pplet di splay m ethod, r equesting repainting, a ba nner applet, passing parameters to applets, uses of applets.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Dietel H.M., D ietel P .J., "J ava: How t o P rogram", P rentice-Hall, 7th Edition.	**2006**
2.	Flanagan D., "Java in a Nutshell", O'Reilly Media, Inc., 5th Edition.	**2005**
3.	Eckel B., "Thinking in Java", Prentice-Hall.	**1998**
4.	Gosling J., Joy B., Steele G., Bracha G., "The J ava Language Specification", Prentice-Hall, 2nd Edition.	**2000**
5.	Xavier C ., "Java P rogramming – A P ractical A pproach", Tata McGraw-Hill.	**2011**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Department of Computer Science and Engineering**

1. Subject Code**: CSN-106** Course Title: **Discrete Structures**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight**: CWS: 25** **PRS: 0** **MTE : 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester: **Spring** **7.** Subject Area**: DCC**

8. Pre-requisite**: NIL**

9. Objective: To introduce to the students the fundamental discrete structures used in computer science.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Sets:** Properties, relations, functions, finite and infinite sets, lattice.	**6**
2.	**Graphs:** Directed, undirected, directed acyclic, and bipartite graphs; Connected components, Eulerian graphs, Hamiltonian cycles; Some fundamental theorems, applications.	**10**
3.	**Logic:** Propositional and predicate logic; Syntax, semantics, resolution principle, soundness, completeness, unification, inferencing; Applications.	**10**
4.	**Abstract Algebra:** Groups, rings, fields, Galois field, Euler's phi function, Fermat's theorem, discrete logarithm, applications.	**10**
5.	**Introduction to Number Theory:** Remainder theorem, gcd, factorization theorem.	**6**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Herstein, I., "Abstract Algebra", Pearson Education.	2005
2.	Harary, F., "Graph Theory", Narosa Publishing House.	2001
3.	Huth, M. and Ryan, M., "Logic in Computer Science: Modeling and Reasoning About Systems", Cambridge University Press.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**: Department of Computer Science and Engineering**

1. Subject Code**: CSN-212** Course Title**: Design and Analysis of Algorithms**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**: CWS:25** **PRS:0** **MTE:25** **ETE:5** **PRE:0**

5. Credits**:4** 6. Semester **: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**: CSn-102**

9. Objective: To familiarize students with the design strategies and bounds on the performance of different computer algorithms.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Review of Data Structures**.	2
2.	**Program P erformance**: T ime and space c omplexity, asymptotic not ation, c omplexity a nalysis, r ecurrence e quations and their solution.	4
3.	**Algorithmic T echniques**: A lgorithm de sign strategies, divide and c onquer, m erge s ort, qui ck s ort a nd i ts pe rformance analysis, randomized qui ck s ort, S trassen's m atrix multiplication; G reedy method a nd i ts a pplications, kna psack problem; D ynamic pr ogramming and i ts pe rformance a nalysis, optimal bi nary s earch t rees, 0/ 1 kna psack pr oblem; T raveling salesman problem; Back-tracking, n-queens pr oblem, gr aph coloring, Hamiltonian c ycles, kna psack pr oblem; B ranch a nd bound e xamples, 15 -puzzle pr oblem, 0/ 1 kna psack, t raveling salesman.	14
4.	**Graph A lgorithms**: D FS a nd B FS, s panning t rees, biconnectivity; Minimum cost spanning trees: Kruskal's, Prim's and S ollin's a lgorithms; P ath f inding a nd shortest pa th algorithms; Topological sorting; Bipartite graphs.	6
5.	**Infeasibility**: P and NP-classes, NP-hard problems, reduction.	4
6.	**Parallel A lgorithms**: D ata a nd c ontrol pa rallelism, e mbedding of problem graphs into processor graphs, parallel algorithms for matrix multiplication.	6
7.	**Other Algorithms**: N umber the oretic a lgorithms, string matching a lgorithms, a pproximation a lgorithms, r andomized algorithms.	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Sahni, S., "Data Structures, Algorithms and Applications in C++", WCB/McGraw-Hill.	2001
2.	Mchugh, J.A., "Algorithmic Graph Theory", Prentice-Hall.	1990
3.	Quinn, M.J., "Parallel Computing Theory & Practice", McGraw-Hill.	1994
4.	Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., "Introduction to Algorithms", 2nd Ed., Prentice-Hall of India.	2002
5.	Dasgupta, S., Papadimitriou, C. and Vazirani, U., "Algorithms", Tata McGraw-Hill.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-221** Course Title: **Computer Architecture and Microprocessors**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical :0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester: **Autumn** 7. Pre-requisite: **EC – 104**

8. Subject Area: **DCC**

9. Objective: To familiarize students with the architecture of a processor and machine level programming.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	CPU structure and functions, processor ganization, ALU, data paths, internal registers, status flags; System bus structure: Data, address and control buses.	5
2.	Processor control, micro-operations, instruction fetch, hardwired control, microprogrammed control, microinstruction sequencing and execution.	6
3.	Instruction set principles, machine instructions, types of operations and operands, encoding an instruction set, assembly language programming, addressing modes and formats.	8
4.	Memory system, internal and external memory, memory hierarchy, cache memory and its working, virtual memory concept.	5
5.	I/O ganization; I/O techniques: interrupts, polling, DMA; Synchronous vs. asynchronous I/O.	4
6.	8085 microprocessor architecture; Instruction set, instruction types and formats; Instruction execution, instruction cycles, different types of machine cycles and timing diagram.	8
7.	16-bit microprocessors, 8086 architecture, registers, memory segmentation and addressing, 32-bit/64-bit microprocessor families.	6
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication / Reprint
1.	Mano, M.M., "Computer System Architecture" 3rd Ed., Prentice-Hall of India.	2004
2.	Rajaraman, V . and R adhakrishnan, T ., " Computer O rganization a nd Architecture", Prentice-Hall of India.	2007
3.	Govindrajalu, B ., "Computer A rchitecture a nd Organization", T ata McGraw-Hill.	2004
4.	Stallings, W ., " Computer O rganization a nd A rchitecture", 5 th Ed., Pearson Education.	2001
5.	Hall, D.V., "Microprocessors and Interfacing", 2nd Ed., Tata McGraw-Hill.	2006
6.	Brey, B.B., "The Intel Microprocessors", 6th Ed., Pearson Education.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science Engineering**

1. Subject Code: **CSN-232** Course Title: **Operating Systems**
2. Contact Hours: **L: 3 T: 1 P: 0**
3. Examination Duration (Hrs.): **Theory3 Practical0**
4. Relative Weight: **CWS:25 PRS:0 MTE: 25 ETE:50 PRE:0**
5. Credits: **4** 6. Semester **Spring** 7. Pre-requisite: **CSN-252**
8. Subject Area: **DCC**
9. Objective: To provide an understanding of the functions and modules of an operating system and study the concepts underlying its design and implementation.
10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Fundamental Concepts of Operating System:** Operating system functions and characteristics, historical evolution of operating systems, issuess in operating system design.	5
2.	**Process Management:** Process abstraction, process address space, process management, system calls, threads, process hierarchy.	6
3.	**CPU Scheduling:** Levels of scheduling, comparative study of scheduling algorithms, multiple processor scheduling.	4
4.	**Deadlocks:** Characterization, prevention and avoidance, deadlock detection and recovery.	4
5.	**Concurrent Processes:** Critical section problem, semaphores, monitors, inter-process communication, message passing mechanisms.	5
6.	**Memory Management:** Storage allocation methods, virtual memory concept, demand paging, page replacement algorithms, segmentation, thrashing.	5
7.	**File Systems:** Functions, file access and allocation methods, directory system, file protection mechanisms, implementation issues, file system hierarchy.	5
8.	**Device Management:** Hardware organization, device scheduling policies, device drivers.	5
9.	**Case Studies:** Windows, Unix, Linux.	3
	Total	**42**
	Laboratory component Creating processes in Unix with commands like Fork and Exec; Pipes and process communication; Performance study of various CPU scheduling algorithms; Process synchronization using semaphores, and threading.	**14x2**

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Silberscharz, A. and Galvin, P.B., "Operating System Concepts", 7th Ed., Addison-Wesley.	2006
2.	Tanenbaum, A ., " Modern O perating S ystems", P rentice-Hall of India.	2004
3.	Nutt, G., "Operating Systems", Addison-Wesley.	2004
4.	Joshi, R . C. a nd T apaswi, S ., " Operating S ystems", W iley Dreamtech.	2005

11. Suggested Books:

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**: Department of Computer Science and Engineering**

1. Subject Code**: CSN-252** Course Title**: System Software**

2. Contact Hours: **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory :2** **Practical:0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**: 3** 6. Semester **Spring** 7. Pre-requisite**: CS - 101 / CS - 103**

8. Subject Area**: DCC**

9. Objective: The objective of the course is to familiarize students with the design and functioning of computer software.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	Introduction to system software, machine architecture, machine level representation of programs, assembly language programming and optimizing program performance.	6
2.	Assemblers, basic function, machine dependent and independent assembler features, assembler design options.	4
3.	Two-pass, one-pass and multi-pass assembler design.	6
4.	Macro-processors, basic functions, machine independent features, nested definitions and calls, design options.	4
5.	General purpose macro-processor design, macro-processing within language translators.	2
6.	Loaders and linkers, basic functions, machine dependent and independent features, linkers, loaders and editors, design options.	3
7.	Relocating loaders and dynamic linking loader designs.	3
	Total	**28**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Beck, L.L., "System Software", 3rd Ed., Addison Wesley.	1997
2.	Dhamdhere, D.M., "System Programming & Operating Systems", 2nd Ed., Tata McGraw-Hill.	1999
3.	Abel, P. "IBM PC Assembly Language and Programming", 3rd Ed., Prentice-Hall of India.	2000
4.	Bryant, R.E. and O'Hallaron, D.R., "Computer Systems: A Programmer's Perspective", Prentice-Hall of India.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-254** Course Title: **Software Engineering**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weightage: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: **CSN-102**

8. Subject Area: **DCC**

9. Objective: To introduce the concepts of software development, design and implementation.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Introduction to software and software engineering, various software process modules, capability, maturity, module and KPAs.	6
2.	Project planning, project introduction, team organization, scheduling and management, constructive cost model.	6
3.	Software measures, indicators and metrics, software risk analysis and management.	5
4.	Software requirement analysis and specifications, applicability to small, medium, and large-scale systems.	4
5.	Software design, technical design, objectives of design, design metrics, modularity, module coupling and cohesion, relation between cohesion and coupling; Design strategies: Bottom up design, top down design, hybrid design, functional oriented design, object oriented design; IEEE recommended practice for software design description	8
6.	Software testing, testability, testing process, structural testing, unit testing and integrated testing, debugging, testing tools, software maintenance, maintenance process, maintenance cost, reverse engineering and re-engineering.	7
7.	Configuration management, assessing and controlling software quality.	3
8.	CASE tools and workbenches.	3
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Pressman R., "Software Engineering", 7th Ed., McGraw-Hill.	2000
2.	Sommerville, I., " Software E ngineering", 6 th Ed., P earson Education.	2007
3.	Dfleeger, S. L., "Software Engineering", Pearson Education.	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-261** Course Title: **Data Structures Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical:3**

4. Relative Weight: **CWS:0** **PRS: 50** **MTE: 0** **ETE:0** **PRE:50**

5. Credits: **2** 6. Semester: **Autumn** 7. Pre-requisite: **CSN-103**

8. Subject Area: **DCC**

9. Objective: To provide basic data structure concepts in an object-oriented setting for design, implementation, testing and maintenance of software systems.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Laboratory component** (a) Programming of various data structures and applications in C++ and Java. (b) Data structure programming using STL.	**14x2**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.	2001
2.	Sahni, S., "Data Structures, Algorithms, and Applications in Java", WCB/McGraw-Hill.	2001
3.	Drozdek, A., "Data Structures and Algorithms in C ++", Vikas Publishing House.	2002
4.	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.	1985
5.	Lafore, R., "Data Structures and Algorithms in Java", 2nd Ed., Dorling Kindersley.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science & Engineering**

1. Subject Code: CSN-291 **Course Title**: **Object Oriented Analysis and Design**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical:0**

4. Relative Weight: **CWS:15** **PRS:25** **MTE:20** **ETE:40** **PRE:0**

5. Credits:**4** 6. Semester: **Autumn** 7. Pre-requisite: **CSN-103**

8. Subject Area: **DCC**

9. Objective: In this course, the students will learn fundamental principles of object-oriented modeling, requirements development, analysis, and design. In particular, student will be introduced the various modeling concepts provided by Unified Modeling Language; identify use cases and expand them into full behavioral designs.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction to Course** Object-Oriented Programming Languages and the object-oriented model, Object-oriented analysis, design, and implementation, Objects and Classes, Messages and Interfaces, Inheritance and Polymorphism	4
2.	**Introduction to a Unified Methodology** Types of models: Unified Modeling Language(UML) views and basic features, Object-oriented design methodologies, the rational unified process, Object-oriented CASE tools	4
3.	**Object Oriented Analysis**: Object Orientation, OO Methods, OOA approaches, Analysis in OMT: Identify objects and classes, Identify associations and aggregations, Identify attributes, Simplify object classes using inheritance, Verify access paths for likely queries, Iterate and refine model, Group classes into modules, Analysis in Use Cases	6
4.	**Object Oriented Concepts and Examples**: Object oriented design to object oriented programming, Abstraction and ADT, Class Hierarchies, Modularity, Namespace, Assemblies, Inheritance, Encapsulation and Information hiding, Interfaces, Polymorphism, Overloading and overriding, Early and Late binding, Boxing and Unboxing, Abstract and sealed classes, Design Issues for OOP Languages, The Exclusivity of Objects, Subclasses as Types, Type Checking and Polymorphism, Single and Multiple Inheritance, Object Allocation and De-Allocation, Dynamic and Static Binding, Nested Classes	4

5.	**Classes and Class Models in UML**: Class models and diagrams, Attributes and operations, Association and whole-part relationships, Aggregation and composition, Roles, navigability, and constraints, Generalization and inheritance relationships, Dependency, Qualified and derived associations, Association classes, Properties, tagged values, and Stereotypes, Abstract classes and Parameterized classes.	6
6.	**Use Case Models in UML**: Actors a nd s ervices, S ystem bounda ry, U se-case re lationships and Use-case g eneralization, A ctors and classes, Using us e-cases i n software development	4
7.	**OO Modeling, Design Methodologies and Interaction Diagrams**: Design approaches, methods to get design entities from requirements, Domain modeling and class diagrams, Class associations, Whole part relationships, Generalization and Inheritance	6
8.	**Interaction, State and Activity Diagrams** Interaction and collaboration, Collaboration diagrams, Sequence diagrams, Message passing and timing, Activity diagrams, State diagrams, Packages, Subsystems, Models	8
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Bennett, S., "Schuam's Outline of UML". New York: McGraw-Hill	2004
2.	S. Perdita. " Using U ML: S oftware E ngineering w ith O bjects a nd Components." Addison-Wesley	2000
3.	R. Miles, "Learning UML 2.0", O'REILLY	2006
4.	G. Booc h, " Object-Oriented A nalysis a nd D esign w ith Application",Willy.	2007
5.	E. Gamma., " Design P atterns: E lements of Re usable O bject-Oriented Software", Addison-Wesley	1994

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Computer Science and Engineering**

1. Subject Code**: CSN-312** Course Title**: Principles of Programming Languages**

2. Contact Hours: **L: 3 T: 0 P: 0**

3. Examination Duration (Hrs.): **Theory 3 Practical 0**

4. Relative Weight**: CWS**:**25 PRS**:**0 MTE**: **25 ETE**:**50 PRE**:**0**

5. Credits**:3** 6. Semester **: Spring** **7**. Pre-requisite: **CSN-353**

8. Subject Area**: DCC**

9. Objective: To introduce the semantics of programming languages and develops skills in describing, analyzing, and using the features of programming languages.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Lambda Calculus and Turing Machines:** Equivalence of Lambda calculus and Turing machines, free and bound variables, substitutions.	6
2.	**Sequential Programming Languages:** Constructs, programs as state transformers, denotational semantics.	6
3.	**Object-oriented Programming Languages:** Constructs, mathematical structures, implementation, constraint matching.	4
4.	**Type Theory:** Operational semantics, basic type systems and type soundness, advanced type systems.	6
5.	**Nondeterminism:** Predicate transformers, guarded command language, algebraic specification.	6
6.	**Program Correctness:** Program termination, well-foundedness, logics of programs, correctness proof.	6
7.	**Program Verification:** Hoare logic, model checking, model checkers, algorithmic versus deductive approaches.	8
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Sethi, R ., " Programming Languages: C oncepts a nd C onstructs", Pearson Education.	2004
2.	Tucker, A . and N oonan, R ., " Programming Languages: P rinciples and Paradigms", Tata McGraw-Hill.	2007
3.	Van R oy, P . a nd H aridi, S ., " Concepts, T echniques a nd M odels of Computer Programming", Prentice-Hall of India.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-341** Course Title: **Computer Networks**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory :3** **Practical:0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester **Autumn** 7. Pre-requisite: **CSN-252**

8. Subject Area: **DCC**

9. Objective: To familiarize students with the layered design and protocols of computer networks, including the Internet.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Introduction:** Use of computer networks, network hardware and software; Layering, reference models and their comparison.	7
2.	**Physical Layer:** Theoretical basis for data communication, transmission media and impairments, switching systems.	6
3.	**Data Link Layer:** Design issues, framing, error detection and correction, elementary and sliding window protocols, examples of data link layer protocols.	6
4.	**Medium Access Control Sub Layer:** Channel allocation problem, multiple access protocols, Ethernet, data link layer switching.	6
5.	**Network Layer:** Design issues, routing algorithms, congestion control, QOS, internetworking, IP and IP addressing.	6
6.	**Transport Layer:** Transport service, elements of transport protocols, TCP and UDP.	6
7.	**Application Layer Overview:** Email, DNS, WWW.	5
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Tanenbaum, A .S, "Computer N etworks", 4th Ed., P earson Education.	2003
2.	Forouzan, B .A., "Data Communication a nd N etworking", 4 th Ed., Tata McGraw-Hill.	2006
3.	Stallings W ., " Data a nd C omputer C ommunication", 8 th Ed., Prentice-Hall.	2007
4.	Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Ed., Addison Wesley.	2004
5.	Comer, D.E. and Droms, R.E., "Computer Networks and Internets", 4th Ed., Prentice-Hall.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-351** Course Title: **Database Management Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester: **Autumn** 7. Pre-requisite: **CS - 102**

8. Subject Area: **DCC**

9. Objective: To introduce the concepts of database management systems and the design of relational databases.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Introduction to database management, data abstraction and system structure.	3
2.	Entity relational model, entity sets, relationship sets, mapping cardinalities, keys, E-R diagrams.	3
3.	Relational model, database schema, relational algebra, outer join and manipulation of databases.	6
4.	Tuple relational calculus: Example queries, formal definitions and safety of expressions; SQL: Query processing and optimization, set operations, aggregate functions, data definition language and views, comparison of queries in relational algebra, SQL, tuple relation calculus and domain relation calculus.	7
5.	Relational database design, various normal forms, functional dependencies, canonical cover, lossless join, dependency preservation, multi value dependency and higher normal forms, transaction management, ACID property.	6
6.	Serializability and testing for serializability, concurrency control schemes, lock-based protocols, two-phase locking protocols, graph-based protocols, time stamp-based protocols, deadlocks.	5
7.	Recovery systems, log-based recovery, deferred and immediate database modification, object oriented database design.	6
8.	Data warehousing, heterogeneous components systems, data scrubbing.	3
9.	Data mining and knowledge discovery, basic mathematical, numerical and statistical techniques; Applications in information retrieval.	3
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Abraham, H. and Sudershan, S., "Database System Concepts", 4th Ed., McGraw-Hill.	2002
2.	Elmasi, R. and Navathe, S.B., "Fundamentals of Database Systems", 4th Ed., Pearson Education.	2005
3.	Date, C. J., "Introduction to Database Systems", Pearson Education.	2002
4.	Ramakrishnan, R. and Gekhre, J., "Database Management Systems", 3rd Ed., McGraw-Hill.	2003
5.	Pang, N. T., Steinbach, M. and Kumar, V., "Introduction to Data Mining", Pearson Education.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science Engineering**

1. Subject Code: **CSN-352** Course Title: **Compiler Design**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory3** **Practical0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits:**4** 6. Semester Spring 7. Pre-requisite: **CS - 353**

8. Subject Area: **DCC**

9. Objective: To introduce students to the techniques used in designing and writing compilers.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	Introduction to the translation process, phases of the compiler, compiler tools.	3
2.	Role of lexical analyzer, specification and recognition of tokens, automatic generation of lexical analyzer.	6
3.	Top down parsing methods, elimination of left recursion, recursive descent and predictive parsers; Bottom up parsing, shift-reduce parsing, precedence parsing, LR parsers, SLR (1) table construction, limitations of SLR parsing, non-SLR (1) grammars; Introduction to canonical and LALR parsing.	8
4.	Type checking, type systems, type expressions, type conversion and overloading.	3
5.	Run time environments, storage organization and allocation strategies, parameter passing, symbol tables.	4
6.	Intermediate code generation, interpreters, intermediate languages, syntax trees, postfix code, triples and indirect triples, syntax directed translation of simple statements.	6
7.	Issues in code generation, basic blocks and flow graphs, next use information, register allocation and assignment, simple code generation.	6
8.	Sources of optimization, optimization of basic blocks, data flow analysis, code improving transformations.	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Aho, A .V., Lam, M ., Sethi, R . a nd U llman, J .D., " Compilers: Principles, Techniques and Tools", 2nd Ed., Pearson Education.	2007
2.	Tremblay, J .P. a nd S orenson, P .G., " Theory and P ractice o f Compiler Writing", SR Publications.	2005
3.	Cooper, K .D. a nd T orczon, L., "Engineering a Compiler", M organ Kaufmann.	2004
4.	Louden, K .C., "Compiler C onstruction: P rinciples a nd P ractice", Course Technology.	1997
5.	Tremblay, J.P. and Sorenson, P.G., "Parsing Techniques: A Practical Guide", Ellis Horwood.	1998

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-353** Course Title: **Theory of Computation**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory :3** **Practical: 0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester: **Autumn** 7. Pre-requisite: **CS-106**

8. Subject Area: **DCC**

9. Objective: To provide an understanding of the theoretical development of computer science, particularly for finite representations of languages and machines.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Abstract machines and computation, formal languages and grammars.	3
2.	Regular languages, finite state machines, deterministic and non-deterministic finite state machines, regular grammars, regular expressions, equivalence of the three models, state equivalence and minimization.	9
3.	Properties of finite state languages, closure, decidability, pumping lemma.	5
4.	Context-free language models, context-free grammars, simplification of content-free grammars, Chomsky normal form, Greibach normal form.	5
5.	Pushdown automata, deterministic and non-deterministic pushdown automata and their equivalence with context free languages, parsing.	7
6.	Closure properties of context-free languages.	3
7.	Turing machines, computable languages and functions, modifications of Turing machines, restricted Turing machines, Church's hypothesis.	6
8.	Recursive, and recursively enumerable languages; Undecidability, notion of reduction.	4
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Hopcropt, J .E., M otwani, R . a nd U llman, J.D., " Introduction t o Automata T heory, Languages and C omputation", P earson Education.	2001
2.	Lewis, H .R. and P apadimitriou, C .H., "Elements of t he T heory of Computation", 2nd Ed., Prentice-Hall.	1998
3.	Linz, P ., " An Introduction t o F ormal Languages a nd A utomata", Narosa Publishing House.	1998
4.	Cohen, D .I.A., "Introduction to C omputer T heory", J ohn W iley & Sons.	1991
5.	Denning, P .J., D ennis, J .B., a nd Q ualitz, J.E., " Machines, Languages and Computation", Prentice-Hall.	1978

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN–361** Course Title: **Computer Networks Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical :0**

4. Relative Weight: **CWS:0** **PRS:100** **MTE:0** **ETE:0** **PRE:0**

5. Credits: **2** 6. Semester : **Autumn** 7. Pre-requisite: **CSN-341**

8. Subject Area: **DCC**

9. Objective: To design program and configure various hardware and software components of computer networks, including protocols.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
	Socket programming using RPC and RMI. Cryptography algorithms, DES, RSA, and digital signatures. Implementation of various LAN protocols and configurations. Network simulation using the NS2 package. Network simulation using the Qualnet software. Configuration of PC as router and switch.	14 x 3
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Tanenbaum, A.S., " Computer Networks", 4th Ed., Pearson Education.	2003
2.	Forouzan, B .A., "Data Communication and Networking", 4th Ed., Tata McGraw-Hill.	2006
3.	Stallings, W., "Cryptography and Network Security: Principles and Practice", 4th Ed., Prentice-Hall of India.	2006
4.	Stallings, W ., " Data and Computer Communication", 8th Ed., Prentice-Hall of India.	2007
5.	Stevens, W. R., "Unix Network Programming: Vol. II", 2nd Ed., Pearson Education	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-362** Course Title: **Compiler Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical:0**

4. Relative Weight: **CWS:0** **PRS:100** **MTE:0** **ETE:0** **PRE:0**

5. Credits:**2** 6. Semester: **Spring** 7. Pre-requisite: **CS - 353**

8. Subject Area: **DCC**

9. Objective: To give the students practice in writing various phases of a compiler and to familiarize them with various compiler writing tools.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
	Design and coding of lexical analyzer manually. Use of LEX, LEX specification for tokens and construction of lexical analyzer, programming problems with LEX. Parser construction, producing simple desk calculator with YACC, generating postfix code with YACC. Machine code generation.	14 x 3
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Aho, A.V., Lam, M., Sethi, R. and Ullman, J.D., "Compilers: Principles, Techniques and Tools", 2nd Ed., Pearson Education.	2007
2.	Das, V.V., "Compiler Design using FLEX and YACC", Prentice-Hall of India.	2007
3.	Tremblay, J.P. and Sorenson, P.G., "Parsing Techniques: A Practical Guide", Ellis Horwood.	1998

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-371** Course Title: **Artificial Intelligence**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical:0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits: **04** 6. Semester: **Autumn** 7. Pre-requisite: **CS-102**

8. Subject Area: **DEC**

9. Objective: To acquaint the students with the theoretical and computational techniques in Artificial Intelligence.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Fundamental Concepts:** Agents, environments, general model; Problem solving techniques.	4
2.	**Search Techniques:** Uninformed search, heuristic search, adversarial search and game trees; Solution of constraint satisfaction problems using search.	6
3.	**Knowledge Representation:** Propositional and predicate calculus, semantics for predicate calculus, inference rules, unification, semantic networks, conceptual graphs, structured representation, frames, scripts.	8
4.	**Prolog:** Basic constructs, answer extraction.	4
5.	**Bayesian Reasoning:** Bayesian networks, dynamic Bayesian networks.	4
6.	**Planning:** State-space search, planning graphs.	4
7.	**Learning:** Inductive learning, decision tree learning.	4
8.	**Advanced Topics:** Role of knowledge in language understanding, stages of language analysis, parsing using context free grammars, transition network parser, Chomsky hierarchy and context sensitive grammars, rule based expert systems, neural networks, genetic algorithms.	8
	Total	**42**

11. Suggested Books:

Sl.No.	Name of Books/Authors	Year of Publication
1.	Russell, S . a nd N orvig, P ., "Artificial Intelligence: A M odern Approach", Pearson Education.	2006
2.	Rich, E . a nd K night, K ., " Artificial Intelligence", T ata M cGraw-Hill.	2006
3.	Nilsson, N. J., "Artificial Intelligence: A New S ynthesis", Morgan Kaufmann.	1998
4.	Bratko, I ., "Prolog P rogramming f or A rtificial Intelligence", 3rd Ed., Pearson Education.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Computer Science and Engineering**

1. Subject Code**: CSN-372** Course Title**: Computer Graphics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical:0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**: 04** 6. Semester: **Autumn**

7. Pre-requisite**: i)** Knowledge of object oriented programming and basic

8. Subject Area**: DEC**

9. Objective Of Course: to introduce the concepts of computer graphics through theoretical, algorithmic and advanced modeling aspects along with, applications in 3D graphics and visualization. This course is also covering part of OpenGL for graphics. After successful completion of the course student should be able to apply the concepts and techniques to various problem domain and visualization of data-sets and processes.

10. Details Of Course:

Sl.No.	Contents	Contact Hours
1	Overview of graphics systems – What, Why & Where about Graphics, Hardware & Software, Input & Output Technology, Mathematical complexity involved - Demonstration through some examples	3
2	Raster Graphics Algorithms for Drawing 2D objects Line, Circle, Ellipse, Parabola, Hyperbola, Polygon & Filled Closed Objects	3
3	**Concepts of 3D and OpenGL:** Introduction to 3D- Graphics & 3D Coordinate Geometry and Introduction of OpenGL	4
4	2D & 3D Scaling, Translation, Rotation, Shear, Reflection, Projection and Composite Transformations	3
5	Viewing & Clipping in 2D -Cohen's and Parametric Line Methods	3
6	Viewing & Clipping in 3D (Perspective & Parallel projection, Clipping against Canonical View Volume, Clipping in Homogeneous Coordinates, and Mapping into a Viewport	4
7	Hermite, Bezier, Continuties, B spline Curves & Surfaces Rational Cubic Polynomial Curves & Quadric Surfaces	5
8	Solid Modeling - Representations, Operations, Geometry, and Interface	3
9	Visible Surface Detection - Need & Algorithms, Ray Tracing	4

	and Hidden Line elimination	
10	Light & Color Models - Light, halftoning, Color Models, Color Conversion & Interpolation, Dithering Matrix	2
11	Rendering - Models, Physics, Shading Polygons & Surface, & Shadows	4
12	Animation - Languages, Techniques, Control, Basic Rules & Problems	2
13	Applications of 3D Graphics in Visualization	2
	Total	42

11. Books recommended

Sl.No.	**Name of Books/Authors**	**Year of Publication**
1	James D. Foley, A. Van Dam, S.K. Feiner, and J.F. Hughes, Computer Graphics: Principles and practice, 2nd ed in C, Addision-Wesley Publishing Company.	1996
2	Rogers B., Mathematical Elements of Computer Graphics, Tata McGraw Hill.	2002
3	D. Hearn and M.P. Baker, Computer Graphics, C Version, Pearson Education, 2002.	2002
4	D. Hearn and M.P. Baker, Computer Graphics with OpenGL Version, (3rd edition), Pearson Education.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Computer Science and Engineering**

1. 1. Subject Code: **CSN-373** **Course Title**: Probability Theory for Computer Engineers

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical:0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**: 04** 6. Semester: **Autumn** 7. Pre-requisite**: Nil**

8. Subject Area**:**

Objective: To impart to the students in-depth knowledge of Probability and Statistics so that they can be well equipped to employ them in state-of-art applications in Engineering.

9. Details of the Course:

Sl.No.	Contents	Contact Hours
1	Concept of probability, random variable and distribution function: discrete and continuous, moments and moment generating functions.	09
2	Special distributions (discrete): Binomial, Poisson, Negative binomial, Geometric. (continous): Uniform, Exponential, Gamma, Beta, Normal, Lognormal, Function of Random Variable	09
4	Bivariate random variables: joint, marginal, conditional distribution. Statistical independence, product moment.	03
5	Random sample, law of large numbers, central limit theorem, correlation, regression.	07
6	Estimation: maximum likelihood estimation, unbiasedness and efficiency, interval estimation with normal, t, χ^2 distribution.	07
7	Testing of Hypothesis: simple and composite hypothesis, type I and type II errors. Power of test, some MP tests for simple vs simple hypothesis. Some tests based on normal, t, χ^2 distribution.	07
	TOTAL	**42**

11. Suggested Books:

Sl.No.	Name of Books/Authors	Year of Publication
1.	Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley and Sons, New York.	2001
2.	V. K. Rohatgi and A. K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, (John Wiley and Sons) , (2^{nd} Ed.)	2000
3.	R. V. Hogg and A. Craig: Introduction to Mathematical Statistics, (Pearson Education) (5^{th} Ed.)	2006
4.	Richard A. Johnson, I. Miller and John E. Freund: Miller & Freund's probability and statistics for engineers, (Prentice Hall PTR) (8^{th} Ed.)	2011
5.	W. W. Hines, D. C. Montgomery, D. M. Goldsman and C. M. Borror : Probability and Statistics in Engineering, (John Wiley & sons) (4^{th} Ed.)	2003
6.	A. Papoulis, S.U. Pillai: Probability, Random Variables and Stochastic Processes(Tata McGraw-Hill) (4^{th} Ed.)	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Computer Science and Engineering**

1. Subject Code**: CSN-381** Course Title**: Information Retrieval**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weightage**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits**:4** 6. Semester **Spring** 7. Pre-requisite**: CS - 211**

8. Subject Area**: DEC**

9. Objective: To provide an understanding of the information retrieval techniques and web search.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction to the Course:** Information retrieval problem, first take at building an inverted index, processing of Boolean queries, extended Boolean model vs. ranked retrieval.	03
2.	**Term vocabulary and postings lists:** document delineation and character sequence decoding, determining vocabulary of terms, Faster postings list intersection via skip pointers, positional postings and phrase queries.	03
3.	**Dictionaries, Tolerant Retrieval and Indexing:** search structures for dictionaries, wildcard queries, spelling correction, Phonetic correction; Index construction, Blocked sort-based indexing, single-pass in-memory indexing, distributed indexing, dynamic indexing and other types; Index compression: Heaps' and Zipf's law, dictionary compression and postings file compression.	06
4.	**Scoring and IR System Evaluation:** parametric and zone indexes, term frequency and weighing, vector space model for scoring, variant tf-idf functions, efficient scoring and ranking, components of an IR system, vector space scoring and query operator interaction; IR system evaluation, Standard test collections, evaluation of unranked and ranked retrieval results, Assessing relevance, System quality and user utility; Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.	08
5.	**XML and Probabilistic Information Retrieval:** Basic concepts of XML retrieval and challenges, vector space model for XML retrieval, Text-centric vs. data centric XML retrieval; probability ranking principal, binary independence model, appraisal and some extensions; Language models for information retrieval, query likelihood model, language modeling vs. other approaches in IR.	04
6.	**Document Classification:** Text classification problem, Naive Bayes text classification, Bernoulli model, Feature selection,	06

	evaluation of text classification; Vector space classification: Document representations and measure of relatedness in vector spaces, Rocchio classification, k nearest neighbour, Linear vs. Non-linear classifiers, bias-variance tradeoff; Support vector machines, extensions to SVM models, Issues in the classification of text documents, Machine learning methods in adhoc information retrieval.	
7.	**Document Clustering and Matrix Decomposition:** Flat clustering, cardinality, evaluation of clustering, K-means, Model-based clustering; Hierarchical Agglomerative clustering, single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Optimality of HAC, Divisive clustering, Cluster labeling; Matrix decompositions, Term-document matrices and singular value decomposition, Low-rank approximations, Latent semantic indexing.	06
8.	**Web Search**: basics concepts, web graph, spam, search user experience, Index size and estimation, Near-duplicates and shingling; Web crawling and indexes: overview, crawler architecture, DNS resolution, URL frontier, Distributing indexes and connectivity servers; Link analysis: Anchor text and web graph, PageRank, Hubs and Authorities.	06
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Manning, C. D., Raghavan, P., & Schütze, H. "Introduction to information retrieval". Cambridge: Cambridge university press.	2008
2.	Witten, I. H., Moffat, A., & Bell, T. C. "Managing gigabytes: compressing and indexing documents and images." Morgan Kaufmann.	1999
3.	Grossman, D. A." Information retrieval: Algorithms and heuristics" Springer.	2004
4.	Baeza-Yates, R., & Ribeiro-Neto, B. "Modern information retrieval" New York: ACM press.	1999
5.	Belew, R. K." Finding out about: a cognitive perspective on search engine technology and the WWW". Cambridge University Press.	2000
6.	Chakrabarti, S. "Mining the Web: Discovering knowledge from hypertext data." Morgan Kaufmann.	2003
7.	Manning, C. D." Foundations of statistical natural language processing." H. Schütze (Ed.). MIT press.	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. / CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-382** Course Title: **Machine Learning**

2. Contact Hours: **L: 3** **T: 1** **P: 1**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester **Spring** 7. Pre-requisite: **Nil**

8. Subject Area: **DEC**

9. Objective: To provide an understanding of the theoretical concepts of machine learning and a working knowledge of state-of-art techniques used in this area.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Introduction to Machine Learning, supervised learning, learning multiple classes, regression, model selection and generalization, Bayesian decision theory, losses and risks, discriminant functions, utility theory, association rules.	**4**
2.	Data Pre-processing and understanding, parametric methods, maximum likelihood estimation, bias and variance, multivariate data, parameter estimation, estimating missing values, multivariate normal distribution, multivariate classification and regression, dimensionality reduction, subset selection, PCA, LDA, Isomaps, LLE .	**6**
3.	Clustering, mixture densities, K-means algorithm, EM-algorithm, hierarchical clustering, choosing number of clusters. Non-parametric methods, non-parametric density estimation, non-parametric classification and regression.	**6**
4.	Classification Techniques, decision trees, pruning, rule extraction from trees, learning rules from data, Linear discrimination, two classes, multiple classes, pairwise separation. Perceptrons, multilayer perceptrons, backpropagation algorithm, training procedures and network tuning. Competitive learning, Radial basis functions, Incorporating rule based knowledge, Kernel machines, hyperplanes, SVM, kernel trick, kernel machines for regression, kernel dimensionality reduction.	**8**
5.	Bayesian Estimation, estimating parameter of Distributions and Functions. Graphical models, conditional independence, d-separation, belief propagation, Markov random fields, learning the structure of a graphical model, influence diagrams.	**6**

6.	Hidden M arkov M odels, di screte m arkov pr ocesses, HMM, three problems of H MM, evaluation pr oblem, f inding s tate sequence, learning model parameters, HMM with input.	**6**
7.	Reinforcement l earning, single s tate c ase, el ements of reinforcement l earning, m odel ba sed l earning, t emporal difference l earning, generalization, pa rtially obs ervable s tates. Combining m ultiple l earners, m odel c ombinations s chemes, voting, e rror-correcting out put c odes, b agging, boos ting, cascading.	**6**
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Ethem A lpaydin " Introduction to M achine L earning" S eond E dition, PHI Learning	2012
2.	Christopher M . B ishop " Pattern R ecognition a nd M achine L earning", Springer	2013
3.	Trevor Hastie R . T ibshirani, J . F riedman "The E lements of Statistical Learning" Second Edition, Springer	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-471** Course Title: **Computer Vision**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: Nil**

9. Objective**:**To introduce various topics of computer vision with their applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Image formation and camera calibration:** Introduction to computer vision,geometric camera models, orthographic and perspective projections, weak-perspective projection, intrinsic and extrinsic camera parameters, linear and nonlinear approaches of camera calibration	**8**
2.	**Feature detection and matching:** Edge detection, interest points and corners, local image features, feature matching and Hough transform, model fitting and RANSAC, scale invariant feature matching	**6**
3.	**Stereo Vision:** Stereo camera geometry and epipolar constraints, essential and fundamental matrix, image rectification, local methods for stereo matching: correlation and multi-scale approaches, global methods for stereo matching: order constraints and dynamic programming, smoothness and graph based energy minimization, optical flow	**12**
4.	**Shape from Shading:** Modeling pixel brightness, reflection at surfaces, the Lambertian and specular model, area sources, photometric stereo: shape from multiple shaded images, modeling inter-reflection, shape from one shaded image	**10**
5.	**Structure from motion:** Camera self-calibration, Euclidean structure and motion from two images, Euclidean structure and motion from multiple images, structure and motion from weak-perspective and multiple cameras	**6**
	Total	**42**

11. Suggested Books:

S. No.	Title/Authors/Publishers	Year of Publication/ Reprint
1.	Forsyth, D . A . and P once, J ., " Computer V ision: A M odern Approach", Prentice Hall, 2nd Ed.	**2011**
2.	Szeliki, R ., "Computer V ision: A lgorithms a nd Applications", Springer	**2011**
3.	Hartley, R . a nd Z isserman, A ., "Multiple V iew G eometry in Computer Vision", Cambridge University Press	**2003**
4.	Gonzalez, R . C. a nd Woods, R . E ., " Digital Image P rocessing", Prentice Hall, 3rd Ed.	**2009**
5.	Trucco, E. a nd V erri, A., " Introductory T echniques f or 3 -D Computer Vision", Prentice Hall	**1998**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-475** Course Title: **Parallel and Distributed Algorithms**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-212**

9. Objective: To provide an in-depth understanding of the fundamentals of parallel and Distributed algorithms.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to data and control parallelism.	2
2.	PRAM model and its variants, EREW, ERCW, CRCW, PRAM algorithms, cost optimality criterion, Brent's theorem and its importance.	8
3.	Processor organizations such as mesh and hypercube, embedding of problem graphs into processor graphs.	4
4.	Parallel algorithms for matrix multiplication, merging and sorting for different processor organizations such as mesh and hypercube.	8
5.	Introduction to distributed systems, synchronous / asynchronous network models, leader election problem in ring and general networks; Type of faults, fail safe systems, Byzantine faults, distributed consensus with link and process failures.	8
6.	Algorithms for BFS, DFS, shortest paths and spanning trees in distributed systems.	6
7.	Asynchronous networks: Broadcast and multicast, logical time, global s napshot a nd s table pr operties; N etwork r esource allocation.	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Quinn, M. J., "Parallel Computing Theory & Practice", McGraw-Hill	1994
2.	Horowitz, E., Sahni, S. and Rajasekaran, S., "Computer Algorithms: C++", Galgotia Publications	2002
3.	Lynch, N. A., "Distributed Algorithms", Morgan Kaufmann.	2003
4.	Miller, R. and Boxer, L., "Algorithms Sequential & Parallel: A Unified Approach" , 2nd Ed., Charles River Media.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-476** Course Title: **Software Project Management**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-254**

9. Objective**:** To introduce the concepts, practices, and methodologies involved in software project management

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Introduction: Conventional s oftware m anagement, c onventional software m anagement pe rformance, processes and project management, project management and CMM. Software economics: Evolution, pragmatic software cost estimation. Reducing Software product s ize, i mproving s oftware p rocesses, i mproving t eam effectiveness, achieving required quality, peer inspections.	6
2.	Project and Process P lanning: T he pr ocess d atabase, process capability baseline, pr ocess a ssets, pr ocess pl anning, s tandard process of planning, process tailoring, change management process. Iterative pr ocess pl anning: w ork br eakdown s tructures, pl anning guidelines, iterative planning process, pragmatic planning.	6
3.	Estimation and Scheduling: B asic c oncepts, Effort e stimation models, e stimating s chedules, bot tom-up effort e stimation, t op-down e ffort e stimation, c ost a nd s chedule e stimation, us e-case point a pproach, e ffectiveness a nalysis of a pproaches, O verall Scheduling, Detailed scheduling and their effectiveness analysis.	6
4.	Planning f or Q uality and R isk M anagement: P rocedural and quantitative approach to quality management, setting quality goals, estimating defects for other stages, quality process planning, defect prevention planning. Risk assessment, Risk control.	6
5.	Software Fault Prediction: Fault proneness, fault density, nature of faults, categories of s oftware faults, software f ault pr ediction methods, ut ilization of f ault pr ediction i n software p roject management.	6
6.	Project T racking and management: M etrics and measurements,	6

	process monitoring through statistical process control, effort data collection, logging and tracking defects, measuring size and schedule, project tracking, Seven core metrics, management indicators, quality indicators. Team Management, Configuration management process.	
7.	Project Control: Project review process, data collection, tracking project activities, generating status reports from tracking, milestone analysis, defect analysis and prevention, project closure, next generation software economics, modern process transitions.	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Royce Q., Software Project Management: A Unified Framework, Pearson Education publisher.	2005
2.	Jalote, P., Software Project Management in Practice, Pearson Education Publisher.	2005
3.	Hughes. B., and Cotterell M., Software Project Management, McGraw Hill publication, 5th ed.	2009
4.	Henry, J., Software Project Management, Pearson Education publisher.	2006
5.	Available literature on software fault prediction.	

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-481** Course Title: **Bioinformatics**

2. Contact Hours: **L: 3** **T: 4** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits**:4** 6. Semester**: Spring** 7.Subject Area**: DEC**

8. Pre-requisite**: Nil**

9. Objective**:** To expose students to the algorithms, data structures and application areas in bioinformatics.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	**Sequence c omparison an d alignment methods:** Dynamic programming; G lobal, semi global and local alignment algorithms; G ap m odel; D atabase searching tools; M ultiple sequence alignment.	6
2.	**Suffix tree:** Implicit s uffix tr ee; E xplicit s uffix t ree; Suffix link; Ukkonen's algorithm; Applications of Suffix tree.	6
3.	**Phylogenetic tree:** Rooted and unrooted tree, Newick format, scaled and unscaled tree, character and distance ba sed methods, di stance m atrix, U PGMA, W PGMA, additive tr ee, neighbor joining me thod, parsimony, maximum like lihood approach, phylogenic comparison, agreement tree.	6
4.	**Gene n etwork analysis:** Bayesian ne twork, Gene ne twork, clustering, classification, DNA a rray; Gene ne twork reconstruction m ethods: Boolean, linear, non-linear and machine learning.	8
5	**Sequencing techniques by h ybridization:** Microarray, Hamiltonian path, Euler path.	6
6.	**RNA structure prediction:** RNA s econdary structure, psuedoknot, l oops, R NA s econdary structure pr ediction algorithm, R NA s tructure c omparison, i nferring R NA structure.	8
7.	Computational aspects of drug designing.	2
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors / Books / Publishers	Year of Publication
1.	Krane, D. E. and Raymer, M. L., "Fundamental Concepts of Bioinformatics", Benjamin Cummings.	2005
2.	Baxevanis, A. D. and Ouellette, B. F. F., "Bioinformatics: A Practical Guide to Analysis of Genes and Proteins", 2nd Ed., Wiley.	2003
3.	Rastogi, S.C., M endiratta, N. and Rastogi, P., "Bioinformatics: C oncepts, Skills a nd Applications", CBS	2001
4.	Xiong, J., "Essential Bioinformatics", Cambridge University Press.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-483** Course Title: **Intrusion Detection System**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-341**

9. Objective**:**To To introduce the elements of intrusion detection systems and its models.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Intruder types, intrusion methods, processes and detection, message integrity and authentication, honey pots.	8
2.	General IDS model, data mining based IDS, Denning model, data mining framework for constructing features and models for intrusion detection systems.	6
3.	Unsupervised anomaly detection, CV5 clustering, SVM, probabilistic and statistical modeling, general IDS model and taxonomy, evaluation of IDS, cost sensitive IDS.	8
4.	NBAD, specification based and rate based DDOS, scans/probes, predicting attacks, network based anomaly detection, stealthy surveillance detection; Defending against DOS attacks in scout: signature-based solutions, snort rules.	6
5.	Host-based anomaly detection, taxonomy of security flaws in software, self-modeling system calls for intrusion detection with dynamic window size	6
6.	Secure intrusion detection systems, network security, secure intrusion detection environment, secure policy manager, secure IDS sensor, alarm management, intrusion detection system signatures, sensor configuration, signature and intrusion detection configuration, IP blocking configuration, intrusion detection system architecture.	8
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Endorf, C., Schultz E. and Mellander J., "Intrusion Detection and Prevention," McGraw-Hill.	2003
2.	Marchette, D. J., "Computer Intrusion Detection and Network Monitoring: A Statistical Viewpoint", Springer.	2001
3.	Rash, M., Orebaugh, A. and Clark, G., "Intrusion Prevention and Active Response: Deploying Network and Host IPS", Syngress.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-484** Course Title: **Multimedia Technologies**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Spring** 7.Subject Area**: DEC**

8. Pre-requisite**:** Student must have the knowledge of basics concepts of data structure, discrete mathematics, and computer networks.

9. Objective**:** To introduce the various concepts, techniques, methodologies, and communication related issues of multimedia technologies.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Introduction: Components of M ultimedia, Multimedia a nd Hypermedia m ultimedia bui lding bl ocks, c ommunication a nd information transfer m odel, multimedia inf ormation systems, application pur poses of m ultimedia, e lectronics pe rformance support s ystems. Interaction T echnologies a nd devices: H uman Computer Interface, Input/output t echnologies, c ombined I/O device, storage technologies, processing technologies.	6
2.	Multimedia A uthoring a nd da ta representation: M ultimedia Authoring: P roduction, presentation, a nd auto a uthoring. Image data t ypes, image r epresentation, image acquisition, pi cture display, working with image.	6
3.	Compression Technologies for multimedia: ne ed for da ta compression, compression basics, lossless and lossy compression, image compression standards, video compression standards, basic audio compression standards.	8
4.	Text, Hypertext and H ypermedia, and Digital a udio: V isual representation of t ext, digital r epresentation of characters, Formatting a spect t ext, H ypertext a nd h ypermedia, pr oducing digital audio, Psychoacoustics, processing sound, representation of audio f iles, di gitization of s ound, M IDI, quantization a nd transmission of audio.	8
5.	Designing multimedia: D evelopment ph ases and teams, analysis phase, de sign pha se, de velopment pha se, i mplementation pha se, evaluation and testing.	4

6.	Multimedia networks and communication: Multimedia in the Internet, streaming stored audio/video, streaming live audio/video, real-time interactive audio/video, Real-time interactive protocols: RTP, RTCP, Session Initialization protocol (SIP), H.323, SCTP. QoS: Data flow, flow classes, flow control, Integrated services, Differentiated services. Multimedia content management systems, multimedia indexing, multimedia retrieval.	8
	Total	**42**

11. Suggested Books:

Sl.No.	Name of Books / Authors	Year of Publication
1.	Li. Z., Drew M., Fundamentals of Multimedia, Pearson Education publishers.	2004
2.	Chow V. W. S., Multimedia technology and applications, Springer	
3.	Banerji A., and Ghosh A.M., Multimedia Technologies, McGraw Hill International	2009
4.	Stamou G., and Kollias S., Multimedia Contents and the Semantic Web, John Wiley & Sons.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-485** Course Title: **Quantum Computation**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits**:4** 6. Semester**:Spring** 7.Subject Area**: DEC**

8. Pre-requisite**:CSN-106**

9. Objective**:** The objective of this course is to provide the students an introduction to quantum computation. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

10. Details of Course:

S.No.	Particulars	Contact Hours
1	**Introduction to Quantum Computation:** Quantum bits, Bloch sphere representation of a qubit, multiple qubits.	02
2	**Background Mathematics and Physics:** Hilbert space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.	08
3	**Quantum Circuits:** single qubit gates, multiple qubit gates, design of quantum circuits.	06
4	**Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	06
5	**Quantum Algorithms:**Classical computation on quantum computers. Relationship between quantum and classical complexity classes.Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.	10
5	**Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation.	10
	Total	**42**

11. Suggested Books:

S.No.	Author(s)/Name of Books/Publishers	Year of Publication
1	Nielsen M. A ., **Quantum C omputation a nd Q uantum I nformation**, Cambridge University Press.	2002
2	Benenti G., Casati G. and Strini G., **Principles of Quantum Computation and Information**, V ol. I : B asic Concepts, V ol I I: B asic T ools an d S pecial T opics, World Scientific.	2004
3	Pittenger A. O., **An Introduction to Quantum Computing Algorithms**	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-491** Course Title: **Structure of Information Networks**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 | 3 **Practical** 0 | 0

4. Relative Weight: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 | 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: **Nil**

8. Subject Area: **MSC/DHC**

9. Objective: To familiarize students with the concepts and issues about how the social, technological, and natural worlds are connected, and how the study of networks sheds light on these connections.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Graph Theory and Social Networks: Graphs, Strong and Weak Ties, Positive and Negative Relationships	7
2.	Game Theory: Games, Modeling Network Traffic using Game Theory, Auctions	7
3.	Markets and Strategic Interaction on Networks: Matching Markets, Network Models of Markets with Intermediaries, Bargaining and Power in Networks	7
4.	Information Networks and the World-Wide Web: The Structure of the Web, Link Analysis and Web Search, Sponsored Search Markets	7
5.	Network Dynamics: Population Models - Evolutionary Game Theory, Information Cascades, Network Effects, Power Laws and Rich-Get-Richer Phenomena, Markets and Information	7
6.	Network Dynamics: Structural Models: Cascading Behavior in Networks, The Small-World Phenomenon, Epidemics	7
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors
1.	D. E asley, J . K leinberg. Networks, C rowds, a nd M arkets: R easoning A bout a H ighly Connected World. Cambridge University Press, 2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-492** Course Title: **High Performance Computing**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weightage: **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 00

5. Credits: 0 4 6. Semester √ **Autumn** ☐ **Spring** ☐ **Both**

7. Pre-requisite: CSN-221 **Computer Architecture & Microprocessors**

8. Subject Area: **MSC/DHC**

9. O bjective: Students w ill be a ble build and s imulate the c omplex m odels us ing High Performance Computing. They are expected to design various related algorithms and implement programming.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	HPC Building Blocks: Single Processor Performance, Memory Hierarchy, Pipelining, Multi-core, Multi-threaded, Superscalar Architectures, Vector Computers, Interconnects, Clusters, Distributed Memory Computers, Grid Computing, Cloud Computing, and Petascale Systems.	9
2.	Accelerators, Parallel I/O, File Systems, and Operating Systems Perspective	5
4.	Parallel Programming: Asymptotic Analysis of Parallel Programs, Principles of Message Passing, MPI, Shared Memory, Designing Asynchronous Programs, openMP, GPU Programming, CUDA, and MapReduce.	8
3.	Parallel Algorithms: Algorithmic Primitives, Decomposition Techniques, Mapping Techniques, Load Balancing, Various Parallel Models and Algorithms. Performance Metrics for Parallel Systems, Effect of Granularity, Data Mapping, Scalability, and Time.	10
5.	Power-Aware Computing: Designing of power-aware processing, memory, and interconnect. Power Management Software.	5
6.	Advances: Optics in Parallel Computing, Quantum Computing, Application of Nanotechnology.	5
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey.	2003
2.	Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series.	2007
3.	Parallel Programming in C with MPI and OpenMP, Michael J Quinn, McGraw Hill	2003
4.	"Scalable Parallel Computing", by Kai Hwang, McGraw Hill Thamarai Selvi, McGraw Hill	1998
5.	"Parallel Computer Architecture: A hardware/Software Approach", by David Culler Jaswinder Pal Singh, Morgan Kaufmann.	1999
6.	"Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill	1993
7.	Programming Massively Parallel Processors: A Hands-on Approach, David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science & Engineering**

1. Subject Code: CSN-493 Course Title: **Advanced Data Mining**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 00

5. Credits: 4 6. Semester: **Spring**

7. Pre-requisite:**CSN-102** 8. Subject Area: **MSC/DHC**

9. Objective: To introduce students to the various advanced concepts and techniques in data mining

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction to data mining:** Motivation and significance of data mining, data mining functionalities – clustering, classification, association rule mining, data pre-processing, major issues in data mining.	5
2.	**Classification:** Definition and Basics, Model over-fitting and under-fitting, performance evaluation and comparisons, rule based classifier – direct and in direct methods, Nearest neighbor classifiers, Ensemble methods.	6
3.	**Association Rule Mining:** Definition and basic concepts, handling categorical attributes, sequential patterns, mining patterns from graphs and sub graphs, techniques for infrequent pattern mining	6
4.	**Cluster Analysis:** Definition and basic concepts, characteristics of clustering algorithms, fuzzy clustering, grid based clustering, subspace clustering, constraint based clustering, clustering high dimensional data	6
5.	**Mining time series data, sequences and data streams:** Basic concepts, trend analysis, similarity search in time series data, sequential pattern mining, methods for stream data processing, frequent pattern mining from data streams, classification of dynamic data streams and evolving data stream concepts	6
6.	**Spatial and Web Mining:** Definition and basic concepts, finding spatial associations and co-location patterns, spatial classification, spatial trend analysis, mining web pages, discovering semantics based on natural language processing, document summarization.	6
7.	**Applications and Trends:** Data mining applications – Financial	4

	data analysis, mining retail data, biological data analysis, mining telecommunication data, other scientific applications of data mining, trends in data mining	
8.	**Case Studies:** Some commercial Data mining software and functionalities	3
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors / Books / Publishers	Year of Publication
1.	Han, J. and Kamber, M., "Data Mining - Concepts and Techniques", 3rd Ed., Morgan Kaufmann Series.	2011
2.	Alex Berson, Smith S J, "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Publishers.	2010
3.	Tan, P.N., Steinbach, M. and Kumar, V., "Introduction to Data Mining", Addison Wesley – Pearson.	2011
4.	Pujari, A. K., "Data Mining Techniques", 4 th Ed., Sangam Books.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-494** Course Title: **Big Data Analytics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 | 3 **Practical** 0 | 0

4. Relative Weightage: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 | 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: **NIL**

8. Subject Area: **MSC/DHC**

9. Objective: The purpose of this course is to introduce the students with Big Data Storage Systems and important algorithms that form the basis of Big Data Processing. The course also introduces the students with major application areas of Big Data Analytics.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction to Big Data:** Introduction to Big Data The four dimensions of Big Data: volume, velocity, variety, veracity, Drivers for Big Data, Introducing the Storage, Query Stack, Revisit useful technologies and concepts, Real-time Big Data Analytics	6
2.	**Distributed File Systems:** Hadoop Distributed File System, Google File System, Data Consistency	6
3	**Big Data Storage Models:** Distributed Hash-table, Key-Value Storage Model (Amazon's Dynamo), Document Storage Model (Facebook's Cassandra), Graph storage models	10
4.	**Scalable Algorithms:** Mining large graphs, with focus on social networks and web graphs. Centrality, similarity, all-distances sketches, community detection, link analysis, spectral techniques. Map-reduce, Pig Latin, and NoSQL, Algorithms for detecting similar items, Recommendation systems, Data stream analysis algorithms, Clustering algorithms, Detecting frequent items	10
5.	**Big Data Applications:** Advertising on the Web, Web Page Quality Ranking, Mining Social-Networking Group, Human Interaction With Big-Data. Recommendation systems with case studies of Amazon's	6

	Item-to-Item recommendation and Netfix Prize, Link Analysis with case studies of the PageRank algorithm and the Spam farm analysis, Crowd Sourcing	
6	**Big Data Issues:** Privacy, Visualization, Compliance and Security, Structured vs Unstructured Data	4
	Total	42

Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Mining of massive datasets, Anand Rajaraman, Jure Leskovec, and Jeffrey Ullman	2014
2.	An Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze	2009
3	Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-495** Course Title: **Distributed Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weightage: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: **Knowledge of Computer Networks**

8. Subject Area: **MSC/DHC**

9. Objective: To familiarize students with the latest distributed system technologies.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction:** Historical ba ckground, ke y characteristics, de sign goals and challenges; Review of ne tworking a nd i nternetworking, Internet protocols.	4
2.	**Processes an d I nter p rocess C ommunication:** processes and threads, vi rtualization, c ode m igration; T he A PI f or t he Internet protocols, External data representation, Client-server communication, Multicast c ommunication, message or iented c ommunication, Network virtualization: Overlay networks, RPC, MPI	10
3.	**Naming:** Name s ervices and Domain N ame System, Directory services, Case study: X.500 directory service	2
4.	**Time, Global S tates and Sy nchronization:** Physical and logical clocks, global states, mutual exclusion, election algorithms	4
5.	**Consistency an d R eplication:** Consistency m odels, R eplica management, Consistency protocols, Case studies of highly available services: the gossip architecture and Coda	4
6.	**Fault T olerance an d Security:** Distributed Commit, R ecovery, Security Issues, Cryptography.	6
7.	**Distributed Fi le Systems:** File se rvice architecture, Case s tudy: S un Network File System, The Andrew File System	4
8.	**Peer t o peer S ystems:** Introduction, N apster, P eer-to-peer middleware, Routing overlays, Case studies: Pastry, Tapestry	4

9.	**Distributed Object Based Systems:** Distributed objects, Java beans, CORBA	4
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Tanenbaum, A.S, "Distributed Systems: Principles and Paradigms", 2nd Ed., Pearson Education.	2006
2.	Coulouris G., Dollimore J., Kindberg T. and Blair G., "Distributed Systems: Concepts and Design", 5th Edition, Addison Wesley.	2011
3.	Hwang K., Dongarra J., Geoffrey C. Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Morgan Kaufmann	2011
4.	Mahajan S., Shah S., " Distributed Computing", 1st Ed., Oxford University Press.	2010
5.	Comer, D.E. and Droms, R.E., "Computer Networks and Internets", 4th Ed., Prentice-Hall.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science and Engineering**

1. Subject Code: CSN-501 **Course Title:** Advanced Algorithms

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 25 50 00

5. Credits**:** 0 4 6. Semester **Autumn**

7. Pre-requisite**: CSN-212** 8. Subject Area**: MSC / DHC**

9. Objective: To introduce some advanced concepts in algorithms.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Revisit t he not ions of greedy s trategy, dynamic p rogramming, gr aph algorithms, complexity classes P, NP, NP-hard, NP-complete.	10
2.	Approximation Algorithms: pe rformance r atio, ve rtex c over pr oblem, travelling salesman problem, set covering problem, subset sum problem.	12
3.	Randomized Algorithms: Tools and techniques. Applications.	10
4.	Multithreaded Algorithms: Dynamic mul tithreaded programming, multithreaded matrix multiplication, multithreaded merge sort.	10
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Cormen T , Leiserson C , Rivest R , and Stein C: Introduction t o Algorithms, MIT Press.	2009
2.	Motwani a nd R aghavan: R andomized A lgorithms. C ambridge University Press.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-503** Course Title: **Advanced Computer Networks**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 4 6. Semester √ **Autumn** ☐ **Spring** ☐ **Both**

7. Pre-requisite: **CSN-341**

8. Subject Area: **MSC/DHC**

9. Objective: To familiarize students with the architecture of a processor and machine level programming.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Basic networking concepts revisited: introduction to networks, layering and link layer, network layer, routing, end-to-end layer, congestion control,	5
2.	Modeling and measurement: network traffic modeling, network measurement, simulation issues, network coding techniques	6
3.	Routing and router design, scheduling and QoS, integrated and differentiated services, RSVP	5
4.	Wireless networks and mobility supports, MAC protocol, routing, AODV, group communication, multicast	4
5.	Flow and congestion control, TCP variants, TCP modeling, active queue management	6
6.	Overlay networks: RON, P2P, CDN, Web caching, cross-layer optimizations, Emerging network types: data center, DTN, 4G mobile networks (LTE, Wi-Max), Online social networks (OSN), wireless sensor networks (WSN) – cross-layer sensor data dissemination	10
7.	Emerging applications – VoIP, SIP, video over P2P	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors
1.	J.F. Kurose and K.W. Ross, Computer networking: A top-down approach, 6th edition, Adison Wesley.
2.	L.L. Peterson and BS. Davie, Computer Networks ISE: A System Approach, 5th edition, Morgan Kaufman.
3.	B.A. Forouzan, Data communication & networking, 5th Edition, Tata Mc-Graw Hills.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-506** Course Title: **Advanced Computer Architecture**

2. Contact Hours: **L : 3** **T : 1** **P : 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 4 6. Semester: √ **Autumn** **Spring** **Both**

7. Pre-requisite: **CSN – 221 or equivalent**

8. Subject Area: **MSC/DHC**

9. Objective: To expose students to advanced techniques of computer design such as pipelining, vector processing and multiprocessing.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	Fundamentals of computer design, Amdahl's law, measuring and reporting performance.	2
2.	Principles of linear pipelining; Instruction level parallelism and instruction pipelines, speedup, data dependency hazards, remedial measures, branch handling; Arithmetic pipelines; Pipeline control methods; Job sequencing, collision prevention and pipeline chaining; Case study of pipelined systems.	8
3.	Loop unrolling, software pipelining and trace scheduling techniques for exposing instruction level parallelism.	4
4.	Dynamic scheduling algorithms, exploiting ILP using static scheduling and dynamic scheduling, hardware based speculation, multiple issues, and speculation.	8
5.	Data level parallelism, Vector procession characteristics and requirements, pipelined vector processing, vectorization methods, examples of vector processing.	4
6.	Graphics procesing units (GPUs), Instruction set architecture, Programming on GPU, Comparison with vector processors	4
7.	Array procesing, SIMD array processors, communication between PEs, SIMD interconnection networks, algorithms for array processing	2

8.	Data a nd control pa rallelism, PRAM model of pa rallel computation, pa rallel a lgorithms. E mbedding o f t ask graphs i n processor graphs, di lation a nd l oading, l oad ba lancing, Overview of parallel programming with MPI and Open MP.	4
9.	Multiprocessors a nd m ulti-computers; P rocessor or ganizations: mesh, bi nary t ree, h ypercube; S hared m emory and m essage passing systems; Mapping and Scheduling:	6
	Total	**42**

11. Suggested Books:

Sl. No.	**Name of Books / Authors**	**Year of Publication**
1.	Hennessy, J . L. and P atterson, D . A ., " Computer A rchitecture", 4 th Ed., Morgan Kaufmann.	2007
2.	Sima, D ., F ountain, T . a nd Kacsuk, P ., " Advanced C omputer Architecture: A Design Space Approach", Pearson Education.	2007
3.	Michael, J .Q., " Parallel C omputing: T heory and P ractice", T ata McGraw-Hill.	2002
4.	Hwang, K., "Advanced Computer Architecture", Tata McGraw-Hill.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science & Engineering**

1. Subject Code: **CSN-510** Course Title: **Network Programming**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**3** 6. Semester: **Spring**

7. Pre-requisite: **CSN-341 or equivalent**

8. Subject Area: **MSC**

9. Objective: To familiarize students with advanced concepts of network programming in UNIX environment.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	OSI model, client server model, TCP/IP protocols, introduction to Unix; Process, groups, job control and non-job control shells, reliable and unreliable signals.	6
2.	Inter process communication in Unix, pipes, message queues, shared memory, mmap function and its use, RPC, authentication, timeout and retransmission, call semantics, XDR.	6
3.	Daemon processes and inetd daemon.	2
4.	Introduction to Berkeley sockets, socket addressing, TCP and UDP socket functions, sockets and Unix signals, socket implementation, client and server examples for TCP and UDP and their behavior under abnormal conditions.	8
5.	Socket options, IPv4, IPv6, TCP, I/O multiplexing, Unix I/O models, select and poll functions	4
6.	Unix domain protocols	2
7.	Routing sockets, raw sockets, example programs, ping, traceroute, methods for writing client and server in Unix, iterative server, concurrent server, preforking, prethreading.	6
8.	Data link access, libpcap, BPF, DLPI, Linux SOCK_PACKET, programming using libpcap	4
9.	Socket Programming in JAVA	4
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Stevens, W .R., F enner, B . a nd R udoff A .M., " Unix N etwork Programming: Vol. I", 3rd Ed., Pearson Education	2004
2.	Stevens, W .R., " Unix N etwork P rogramming: V ol. II", 2 nd Ed., Pearson Education	2002
3.	Stevens, W .R., " Advanced P rogramming i n U nix E nvironment", Pearson Education	2002
4.	Bovet, D .A. a nd C esati, M ., " Understanding t he Linux K ernel", 2nd Ed., O'Reilly.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science and Engineering**

1. Subject Code: CSN-511 Course Title: **Advanced Database Management Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 0 **MTE** 35 **ETE** 50 **PRE** 0

5. Credits: 4 6. Semester: **Spring**

7. Subject Area: **MSC/DHC**

8. Pre-requisite: **CSN-351**

9. Objective: To educate students about advanced concepts pertaining to databases, database management systems and their applications

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Review of DBMS concepts; Relational database systems, applications of DBMS.	3
2.	Transactions & Serializability: Concurrent executions, Serializability View and conflict serializability, Recoverability,	6
3.	Concurrency Control: Lock based protocols, timestamp based protocols, validation based protocols, deadlock handling, insert and delete operations	6
4.	Recovery System: Failure classification, recovery and atomicity, log based recovery, shadow paging, buffer management, remote backup systems	6
5.	Distributed Databases: Homogeneous and heterogeneous databases, distributed transactions, commit protocols, concurrency control in distributed databases	6
6.	Advanced Data Types: Time in databases, spatial and geographic databases, multimedia databases	5
7.	Advanced applications : Knowledge discovery and data mining, data mining functionalities, classification of data mining systems, data warehousing concepts, slicing, dicing, schemas, data warehouse architecture, introduction to Data Mining Query Language (DMQL)	6
8.	Study of typical DBMS packages.	4
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors / Books / Publishers	Year of Publication
1.	Silberchatz, A ., K orth, H . F . a nd S udarshan, S ., " Database System Concepts", 6th Ed., Tata-McGraw Hill.	2010
2.	Han, J . a nd K amber, M ., " Data M ining: Concepts a nd Techniques", 2nd Ed., Morgan Kaufmann.	2006
3.	Ray Chhanda, "Distributed Database Systems", Pearson.	2009
4.	Date, C. J, " An Introduction t o Database Systems", 8th Ed., Pearson.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science and Engineering**

1. Subject Code**: CSN-512** Course Title: **Formal Methods and Software Verification**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 | 3 **Practical** 0 | 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 25 50 00

5. Credits**:** 0 | 4 6. Semester **Autumn**

7. Pre-requisite**: NIL** 8. Subject Area**:** MSC/**DHC**

9. Objective: To introduce the basic model checking techniques and tools for software verification.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Temporal logics:** syntax and semantics of temporal logics PLTL, CTL, and CTL*	6
2.	**Model checking**: Model checking CTL, PLTL, state explosion problem	6
3.	**Symbolic model checking**: binary decision diagrams (BDDs), representing automata by BDDs, BDD based model checking.	6
4.	**Reachability properties**: Safety properties, Liveness properties, deadlock freeness	6
5.	**Fairness properties:** PLTL, CTL	6
6.	**SMV:** symbolic model checker	6
7.	**SPIN:** model checker based on communicating automata	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Berard, B. Bidoit, M. Finkel, A. Laroussine, F. Petit, A. Petrucci, L. Schnoebelen, Ph. And McKenzie, P. Systems and Software verification. Springer.	2001
2.	Huth, M. and Ryan, M., " Logic in Computer Science: Modeling and Reasoning About Systems", Cambridge University Press.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-513** Course Title: **Information and Network Security**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-106**

9. Objective**:** This course provides an introduction of symmetric key and public key encryption techniques, hash functions, message authentication codes, digital signatures. Application of these cryptographic techniques in different fields email, web and IP security is discussed. The goal of this course is to provide the students adequate foundation to apply cryptographic technique to emerging area of information and network security.

10. Details of Course:

S.No.	Particulars	Contact Hours
1	**Classical Encryption:** symmetric cipher models, Vigenere cipher, stream ciphers, LFSR based ciphers.	02
2	**Block Ciphers:** Substitution and permutation networks (SPN), Feistel structure, description of Data Encryption Standard (DES). Review of finite fields. Advanced Encryption Standart (AES). Linear and differential attacks on block ciphers.	06
3	**Public Key Encrytion:** Principles of public key cryptosystems, RSA, El Gamal cryptosystems. Testing primality: quadratic reciprocity, Chinese Remainder Theorem (CRT), Miller – Rabin algorithm, Solovay Strassen algorithm.	08
4	**Hash Functions:** Random oracle model, security of hash functions, Merkel Damgard iterative construction. Message Authentication and has functions. MD5 message digest algorithm. Secure Hash Algorithm.	06
5	**Digital Signatures:** Properties of digital signatures. Generic signatures. RSA signature, El Gamal signature.	04
5	**Authentication Application:** Kerberos. X.509 Authentication service.	04
6	**Electronic Mail Security:** Pretty Good Privacy (PGP). S/MIME.	04
7	**IP Security:** IP security overview, architechture, key management.	04
8	**WEB SECURITY:** Secure Sockets Layer (SSL) and Transport Layer Security (TLS). Secure Electronic Transaction.	04
	Total	**42**

11. Suggested Books:

S.No.	Author(s)/Name of Books/Publishers	Year of Publication
1	Stallings W ., **Cryptography a nd N etwork Se curity**, 4/ E, P earson E ducation India.	2006
2	Stinson D ., **Cryptography Theory an d P ractice,** 3/E, (Special I ndian E dition, first reprint 2011) Chapman & Hall/CRC	2006
3	Pieprzyk J ., H ardjono T . an d S eberry J . **Fundamentals o f Computer Se curity**, Springer (International Edition) (First Indian reprint 2008)	2003
4	Koblitz N. **A Course in Number Theory and Cryptography**, 2/E, Springer	1994
5	Menezes, A. **Handbook of Applied Cryptography**, CRC Press, (available free of cost at: http://cacr.uwaterloo.ca/hac/)	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science and Engineering**

1. Subject Code: CSN-514 **Course Title:** Advanced Automata Theory

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 00

5. Credits**:** 0 4 6. Semester **Spring**

7. Pre-requisite**: CSN-353** 8. Subject Area**:** MSC/**DHC**

9. Objective: To provide a deeper understanding of automata theory.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Automata and Logical specification: MSO logic over words, The equivalence theorem, consequences and applications in model checking, FO and MSO definability.	7
2.	Congruences and minimization: homomorphisms, quotients, and abstraction; minimization and equivalence of DFAs; equivalence and reduction of NFAs.	7
3.	Tree automata: trees and tree languages;deterministic tree automata,nondeterministic tree automata,emptiness, congruences and minimization; logic oriented formalisms over trees; applications.	8
4.	Pushdown and counter systems	8
5.	Communicating systems	6
6.	Petri nets	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Thomas, W. “Applied Automata Theory”. Springer	2005
2.	Pin, J. “Mathematical foundations of automata theory.” Springer	2012

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-515** Course Title: **Data Mining & Warehousing**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-102**

9. Objective**:** To educate students to the various concepts, algorithms and techniques in data mining and warehousing and their applications.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction to data mining:** Motivation and significance of data mining, data mining functionalities, interestingness measures, classification of data mining system, major issues in data mining.	3
2.	**Data pre-processing:** Need, data summarization, data cleaning, data integration and transformation, data reduction techniques – Singular Value Decomposition (SVD), Discrete Fourier Transform (DFT), Discrete Wavelet Transform (DWT), data discretization and concept hierarchy generalization.	6
3.	**Data warehouse and OLAP technology:** Data warehouse definition, multidimensional data model(s), data warehouse architecture, OLAP server types, data warehouse implementation, on-line analytical processing and mining,	4
4.	**Data cube computation and data generalization:** Efficient methods for data cube computation, discovery driven exploration of data cubes, complex aggregation, attribute oriented induction for data generalization.	4
5.	**Mining frequent patterns, associations and correlations:** Basic concepts, efficient and scalable frequent itemset mining algorithms, mining various kinds of association rules – multilevel and multidimensional, association rule mining versus correlation analysis, constraint based association mining.	6
6.	**Classification and prediction:** Definition, decision tree induction, Bayesian classification, rule based classification, classification by backpropagation and support vector machines, associative classification, lazy learners, prediction, accuracy and error measures.	6

7.	**Cluster analysis:** Definition, clustering algorithms – partitioning, hierarchical, density based, grid based and model based; Clustering high dimensional data, constraint based cluster analysis, outlier analysis – density based and distance based.	6
8.	**Data mining on complex data and applications:** Algorithms for mining of spatial data, multimedia data, text data; Data mining applications, social impacts of data mining, trends in data mining.	7
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors / Books / Publishers	Year of Publication
1.	Han, J. and Kamber, M., " Data Mining - Concepts and Techniques", 3rd Ed., Morgan Kaufmann Series.	2011
2.	Ali, A. B. M. S. and Wasimi, S. A., "Data Mining - Methods and Techniques", Cengage Publishers.	2009
3.	Tan, P.N., Steinbach, M. and Kumar, V., "Introduction to Data Mining", Addison Wesley – Pearson.	2008
4.	Pujari, A. K., "Data Mining Techniques", 4th Ed., Sangam Books.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-516** Course Title: **Modeling and Simulation**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7.Subject Area**: DEC**

8. Pre-requisite**: Knowledge of Probability theory**

9. Objective: To acquaint the student to modeling and simulation techniques for discrete, dynamic and stochastic systems.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction:** Systems, mode ls, deterministic a nd stochastic systems, static and dynamic systems, discrete event simulation, continuous simulation, Monte Carlo simulation.	4
2.	**Discrete Event Simulation:** Time-advance mechanisms, event modeling of di screte d ynamic s ystems, event graphs, pr ocess oriented a nd event or iented approaches, single-server s ingle queue model.	4
3.	**GPSS:** Program m odel, entities a nd t ransactions, bl ocks i n GPSS, us er de fined f unctions, S NA, l ogic s witches, s ave locations, us er c hains, t abulation of r esult, pr ogramming examples.	8
4.	**Random N umber Generation:** Congruence generators, l ong period generators, statistical qua lity m easures o f g enerators, uniformity a nd i ndependence t esting, chi-square a nd ot her hypotheses testing, runs testing.	5
5.	**Random V ariate G eneration:** random va riable, pr obability density and distribution f unctions, Location, s cale a nd s hape parameters, di screte a nd c ontinuous pr obability distributions; Inverse t ransform m ethod, c omposition a nd a cceptance-rejection m ethods, e fficiency and qua lity measures of generators; Input M odelling, s election of di stribution f or a random s ource, f itting di stributions t o da ta, c onstructing empirical distributions from data.	6
6.	**Random Processes an d Queuing Models:** random pr ocess, discrete/continuous t ime pr ocesses, Markovian pr operty, Markov c hain, state tr ansition diagrams, birth-death process, Little's theorem, steady state analysis of M/M/1 model; multi-	10

	server models, M /G/1 and ot her qu euing m odels, Burke's theorem, network of queues, Jackson theorem.	
7.	**Network Si mulation:** SimEvent tool bo x in M ATLAB, general features of network simulation packages, case study of OMNET++/ns2/ns3/NetSim.	5
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Karian, Z.A. and Dudewicz, E.J., "Modern Statistical Systems and GPSS Simulation", 2nd Ed., CRC Press.	1999
2.	Banks, J ., C arson, L.S., N elson, B .L. a nd N icol, D .M., "Discrete E vent S ystem S imulation", 4th Ed., P earson Education.	2007
3.	Law, A .M. a nd K elton, W .D., " Simulation, Modeling a nd Analysis", 3rd Ed., Tata McGraw-Hill.	2003
4.	Alberto L eon-Garcia, "Probability and R andom Processes f or Electrical Engineers", 2nd Ed., Pearson Education	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-517** Course Title: **Advanced topics in Software Engineering**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weightage: **CWS** 25 **PRS** 00 25 50 00

5. Credits: 0 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: Student must have the knowledge of basics concepts of software engineering.

8. Subject Area: **MSC/DHC**

9. Objective: To introduce the advanced concepts related to software engineering, metrics, and technical aspects of project management.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Product Metrics: Software Quality, Framework for product metrics, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.	5
2.	Web Engineering: Engineering Layers, Engineering Process, Formulating web based systems, Planning, Team, Project Management, Metrics for Web Engineering and WebApps, Analysis model for WebApps, Content Model, Interaction Model, Functional model, Configuration model, Navigation analysis, WebApp Design and Testing.	8
3.	Cleanroom software engineering: Clean Room approach, functional specification, Cleanroom design, Cleanroom testing.	4
4.	Component based Development: The CBSE Process, Domain engineering, Component based development, Classifying and Retrieving Components, Economics of CBSE.	5
5.	Formal Methods: Basics, Mathematics in Software Development, mathematical preliminaries, applying	7

	mathematical not ations f or f ormal s pecification, Object Constraint language.	
6.	Formal S pecification: F ormal S pecification in the S oftware process, S ub-system i nterface s pecification, Behavioral Specification.	7
7.	Agile D evelopment: A gile p ractices, extreme pr ogramming, planning, t esting, r efactoring, A gile d esign b asics. S oftware process models and metrics for evolving technologies.	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books / Authors	Year of Publication
1.	Duke, R . a nd R ose, G ., "Formal O bject O riented Specification Using O bject-Z", Cornerstones of C omputing S eries (editors: R . Bird, C.A.R. Hoare), Macmillan Press.	2000
2.	Diller,A., " *Z:* An Introduction t o F ormal M ethods", 2nd e d., Wiley.	1994
3.	Heineman, G.T., and Councill, W.T., "Component-Based Software Engineering: Putting the Pieces Together", Pearson Higher Education/Addison Wesley.	2001
4.	Prowell, S .J., Trammell, C .J., L inger, R .C., P oore, J.H., "Cleanroom Software Engineering: Technology and Process", Addison Wesley.	1999
5.	Pressman R., S., "Software Engineering: A Practitioner's Approach", 6th Ed., Tata McGraw-Hill.	2010
6.	Sommerville, I., "Software Engineering", 6th Ed., Pearson Education.	2007
7.	Pressman, R. S. and Lowe, D., "Web Engineering: A Practitioner's Approach", Special Indian Edition, Tata McGraw-Hill.	2008
8.	Martin, R.C., Agile Software Development: Principles, Patterns, and Practics, Pearson Education Publisher.	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Computer Science and Engineering**

1. Subject Code: CSN-518 **Course Title:** Logic and Automated Reasoning

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 25 50 00

5. Credits**:** 0 4 6. Semester **Spring**

7. Pre-requisite**: NIL** 8. Subject Area**:** MSC/**DHC**

9. Objective: To provide the foundations of some basic logical languages and their mechanization.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Propositional L ogic: syntax, s emantics, s oundness a nd c ompleteness theorems.	8
2.	Boolean s atisfiability p roblem (SAT): nor mal f orms, H orn c lauses, resolution principle, DPLL algorithm, recent SAT solvers.	6
3.	First-order L ogic**:** syntax, s emantics, s oundness and completeness theorems.	8
4.	Higher-order Logic (HOL): syntax, semantics, and types.	8
5.	Automated theorem p roving: F irst-order t heorem pr oving, uni fication, term rewriting.	6
6.	Theorem provers for HOL: Isabelle/Coq	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Huth, M . a nd R yan, M ., " Logic i n C omputer S cience: M odeling a nd Reasoning About Systems", Cambridge University Press.	2005
2.	Nipkow, T. Paulson, L. Wenzel, M. "Isabelle/HOL a proof assistant for higher-order logic."	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-519** Course Title: **Social Network Analysis**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory :3** **Practical :0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits: **4** 6. Semester Spring 7. Pre-requisite: **Nil**

8. Subject Area: **DCC**

9. Objective: To introduce the basic notions used for social network analysis.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.	4
2.	Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks	4
3.	Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Epidemics and information cascades	4
4.	Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions, Ego networks, Weak ties, Structural holes	6
5.	Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity	6
6.	The Erdos Renyi Model, Clustering Models, Preferential Attachment	6
7.	Navigation in Networks Revisited, Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory	6
8.	Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors
1.	S. Wasserman and K. Faust. *Social Network Analysis: Methods and Applications* (Cambridge, Cambridge University Press, 1994).
2.	D. Easley and J. Kleinberg, *Networks, Crowds and Markets: Reasoning about a highly connected world*

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-520** Course Title: **Cloud Computing**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Spring** 7.Subject Area**: DEC**

8. Pre-requisite**: CSN-341**

9. O bjective: This c ourse w ill c over th e s tudy of v arious algorithms invol ved in better implementing the c loud-based s ystems s tarting t hrough f undamentals of deployment.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models.	3
2.	Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.	5
3.	Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from Inside and Outside a Cloud Architecture. MapReduce and its extensions to Cloud Computing, HDFS, and GFS.	7
4.	Interoperability and Service Monitoring: Issues with interoperability, Vendor lock-in, Interoperability approaches. SLA Management, Metering Issues, and Report generation.	5
5.	Resource Management and Load Balancing: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques.	9
6.	Migration and Fault Tolerance: Broad Aspects of Migration into Cloud, Migration of virtual Machines and techniques. Fault Tolerance Mechanisms.	3

7.	Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues. IDS: host-based and network-based, Security-as-a-Service. Trust Management, Identity Management, and Access Controls Techniques	7
8.	Advances: Grid of Clouds, Green Cloud, Mobile Cloud Computing	3
	Total	**42**

11. Suggested Books:

Sl. No.	**Name of Books / Authors**	**Year of Publication**
1.	Cloud Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers	2011
2.	Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers	2010
3.	Cloud Computing : Web-based Applications that change the way you work and collaborate online, Michael Miller, Pearson Education	2008
4.	Mastering Cloud computing, Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, McGraw Hill	2013
5.	Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, David S. Linthicum	2010
6.	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly	2010
7.	Cloud Computing : A Practical Approach, Toby Velte, Antohy T Velte, Robert Elsenpeter, McGraw Hill	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Computer Science and Engineering**

1. Subject Code: **CSN-521** Course Title: **Mobile and Pervasive Computing**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 0 3 **Practical** 0 0

4. Relative Weight: **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 00

5. Credits: 0 4 6. Semester [ ] **Autumn** [√] **Spring** [ ] **Both**

7. Pre-requisite: **Nil**

8. Subject Area: **DCC**

9. Objective: To familiarize students with the concepts and issues of mobile and pervasive computing technologies.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Introduction to mobile computing and pervasive/ubiquitous computing, Pervasive computing systems - HP's Cooltown, Microsoft's EasyLiving	5
2.	Enabling technologies for mobile and pervasive computing: sensor technology and wireless sensor networks, RFID technology, smartphones	10
3.	Mobile and pervasive networking: wireless TCP, Mobile IP, ad-hoc routing; data access and management; pervasive computing middleware: AURA, GAIA, ONE.WORLD, service discovery	10
4.	Context-aware computing: location-aware systems-Active Badge, RADAR, Cricket, GPS; location-aware services; issues and challenges in context-awareness	5
5.	Security and privacy in pervasive and mobile computing environment	5
6.	Applications: Internet of Things, smart homes/offices, intelligent traffic systems, social computing, wearable computing	7
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/Authors
1.	Jochen B urkhardt, Pervasive C omputing : Technology and A rchitecture of M obile Internet Applications 14th Edition, Pearson Education Singapore Pte Ltd 2002.
2.	Stefan Poslad, Ubiquitous C omputing: Smart D evices, E nvironments And I nteractions 1st Edition, 2010, Wiley India Pvt Ltd
3.	Laurence T . Y ang, Handbook O n M obile And U biquitous C omputing S tatus And Perspective, 2012, CRC Press

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

NAME OF THE DEPARTMENT: Computer Science and Engineering

1. **Subject Code: CSN-522** **Course Title:** Advanced Graph Theory
2. **Contact Hours:** L: _3__; T: __1___; P: __0___
3. **Examination Duration (Hrs.): Theory** 0 3 **Practical** - -
4. **Relative Weightage:** CWS 2 5 MTE 2 5 ETE 5 0
5. **Credits:** 0 4 6. **Semester:** ( ) Spring ( ) Autumn (√) Both
7. **Pre-requisite: CS106**
8. **Subject Area: MSC/DHC**
9. **Objective of t he course:** The objective of this course is to provide the students a detailed understanding of graph theory.
10. **Details of the Course:**

S. No.	Particulars	Contact Hours
1	**Review o f b asics:** Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group; Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem, minimum spanning trees. Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference,	04
2	**Matchings:** Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem;	10
3	**Extremal Pro blems:**Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces.	10
4	**Directed G raphs :** Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branching.	06
5	**Networks and flows:** Flow cuts, max flow min cut theorem, perfect square.	06
6	**Random Graphs:**The basic models - use of expectations, simple properties of almost all graphs, almost determined variables – use of variance, Hamiltonian cycles, the phase transition.	06
	Total	**42**

11. Suggested Books:

S.No.	Author(s)/Name of Books/Publishers	Year of Publication
1	Douglas B. West, Introduction to Graph Theory, Prentice Hall of India.	2002
2	Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science. Prentice-Hall.	2004
3	Frank Harary, Graph Theory, Narosa.	2000
4	R. Ahuja, T. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications, Prentice-Hall.	
5	Bollobas, Bela, Modern Graph Theory, Springer	
6	Diestel, R. Graph Theory, Springer	

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

Name of Department: Computer Science and Engineering

1. **Subject Code: CSN-523** **Course Title:** Computational Geometry
2. **Contact Hours L :** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs) : Theory** 03 **Practical**
4. **Relative Weightage: CWS** 25 **MTE** 25 **ETE** 50
5. **Credits** 04 Spring 6**. Semester**
7. **Pre Requisite: CSN-212**
8. **Subject Area: DEC**
9. **Objective Of Course:** To introduce geometric algorithms and to give an exposure to algorithms and data structures for geometric problems.
10. **Details Of Course:**

S. No.	Topics	No. of Lectures
1	**Polygon Triangulation:** Triangulation Theory, Area of Polygon, Segment intersection, Segment-triangle intersection. **Polygon Partitioning**: Monotone Partitioning, Trapezoidalization, Partition into Monotone Mountains, Linear-Time Triangulation, Convex Partitioning.	6
2	**Convex Hulls in Two Dimensions:** Definitions of Convexity and Convex Hulls, Naive Algorithms for Extreme Points, Gift Wrapping, QuickHull, Graham's Algorithm, Lower Bound, Incremental Algorithm, Divide and Conquer	5
3	**Convex Hulls in Three Dimensions:** Polyhedra and data structures, Gift wrapping, Preparata-Hong algorithm, Incremental algorithm, Randomized incremental algorithm	6
4	**Voronoi Diagrams:** Definitions and Basic Properties, Delaunay Triangulations, Algorithms, Applications in Detail, Medial Axis, Connection to Convex Hulls, Connection to Arrangements	6
5	**Arrangements:** Combinatorics of Arrangements, Incremental Algorithm, Three and Higher Dimensions, Duality, Higher-Order Voronoi Diagrams,	6

	Applications	
6	**Search an d I ntersection**: S egment-Segment Intersection, S egment-Triangle Intersection, Point in Polygon, Point in Polyhedron, Intersection of C onvex P olygons, Intersection of Segments, Intersection of N on-convex Polygons, Extreme Point of Convex Polygon, Extremal Polytope Queries, Planar Point Location	8
7	**Motion Planning**: Shortest Paths, Moving a Disk, Translating a Convex Polygon, Moving a Ladder, Robot Arm Motion, Separability	5
	Total	42

11. **Books recommended**

S. No	Name of Authors/Books/ Publishers	Year of Publication
1	M. de Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf**, Computational Geometry: Algorithms and Applications (2nd Edition)**, , Springer-Verlag.	2000
2	J. O'Rourke, **Computational Geometry in C**, 2nd ed., Cambridge Univ. Press, 1998.	1998
3	B. Casselman, **Mathematical Illustrations: A Manual of Geometry and PostScript**, Springer-Verlag,. (http://www.math.ubc.ca/~cass/graphics/manual)	2005
4	K. Mulmuley, **Computational Geometry: An Introduction Through Randomized Algorithms**, Prentice Hall.	1994

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics and Communication Engineering**

1. Subject Code: **ECN-102** Course Title: **Fundamentals of Electronics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage**: CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: ESC**

8. Pre-requisite**: Nil**

9. Objective: To impart knowledge of basic principles of electronics to UG students from other disciplines of engineering and science.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of properties of metals, dielectrics and semiconductors.	**1**
2.	**Diodes**: Working principle and characteristics and diode applications (rectification with capacitive filter and zener regulation).	**4**
3.	**BJT**: Operation and characteristics, brief overview of DC biasing, 're' model, Amplifier (CE, CB and CC).	**6**
4.	**MOSFET**: Introduction to MOSFET operation and characteristics.	**1**
5.	**Operational Amplifiers**: Input modes and parameters, introduction to concept of negative feedback, negative feedback in OPAMP, bias currents and offsets, open and closed loop responses.	**5**
6.	**Op-Amp Applications**: Comparator, summing, integrator, differentiator, instrumentation amplifiers, isolation amplifiers, Operational Transconductance Amplifiers, Log and Antilog amplifiers, Converters, Introduction to OPAMP based active filters, Brief description of OPAMP based oscillators.	**8**
7.	**Basic Digital Electronics**: Binary number system, Boolean algebra, Logic gates, adders, one-bit memory, flip-flops (SR, JK), shift registers, Asynchronous counter.	**8**
8.	**Introduction to microprocessor**: Four-bit microprocessor architecture, stored program computer, instruction set and basic assembly language programming.	**9**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Boylstead R.L., Nashelsky L., "Electronic D evices and Circuit Theory", Pearson, 10th Edition.	2009
2.	Floyd T .L., Buchla D.L., " Electronics Fundamentals: C ircuits, Devices and Applications", 8th Edition	2010
3.	Millman J., Halkias C .C., J it S ., " Electronic D evices a nd C ircuits", Tata McGraw-Hill, 2nd Edition.	2007
4.	Dorf R.C., Smith R.J., "Circuits, Devices and Systems: A First Course in Electrical Engineering", 5th Edition	1991

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics and Communication Engineering**

1. Subject Code: **ECN-104** Course Title: **Digital Logic Design**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory : 3** **Practical : 0**

4. Relative Weightage**: CWS : 25** **PRS: 0** **MTE: 25** **ETE : 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**: NIL**

9. Objective: To acquaint the students with the fundamental principles of Digital Logic Circuits and their design.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Number systems and Boolean algebra**: Introduction to number system and Boolean algebra; Boolean identities, basic logic functions, standard forms of logic expressions, simplification of logic expressions.	**5**
2.	**Logic families:** Brief overview of Transistor as a switch; Logic gate characteristics – propagation delay, speed, noise margin, fan-out and power dissipation; Standard TTL and static CMOS gates.	**4**
3.	**Combinational logic**: Arithmetic circuits, decoders, encoders, multiplexers, de-multiplexers, and their use in logic synthesis; Hazards in combinational circuits.	**6**
4.	**Introduction to VHDL**: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.	**6**
5.	**Sequential logic circuits**: Latches and Flip Flops (SR, D, JK, T); Timing in sequential circuits; Shift register; Counters – synchronous, asynchronous; Sequential circuit design examples in VHDL and simulation.	**6**
6.	**Finite state machines**: Basic concepts and design; Moore and Mealy machines examples; State minimization/reduction, state assignment; Finite state machine design case studies and FSM circuit design examples in VHDL and simulation.	**7**
7.	ROM and RAM, PLA, PAL and FPGA; RTL based design projects and their implementation in FPGA using VHDL.	**5**

8.	Astable and monostable multivibrator circuits using basic logic gates; Internal structure of 555 and its applications, clock circuits.	**3**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 4th Edition.	2006
2.	Katz R.H., Borriello G., "Contemporary Logic Desing", Prentice Hall India, 2nd Edition.	2008
3.	Kohavi Z., Jha N.K., "Switching and Finite Automata Theory", Cambridge University Press, India, 2nd Edition.	2011
4.	Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th Edition.	2008
5.	Harris D., Harris S., "Digital Design and Computer Architecture", Elsevier Publications, 2nd Edition.	2007
6.	Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd Edition.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Electronics and Computer Engineering**

1. Subject Code: **ECN-203** Course Title: **Signals and Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory3** **Practical0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits:**4** 6. Semester Autumn 7. Pre-requisite: **MA – xxx (Maths 1 + Maths 2)**

8. Subject Area: **DCC**

9. Objective: To provide a thorough understanding of the fundamentals of signals and systems required in the study of signal processing, communication systems and control systems.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	Classification and representation of signals and systems, examples; Impulse response and step response of a system.	6
2.	Review of Fourier series and its exponential representation; Review of Fourier transform and its properties, relationship between Fourier transform and Fourier series; Generalized Fourier transform; Amplitude and phase spectra, energy and power spectral density, signal bandwidth.	6
3.	Relationship of Laplace and Fourier transforms; Transfer function and its block diagram representation, convolution integral and the Fourier transfer function; System properties, linearity and time invariance, bandwidth.	6
4.	Review of z-transform and its properties, geometric evaluation of Fourier transform from pole-zero plot; Discrete time Fourier transform and its properties; Discrete convolution and duality; Discrete Fourier transform and its properties; Computation of discrete time Fourier transform and discrete Fourier transform, approximation of Fourier transform and discrete convolution using discrete Fourier transform.	10
5.	Difference equation, impulse response, convolution sum and transfer function representation of discrete time linear time invariant systems; Transform analysis and networks structures for discrete-time systems.	8
6.	Distortionless transmission, ideal and non-ideal filters, Butterworth and Chebyshev filters; Time and frequency domain analysis of continuous time LTI systems.	6
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Oppenheim, A .V., Willsky, A .S. a nd N awab, S .H., " Signals & Systems", 2nd Ed., Prentice-Hall of India.	1997
2.	Haykin, S . a nd V an B een, B ., " Signals a nd S ystems" 2 nd Ed., J ohn Wiley & Sons.	2003
3.	Roberts, M.J., "Fundamentals of Signals & Systems", Tata McGraw-Hill.	2007
4.	Ziemer, R.E., Tranter, W.H. and Fannin, D.R., "Signals and Systems: Continuous and Discrete", 4th Ed., Pearson Education.	2001
5.	Lathi, B. P., "Linear Systems and Signals", 2nd Ed., Oxford University Press.	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Electronics and Computer Engineering**

1. Subject Code: **ECN-252** Course Title: **Digital Electronic Circuits Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical :3**

4. Relative Weight: **CWS:0** **PRS:50** **MTE:0** **ETE:0** **PRE:50**

5. Credits: **2** 6. Semester : **Spring** 7. Pre-requisite: **EC - 203**

8. Subject Area: **DCC**

9. Objective: To provide hands-on experience on the various building blocks of digital circuits.

10. Details of the Course:

Sl.No.	Contents	ContactHours
1 2	**Hardware based** Design of binary adders. Design and testing of switch debouncers. Design of TTL- and 555-based multivibrators, timers and clock circuits. Basic programming of 8085 microprocessor. Simple I/O exercises using 8255. **VHDL and FPGA kit based** Design of a 'last-in, first-out'(LIFO) stack or a FIFO queue. (i) Design of a 'rising edge detector' circuit using an FSM. (ii) Design of a debouncing circuit. Design of a UART receiver and transmitter. Design of various types of memory Interfacing of a PS/2 keyboard (Controlling the stopwatch through a PS/2 keyboard) Interfacing of a VGA monitor (A simple animation) Design of a simple single-cycle 'reduced instruction set computer (RISC)' based on the MIPS design Design of a pipelined RISC processor with various enhancements like forwarding, hazard detection	14 x 4
	Total	**56**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mano, M .M. a nd Ciletti, M .D., " Digital D esign", 4 th Ed., P rentice-Hall.	2006
2.	Gaonkar, R .S., " Microprocessor A rchitecture, P rogramming a nd Applications", 5th Ed., Penram International.	2007
3.	Pong P . C hu, " FPGA P rototyping b y V HDL E xamples: X ilinx Spartan-3 Version" Wiley.	2008
4.	Bhasker, J., "A VHDL Primer," Pearson India.	2005
5.	Volnei A. Pedroni , "Circuit Design and Simulation with VHDL," 2nd Ed. PHI India	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

1. Subject Code: **MAN-010** Course Title: **Optimization Techniques**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

8. Pre-requisite**: Nil**

9. Objective: To acquaint the students with the basic concepts of Optimization.

10. Details of Course

S. No.	Contents	Contact Hours
1	Different Types of OR Models, Case studies in Engineering applications	**2**
2	Convex Sets, Graphical Method, Simplex Method, Big – M Method, Two Phase Method, Revised Simplex Method	**10**
3	Duality Theory, Dual Simplex Method, Sensitivity Analysis	**7**
4	Cutting Plane and Branch and Bound Techniques for all Integer and Mixed Integer Programming Problems, 0-1 Integer Problems, Travelling Salesman Problem, Cargo Loading Problem	**9**
5	Transportation Problems and Assignment Problems	**4**
6	Game Theory: Rectangular Games, Minmax Theorem, Graphical Solution of 2 X n and m X 2 games, Reduction to Linear Programming Problems	**5**
7	Sequencing and Scheduling: Processing of Jobs through Machines, CPM and PERT	**5**
	TOTAL	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Taha, H.A., "Operations Research: An Introduction", MacMillan Pub Co., NY, Ninth Edition (Reprint).	2013
2.	Ravindran, A., Phillips, D.T. and Solberg, J.J., "Operations Research: Principles and Practice", John Wiley and Sons, NY, Second Edition (Reprint).	2012
3.	Pant, J.C., "Introduction to Optimization", Jain Brothers,	2012
4.	Hillier, F. S. and Lieberman, G. J., "Introduction to Operations Research," 9th Edition, McGraw-Hill	2009
5.	Mittal, K.V. and Mohan, C., " Optimization Methods in System Analysis and Operations Research"	1996
6.	Mohan C. and Deep K., "Optimization Techniques"	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mechanical & Industrial Engineering**

1. Subject Code: **MIN-106** Course Title: **Engineering Thermodynamics**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage: **CWS: 15** **PRS: 15** **MTE: 30** **ETE: 40** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **DCC/ESC**

8. Pre-requisite: **Nil**

9. Objective: To familiarize the students with basic concepts of macroscopic thermodynamics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to thermodynamic system, surrounding, state, process, properties, equilibrium, heat and work, Zeroth Law of Thermodynamics	**3**
2.	**Properties of Pure Simple Compressible Substance:** PvT surface, Pv, T v, T P di agrams. E quation of s tate f or i deal a nd r eal ga ses. Virial equation of state, van der Waal equation, use of steam tables and Mollier diagram	**6**
3.	**First L aw of T hermodynamics:** First l aw a pplication t o non-flow processes s uch as i sochoric, i sobaric, i sothermal, a diabatic a nd polytropic pr ocesses. Steady f low en ergy equ ation, f low w ork. Application to various practical systems viz. no zzles, di ffuser, turbines, he at e xchangers e tc. A pplication of energy e quation t o transient flow problems.	**7**
4.	**Second L aw o f T hermodynamics:** Second l aw, r eversible a nd irreversible p rocesses, Clausius a nd K elvin P lanck s tatements, Carnot cycle, corollaries of second law: thermodynamic temperature scale, C lausius i nequality, e ntropy as a p roperty, pr inciple o f increase of entropy. Calculation of entropy change.	**6**
5.	**Entropy an d E xergy:** Entropy a nd i ts g eneration, e ntropy ba lance for c losed s ystem a nd for c ontrol vol ume, ba sic concepts of e xergy and i rreversibility, exergy for closed s ystem and c ontrol vol ume, exegetic efficiency.	**5**

6.	**Gas-Vapour M ixtures and A ir-conditioning:** Properties of g as-vapour m ixtures, a diabatic-saturation a nd w et-bulb t emperatures, psychrometric chart, human comfort and air conditioning, various air conditioning processes.	**4**
7.	**Gas and Vapour Power Cycles:** Otto, Diesel, Dual, Stirling, Joule-Brayton c ycle. Thermal ef ficiency and mean effective pr essure, Rankine cycle.	**5**
8.	**Refrigeration C ycles:** reverse C arnot c ycle, v apour c ompression refrigeration cycle.	**4**
	TOTAL	**42**

List of Experiments:

1. Study of P-V-T surface of H_2O and CO_2.
2. Determine P-T relationship for steam and verify Clausius Clapeyron equation.
3. Determine the calorific value of coal using Bomb calorimeter.
4. Analysing exhaust gases using Orsat apparatus.
5. Determine Relative Humidity and Specific Humidity of air using Sling Psychrometer and Psychrometric Chart.
6. Determine COP of a vapour compression refrigeration unit.
7. Analysing different processes on an air conditioning unit.

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Borgnakke, C . a nd Sonntag, R .E., " F undamentals of Thermodynamics," Wiley India	2011
2.	Cengel, Y.A. a nd Boles, M .A., " Thermodynamics an Engineering Approach", Tata McGraw-Hill	2008
3.	Moran, M .J. a nd S hapiro, H .M., " Fundamentals of E ngineering Thermodynamics", 4th Ed., John Wiley	2010
4.	Russel, L.D., Adebiyi, G. A.," Engineering Thermodynamics", Oxford University Press	2007
5.	Arora, C.P., "Thermodynamics", Tata-McGraw Hill	2001
6.	Nag, P.K., "Engineering Thermodynamics", Tata-McGraw Hill	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE **:** **Department of Physics**

1. Subject Code**:** **PHN-006** Course Title**: Quantum Mechanics and Statistical Mechanics**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weightage**:** **CWS: 15** **PRS: 15** **MTE: 30** **ETE: 40** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

8. Pre-requisite**: None**

9. Objective: To provide basic knowledge and applications of Statistical Mechanics and Quantum Mechanics.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Postulates of classical statistical mechanics, the three ensembles: micro canonical, canonical and grand canonical; Micro canonical: Definition of entropy from microstates, Derivation of the laws of thermodynamics, concept of temperature from the derivative of entropy.	**8**
2	Statistical distributions: Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions; Applications: equipartition of energy, Bose-Einstein Condensation, Black body radiation: Classical Rayleigh-Jeans law, Wien's law, Planck's Quantum radiation law, Stefan's law, Wien's displacement law, Stimulated emission, Einstein's A and B coefficients, Specific heat of solids, free electrons in a metal.	**10**
3	Photoelectric effect, Compton effect, Frank-Hertz experiment, wave particle duality and wave packets, de Broglie waves, phase and group velocities, Davisson-Germer experiment and gamma ray scattering from electrons, uncertainty principle (single slit thought experiment), applications of the uncertainty principle.	**7**
4	Basic postulates of quantum mechanics and physical meaning of the wave function, Schrödinger wave equation, stationary states, expectation values, probability current density; Applications: Particle in a 1-D box, 1-D step potential, reflection and transmission by a barrier and tunneling and their applications in electronics, electron in periodic potential, energy band gap, qualitative discussion of Kronig-Penney model, 1-D linear harmonic oscillator.	**11**
5	H-atom and the related quantum numbers *(n,l,m)*, normal and anomalous Zeeman effect, Anomalous Zeeman effect (Na D1 and D2 lines), Stern-Gerlach experiment, Fine structure of $H_{\square}$ line.	**6**

	Total	**42**

List of experiments:

1. Study of magnetic field of a pair of coils in Helmholtz arrangement
2. Determination of e/m
3. Determination of first excitation potential of a gas by Frank-Hertz experiment
4. Determination of Stefan's constant
5. Determination of Planck's constant by radiation
6. To study and verify Malus' law
7. Study of polarization of light using quarter wave plate
8. Determination of Brewster's angle at glass-air interface
9. Determination of width of a slit by single-slit diffraction pattern
10. Four probe method of finding resistivity of semiconductor
11. Quincke's Method for determining mass susceptibility
12. Wavelength of Na light by Newton's ring method

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	A. Beiser, "Concepts of Modern Physics", Tata McGraw Hill	2009
2.	F. Reif," Fundamentals of Statistical and Thermal Physics", Sarat	2010
3.	R.P. Feynman, "The Feynman Lectures On Physics (Vol. 1-3)", Narosa	2008
4.	I.S. Tyagi, "Principles of Quantum Mechanics", Pearson Education	2013
5.	D.J. Griffiths," Introduction t o Quantum M echanics", Pearson Education	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **DEPARTMENT OF CIVIL ENGINEERING**

1. Subject code: **CEN-105** Course Title: **Introduction to Environmental Studies**
2. Contact Hours: **L: 3 T: 0 P: 0**
3. Examination Duration (Hrs): **Theory:** 3 **Practical:** 0
4. Relative Weightage: **CWS:** 15 **PRS:** 0 **MTE:** 35 **ETE:** 50 **PRE:** 00
5. Credits: **3** 6. Semester: **Autumn** 7. Subject Area: **GSC**
8. Pre-requisite: **Nil**
9. Objective: To introduce fundamentals of environmental pollution and its control.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Overview: Environment and Natural Processes; Development (Resource Utilization & Waste Generation); Environmental issues; Concept of Sustainable Development; Issues affecting future development (population, urbanization, health, water scarcity, energy, climate change, toxic chemicals, finite resources etc.); Environmental units	6
2.	Air –Water interaction: (Liquid phase-gas phase equilibrium) Henry's Law Constant with units, Dimensionless Henry's Law Constant	3
3.	Water –Soil Interaction: Carbonate System (Alkalinity and buffering capacity); Major ions in water; Natural Organic Matter (NOMs); Water quality parameters; Physical processes (Mass Balance): Spatio-temporal variation in quality of river water, lake water, ground water; Water quality standards	9
4.	Wetlands, water treatment and wastewater treatment .	6
5.	Air resources: Atmosphere; Air pollutants; Emissions and control of air pollutants; Atmospheric meteorology and dispersion; Transport of air (global, regional, local); Air/ atmospheric stability; Plume shape; Gaussian modeling; Air quality standards	9
6.	Land pollution and solid waste management	3
7.	Ecosystem: Structure and function; Energy flow in ecosystem; Material flow in ecosystem; Biodiversity and ecosystem health; Bio-amplification and bio-magnification	3
8.	Hazardous Waste: Definition; Classification; Storage and management; Site remediation; Environmental Risk: assessment, and management	3
Total		**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e	2008
2.	Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e	2007
3.	Peavy H. S., Rowe D.R. and Tchobanoglous G., "Environmental Engineering", McGraw Hill, New York	1986
4.	Mines R. O. and Lackey L. W. ""Introduction to Environmental Engineering", Prentice Hall, New Yark	2009
5.	Miheicic J. R. and Zimmerman J. B. " Environmental Engineering: Fundamentals, Sustainability, Design" John Wiley and Sons, Inc.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001A** Course Title: **Communication Skills (Basic)**

2. Contact Hours: **L: 1** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits**:** 2 6. Semester**: Autumn/Spring** 7. Subject Area**: HSS**

8. Pre-requisite**: NIL**

9. Objective:
The course intends to build the required communication skills of the students having limited communicative abilities, so that they may communicate effectively in real-life situations

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Understanding the Basics of Communication Skills: Listening, Speaking, Reading & Writing, Scope and Importance	**01**
2.	Grammar & Composition: Time and Tense, Agreement, Active-Passive, Narration, Use of Determiners, Prepositions & Phrasal Verbs	**05**
3.	Vocabulary Building & Writing: Word-formation, Synonyms, Antonyms, Homonyms, One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words	**02**
4.	Introduction to Sounds (Vowels & Consonants) Organs of Speech, Place and Manner of Articulation, Stress & Intonation, Listening Comprehension (Practical Sessions in Language Laboratory)	**02**

5.	Speaking, Countering Stage-fright and Related Barriers to Communication.	**02**
6.	Reading and Comprehension: Two lessons to be identified by the department.	**02**
	Total	**14**

List of Practicals:

1. Ice-breaking Exercises
2. Assignments on Time and Tense, Agreement, Active-Passive
3. Laboratory Session on Narration, Use of Determiners, Prepositions & Phrasal Verbs, Revisionary Exercises & Quiz
4. Laboratory Session on Synonyms, Antonyms, Homonyms
5. Assignments and Practice Sheets on One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words
6. Laboratory Session on Practice of sounds, Intonation and Stress, Listening Comprehension
7. Individual presentation, debates, Extempore & Turncoats
8. Exercises in Composition and Comprehension

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Murphy, Raymond. *Intermediate English Grammar*, New Delhi, Cambridge University Press.	**2009**
2.	Quirk, Randolph & Sidney Greenbaum. *A University Grammar of English*, New Delhi, Pearson.	**2009**
3.	McCarthy, Michael & Felicity O' Dell. *English Vocabulary in Use*, New Delhi, Cambridge University Press	**2010**
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	**2010**
5.	Birchfield, Susan M. *Fowler's Modern English Usage*, New Delhi, OUP.	**2004**
6.	Llyod, Susan M. *Roget's Thesaurus of English Words and Phrases*. New Delhi: Penguin.	**2010**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001B** Course Title: **Communication Skills (Advanced)**

2. Contact Hours: **L: 1** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight**:** **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits**:** 2 6. Semester**: Autumn/Spring** 7. Subject Area**: HSS**

8. Pre-requisite**: NIL**

9. Objective: The course intends to train the learners in using both verbal and non-verbal communication effectively.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Advanced Communication Skills: Scope, Relevance, & Importance	**01**
2.	Soft Skills: Interpersonal Communication; Verbal & Non-verbal, Persuasion, Negotiation, Neuro-Linguistic Programming	**03**
3.	Communication and Media (Social and Popular), The Social and Political Context of Communication, Recent Developments and Current Debates in Media	**04**
4.	Cross-cultural and Global Issues in Communication: Race, Ethnicity, Gender & Diaspora	**03**
5.	Rhetoric and Public Communication, Audience Awareness, Emotionality	**03**
	Total	**14**

List of Experiments:

1. Discussion on the Process of Communication in Personal and Professional Life
2. Group Discussion, Case Studies and Role-Play
3. Assignments on E-mail Etiquette, Social Networking, Blog Writing, Discussions on Current Issues
4. Non-Verbal Communication in Cross-Cultural Situations, Case Studies, Group Discussions and Readings on Topics Related to Race, Ethnicity , Gender and Diaspora
5. Individual Presentations (Audience Awareness, Delivery and Content of Presentation)

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Rentz, Kathryn, Marie E. Flatley & Paula Lentz. *Lesikar's Business Communication CONNECTING IH A DIGITAL WORLD*, McGraw-Hill, Irwin	**2012**
2.	Bovee, Courtland L & John V. Thill. *Business Communication Today*. New Delhi, Pearson Education	**2010**
3.	McMurrey, David A. & Joanne Buckley. *Handbook for Technical Writing*, New Delhi, Cengage Learning.	**2009**
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	**2010**
5.	Allan & Barbara Pease. *The Definitive Book of Body Language*, New York, Bantam	**2004**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HSN-002** Course Title: **Ethics and Self-awareness**

2. Contact Hours: **L: 01** **T: 0 1** **P: 0**

3. Examination Duration (Hrs.): **Theory 2** **Practical 0**

4.Relative Weight**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credit **02** 6. Semester**: Autumn** 7. Subject Area**: HSSC**

8. Pre-requisite**: NIL**

9. Objective: To introduce the concepts pertaining to ethical and moral reasoning and action and to develop self - awareness.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction**: Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.	**1**
2	**Psycho-social theories of moral development**: View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday context.	**3**
3	**Ethical Concerns**: Work Ethics and Work Values, Business Ethics, Human values in organizations.	**3**
4	**Self-Awareness**: Self Concept: Johari Window, Self and Culture, Self Knowledge, Self-Esteem; Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts.	**4**
5.	**Self Development**: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).	**3**
	Total	**14**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication
1.	Hall, Calvin S., Lindzey, Dardner., & Cambell, John B.,"Theories of Personality",Hamilton Printing Company.	1998
2.	Car Alan, "Positive Psychology: The Science of Happiness and Human Strengths", Brunner-Routledge.	2004
3.	Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press.	2004
4.	Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press.	2007
5.	Corey, G., Schneider Corey, M., & Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole.	2011
6.	Snyder, C.R., Lopez, Shane, J., & Pedrotti, J.T., "Positive Psychology" Sage, 2nd edition.	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Mathematics Department**

1. Subject Code: **MAN-001** Course Title: **Mathematics I**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage**:** **CWS** 25 **PRS** 00 25 50 0

5. Credits**:** 4 6. Semester**: Autumn** 7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: **To provide essential knowledge of basic tools of Differential Calculus, Integral Calculus , Vector Calculus and Matrix Algebra for degree students.**

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Matrix Algebra:** Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties. Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	**8**
2.	**Differential Calculus:** Limit, Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers	**12**
3.	**Integral Calculus:** Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia..	**12**
4.	**Vector Calculus:** Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stroke's theorem and their applications.	**10**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K.	2011
2.	R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House.	2005
3.	M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Physics Department**

1. Subject Code: **PHN-005** Course Title: **Electrodynamics and Optics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage**:** **CWS** 25 **PRS** 0 25 50 0

5. Credits**:** 4 6. Semester**: Autumn** 7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: **To familiarize students with the basic principles of electrodynamics and optics and extend its applications to interference, diffraction, and lasers.**

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic principles of electrostatics and magnetostatics, Maxwell's equations in differential form, physical significance of Maxwell's equations., wave equation and its solution for a dielectric medium, plane waves in a dielectric, concept of polarization, linear, circular and elliptical polarization, the Poynting vector, energy density and intensity of an e-m wave, reflection and refraction at the interface of two dielectrics	**14**
2.	Interference of light waves, Young's double slit experiment, interference pattern, intensity distribution, interference with white light, displacement of fringes, phase change on reflection. Interference by division of amplitude, interference by a plane parallel film when illuminated by a plane wave, interference by a film with two non-parallel reflecting surfaces (wedge shaped films), colours of thin films, Newton's rings, the Michelson interferometer. Coherence, Young's double slit and Michelson interferometer to explain coherence, the line width, spatial coherence, optical beats.	**10**
3.	Fraunhofer diffraction, single-slit diffraction pattern, diffraction by a circular aperture, directionality of laser beams, focusing of laser beams, limit of resolution, resolving power of a microscope, two-slit Fraunhofer diffraction, N-slit Fraunhofer diffraction, diffraction grating, grating spectrum and resolving power.	**6**
4.	Polarization and double refraction, wire grid polarizer, polarization by reflection and double refraction, Malus law, Brewster's law, superposition	**6**

	of two disturbances, the mathematical analysis. Phenomenon of double refraction, normal and oblique incidence, interference of polarized light, quarter-wave and half-wave plates, analysis of polarized light, optical activity.	
5.	Basic properties of lasers, spontaneous and stimulated emissions, main components of a laser, ruby and He-Ne laser, semiconductor diode laser	**6**
	Total	**42**

11. Suggested Books:

S. No.	**Name of Authors/ Books/Publishers**	**Year of Publication/Reprint**
1.	D. J. Griffiths, "Introduction of Electrodynamics," PHI Learning Pvt. Ltd.	2009
2.	M. N. O. Sadiku, " Elements of Electromagnetics," Oxford Univ. Press	2009
3.	A. Ghatak, "Optics," 6th Ed., Tata McGraw-Hill Publishing Co. Ltd.	2012
4.	E. Hecht, "Optics," 4th Ed., Pearson Education Pvt. Ltd.	2003
5.	F. Jenkins and H. White, "Fundamentals of Optics," 4th Ed. McGraw Hill	2001