Dr. Babasaheb Ambedkar Marathwada Univeristy

Aurangabad

Department of Computer Science & Information Technology

Reaccredited with 'A' Grade

Curriculum Book

M.Sc. Computer Science

2016-2018

OBE Curriculum with w.e.f. Academic Year 2017-2018

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

DEPARTMENT OF COMPUTER SCIENCE AND
INFORMATION TECHNOLOGY

Syllabus Book of

M.Sc. (Computer Science)

Faculty of Science and Technology

W.E.F. ACADEMIC YEAR JUNE, 2016-18

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Department of Computer Science and Information Technology

Choice Based Credit System (CBCS)
M.Sc. Computer Science
(2016-2018)

SCHEME FOR CHOICE BASED CREDIT SYSTEM (CBCS)
W.E.F. JUNE, 2016 (ACADEMIC YEAR, 2016-18 Onwards)

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M.Sc. (Computer Science) 2016-18

About the Revised Syllabus

- This version came into effect in June 2016. There have been many advancements in Computer Science and Information Technology and consequent changes in needs of society, industry in respect in which the syllabus was required to be updated.
- This document present the revised version of M.Sc. Computer Science syllabus which becomes effective for teaching with immediate effect. It is designed to facilitate students in the development of concept based approach for problem solving using IT as a tool. The self-learning approach is built in the syllabus thereby training the candidate to update themselves on the changing technologies in their area of work. The outstanding syllabus has been designed to produce junior programmers, EDP Assistants, web designers, etc. equipped with latest knowledge and skills.

About Admission Procedure

Department of Computer Science and Information Technology adopted a credit-based system under the Academic Flexibility Program of the University from the academic year 2011-12.

It is a flexible, cafeteria-type learning system with an inbuilt horizontal mobility for students to all desire units of education in the Department/Departments with provision for even inter Departmental mobility for students. CBCS operates on modular pattern based on module/units called "credits", wherein 'credit' defines the quantum of contents/syllabus prepared for a course/paper and determines the minimum number of teaching-learning hours required

OBE & CBCS permits students to:

- Learn at their own pace,
- Choose electives from a wide range of elective courses offered by the department,
- Undergo additional/value added courses and acquire more than the required number of credits, depending upon the learner aptitude,
- Adopt an interdisciplinary approach in learning,
- Make best use of the expertise of faculty across the Department, beside the particular department faculty
- Acquire knowledge, skill and attitude of learning outcomes through participatory teaching and learning and continuous evaluation process

This provides the flexibility to make the system more responsive to the changing needs of our students, the professionals and society. The credit-based system also facilitates the transfer of credits.
Masters programs offered by the Department

1. M. Sc. Computer Science
2. M. Sc. Information Technology
3. M. Phil. Computer Science

Admission/ Promotion in M.Sc. Computer Science Program: M. Sc. Computer Science
Duration: (Four Semesters means Two Academic Years)
Intake: 32
Eligibility:

1. B.Sc. Computer Science OR B.Sc. IT OR B. Sc. Computer Application OR B.E/B. Tech. in Computer Science and Engineering/IT. OR
2. Any Science Graduate with at least one Optional Subject as Computer Science.

Program Outcomes: The overall objective of this course is to cater the need of computational field. The content of this course is according to the current trends of research in Computer Science and requirements of industry expectations. Some courses of this program are exclusively designed towards development of analytical, presentation and personality development skills among the students, through which the students get prepared and trend for building their carrier in computer science and its related applied technology, research and development.

In line with Outcome based education the program specific outcomes for M.Sc. Computer Science programs are as follows

- To be fundamentally strong at core subjects of computer science.
- An ability to apply programming and computational skills for industrial solutions.
- Realizes the importance of lifelong learning and continuous professional development.
- Broad understanding of latest technological trends.
- An ability to identify opportunities for establishing an enterprise for immediate Employment.
- Ability to understand and apply fundamental research concepts.
- An ability to use efficient soft skills for professional development.
- To be rational in professional ethics and attitude.
- Able to use current tools and technologies to cater multidisciplinary needs.
- An ability to indulge in lifelong learning for professional development.
- Ability to sustain in the areas of Data Science and Analytics.

Fees

Sr. No	Head	Fees
1	Tuition	3,500/-
2	Registration	50/-
3	Admission	200/-
4	Library	100/-
5	Laboratory	1,250/-
6	Medical Exam	100/-
7	MKCL	50/-
8	Avishkar, Indradhanushya and Other Students Activities	200/-
	Total	**5,450/•***

***Fees likely to be modified as per the university rule and regulation from time to time and will be applicable to the concern students**

Admission to the M. Sc. Computer Science and M. Sc. Information Technology course in the department will be done on the performance of CET score and on their performance in the qualifying graduate level examination.

The student will apply on the application form of the University provided with the prospectus/e-prospectus. Once the student is admitted to the concern department/ course, he/she will be promoted to next semester with full carryon; subject to the registration of student in every consecutive semester. Dropout student will be allowed to register for respective semester as and when the concerned courses are offered by the department, subject to the condition that his/her tenure should not exceed more than twice the duration of course from the date of first registration at parent department. The admission of concern student will be automatically get cancelled if he/she fails to complete the course in maximum period (Four years/Eight semesters)

Credits and Degrees

i) A candidate who has successfully completed all the core courses, Elective/ Specialized courses and, seminars and project prescribed and or optional service courses approved by the University for the program with prescribed CGPA shall be eligible to receive the degree.

ii) One Credit shall mean one teaching period of one hour per week for one semester (of 15 weeks) for theory courses and two practical/laboratory/field/demonstration hours/ week for one semester.

iii) Every student will have to complete at least 100 credits to obtain the master's degree of M. Sc.

Computer Science/ M. Sc. Information Technology (Post graduate degree) out of which 96 credits should be from this Department and four or eight credits of service courses from this or other Department. However the Department can design the curriculum of more credits and it will be compulsory for the students of this Department to complete the credits accordingly

Courses

(i) Core Course: - A core course is a course that a student admitted to M. Sc. Computer Science/ M. Sc. Information Technology program must successfully completed to receive the degree. Normally no theory course shall have more than 4 credits.

(ii) Elective Course: Means optional course from the basic subject or specialization. The elective course defined specialization that student want to perceive. The horizontal learning path is to be followed by the student for selection of elective course. Department may offer more than one specialization depending availability of resources.

(iii) Service course (SC): The service courses will be offered in third and fourth semesters in the department. Student should complete one service course in each semester.

(iv) Each Course shall include lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / midterm and term end examinations/ paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs.

(iv) Bridge Course: This course specially designed to provide subject prerequisites / skills required by the student prior to learning the defined course in curricula. According to the need of the student department may arrange/schedule the bridge course at the begging of semester.

(v) Attendance: - Students must have 75% of attendance in each Core and Elective course for appearing the examination. However student having 65% attendance with medical certificate may apply to the H.O.D. for commendation of attendance.

Registration for Service Course:

i) The student will register the service course of his interest after the start of semester in the concerned department on official registration form. The teacher in-charge of the respective course will keep the record of the students registered. Maximum fifteen days period will be given from the date of admission for completion of registration procedure. The Departmental Committee shall follow a selection procedure after counselling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other courses.

ii) No student shall be permitted to register for more than one service course in a semester.

iii) The University department shall decide the maximum number of students in each service course taking into account the teachers and Physical facilities available in the Department.

iv) The University may make available to all students a listing of all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the course. This information shall be made available on the University website.
v) Normally no service course shall be offered unless a minimum of 10 Students are registered.
vi) The student shall have to pay the prescribed fee per course per semester/year for the registration as decided by the University.

Departmental Committee:
Every P.G. program of the University/College shall be monitored by a committee constituted for this purpose by the Department. The Committee shall consist of H.O.D. as a Chairman and some/all the teachers of the Department as its members.

Results Grievances Redressal Committee:
The department shall form a Grievance Redressal Committee for each course with the Course Teacher and the HOD. This Committee shall solve all grievances relating to the Assessment of the students.

Awards of Grades
(i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Program. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-I.

Sr. No	Equivalent Percentage	Grade Points	Grade	Grade Description
1.	90.00 – 100	9.00 – 10	O	Outstanding
2.	80.00 – 89.99	8.00 – 8.99	A++	Excellent
3.	70.00 – 79.99	7.00 – 7.99	A+	Exceptional
4.	60.00 – 69.99	6.00 – 6.99	A	Very Good
5.	55.00 – 59.99	5.50 – 5.99	B+	Good
6.	50.00 – 54.99	5.00 – 5.49	B	Fair
7.	45.00 – 49.99	4.50 – 4.99	C+	Average
8.	40.01 – 44.99	4.01 – 4.49	C	Below Average
9.	40	4.0	D	Pass
10.	<40	0.00	F	Fail

Table I: Ten Point Grades and Grade Description

ii) Non-appearance in any examination/ assessment shall be treated as the students have secured zero mark in that subject examination/assessment.
iii) Minimum D grade (4.00 grade points) shall be the limit to clear /pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations. There will be no revaluation or recounting under this system.
iv.) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10

Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

Computation of SGPA (Semester grade point average) &CGPA (Cumulative grade point average)

The computation of SGPA &CGPA, will be as below:

a. **Semester Grade Point Average (SGPA)** is the weighted average of points obtained by a student in a semester and will be computed as follows:

$$SGPA = \frac{Sum(CourseCredit * Number\ of\ Points\ in\ concern\ gained\ by\ student)}{Sum(CourseCredits)}$$

The Semester Grade Point Average (SGPA) for all the four semesters will be mentioned at the end of every semester.

b. **The Cumulative Grade Point Average (CGPA)** will be used to describe the overall performance of a student in all semesters of the course and will be computed as under:

$$CGPA = \frac{Sum(All\ Four\ Semester\ Credits\ gained\ by\ the\ student)}{Sum(Credits\ of\ All\ Semesters)}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Evaluation method:

Each theory course will be of 100 Marks and be divided in to internal examination (Sessional) of 20 Marks and Semester end examination of 80 Marks. (20+80 = 100 Marks). Each Practical course will be of 50 marks. Research project / Internship / field projects if any, will be of 100 marks.

a. Internal Evaluation Method

There shall be two mid semester examinations, first based on 40 percent syllabus taught and second based on 60 percent syllabus taught. The setting of the question papers and the assessment will be done by the concerned teacher who has taught the syllabus. Average score obtained out of two mid semester examinations will be considered for the preparation of final sessional marks/grade.

b. Term end examination and evaluation

i. Semester end examination time table will be declared by the departmental committee and accordingly the concern course teacher will have to set question paper, conduct theory examination, practical examination with external expert, evaluate, satisfy the objection / query of the student (if any) and submit the result to DC.

ii. The semester end examination theory question paper will have two parts (20+60 = 80 Marks)

iii. Template of question paper is designed in light of Outcome based education method and determine the attainment level of students. The pattern of question paper is as below
    a. Q1 will be based on (fill in the blanks/ multiple choice questions/ match columns / state true or false / answer in one sentence) as compulsory questions and it should cover entire syllabus and carries 20 Marks.
    b. Student will require to solve any five questions from Q2 to Q8 where Q2 of type **comprehension**, Q3 and Q4 are **application oriented**, Q5 based on **analysis**, Q6 will be on **synthesis**, Q7 checks **evaluation** ability of student, and Q8 on **Comprehension** ability.

iv. Semester end Practical examinations will be of 50 marks each and students will be examined by one external and one internal examiner. Seminar and Project work (if any) will be evaluated by the external examiners along with guide.

v. At the end of each semester the Committee of Department shall assign grade points and grades to the students.

vi. The Committee of Department shall prepare the copies of the result sheet in duplicate. Every student shall have the right to scrutinize answer scripts of Mid semester/Term end semester examinations and seek clarifications from the teacher regarding evaluation of the scripts immediately thereafter or within 3 days of receiving the evaluated scripts.

vii. The Head of the department shall display the grade points and grades for the notice of students. The head of the department shall send all records of evaluation for Safekeeping to the Controller of Examinations as soon as all the formalities are over.

Grade Card

The University shall issue at the beginning of each semester a grade card for the student, containing the
Grades obtained by the student in the previous semester and his Semester Grade Point Average (SGPA).

The grade card shall list:
(a) The title of the courses along with code taken by the student
(b) The credits associated with the course,
(c) The grade and grade points secured by the student,
(d) The total credits earned by the student in that semester.
(e) The SGPA of the student,
(f) The total credits earned by the students till that semester and
(g) The CGPA of the student (At the end of the IVth Semester).

Cumulative Grade Card

At the end of the IVth semester, the University shall issue Cumulative Grade Card to the Students showing details of Grades obtained by the student in each subject in all semesters along with CG PA and total credits earned.

Course Structure of M. Sc. [Computer Science]

W. E. F. (Academic Year 2017-18)

Course Code	Semester – I Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC401	Constitution of India	2	2	10	40
CSC402	Research Methodology	2	2	10	40
CSC403	Advance Operating System	3	3	20	80
CSC404	Data Structures and Algorithms	3	3	20	80
CSC405	Discrete Mathematical Structures	3	3	20	80
CSC406	Programming in Core Java	3	3	20	80
CSC451	Practical based on CSC403	2	4	-	50
CSC452	Practical based on CSC404	2	4	-	50
CSC453	Practical based on CSC 405	2	4	-	50
CSC454	Practical based on CSC406	2	4	-	50
	Total No. of Credits	24	-	-	-

Course Code	Semester – II Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC407	Research Project Review Writing	1	1	25	-
CSC408	Relational DBMS & SQL	3	3	20	80
CSC409	Software Engineering and CASE Tools	3	3	20	80
CSC410	Compiler Design	3	3	20	80
CSC411	Advance Java	3	3	20	80
CSC412	Computer System Architecture	3	3	20	80
CSC455	Practical based on CSC408	2	4	-	50
CSC456	Practical based on CSC409	2	4	-	50
CSC457	Practical based on CSC 410	2	4	-	50
CSC458	Practical based on CSC411	2	4	-	50
CSC459	Practical based on CSC412	2	4	-	50
	Total No. of Credits	26	-	-	-

Course Code	Semester – III Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC501	Advance Computer Networks	3	3	20	80
CSC502	Computer Graphics	3	3	20	80
-	Elective –I (Generic)	3	3	20	80
CSC551	Project/Dissertation Part –I	12	2 4	100	200
CSC552	Practical based on CSC501	2	4	-	50
CSC553	Practical based on CSC 502	2	4	-	50
-	Practical based on Elective-I	2	4	-	50
	Total No. of Credits	27	-	-	-

Course Code	Semester - IV Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC503	Pattern Recognition	3	3	20	80
-	Elective –II (Discipline Centric)	3	3	20	80
CSC554	Project/Dissertation Part -II	1 2	2 4	100	200
CSC555	Seminars	1	2	-	25
-	Service Course	4	4	20	80
CSC556	Practical based on CSC503	2	4	-	50
-	Practical based on Elective-II	2	4	-	50
	Total No. of Credits	24	-	-	-

Course Code	Elective-I Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC521	Digital Signal Processing	3	3	20	80
CSC522	Digital Image Processing	3	3	20	80
CSC523	Information Theory	3	3	20	80
CSC524	Soft Computing	3	3	20	80
CSC525	Data Mining	3	3	20	80
CSC526	Network Security	3	3	20	80
CSC527	Mobile Computing	3	3	20	80
CSC557	Practical Based on CSC521	2	4	-	50
CSC558	Practical Based on CSC522	2	4	-	50
CSC559	Practical Based on CSC523	2	4	-	50
CSC560	Practical Based on CSC524	2	4	-	50
CSC561	Practical Based on CSC525	2	4	-	50
CSC562	Practical Based on CSC526	2	4	-	50
CSC563	Practical Based on CSC527	2	4	-	50

Elective-II	Total Marks

Course Code	Course Title	No. of Credits	No. of Hrs./Week	Internal	External
CSC528	Data Warehousing	3	3	20	80
CSC529	Biometrics and Security Systems	3	3	20	80
CSC530	Cloud Computing	3	3	20	80
CSC531	Decision Support System	3	3	20	80
CSC532	Remote Sensing and GIS	3	3	20	80
CSC533	Human Computer Interaction	3	3	20	80
CSC534	Computer Vision	3	3	20	80
CSC564	Practical Based on CSC528	2	4	-	50
CSC565	Practical Based on CSC529	2	4	-	50
CSC566	Practical Based on CSC530	2	4	-	50
CSC567	Practical Based on CSC531	2	4	-	50
CSC568	Practical Based on CSC532	2	4	-	50
CSC569	Practical Based on CSC533	2	4	-	50
CSC570	Practical Based on CSC534	2	4	-	50

Total (I+II+III+IV) Semester (24+26+27+27) Credits = 104

Service Courses

The student should opt service course of 4 credits either from parent department or from other department.

Course Code	Elective-II Course Title	No. of Credits	No. of Hrs./Week	Total Marks Internal	External
CSC541	Communication Skills	4	4	20	80
CSC542	Introduction to MATLAB	4	4	20	80
CSC543	Web Developments	4	4	20	80
CSC544	Personality Development	4	4	20	80
CSC545	Aptitude Development	4	4	20	80
CSC546	Android Programming	4	4	20	80
CSC547	Intellectual Property Rights	4	4	20	80

Detailed Syllabus

Semester – I

1. Constitution of India

Course Code	**CSC401**	**Course Title**	**Constitution of India**
Number of Credits	**2 Credits (TH)**	**Internal**	**10%**
Total Contact Hours	**3 Hrs. (TH/Week)**	**External (Semester/Term End Exam)**	**40%**

Prerequisite: There is no prerequisite for the course.

Course Objectives:

1. Student will be able to understand the constitution of India
2. Student will be able to know the constitutional and fundamental rights.

Course Outline:

Unit 1: History of Making of the Indian Constitution: History & Drafting committee, (composition &Working).

Unit 2: Philosophy of the Indian Constitution: Preamble, Salient Features.

Unit 3: Contours of constitutional Rights & duties: Fundamental Rights - Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and educational rights, Right To Constitutional Remedies, Directive Principles of State Policy, Fundamental duties.

Unit 4: Organs of Governance: Parliament – Composition, Qualification and disqualification, Power and function, Executive – President, Governor, Council of Ministers, Judiciary - Appointment and Transfer of Judges, Qualifications, Power and Function.

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian constitution, 1st Edition, 2015.
3. M. P. Jain, Indian constitution Law, 7th Edn, Lexis Nexis, 2014.
4. D. D. Basu, Introduction to India, Lexis Nexis, 2014.
5. M. P. Jain , outline of Indian Legal and Constitutional history , Lexis Nexis , 2014.
6. ग्रॅनव्हिल ऑस्टिन ,संघटना राष्ट्राची कोनशीला , डायमंड प्रकाशन , पुणे , २०१३.
7. भारताचे शासन आणि राजकारण , विद्या प्रकाशन , नागपूर.

Note:

1. All latest volumes of above mentioned books must be preferred. The above list of Books is not an exhaustive one.
2. This Course is bilingual (English & Marathi), The Examination Will also be bilingual

2. Research Methodology

Course Code	**CSC402**	**Course Title**	**Research Methodology**
Number of Credits	**3 Credits (TH)**	**Internal**	**20%**
Total Contact Hours	**3Hrs. (TH/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: No mandatory prerequisites for this course however the student should be able to identify the problem in respective domain.

Course Objectives:

1. To identify the overall process of designing a research study from its inception to its report.
2. To equip students with a basic understanding of the underlying principles of quantitative and qualitative research.
3. To introduce students to the key data generation methods.
4. To enable students to choose the most appropriate research method to address a particular research question.
5. To enable students to gain a basic overview of a range of quantitative and qualitative approaches to analysis.
6. To provide students with the knowledge and skill to undertake the design of a research proposal.

Course Outline:

Unit 1: Definition of research: Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Definition and Dimension of a Theory, Functions and Characteristics; **Types of Theory:** General Theory and Particular/ Empirical Theory. Cases and their Limitations; Causal Relations. Philosophy and validity of research. Objective of research.

Unit 2: Characteristics of research: Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach. **Types of research:** Pure and applied research. Descriptive and explanatory research, Qualitative and quantitative approaches.

Unit 3: Research procedure: Formulating the Research Problem, Literature Review, Developing the objectives, preparing the research design including sample Design, Sample size.

Unit 4: Considerations in selecting research problem: Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.

Unit 5: Outcome of research: Preparation of the Report on conclusions reached. Testing validity of research outcomes. Suggestions and recommendations, identifying future scope.

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.
2. Kothari, C. R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education.

Course Outcomes:

Learning outcomes on successful completion of this course, student should be able to:

- Critically analyze research methodologies identified in existing literature.
- Choose appropriate quantitative or qualitative method to collect data.
- Propose and distinguish appropriate research designs and methodologies to apply to a specific research project.
- Develop a comprehensive research methodology for a research question.
- Apply the understanding of feasibility and practicality of research methodology for a proposed project.

3. Advance Operating System

Course Code	**CSC403**	**Course Title**	**Advance Operating System**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- The students are expected to have basic knowledge of Operating System.
- The students must be comfortable with UNIX and C Programming.

Course Objectives:

This course introduces basic issues in operating systems. Topics include Threads, processes, concurrency, memory management, I/O Control and case studies.

1. To make students able to learn different types of operating systems along with concept of file systems and CPU scheduling algorithms used in operating system.
2. To provide students' knowledge of memory management and deadlock handling algorithms.
3. To provide Hands-on study of Linux operating system design and kernel internals, Thread Programming.

Course Outline:

Unit 1: Introduction: Introduction to hardware support for operating systems: privileged mode execution, saving and restoring CPU state, traps and interrupts, timers, memory protection. Operating system techniques for protecting user and hardware resources. Overview of the key operating system abstractions and the use of system calls to manipulate them. Definition of OS, Types of OS: main Frame, Desktop, Multiprocessor, Distributed, Clustered, Real time, Multi programming, Time Sharing, Embedded OS. Overview of operating systems responsibilities. Operating system components and structures. Desirable Qualities of OS. **Process:** Definition Processes and programs. Implicit and Explicit tasking, Program execution, Independent and Co- operation process, Process relationship, Process - related states, Process State transitions, Process Control Block, Context switches, Threads: Necessity and Advantage of Threads, Types of Threads. System Calls and System call Execution. **Interprocess Communication:** Basic concepts, Shared Memory System, Message Passing: Direct versus Indirect Communication, Critical Sections, Race conditions, Mutual Exclusion. **Process Scheduling:** Objectives of scheduling, Types of Schedulers: Short, Long, Medium, Comparison between schedulers, Scheduling Criteria, Scheduling Algorithms: Types Preemptive and NonPreemptive scheduling, FCFS, RR, SJF and Priority based Scheduling; Evaluation of Scheduling algorithms.

Unit 2: Threads and Concurrency: Threads, process context switch vs thread switch, true concurrency vs pseudo concurrency, operating systems as concurrent programs, concurrency through multi-threading, concurrency through interrupt handling, concurrent access to shared memory, race conditions, mutual exclusion, synchronization primitives based on atomic instructions. Thread programming using OpenMP: OpenMP programming model, Specifying current task in OpenMP, Synchronization Constructs in OpenMP, Data Handling, Library function, Environment variables. **Synchronization Primitives:** Atomic instructions, locks, spinlocks, mutex semaphores, counting semaphores, and their use in solutions to Producer Consumer synchronization. **Classic Synchronization Problems:** Classic synchronization problems: Producer Consumer, Dining

Philosophers, Readers and Writers, Sleeping Barber. **Monitors and Message Passing:** Monitors, condition variables, message passing, and their use in solutions to classic synchronization problems: Producer Consumer, Dining Philosophers, Readers and Writers, Sleeping Barber. **Deadlock:** Definition, Characteristics A resource Allocation graph, livelock, Deadlock prevention, Deadlock avoidance: Banker s Algorithm, Deadlock Detection and Recovery.

Unit 3: Introduction: Overlays and Swapping, Logical and Physical address space, Contiguous allocation methods, Single partition and multiple partition Systems, Relocation Memory Management. **Paging:** Principle of operation, Page allocation, Hardware support for paging, Paging address translation by direct mapping and associate mapping , Protection and sharing, Advantages and disadvantages of paging **Segmentation:** Principle of operation, Address translation, Advantages and disadvantages of segmentation , Comparison between segmentation and Paging. **Virtual Memory:** Necessity, Hardware and control structures, Locality of reference, Page fault, Working set, Dirty page/Dirty bit, Demand paging, Thrashing, Page replacement Policies: FIFO, LRU, NRU.

Unit 4: I/O Management: I/O buffering, Single and Double Buffer schemes, Disk Organization. **File Management:** File Concepts, File descriptor, Access methods: Sequential, indexed and direct, File sharing, Protection, Access rights, File System structure, Byte Sequence, Record sequence and Tree-based, Recovery and Disk formatting. **Secondary Storage Management:** File allocation methods: Contiguous Allocation and Non Contiguous allocation, Chained, Indexed allocation, free space management, Disk Scheduling: FCFS, SSTF, SCAN and C- SCAN, Disk Cache. **Protection and Security:** System performance, protection and security, policies and methods, Access Matrix.

Unit 1: Introduction : History of Linux , Features of Linux, Drawbacks of Linux , Components of Linux, Memory Management Subsystems , Linux Process and Thread Management, File Management System, Device Drivers **Linux Commands and Utilities:** cat, tail, cmp, diff, wc, sort , mkdir, cd, rmdir, pwd, cp, more, passwd, who, whoami, mv, chmod, kill, write, wall, merge , mail, pipes, filters and redirection utilities. **Shell Scripts:** Creating and executing simple shell programs, variables, special characters, comparison of expressions, iteration statements, conditional statements functions. **System Administration:** Installing Linux, Booting the system, Maintaining user accounts, File systems and Special Files, Backups and Restoration.

Book:

1. Operating Systems Concepts, 8th edition, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne; Wiley, ISBN 0-470-12872-0,2010.

Reference Books:

1. Operating Systems: Internals and Design Principles, 6th edition, William Stallings; Prentice Hall, ISBN-10: 0136006329, Operating Systems, 3rd edition
2. Modern Operating Systems, Andrew S. Tanenbaum; Prentice Hall, ISBN-10: 0- 13-600663-9, 2008, 3rd edition.
3. Using OpenMP,Portable Shared Memory Parallel Programming ,Barbara Chapman, Gabriele Jost and Ruud van der Pas, MIT Press,ISBN: 9780262533027 ,2007

Web:

1. http://codex.cs.yale.edu/avi/os-book/OS8/os8c/slide-dir
2. http://openmp.org/wp/resources/
3. http://www.compunity.org/training/tutorials/3%20Overview_OpenMP.pdf

Lab Exercise: CSC451 Practical based on CSC403:

At least five experiments should be carried out on each unit.

By considering the sample experiment list as guidelines:

a. Implementing a CPU scheduling policy in a Linux OS.

b. Implementing a memory management policy in a Linux OS.

c. Implementing a file system in a Linux OS.

d. Process control system calls: The demonstration of fork, execve and wait system calls along with zombie and orphan states.

e. Thread management using OpenMP API.: Thread execution, Static scheduling, Dynamic scheduling, Synchronization Conctructs in OpenMP, Data Handling, Library function, Environment variables.

f. Thread synchronization using counting semaphores and mutual exclusion using mutex. Application to demonstrate: producer-consumer problem with counting semaphores and mutex.

g. Deadlock Avoidance Using Semaphores

h. Implement the deadlock-free solution to Dining Philosophers problem to illustrate the problem of deadlock and/or starvation that can occur when many synchronized threads are competing for limited resources.

i. Demonstrate the following CPU Scheduling Algorithms

a. FCFS b. SJF c. Priority d. Round Robin Demonstrate all Page Replacement Algorithms

a. FIFO b. LRU c. MRU

j. Simulate Bankers algorithm for Deadlock Avoidance

k. Simulate Bankers Algorithm for deadlock Prevention

Course Outcomes:

Students who complete this course successfully are expected to:

- Gain extensive knowledge on principles and modules of operating systems.
- Understand key mechanisms in design of operating systems modules
- Understand process management, concurrent processes and threads, memory management, virtual memory concepts, deadlocks.
- Compare performance of processor scheduling algorithms.
- Produce algorithmic solutions to process synchronization problems.
- Use modern operating system calls such as Linux process and synchronization libraries.
- Learn thread and multicore programming.

3. Data Structure and Algorithms

Course Code	**CSC404**	**Course Title**	**Data Structures and Algorithms**
Number of Credits	**3 Credits (TH) 2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week) 4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- Basic knowledge of the concepts such as inheritance, arrays, strings, memory allocation and pointers.
- Rudimentary understanding of mathematics

Course Objectives:

Understanding basic data structures and algorithms:

1. Define basic static and dynamic data structures and relevant standard algorithms for them.
2. Demonstrate advantages and disadvantages of specific algorithms and data structures.
3. Select basic data structures and algorithms for autonomous realization of simple Programs or program parts.
4. Determine and demonstrate bugs in program, recognize needed basic operations with data Structures.
5. Formulate new solutions for programing problems or improve existing code using learned algorithms and data structures.
6. Evaluate algorithms and data structures in terms of time and memory complexity of basic operations.
7. Analyze the algorithms in terms of memory space and execution time.

Course Outline:

Unit 1: Introduction to Data Structure & Algorithm Notations: Introduction to Data Structure, Types of data structure 1. Primitive 2. Non Primitive 3. Linear 4. Nonlinear, Need of data structure, Algorithm Notations, Format Convention, Name of Algorithm, Introductory Comment, Steps, Data Structure, Arrays, Dynamic Storage allocation, Functions Procedures.

Unit 2: Introduction to Algorithm analysis for Time and Space Requirement: Rate and Growth, Basic time analysis of an algorithm, Order Notation, More timing Analysis, Space analysis of an algorithm. Arrays- Ordered List, Sparse Metrics, Array Representations.

Unit 3: Elementary Stacks Data and Structures: Queues: Organization, Operations, multiple stacks, types of queues, **Linked Lists: Singly Linked List, Doubly Linked List, Doubly Linked List and** Dynamic Storage management, Garbage collection and Compaction.

Unit 4: Trees: Terminology, Binary Trees, Tree representation, Tree traversal, Threaded Binary Trees, Binary Search trees, B Tree, **Graph Algorithms:** Terminology and Representation,**' Traversal:** BFS, DFS, Connected Components and Spanning trees, Dijkstra s algorithm.

Unit-5: Searching and Sorting: Linear Vs Binary search, Sorting: - Insertion Sort, Merge Sort, Quick sort, Radix Sort.

Text Books:

1. Fundamentals of Data Structures by Ellis Horowitz and Sartaj Sahani.
2. Introduction to Algorithms by Thomas H Core man et.al, PHI Publication.

References Books:

1. An introduction to data structures with applications, Jean-Paul Trembley, Paul. G. Soresan, Mc-Graw Hill International Editions
2. Data Structures, Howorithiz, Sahani, Galgotia publication
3. Data Structures and Algorithms, Aho, Hopcroft, Ulman,
4. Data Structures using C and C++, Tannenbaum, PHI.

E-Book:

1. http://www.tutorialspoint.com//java/java_data_structures.htm

Lab Exercise: CSC452 Practical based on CSC404:

Practical (Lab Work):

(a) Students should develop various algorithms in Java.
(b) Analyse the programs in terms of space and time complexity.
(c) Use these programs for further development in their projects.

Course Outcomes:

Learning outcomes on successful completion of this course, student should be able to:

- Understand structure and behavior of Algorithms.
- Better scope to write effective programs.
- Helpful in the preparation of UGC SET/NET, various entry level Examinations.

4. Discrete Mathematical Structure

Course Code	**CSC405**	**Course Title**	**Discrete Mathematical Structure**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term Exam)**	**80%**

Prerequisites:

- The students should have the knowledge of basic algebra.
- The students should have the basic knowledge of set, trees, graphs, etc.

Course Objectives:

1. A course designed to prepare math, computer science majors for a background in abstraction, notation and critical thinking for the mathematics most directly related to computer science. Topics include: logic, relations, functions, basic set theory, countability and counting arguments, proof techniques, mathematical induction, graph theory, combinatorics, discrete probability, recursion, recurrence relations, elementary number theory and graph theory.
2. To introduce a number of Discrete Mathematical Structures (DMS) found to be serving as tools even today in the development of theoretical computer science.
3. Course focuses on of how Discrete Structures can actually support computer engineers to solve problems occurred in the development of programming languages.
4. To develop ideas for easy simulation of a problem in computer science.

Course Outline:

Unit 1: Introduction to Logic: Basic definitions and notation, Appropriate use of quantifiers, Tautologies and contradictions. **Sets:** Notation, operations and relations, Finite and infinite sets, Principle of Inclusion & Exclusion. **Relations and Functions:** Basic definitions and properties, Binary relations, Equivalence relations and partitions.

Unit 2: Mathematical Induction: The Well Ordering Principle, Proof by mathematical induction **Recursion:** Recursively defined sequences, Linear recurrence relations with constant coefficient, **Algorithms:** Basic concept of algorithms, Analysis of algorithms, Euclidean algorithm, Searching and sorting algorithms

Unit 3: Counting Techniques: Fundamental counting techniques,' Permutations and combinations, The Pigeonhole Principle, Binomial coefficients and Pascal s Triangle, Introduction to generating functions.

Unit 4: Graph Theory: Fundamental concepts of graphs and subgraphs, Weighted graphs, Paths and circuits, Euler and Hamiltonian paths and circuits, Planar graphs, Graph coloring. **Trees:** Basic definitions and properties of trees, Spanning trees, weighted trees

Unit 5: Boolean algebra: Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits, **Modeling Computation:** Languages and Grammars, Finite-State Machines with Output, Finite-State Machines with No Output, Language Recognition, Turing Machines.

Book:

1. Discrete Mathematics and Its Applications, Kenneth H. Rosen, Mc Graw Hill Education, ISBN-13: 978-0072899054, 4th revised edition, 1999.

Web:

1. https://people.cs.pitt.edu/~milos/courses/cs441/

Lab Exercise: CSC453 Practical based on CSC405:

At least two experiments should be carried out on each unit. Practical Assignments for DMS:

Practical can be performed in Python or any other programming language, following is the list of some assignments:

1. Write a program to find BCD using Euclidian Algorithm of two numbers.
2. Write a program for linear search using array.
3. Write a program for binary search using array.
4. Write a program to find factors of two number.
5. Write a program for union of two sets using array.
6. Write a program for intersection using array.
7. Write a program for set difference using array.
8. Write a program for recursion using array.
9. How probability density function works. Elaborate.
10. WAP to define sets in along with its operations.
11. Along with these assignments, more programs can be developed that will use Problem Solving techniques in Discrete Mathematical Structures.

Course Outcomes:

Students who complete this course successfully are expected to:

- An indepth knowledge on various discrete structures available.
- Understand the theory and techniques of logic, graphs and trees, and algebraic systems
- Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems
- Communicate mathematical ideas
- Gaining of some confidence on how to deal with problems which may arrive in computer science in near future.
- Solve problems using counting techniques and combinatorics.
- Perform operations on discrete structures such as sets, functions, relations or sequences.
- Solve problems involving recurrence relations and generating functions.
- Construct functions and apply counting techniques on sets in the context of discrete probability.
- Apply algorithms and use definitions to solve problems to proof statements in elementary number theory

5. Programming in Core Java

Course Code	**CSC406**	**Course Title**	**Programming in Core Java**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

Before attending this course, students must have:

- The student should know the Object-oriented programming Concepts
- Understanding of the basics of structured programming, including concepts such as flow control, variables, and parameters, and function calls.

Course Objectives:

1. Programming is most core component of Computer Science.
2. Other aspects of the subject is specializations or Master hands on core programming JAVA.
3. Therefore the course provide to students with the knowledge and skills needed to develop applications in Java using Open source platform.
4. The course focuses on fundamental concepts, designing user interfaces, program structure, language syntax, and implementation details.
5. This is the first course in the Java Certification Exam and will serve as the entry point for other Advance Java Courses.
6. This Course can step back and consider more generally how we can organize the process of writing computer programs.
7. We can develop mathematics to help us describe and analyses the behavior of computer programs.
8. We can look at some of the common application

Course Outline:

Unit 1: Program, The main() Method, Useful Stuff Necessary to go Further, System.out.println(), Using the Java Documentation. **B. Java Basics:** Basic Java Syntax: General Syntax Rules, Java Statements, Blocks of Code, Comments, Variables: Data types, Primitive Data Types, Object Data Types, Literal Values, Constants and the final keyword, Mathematics in Java: Expressions, Operator Precedence, Multiple Assignments, Order of Evaluation, Bitwise operators, Compound Operators, Expressions that Mix Data Types: Typecasting Creating and Using Methods, Creating Methods, Variable Scope.

Unit 2: Java Objects: **Objects: Object-Oriented Languages, Object-Oriented Programs, Encapsulation,** Creating and Using an Instance of an Object, References Defining a Class, Constructors, Method Overloading, The this Keyword, static Elements, Garbage Collection, Java Packages, Dealing with Controlling Keyboard Input, Program String, Flow: String Buffer, Boolean Valued and String Builder, Expressions, Complex Creating Boolean Documentation, Expressions, Comments Simple Branching, and Using Two java doc, Mutually Java doc Exclusive Comments Branches,.. Nested Comparisons if...else Statements And Flow Comparing ntol Structures a Number: of Mutually Exclusive Options, Comparing a Number of Mutually Exclusive Option, The switch Statement, Comparing Objects, Conditional Expression, while and do. . .while Loops, for Loops,

Additional Loop Control: break and continue, Breaking Out of a Loop, Continuing a Loop, Classpath, Code Libraries, and JAR files, Using CLASSPATH Creating a jar File (a Library) C. Loops Arrays and the Vectors: For, Each Arrays Loop, : Multi Defining Dimension ald Declaring Arrays, Arrays, Multidimensional Instaating Arrays in Initializing Memory, Example Arrays, Work Printing With a Picture, Arrays Array Type casting Variables, with Copying Arrays Arrays, of Primitives, Arrays Using Objects, Vectors: Enhanced Defining for Vectors and using Vectors.

Unit 3: Constructors Inheritance: the Inheritance: super Keyword, Derived Derived Class Objects,Class Methods Polymorphism, Override Inheritance Base and Class References Methods Dynamic Method Invocation, Creating a Derived Class, Inheritance and Access Inheritance and Inheritance and Default Base Class Constructors, The Instantiation Process at Runtime, Typecasting with Object References: Typecasting, Polymorphism, and Dynamic Method Invocation, More on Overriding, Object Typecasting Example, Checking an Object's Type: Using instanceof, Typecasting with Arrays of Objects, Other Inheritance- Related Keywords: abstract, final, Methods Inherited from Object. B. Packages and Interfaces: Interfaces: Creating an Definition, Implementing Interfaces: Implementing Interfaces Example, Reference Variables and Calling an I terface Method, Interfaces and Inheritanc : Some Use for Interfaces, Interfaces ,and Event Handling Interfaces and "Pluggable Components", Packages: Creating and using packages, Access. **C. Inner Classes:** Inner Classes, Nested Classes, Inner Class Syntax, Instantiating an Inner Class Instance from Within theng Enclosing Risky Code Class, try Inner and Classes catch, Guaranteeing Referencd from Execution Outside of the Code Enclosing the finally Class Block,Working Letting with an Inner Exception Classes be. Thrown D.Exceptions:to the Exceptions: Handling Excepti ns, Exception Objects: At empty Method Caller, Throwing an Exception, Exceptions and Inheritance, Exception Class, Constructors and Methods, Creating and Using Your Own Exception Classes, Rethrowing Exceptions, Initializer Blocks, Static Initializer Blocks, Assertions.

Unit-4: A. Utility Classes: Collection Interfaces, Concrete collections, Collections framework, Algorithms, Legacy Collections Streams: Output Streams, Input Streams, Filter Streams, Readers and Writers. **B. Threads**: Thread Class and Runnable Interface, Thread Synchronization **C. I/O Package**: InputStream and OutputStream classes, Reader and Writer classes **D. Java Networking:** InetAddress, URL, URLConnection, TCP/IP Server Socket, Client Socket, User Datagram Sockets**, D. Applet and Swings**: Applet: Applet Life Cycle, Passing Parameters to Applet, Delegation Event Model, AWT Components, AWT Events, using listeners, Working with Graphics, Loading Image and Multimedia objects in applet

Unit-5: Java Database Connectivity: Java Database Connectivity Architecture, JDBC- ODBC Bridge, JDBC Drivers, JDBC API, JDBC classes, Driver Interface, DriverManager Class, Connection, Statement, ResultSet, Implementing Stored Procedures.

Reference Books:

1. Java 2 Complete Reference by Herbert Schieldt (Sixth Edition)
2. Core Java Vol 1: Sun Press, Eighth Edition
3. Core Java Vol 2: Sun Press

E-book:

1. Java 2 Complete Reference by Herbert Schieldt (Fourth Edition)

Lab Exercise: CSC454 Practical based on CSC406:
There should be minimum 20 lab assignment on the topics discussed in the course using Open Source Platform (Eclipse, Net Bean etc.).

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

- Good JAVA Programmer.
- Useful for NET/SET Examination.
- Useful for JAVA Certification.
- Useful for Applets and Apps Development.

Semester – II

1. Research Project Review Writing

Course Code	**CSC407**	**Course Title**	**Research Project Review Writing**
Number of Credits	**1 Credits (TH)**	**Internal**	**20%**
Total Contact Hours	**1 Hrs. (TH/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- The student should be able to identify the problem in respective domain.
- The student should be cleared with the fundamental of research methodology.

Course Objectives:

1. To learn to review and assess scientific literature critically.
2. To write and present an overview of the relevant literature for a specific research topic.

Course Outline:

Unit I: What is a literature review: The ability to review, and to report on relevant literature is a key academic skill. A literature review: situates your research focus within the context of the wider academic community in your field; reports your critical review of the relevant literature; and identifies a gap within that literature that your research will attempt to address.

Unit 2: Need a literature review: A critical review**,** Published work‘s Concepts Explanation and its Associated critique, Interpretation, Synthesis. Getting started Reading anything on your research area is a good start, What is the specific thesis, problem, or research question that my literature review helps to define, type of literature review am I conducting, Methodology, Policy, Quantitative research, Qualitative research , scope of my literature review.

Unit 3: Ways of finding relevant material: Electronic sources. References of references Hand searching of journals, collecting material, keeping a record, Plagiarism Detection.

Unit 4: Writing it up: the task of shaping a logical and effective report of a literature review is undeniably challenging. Some useful guidance on how to approach the writing up is given by Wellington et al (2005:87): It should be framed by your research questions. It must relate to your study. It must be clear to the reader where it is going: keep signposting along the way. Wherever possible, use original source material rather than summaries or reviews by others.

Unit 5: Using tables: using tables to display numerical data, tables can be useful within a literature review when you are comparing other kinds of material. Reference list format and importance.

Reference Books:

1. Ask Oxford (2006). Found at: http://www.askoxford.com/
2. Murray, R. 2003: How to survive your viva. Maidenhead: Open University Press.
3. Rugg, G. & Petre, M. 2004: The unwritten rules of PhD research. Maidenhead: Open University Press.
4. Tinkler, P. & Jackson, C. 2004: The doctoral examination process: a handbook for students, examinersand supervisors. The Society for Research into Higher Education. Maidenhead: Open University Press.
5. Wellington, J., Bathmaker, A., Hunt, C., McCulloch, G. & Sikes, P. 2005: Succeeding with your doctorate. London: Sage.

Course Outcomes:

- With this course, students will become familiar with and learn to identify the most relevant textbooks, reviews, papers and journals for their research topics.
- During the course the students will also learn how to critically read and assess research papers and reviews.
- The review should point to research gaps that can be operational zed into feasible research questions.

2. Relational Database Management System and SQL

Course Code	**CSC408**	**Course Title**	**Relational Database Management System and SQL**
Number of Credits	**3 Credits (TH) 2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week) 4 Hrs. (PR/Week)**	**External (Semester/Term Exam)**	**80%**

Prerequisite: The students should be aware of basic database concepts.

Course Objectives:

1. To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product- specific tools.
2. To familiarize the participant with the nuances of database environments towards an information-oriented data-processing oriented framework.
3. To give a good formal foundation on the relational model of data.
4. To present SQL and procedural interfaces to SQL comprehensively.
5. To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
6. To motivate the participants to relate all these to one or more commercial product environments as they relate to the developer tasks.

Course Outline:

Unit 1: Introduction: An overview to DBMS, Data models, levels of abstraction, data independence, instances and schema, structure of DBMS, database users, functions of database administrators. **Entity relationship model:** Entities, Attributes and Entity sets, Relation and relationship sets, features of E-R model.

Unit 2: Relational model: Introduction, Integrity constraints over relations, Enforcing data integrity, relational data, logical database design, introduction to views.

Unit 3: Relational algebra and relational calculus: operations on relational algebra, operations on relational calculus, tuple relational calculus, domain relational calculus

Unit 4: Relational Database Design: Functional dependencies, schema refinement, Normal forms-first, second, third, BCNF, fourth and fifth normal forms, multi-valued dependencies. **Structured Query language (SQL):** Basic SQL queries, nested queries, aggregate operators, null values, Embedded SQL. **Query Processing:** Concept, Need of query processing, procedure and its importance, query optimization, estimation of query processing cost, structure of query optimizer and Join strategies. **Indexing and Hashing:** Basic concepts, B+ Tree Index files, B-tree index files, Static Hash functions, Dynamic Hash functions, Comparison of Indexing and Hashing, Index definition in SQL.

Unit 5: Internals of RDBMS: Transaction management, ACID property, Schedules and its various types, serializability, deadlock handling, high performance transaction systems. Concurrency Control: Lock based protocols, Timestamp based protocols, Validation techniques, Multiple Granularity.

Crash Recovery: Failure classification, Log based recovery, Checkpoints, Shadow paging. Distributed Databases:-Structure and design of distributed databases, Design of distributed databases, Transparency and autonomy, distributed query processing, recovery in distributed databases, Commit protocols. **Security and Integrity:** Authorization and views, security specification in SQL, Encryption.

Book:

1. Database System Concepts by Henry Korth and Abraham Silberschatz.

Reference Book:

1. Relational database systems by Desai, Relational database concepts by Aho Ullman.

Lab Exercise: CSI455 Practical based on CSC408:
At least two practicals should be carried on each unit.

Course Outcomes:
At Course Completion the student will be aware of the basic concepts of database management and will be able to understand the design as well as security issues of relational databases.

- Understand, appreciate and effectively explain the underlying concepts of database technologies
- Design and implement a database schema for a given problem-domain
- Normalize a database
- Populate and query a database using SQL DML/DDL commands.
- Declare and enforce integrity constraints on a database using a state-of-the- art RDBMS
- Programming PL/SQL including stored procedures, stored functions, cursors, packages.
- Design and build a GUI application using a 4GL

3. Software Engineering and CASE Tools

Course Code	**CSC409**	**Course Title**	**Software Engineering and CASE Tools**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: The student must be aware of software development paradigms

Course Objectives:

1. Plan and deliver an effective software engineering process, based on knowledge of widely used development lifecycle models.
2. Employ group working skills including general organization, planning and time management and inter-group negotiation.
3. Translate a requirements specification into an implementable design, following a structured and organized process.
4. Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.
5. Evaluate the quality of the requirements, analysis and design work done during the module.
6. Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

Course Outline:

Unit 1: The Nature of Software, Defining Software, Legacy Software, Software Engineering, Software characteristics, Application software. So waterfall model, incremental and evolutionary models. **Requirement engineering:** Requirement engineering task, initiating the requirement engineering process, eliciting requirements, developing use cases, building analysis model, Negotiating requirements, validating requirements, data modeling, functional modeling and behavioral modeling. Requirements Specification: Characteristics of an SRS, Components of an SRS, Specification Languages, Structure of a requirements document.

Unit 2: Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model. **Architectural Design**: Software Architecture, Architectural Genres, Architectural Styles Architectural Design, Assessing Alternative Architectural Designs. **Component Level Design:** Designing Class-Based Components, Conducting Component-Level Design, Cohesion and Coupling. **User Interface Design**: The Golden Rules, Interface Analysis and Design, Interface Analysis Interface Design Steps.

Unit 3: Verification and Validation, Testing Overview: Verification vs Validation, Design of test cases - Box testing: Equivalence Class Partitioning, Graph based testing Boundary Value analysis White- Box Testing: Statement Coverage, Branch Coverage, Condition Coverage, Path Coverage, Cycloramic Complexity Metric Data Plow- Based Testing. Integration Testing: Top down Testing, Bottom Up testing, Regression Testing, fazed vs Incremental Integration testing Systems Testing: Stress Testing Recovery Testing Security Testing. Debugging Techniques, Approaches, Tools

Unit 4: Project Management Concepts, Process and project– metrics, Process Metrics and Software Process Improvement, Project Metrics, Software Measurement, Size-Oriented Metrics, Function-Oriented Metrics, Object-Oriented Metrics, Use-Case Oriented Metrics. Project Planning Process: Software Scope and Feasibility, Resources, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Scheduling, Risk analysis, monitoring and management. Software Configuration Management, Quality Management.

Unit 5: Clean room Software Engineering, Web Engineering, Software Reengineering, Reverse Engineering, Forward Engineering, Computer Aided Software Engineering.

Books:

1. Software Engineering, A Practitioners Approach Roger S. Pressman, 4th /7th Edition,
2. An Integrated Approach– To S/W Engineering, Pankaj Jolote, 1st / 2nd Edition, Narosa.
3. Software Engineering A Programming Approach, D. Belie I. Moray, J. Rough, PHI. Tata Mc Graw Hill, International Education.

Reference Books:

1. James Peter, W Pedrycz, Software Engineering , John Wiley & Sons
2. K. K. Aggarwal & Yogesh Singh, Software Engineering , New Age International, 2001

E-book:

1. Software Engineering – A Practitioners Approach Roger S. Pressman, 5th Edition, Tata McGraw Hill, International Education.

Lab Exercise: CSI456 Practical based on CSC409:

The practical part, students will allotted a case study/Mini Project development of software products from an industry perspective, including generation of appropriate documents, under tight schedules and limited resources.

Course Outcomes:

- Plan and deliver an effective software engineering process, based on knowledge of widely used development lifecycle models.
- Employ group working skills including general organization, planning and time management and inter-group negotiation.
- Translate a requirements specification into an implementable design, following a structured and organized process.
- Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.
- Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

4. Compiler Design

Course Code	**CSC410**	**Course Title**	**Compiler Design**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- The student should have basic understanding of at least one programming language such as C, Java, etc.
- It would be an added advantage if the student has prior exposure to Assembly Programming.

Course Objectives:

1. Introducing students to the concepts and principles of compiler design.
2. Providing students with basic understanding of grammars and language definition.
3. Introducing students to the various phases of designing a compiler.
4. Introducing students to the various programming techniques and structures used in compiler construction.
5. Providing students with practical programming skills necessary for constructing a compiler.

Course Outline:

Unit 1: Introduction: Translator Issues, why to write a Compiler, what is a Compiler, what is the Challenge, Compiler Architecture, Front end and Back end model of compiler, Cross compiler, Incremental compiler, Boot strapping, Lexical Analysis: Concept of Lexical Analysis, Regular Expressions, Deterministic finite automata (DFA), Non-Deterministic finite automata (NFA), Converting regular expressions to DFA, Converting NFA to DFA, Hand coding of Lexical analyzer, Introduction to LEX Tool and LEX file specification, Error detection and recovery in LEX.

Unit 2: Syntax Analysis: Context Free Grammars(CFG), Concept of parsing, Parsing Techniques, Top-Down Parsers: Introduction, Predictive Parsing - Removal of left recursion, Removal of left factoring, Recursive Descent Parsing, Predictive LL(k) Parsing Using Tables, Bottom Up parsing: Introduction, Shift-Reduce Parsing Using the ACTION/GOTO Tables, Table Construction, SLR(1), LR(1) and LALR(1) Grammars, Practical Considerations for LALR(1) Grammars, Introduction to YACC Tool & YACC file specification, Error detection and recovery in YACC.

Unit 3: Semantic Analysis & Intermediate Representation: Need of semantic analysis, Abstract Parse trees for Expressions, variables, statements, functions and class declarations, Syntax directed definitions, Syntax directed translation schemes for declaration processing, type analysis, scope analysis, Symbol Tables (ST),Organization of ST for block structure and non-

block structured languages, Symbol Table management, Type Checkers: type checking for expressions, declarations (variable, type, function, recursive), statements, Intermediate code generation: Intermediate languages, Design issues, Intermediate representations: three address, postfix & abstract syntax trees, Intermediate code generation for declaration, assignment, iterative statements, case statements, arrays, structures, conditional statements, Boolean expressions, procedure/function definition and call.

Unit 4: Run-Time Memory Management & Code generation: Model of a program in execution, Stack and static allocation, Activation records, Issues in the design of code generation, Target machine description, Basic blocks & flow graphs, Expression Trees, Unified algorithms for instruction selection and code generation, Sethi Ullman algorithm for expression trees, Aho Johnson algorithm, Different models of machines, order of evaluation, register allocation, Code generator-generator concept.

Book:

1. Alfred V. Aho, A. V. R. Sethi and J.D. Ullman Compiler Principle, Techniques and Tools Addison Wesley.

Reference Books:

1. Barrent W. A., J. D. Couch, Compiler Construction Theory and Practice , Computer Science series, Asian student edition.
2. Dhamdhere D.M., Compiler Construction Principle– and Practice, Mac. Millan India, New Delhi.
3. Manish Kumar Jhas, Compiler Construction An advance course.
4. John Levine, Tony Mason & Doug Brown, Lex and Yacc
5. Ravendra Singh, Vivek Sharma, Manish Varshney, Design and Implementation of Compiler, New Ag Publications. Prentice Hall. O, Reilly

Lab Exercise: CSC457 Practical based on CSC410:
List of Experiments:

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Write a C program to test whether a given identifier is valid or not.
4. Write a C program to simulate lexical analyzer for validating operators.
5. To Study about Lexical Analyzer Generator(LEX)
6. Create a Lexer to take input from text file and count no of characters, no. of lines & no. of words.
7. Write a Lex program to count number of vowels and consonants in a given input string.
8. Write a program which adds line numbers to the given file and display the same onto the standard output.
9. Write a Lex program to count the number of comment lines in a given C program. Also eliminate them and copy that program into separate file.
10. Write a C program for implementing the functionalities of predictive parser for the mini language.
11. Write a C program for constructing of LL (1) parsing.
12. Write a C program for constructing recursive descent parsing.
13. Write a C program to implement LALR parsing.
14. Write a C program to implement operator precedence parsing.

Course Outcomes:

- Fluency in describing the theory and practice of compilation, in particular, the lexical analysis, syntax, and semantic analysis, code generation and optimization phases of compilation.
- Ability to create lexical rules and grammars for a programming language

5. Advanced Java

Course Code	**CSC411**	**Course Title**	**Advance Java**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: The student must be aware of object-oriented language, C++, and core java

Course Objectives:

1. This course assumes that students are aware of core java programming and hence it starts from Threading and goes up to web programming.
2. It covers some advance topics JSP, Servlet, RMI, EJB, XML, Struts and Hibernate.

Course Outline:

Unit 1: Java Server Pages: Basics and Overview, JSP architecture, JSP tags and JSP expressions, Fixed Template Data, Lifecycle of a JSP, Model View Controller (MVC), Model 1/Model 2 Architecture, Data Sharing among servlets & JSP: Object scopes or "buckets", Request, application, session and page scope, Predefined JSP implicit objects (request, session, application, page), <jsp:useBean>, <jsp:getProperty>, <jsp:setProperty>, <jsp:include>, <jsp:forward>, More JSP Capabilities and Session Management, HTTP as a stateless protocol, Hidden form fields, Cookies: Overview, API, Using cookies, Session overview: Cookies and session tracking, HttpSession, Putting data into a session object, Retrieving data from a session object, Using session data in servlets and JSPs Additional JSP Capabilities, Exception handling and error pages, Directives (page, include, others), Import declarations, Multithreading considerations and data safety, Single Thread Model interface, Additional JSP Capabilities, JSP Directives, JSP Error Pages, JSP and Java Declarations, Scriptlet overview, Scriptlet syntax

Unit 2: JSTL: Using Custom Tags, Custom tags overview, Reducing JSP complexity, Tag Libraries, Tag Library Descriptor (TLD), Loading a tag library in a web app, The JSTL, JSP Expression Language (EL), Using custom tags, The c:url, c:param, c:forEach, c:out tags, Overview of JSTL libraries, The JSTL Expression Language, Expressions, Type Coercion, Operators, String concatenation, Implicit Objects, The Core JSTL Library, General Purpose: c:out, c:set, c:catch, Conditional: c:if, c:choose,, Overview of other– capabilities, Additional Topics : Servlet Filter overview, Filtering examples, lifecycle, & filter chains, Filter API, Modifying a request, Modifying a response, Struts Overview Advanced MVC Struts overview, Command and State patterns, Struts View and Controller elements

Unit 3: API: Servlets: HTML Web Forms, **Application HTTP:**Request Basics:**-** response, How the Web headers**,** works, **GET,** Thin **POST,** Clients, **Overview:** TCP/IP, How HTTP Servlets overview, Work**,** Brief review, Overview of Java EE, servlets & Web applications., Servlet Basics, Servlet Servlet Lifecycle: init(), service(), destroy(), Requests and responses, Core Servlet API: Generic Servlet, Servlet Request, and Servlet Response, HTTP Servlets: Http Servlet Request, Http Servlet Response and Http Servlet, Accessing Parameters, Additional Servlet Capabilities, HTTP headers and MIME types Request Dispatcher: Including and forwarding, Sharing data with the request object attributes, Sharing data with Servlet Context attributes, Error Handling.

Unit 4: A. RMI: RMI Architecture, Designing RMI application, Executing RMI application, **B. Enterprise Java Beans:** Types of Enterprise Java beans, Session Bean & Entity Bean, Features of Session Bean, Life-cycle of Stateful, Session Bean, Features of Entity Bean, Life-cycle of Entity Bean Container-managed Transactions & Bean-managed Transactions Implementing a container-managed Entity Bean

Unit 5: Java Struts and Hibernate: Introduction to the Apache Struts, MVC Architecture, Struts Architecture, Struts Working, Introduction to the Struts Controller, Introduction to the Struts Action Class, Using Struts Action From Class, Using Struts HTML Tags, Introduction to Struts Validator Framework, Client Side Address Validation in Struts, Custom Validators Example Developing Application with Struts Tiles. Introduction to Hibernate, Hibernate framework 3.0, Hibernate Architecture, First Hibernate Application

Reference Books:

1. Java 2 Complete Reference by Herbert Schieldt (Sixth Edition)
2. Core Java Vol 1: Sun Press, Eighth Edition
3. Core Java Vol 2: Sun Press

E-book:

1. Java 2 Complete Reference by Herbert Schieldt (Fourth Edition)

Lab Exercise: CSC458 Practical based on CSC411:
There should be minimum 20 lab assignment on the topics discussed in the course using Open Source Platform (Eclipse, Net Bean etc.).

Course Outcomes:

- After complication of this course students can write good application based on java.
- Students can appear for java certification examinations. Student can also work on networking and web projects

6. Computer System Architecture

Course Code	**CSC412**	**Course Title**	**Computer System Architecture**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: The student must be aware of the basics of digital electronics, microprocessor architecture, and Assembly Language Programming.

Course Objectives:

To study the basic working and organization of various components of computer systems. To have a thorough understanding of the basic structure and operation of a digital computer.

1. To discuss in detail the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
2. To study the different ways of communicating with I/O devices and standard I/O interfaces.
3. To study the hierarchical memory system including cache memories and virtual memory.

Course Outline:

Unit 1: Data Representation: Introduction, Data types, Complements, Fixed Point and Floating Point representation, Error Detecting Codes. **Simplification**

Unit 2: Combinational Circuits, Flip-Flops Sequential Circuits. Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map

Unit 3: Digital Components: Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit.

Unit 4: Central Processing Unit: Introduction, general Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC). Serial **of Transfer, Direct Memory Access, Input-Output Processor**

Unit 5: I/O& Memory Organization: Peripheral Devices, Input Output Interface, Asynchronous Data Transfer, Modes Communication, Memory, Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

E-book

- http://www.tutorialspoint.com/computer_logical_organization/

Lab Exercise: CSC459 Practical based on CSC412:
At least one experiment should be carried out on each unit.

Sr. No.	Title
1.	Write a small study on Logisim software.
2.	Describe the Python language with detail
3.	Describe math library of Python with its advantages
4.	Conversion of any base to decimal and decimal to any base
5.	Convert decimal value 1 to 20 into binary and also find out 1's and 2's compliment
6.	Implement logic diagram of tree variables EX-OR function with truth table of given expression x=A B C DeMorgan s theorem
7.	Implement logic diagram using ⊕ ⊕' (A+B)'+(A+B)'=0.
8.	Implement logic diagram of given Boolean expression F=XYZ+XYZ+XYZ write its truth table
9.	Implement half adder and full adder with three input and write steps of its truth table
10.	Implement SR flip flop and write its truth table
11.	Implement four bit register and write its truth table
12.	Implement four bit shift register and write its truth table
13.	Implement 2:4 line decoder with NAND gate and writes its truth table
14.	To implement 4:1 line multiplexer and write its truth table
15.	Draw logic diagram of 2:4 line multiplexer and write its truth table
16.	Draw block diagram of RAM, ROM and explain the types of memory
17.	Develop mathematical functions (Addition, Subtraction, Multiplication, Division, Mod, Log) using Python.
18.	Program for Decimal to Binary conversion
19.	Program for Decimal to Binary conversion
20.	Program for Decimal to Binary conversion
21.	Program for Decimal to Binary conversion
22.	Program for Decimal to Binary conversion
23.	Program for Decimal to Binary conversion
24.	Program for Decimal to Binary conversion
25.	Program for Decimal to Binary conversion
26.	Program for I] Binary to Decimal II] Decimal to Binary III] Octal to Decimal IV] Exit
27.	Draw and implement logic gates using Logisim I] AND gate II] OR gate III] NOT gate IV] NAND gate

V] NOR gate
VI] EX-OR gate
VII] EX-NOR gate
VIII] Half Adder
IX] Full Adder
X] Multiplexer

28. Develop mathematical functions (Addition, Subtraction, Multiplication, Division, Mod, Log) using Python
29. Program for Decimal to Binary conversion
30. Program for Decimal to Binary conversion

Computer System Architecture Practical will be conducted in two Software's: for Programming, Open Source platform Python will be used and for circuit design, open source platform Multisim or Logisim will be used. The details of these are as follows:

Course Outcomes:

After complication of this course students will be able to understand and able to design circuit and simplify it. Will be able to understand in detail the how logic systems are built. Students will have thorough knowledge about

- Basic structure of a digital computer
- Arithmetic operations of binary number system
- The organization of the Control unit, Arithmetic and Logical unit, Memory unit and the I/O unit.

Semester – III

1. Advance Computer Network

Course Code	**CSC501**	**Course Title**	**Advance Computer Network**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Basic knowledge of Computer network

Course Objectives:

1. This course aims to understand the main abstract concepts related to the layered communication architecture.
2. Also, how does this global network infrastructure work and what are the design principles on which it is based; by learning advanced routing and congestion control algorithms.
3. The focus is to understand basics and principles of new generation of computer networks (VPN, wireless networks, and mobile networks).
4. Topics include internetworking philosophies, unicast and multicast routing, congestion control, network quality of service, mobile networking, router architectures, etc.
5. The focus is on both: the existing technologies as well as the current and emerging research topics in computer networking.

Course Outline:

Unit 1: Introduction: Background and overview of the layered architecture: Layered communication architecture: layers, services, protocols, layer entities, service access points, modes of communication, etc. DLL Protocols, Frame Relay, X.25 protocol, IEEE Standards for LAN, error detection and correction at DLL.

Unit 2: Internetworking and Routing: Advanced Routing algorithms, Advanced Network Congestion Control algorithms, Packet Switching, IP Addressing & DNS.

Unit 3: Overview on Wireless Networks and Mobile Networks: LAN, PAN, Sensor Networks, Ad_hoc Networks, Mobile IP, Mobile TCP, VPN, MAC Protocols. Wireless Protocols: Data Transport and Sensor Data Dissemination, Group Communication: Multicast Routing and Transport, Multicast (cont.); Scalability and Robustness in Networks.

Unit 4: Process to Process delivery: client/server paradigm, multiplexing and demultiplexing, connectionless versus connection oriented services, reliable versus unreliable **Network Security:** Cryptography Techniques, Algorithms: Secret key and Public key, DES, RSA. Digital Signature, Firewalls, Proxy server.

Unit 5: Special Topics: current and emerging trends: Next Generation Networks, Data Centers, Cloud Computing, GSM, GIS, Queuing models, ASN (abstract syntax Notation), distributed Networks.

Reference Book:

1. William Stallings, Wireless Communications & Networks, 2nd edition, Prentice-Hall Pearson, 2005

E-books:

1. http://newwayofengineering.blogspot.in/2014/12/computer-networks-tanenbaum-5th-edition.html
2. http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Computer%20networks/New_index1.html
3. http://nptel.iitm.ac.in/video.php?subjectId=1061050813.
4. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Computer_Networks/index.php

Lab Exercise: CSC552 Practical based on CSC501:

At least two experiments should be carried out on each unit.

Course Outcome:

- The student will be well acquainted with how computer network works, what are the architectures and protocols required for It., as well as some special topics.

2. Computer Graphics

Course Code	**CSC502**	**Course Title**	**Computer Graphics**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- The student should be aware of Computer Systems, Matrix Algebra, Calculus in Three Dimensions, or equivalents.
- The student must be fluent in C/C++ and familiar with modern development tools such as Visual Studio, XCode, or the GNU tool chain.
- The students should have knowledge of the following mathematical topics vectors, vector operations, vector spaces, Matrices, Basic linear algebra such as solving a system of linear equations, Polynomials and Elementary signal processing (Fourier transform and filtering)

Course Objectives:

Understanding basic computer graphics and animation:

1. To understand the basics of various inputs and output computer graphics hardware devices as well as the course will offers an in-depth exploration of fundamental concepts in 2D and 3D computer graphics.
2. After introducing 2D raster graphics techniques, the course focuses on 3D modeling, geometric transformations, 3D viewing and rendering.
3. This course presents an introduction to computer graphics designed to give the student an overview of fundamental principles.

Course Outline:

Unit 1: Introduction to Graphics: The origin of computer graphics, How the interactive graphics display works. Display types: Random Scan and Raster Scan, Definitions: Pixel, Resolution, Aspect Ratio, Active graphics, Passive graphics, Interactive, Non interactive graphics, Application of Computer Graphics.

Unit 2: Line Drawing Technique: Co-ordinate Systems, Incremental method, The Simple DDA, The Symmetrical DDA, Brenham s Algorithm.

Unit 3: Transformations: Transformation principles, Concatenations, Matrix Representation, Three Dimensional Transformations, Transformation in Viewing, The perspective Transformation.

Unit 4: Clipping and Windowing: Cohen-Sutherland algorithm, Mid-point Subdivision, Polygon Clipping, Viewing Transformation, The Windowing Transformation, 3-D Clipping.

Unit 5: Raster Graphics and Solid Area Scan –Conversion: Introduction, Scan Converting Line Drawings, Scan Converting Polygons, Coherence, (YX) Algorithm.

Reference Books:

1. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics (Second Edition), Tata-McGraw Hill Publication.
2. Rogers, Procedural Interactive Computer Graphics, McGraw Hill Book Company Ltd.
3. Mathematical Elements of Interactive Computer Graphics, McGraw Hill Book Company Ltd.

Lab Exercise: CSC553 Practical based on CSC502:

Practical: (Lab Work)

Have a basic understanding of the core concepts of computer graphics. Be capable of using Anim8or to create interactive computer graphics. Have made pictures with their computer.

Make different games and animations.

1. Program for Brenham**'**s line drawing
2. Program for circle generation
1. Program for line clipping
2. Program for 2D transformations
3. Program for 3D transformation
4. Animation

A mini project in Animation

Course Outcomes:

At the end of this course students should:

To understand the various computer graphics hardware and display technologies.

- 2D and 3D viewing technologies
- Various 2D and 3D objects transformation techniques.
- This course is beneficial for UGC-NET/SET examination and aptitude test.

Semester – IV

1. Pattern Recognition

Course Code	**CSC503**	**Course Title**	**Pattern Recognition**
Number of Credits	**3 Credits (TH) 2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week) 4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Student must have knowledge of Digital image processing, neural networks and function analysis.

Course Objectives:

1. To provide the general mechanism and design of Automatic system recognition.
2. Understand basic concepts in pattern recognition.

Course Outline:

Unit 1: Introduction to Pattern Recognition, Bayesian decision theory: Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, discrete features

Unit 2: methods, Maximum-Maximum Likelihood and Bayesian Estimation: Parameter estimation Likelihood estimation, Bayesian estimation, Bayesian Parameter Estimation, Gaussian Case, General Theory, Problem of Dimensionality, Accuracy, Dimension, and Training Sample Size, Computational Complexity and Overfitting.

Unit 3: EM, Hidden Markov models for sequential pattern classification, First-Order Markov Component Models, Analysis First and Order Discriminants Hidden Markov: Principal Models, Component Hidden Markov Analysis Model (PCA) Computation, Exectation Evaluation, Decoding and Learning. **Density estimation, Parzen-window method, Probabilistic Neural Networks**

Unit 4: K-Nearest Neighbour, Estimation and rules, Nearest Neighbour and Fuzzy Classification. Nonparametric

Unit 5: Linear Discriminant function based classifiers: Perceptron, Linear Programming Algorithm, Support Vector Machines (SVM)

Books:

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification 2nd Edition , John Wiley, 2007
2. Christopher M. Bishop, Neural Network for Pattern Recognition, Oxford Ohio Press.

Reference Books:

1. E. Gose, R. Johansonbargh, Pattern Recognition and Image Analysis, PHI
2. Ethen Alpaydin, Neural Network Introduction -A Machine Classroom Learning Approach, Satish Kumar, McGraw Hill.
3. Dr. Rao & Rao, Neural Network & Fuzzy Logic
4. S. Theodoridis and K. Koutroumbas, Pattern Recognition , 4th Ed., Academic Press,
5. C. M. Bishop, Pattern Recognition and Machine Learning , Springer, 2006

Web:

1. http://www.rii.ricoh.com/~stork/DHS.html

Lab Exercise: CSC556 Practical based on CSC503:

At least two experiments should be carried out on each unit.

Course Outcome:

- Students can go for research in Pattern Recognition or work in atomization industry or work as statistical analyzes of data

Elective-I

1. Digital Signal Processing

Course Code	**CSC521**	**Course Title**	**Digital Signal Processing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Before attending this course, students must have basic knowledge about mathematics, set theory, linear algebra, calculus and logic.

Course Objectives:

1. The basic objective of this course is to study the fundamental aspects, representation and analysis of digital signal and it's processing.
2. It will provide the student with an intuitive and practical understanding of the fundamental concepts of signal processing.
3. The intention is to also provide the student with the necessary background for taking advanced level courses in signal such as speech processing, Pattern Recognition, Fuzzy logic, Neural Network.
4. Further, computer simulation exercises are intended to familiarize the student with implementation aspects and the application of theoretical knowledge to practical problems.

Course Outline:

Unit 1: Introduction to Digital Signal Processing: System, ASP-analog signal processing, Digital system, Advantage of DSP over ASP, Application of signal processing.

Unit 2: Classification of Signal: Classification of signal, Multichannel and Multidimensional signal, Continuous time and discrete time signal, continuous valued and discrete valued signal, Deterministic and random signal, periodic and aperiodic signal, symmetric and anti-symmetric signal, energy signal and power signal, characteristics of continuous time and discrete time signal, discrete time signal representation, standard test signal.

Unit 3: Signal and System: Introduction to analog to digital conversion, Aliasing, sampling theorem, anti-aliasing filter, reconstruction of signal, quantization of continuous signal, Classification of system, discrete time system, linear time invariant system(LTI), convolution, stability criteria of LTI system, causality criteria of LTI system**,** cross correlation**,** auto correlation**,** properties of correlation**,** application of correlation**.**

Unit 4: Signal Transformation: Introduction of Fourier, Fourier representation of four signal class, Fourier series, Fourier transforms, properties of Fourier transform, convergence of Fourier transform, inverse Fourier transform, Definition of DFT, Inverse discrete Fourier transform, DFT properties, DFT frequency response characteristics, relationship of DFT to other transform, Z transform, Complex Z plane, Region of convergence (ROC), properties of Z transform, relationship of FFT and Z transform, inverse Z transform.

Unit 5: Fundamentals of Filter Design: Introduction to digital filter, filter design steps, structure of IIR filter , IIR filter design, impulse invariant method, bilinear transformation method, analog filter for designing digital filter, designing high pass, band pass and band stop filter, structure of FIR filter, FIR filter design, FIR filter specification, FIR filter design method, finite precision effect.

Reference Book:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons Inc., New York, 2006.

Lab Exercise: CSC557 Practical based on CSC521:

At least two experiments should be carried out on each unit.

Course Outcomes:

After completing this course, students will be able to:

- Good opportunity to explore and learn more specialized field of Computer science, electrical engineering and automobile industries.
- It provides the students the fundamentals of signal analysis. Signal analysis is a basic tool in many courses offered in the M.Sc. program such as Human Computer Interaction, Pattern Recognition, Fuzzy logic, and neural networks.
- It is important in fulfilling the need for computer engineers who can understand the DSP tools in the marketplace.
- MATLAB is integrated into this course. In projects and appropriate problems, students are asked to do the calculations using MATLAB.
- Students will learn numerous programming tools for design and implementations of filtering algorithms.

2. Digital Image Processing

Course Code	**CSC522**	**Course Title**	**Digital Image Processing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: To learn this course basic knowledge of Digital Signal Processing, Mathematics and Statistical Techniques is must.

Course Objective:

1. To introduce the student to various image processing techniques.

Course Outline:

Unit 1: Image Processing Fundamentals: Digital image, digital image processing, History of digital image processing, State of the art examples of digital image processing, Key stages in digital image processing, The human visual system, Light and the electromagnetic spectrum, Image representation, Image sensing and acquisition, Sampling, quantisation and resolution.

Unit 2: Image Enhancement (Histogram Processing, Point Processing and Spatial Filtering): image enhancement, Different kinds of image enhancement, Histogram processing, Point processing, Neighbourhood operations, Negative images, Thresholding, Logarithmic transformation, Power law transforms, Grey level slicing, Bit plane slicing, Neighbourhood operations, spatial filtering, Smoothing operations, Correlation and convolution, Sharpening filters, 1st derivative filters, 2nd derivative filters, Combining filtering techniques

Unit 3: Image Restoration (Noise Removal): image restoration, Noise and images, Noise models, Noise removal using spatial domain filtering, Periodic noise, Noise removal using frequency domain filtering,

Unit 4: Image Segmentation: Thresholding and thresholding algorithms, Performance evaluation and ROC analysis Connected components labeling, Region growing and region adjacency graph (RAG),Split and merge algorithms, Morphological algorithms, Erode and dilate as max and min operators on binary images Open, close, thinning and other transforms Medial axis transform Introduction to grey-level morphology

Unit 5: Color Image Processing : Fundamentals of colour image processing, Secondary colours, Colour Image Models, Basics of full colour image , Pesudo-color image processing, Colour Image Segmentation.

Book:

1. Digital Image Processing, 3/e, Rafael C. Gonzalez, Richard E. Woods. Pearson Education, ISBN: 9788131726952

Reference Books:

1. S. Sridhar "Digital Image Processing", Oxford Publishers, 2011.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar Digital Image Processing", McGraw Hill Publishers, 2009.
3. B. Chanda and D. Dutta Majumdar "Digital Image Processing and Analysis", Prantice Hall of India.
4. Anil K. Jain "Fundamentals of Digital Image Processing", Prantice Hall of India, 2012.
5. Milan Sonka, Hlavac & Boyel, "Digital Image Processing and Computer Vision", Cengage Learning Publishers, 2010.

E-book:

1. Digital Image Processing, 3/e, Rafael C. Gonzalez, Richard E. Woods. Pearson Education, ISBN: 9788131726952

Lab Exercise: CSC558 Practical based on CSC522:

At least two experiments should be carried out on each unit.

1. Viewing digital images, bits and bytes, raster scan format, quantization
2. Scaling, translation and rotation, sums and differences
3. Histograms and stretches, convolutional filters
4. Fourier transforms and the frequency domain, filters
5. FFTs, Image filtering: smoothing and sharpening
6. 2D convolution and correlation
7. Application of above algorithms for Brain Tumar detection, character detection, etc.

Course Outcome:

- At the completion of course the student have preliminary knowledge about Digital Image Processing.

3. Information Processing

Course Code	**CSC523**	**Course Title**	**Information Processing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: The students should have basic knowledge of mathematic and networking.

Course Objective:

1. The course aims at providing students a foundation in information theory the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

Unit 1: Information Theory: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark- off statistical model for an information source, Entropy and information rate of the mark-off source.

Unit 2: Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels. Fundamental Limits on Performance: Source coding theorem, Huffman coding, Discrete memoryless Channels, Mutual information, Channel Capacity.

Unit 3: Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.

Unit 4: Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes. **Linear Block Codes:** Matrix description, Error detection, and correction, Standard arrays and table lookup for decoding. Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes.

Unit 5: RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes. Convolution Codes, Time domain approach. Transform domain approach.

Books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley, 1996.
2. Digital communication, Simon Haykin, John Wiley, 2003.

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Digital Communications - Glover and Grant; Pearson Ed. 2nd Ed 200

Lab Exercise: CSC559 Practical based on CSC523:

At least two experiments should be carried out on each unit

Course Outcomes:

- Understand the basic classes of compression techniques
- Be able to determine to best class of compression techniques to use in a particular situation.
- Know how to apply compression techniques to practical situations.
- Understand the ideas of entropy and information content.
- Be able to apply these ideas to showing the limits of compression in any situation
- Master the basic ideas behind the Shannon Channel Capacity results
- Be able to assess the limitations for data transmission on a given channel
- Understand how different coding techniques will perform in different situations
- Be able to know which channel coding techniques types to use is different situations
- Be able to assess the potential of new and unique channel coding methods
- Understand the current state of the area for both data compression and channel coding Course

4. Soft Computing

Course Code	**CSC524**	**Course Title**	**Soft Computing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisites:

- Student must have good hands-on, on any higher level programming language.
- They should also have basic knowledge of statistics, mathematics and have profound knowledge of Data Structures.

Course Objectives:

1. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems.
2. The units has a strong practical focus with the implementation of Soft Computing techniques in laboratory exercises and assignments.

Course Outline:

Unit 1: Soft Computing: Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Artificial Intelligence: Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Unit 2: Neural Network: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristic single layer network. Neuron Abstraction, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Network Geometry of Binary Threshold Neurons and Their Network: Patterns Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are pattern Dichotomizes, Non-linearly separable Problems, Capacity of a simple Threshold Logic Neuron

Unit 3: Perceptron: Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of Back propogation Algorithm, momentum, limitation, characteristics and application of Back propogation Algorithm.

Counter propagation network: Architecture, functioning & characteristics of counter Propagation network, Hop field/Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory

Unit 4: Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.

Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

Unit 5: Genetic algorithm: Fundamental, basic concepts, working principle, encoding, fitness function, reproduction.
Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods.

Books:

1. Principles of Soft Computing, Wiley Publications, S.N. Sivanandam & S.N. Deepa, 2nd Edition, 2011.
2. Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, S. Rajasekaran & G.A. Vijayalakshmi Pai, PHI Publication, 1st Edition, 2009.

References:

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, TATA McGraw HILL
3. Network fundamental with Graph, Algorithms & Applications, TMH, N. K. Bose, Ping Liang, Neural 1st Edition,1998.
4. Neural Network & Fuzzy System: A Dynamical Systems Approach to Machine Intelligence, Bart Kosko, PHI Publication, 1st Edition, 2009.
5. Artificial Intelligence, Rich E, Knight K , TMH, 3rd Edition, 2012.
6. Fuzzy sets & Fuzzy Logic, Theory & Applications, George J Klir, Bo Yuan, PHI Publication, 1st Edition, 2009.
7. Neural Network Design, Martin T Hagen, Nelson Candad, 2nd Edition, 2008.
8. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2nd edition 2004
9. Artificial neural networks - B. Yegnanarayana, Prentice Hall of India P Ltd 2005.
10. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
11. Neural networks James A Freeman David M S kapura, Pearson education 2004.
12. C++ Neural Network and Fuzzy Logic 2nd Edition, Valluru B. Rao, Hayagriva V. Rao, Henry Holt and Co.

Lab Exercise: CSC560 Practical based on CSC524:

- At least six experiments should be carried out on each unit.

Or

- One Minor project depicting the concepts learned in the course CSC524

Course Outcomes:

Students who complete this course successfully are expected to:

- Identify and describe soft computing techniques and their roles in building intelligent machines.
- Recognize the feasibility of applying a soft computing methodology for a particular problem
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
- Apply genetic algorithms to combinatorial optimization problems
- Apply neural networks to pattern classification and regression problems
- Effectively use existing software tools to solve real problems using a soft computing approach
- Evaluate and compare solutions by various soft computing approaches for a given problem

5. Data Mining

Course Code	**CSC525**	**Course Title**	**Data Mining**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Student should have knowledge about the Relational Database Management System and Basic knowledge of probability and statistics.

Course Objectives:

1. To develop an understanding of the strengths and limitations of popular data mining techniques and to be able to identify promising business applications of data mining.
2. Students will be able to actively manage and participate in data mining projects executed by consultants or specialists in data mining.
3. A useful take away from the course will be the ability to perform powerful data analysis.

Course Outline:

Unit 1: Introduction to Data Mining: Why Mine Data? Commercial Viewpoint, Scientific Viewpoint Motivation, Definitions, Origins of Data Mining, Data Mining Tasks, Classification, Clustering, Association Rule Discovery, Sequential Pattern Discovery, Regression, Challenges of Data Mining.

Data Mining: What is Data? Attribute Values, Measurement of Length, Types and Properties of Attributes, Discrete and Continuous Attributes, Types of data sets, Data Quality, Data Preprocessing, Aggregation, Sampling, Dimensionality Reduction, Feature subset selection, Feature creation, Discretization and Binarization, Attribute Transformation, Density.

Data Mining: Exploring Data: Data Exploration Techniques, Summary Statistics, Frequency and Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, Visualization, Representation, Arrangement, Selection, Visualization Techniques: Histograms, Box Plots, Scatter Plots, Contour Plots, Matrix Plots, Parallel Coordinates, Other Visualization Techniques, OLAP : OLAP Operations

Unit 2: Data Mining Classification: Basic Concepts, Decision Trees, and Model Evaluation. **Classification:** Definition, Classification Techniques, Tree Induction, Measures of Node Impurity, Practical Issues of Classification, ROC curve, Confidence Interval for Accuracy, Comparing Performance of Two Models, Comparing Performance of Two Algorithms.

Data Mining Classification: Alternative Techniques Rule-Based Classifier, Rule Ordering Schemes, Building Classification Rules, Instance-Based Classifiers, Nearest Neighbor Classifiers, Bayes Classifier, Naive Bayes Classifier, Artificial Neural Networks (ANN), Support Vector Machines.

Unit 3: Data Mining Association Analysis: Basic Concepts and Algorithms Association Rule Mining, Frequent Itemset Generation, Association Rule Discovery : Hash tree, Factors Affecting Complexity, Maximal Frequent Horible Closed Item set, Alternative Methods for Frequent Item set Generation, FP-growth Algorithm, Tree Projection, Rule Generation, Pattern Evaluation, Statistical Independence, Properties of A Good Measure, Support-based Pruning, Subjective Interestingness Measure.

Unit 4: Data Mining Cluster Analysis: Basic Concepts and Algorithms, Applications of Cluster Analysis, Types of Clusters, Clustering Algorithms: K-means and its variants, Hierarchical clustering, Density-based clustering. Graph-Based Clustering, Limitations of Current Merging Schemes, Characteristics of Spatial Data Sets, Shared Near Neighbor Approach, ROCK (Robust Clustering using links), Jarvis-Patrick Clustering, SNN Clustering Algorithm. Data Mining Anomaly Detection, Anomaly/Outlier Detection, Importance, Anomaly Detection Schemes, Density-based: LOF approach.

Unit 5: WEKA (Waikato Environment for Knowledge Analysis): is a well-known suite of machine learning software that supports several typical data mining tasks, particularly data preprocessing, clustering, classification, regression, visualization, and feature selection.
Orange: is a component-based data mining and machine learning software suite that features friendly yet powerful, fast and versatile visual programming front-end for explorative data analysis and visualization, and Python bindings and libraries for scripting. It contains complete set of components for data preprocessing, feature scoring and filtering, modeling, model evaluation, and exploration techniques.
RapidMiner: Formerly called YALE (Yet another Learning Environment), is an environment for machine learning and data mining experiments that is utilized for both research and real-world data mining tasks.
JHepWork: Designed for scientists, engineers and students, jHepWork is a free and open-source data-analysis framework that is created as an attempt to make a data-analysis environment using open-source packages with a comprehensible user interface and to create a tool competitive to commercial programs.
KNIME: (Konstanz Information Miner) is a user friendly, intelligible and comprehensive open-source data integration, processing, analysis, and exploration platform. It gives users the ability to visually create data flows or pipelines, selectively execute some or all analysis steps, and later study the results, models, and interactive views.

Reference Books:

1. Introduction to Data Mining by Tan, Steinbach, Kumar.
2. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers.
3. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten and Eibe Frank, Morgan Kaufmann, 2nd Edition (2005).
4. Principles of Data Mining: David Hand, Heikki Mannila & Padhraic Smyth, PHP Publication.

Lab Exercise: CSC561 Practical based on CSC525:
There should be minimum 10 lab assignment on the topics discussed in the course.
Selecting a project:

1. Preprocessing the data
2. Design of simple classifier
3. Applying algorithms like ANN, a priori etc. as per application.
4. Analyzing the data and extracting the patterns.

Course Outcomes:

- Understand the basic concepts and principles in data mining and visualization.
- Learn commonly used algorithms for mining both structured and unstructured (text) data.
- Understand how to handle a large amount of text data with search engines.

6. Network Security

Course Code	**CSC526**	**Course Title**	**Network Security**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Before attending this course, students must have: Programming experiences in C/C++ or JAVA.

Course Objectives:

1. To study the main security threats of communication networks.
2. To establish certain security mechanisms that avoids or considerably diminishes these threats.
3. To introduce modern cryptography techniques.
4. To study specific cryptography techniques that guarantee security in certain applications (email, e-commerce, web access, etc.).
5. To introduce the most widely known standards for each case

Course Outline:

Unit 1: Introduction, Security Concepts, Threats and Risks, Attacks – Passive and Active, Security Services, Confidentiality, Authentication, Non-Repudiation, Integrity, Access Control, Availability. Security attacks, Unauthorized Access, Impersonation, Denial of Service Malicious Software, Viruses, Worms, Trojan, spyware

Unit 2: Access Control Models, Bell-LaPadula, Biba Integrity Model, Role Base Model. Cryptography: Secret Key and Public Key Cryptosystems: Cryptanalysis and attacks Symmetric Ciphers, Block Ciphers and Stream Ciphers: DES, Triple DES, RC4 and RC5, Cryptographic Modes, RSA., Deffie Hellman key exchange Message Authentication: MD5 and SHA 512 Public Key Infrastructure (PKI): Digital Certificates , Certificate Authorities

Unit 3: Network Attacks: Buffer Overflow, IP Spoofing, TCP Session Hijacking, Sequence Guessing, Network Scanning, ICMP, TCP sweeps, Basic Port Scans Network Security: Objectives and Architectures, Internet Security Protocols, IP encapsulating ,Security Protocol Virtual Private Network: concepts, PPTP, L2TP

Unit 4: Web security Consideration: Secured Socket Layer and Transport layer security, Secured Electronic Transaction (SET) and Secured Mail: Pretty Good Privacy (PGP), S/MIME.
Network Security Authentication Mechanisms: a) Passwords, b) Cryptographic authentication protocol, c) Smart Card, d) Biometrics) Digital Signatures and seals, f) Kerberos, g) X.509 LDAP Directory

Unit 5: Intruders, Intrusion Detection and Prevention, Firewall: Firewall Design Principles, Firewall Characteristics, Types of Firewalls: Packet Filtering Router, Stateful Inspection Firewall, Application Level Gateway or Proxy, Circuit level gateway, Bastion Host Firewall Configuration: Screened Host Firewall System, Screened Subnet Firewall System. Cybercrimes: Crimes against the computer, Crimes using a computer, Indian IT Act 2000: Objectives, Provisions, And Offenses.

Reference Books:

1. Network Security Essentials, William Stallings, Prentice-Hall.
2. Fundamentals of Computer Security Technology, Edward Amoroso, Prentice-Hall.
3. Cryptography and Data Security, Dorothy E. Denning, Addison-Wesley.
4. Computers under Attack, Peter J. Denning, Addison-Wesley.
5. Cryptography: Theory and Practice, Douglas R. Stinson, CRC Press.
6. Computer Crime and Computer Forensics, Dr. R. K. Tiwari, P. K. Sastri, K. V. Ravikumar, First Edition, 2002,
7. Select Publishers
8. Computer Security Gollmann, Dieter, First Edition, 1999, John Wiley & Sons Ltd.

Lab Exercise: CSC562 Practical based on CSC526:

Lab exercise will cover the program related to each unit.

Course Outcomes:

After completing this course, students will be able to:

- Explain concepts related to applied cryptography, including plain text, cipher text, symmetric cryptography, asymmetric cryptography, and digital signatures.
- Explain the theory behind the security of different cryptographic algorithms.
- Explain common network vulnerabilities and attacks, defense mechanisms against network attacks, and cryptographic protection mechanisms.
- Outline the requirements and mechanisms for identification and authentication.
- Identify the possible threats to each mechanism and ways to protect against these threats.
- Explain the requirements of real-time communication security and issues related to the security of web services.
- Explain the requirements of non-real-time security (email security) and ways to provide privacy, source authentication, message integrity, non-repudiation.

7. Mobile Computing

Course Code	**CSC527**	**Course Title**	**Mobile Computing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Student must be aware with computer networking and computer communication basics.

Course Objectives:

1. The course gives an introduction into principles, standards and solutions for mobile communication and its applications within the area of mobile computing will be provided to the students.
2. Based on the physical foundations of mobile communication channels, typical standards such as GSM were considered.
3. In the area of application support, typical software architecture and services for mobile computing are also being considered and discussed.
4. Examples of application areas covered are sales support and service engineering.

Course Outline:

Unit 1: Introduction to Mobile Communication: Mobile Communication development, Communication Principal, Cellular networks, structure of cellular networks. **Frequency distribution and multiplexing:** methods, SDMA, FDMA, TDMA, CDMA, Spread Spectrum Techniques, **GSM**: Properties, Structures, Protocols, Channel Structure, Registers (HLR, VLR), Data Transmission, security aspects (SIM), **GSM Data switching**: HSCSD, GPRS, QOS.

Unit 2: Universal Mobile Telecommunication system: Characteristics,**'** Performance, Architecture, frequency support, Hierarchical cell structure, UTMS Enhancement, Modulation basics, **Long Term Evaluation (LTE)**: Characteristics, User equipment s, frequency bands, **WiMAX**: overview, frequency distribution worldwide, modulations under WiMAX, Network topologies, 4G Characteristics, data rate and mobility.

Unit 3: Network types: WAN, Applications of WAN, wireless standards, 802.11 frequency bands, architecture, Medium access, Data Security in WLAN, Bluetooth and its applications. **Satellite and Broadcast Systems**: Basics, Geostationary satellite, LEO, MEO, GPS, Differential GPS, **Mobile Internet Protocols**: Mobile Internet, DHCP, Mobile IP, Principle, Agent Registration, Mobile IPv6, Cellular IP routing, TCP overview.

Unit 4: Web Based Mobile Application: Technologies for Web applications, challenges, mechanism, responsive web design, Fluid Grids, Design patterns, Sementics, Multimedia, Device access, connectivity, Performance and Integration, Server side adaptation. **Mobile platforms and Middleware:** Operating System for Mobile Devices, Case study of Android OS, Message Queuing, Mobile Databases, queries and transactions, synchronization.

Unit 5: Context Aware Applications: Types of context information, usage of context, context capturing, Context attributes, Activity Detection, context service, architecture, context models,

Location based service: location representation, location models, determining geometric positions, Positioning vs tracking, satellite system, application areas.

Reference Book:

1. J. Schiller, Mobile Communications, 2nd edition, Pearson Education, 2003

E-book:

1. Mobile Communication and computing
   https://drive.google.com/file/d/0B3gHwwlwm_DWWERRUGlodHgxUUE/edit? pli=1

Lab Exercise: CSC563 Practical based on CSC527:

There should be minimum 10 lab assignment on the topics discussed in the course.

Course Outcome:

- At Course Completion student will be able understand the mobile communication and cutting edge technology for devising potential mobile computing applications to the society.

Elective-II

1. Data Warehousing

Course Code	**CSC528**	**Course Title**	**Data Warehousing**
Number of Credits	**3 Credits (TH) 2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week) 4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Student must aware of Relational Database management system, its organization and management using Queries

Course Objectives:

A student completing this course unit should:

1. Have an understanding of the foundations, the design, the maintenance, the evolution and the use of data warehouses, by looking at these topics in a rigorous way.
2. Have mastered the basic range of techniques for creating, controlling and navigating dimensional business databases, by being able to use a powerful tool for dimensional modeling and analysis.
3. Acquire hands-on experience with key components of an integrated data warehousing

Course Outline:

Unit 1: Data Warehousing Concepts: Data Warehouse Architectures **Logical Design in Data Warehouses:** Logical Versus Physical Design in Data Warehouses, Data Warehousing Schemas, Data Warehousing Objects **Physical Design in Data Warehouses:** Physical Design, Data Segment Compression, Integrity Constraints, Indexes and Partitioned Indexes, Materialized Views, Dimensions

Unit 2: Hardware and I/O Considerations in Data Warehouses: Overview of Hardware and I/O Considerations in Data Warehouses, Automatic Striping, Manual Striping, Local and Global Striping, Analyzing Striping, Striping Goals, RAID Configurations, Striping, Mirroring, and Media Recovery, RAID 5, The Importance of Specific Analysis **Parallelism and Partitioning in Data Warehouses:** Granules of Parallelism, Block Range Granules, Partition Granules, Partitioning Design Considerations, Types of Partitioning, Partitioning Methods, Performance Issues for Range, List, Hash, and Composite Partitioning, Partitioning and Data Segment Compression, Data Segment Compression and Bitmap

Indexes, Partition Pruning, Avoiding I/O Bottlenecks, Partition-Wise Joins, Full Partition- Wise Joins, Miscellaneous Partition Operations

Unit 3: Indexes: Bitmap Indexes, Benefits for Data Warehousing Applications, Cardinality, Bitmap Join Indexes, Bitmap Join Index Restrictions, B-tree Indexes, Local Indexes Versus Global Indexes **Integrity Constraints:** Overview of Constraint States, Typical Data Warehouse Integrity Constraints, UNIQUE Constraints in a Data Warehouse, FOREIGN KEY Constraints in a Data Warehouse, RELY Constraints, Integrity Constraints and Parallelism, Integrity Constraints and Partitioning **Materialized Views:** Creating, Registering Existing Materialized Views, Partitioning Materialized Views, Materialized Views in OLAP Environments, Choosing Indexes for Materialized Views, Invalidating Materialized Views Security Issues with Materialized Views, Altering Materialized Views, Dropping

Materialized Views, Analyzing Materialized View Capabilities. **Dimensions:** Creating Dimensions, Viewing Dimensions, Using Dimensions with Constraints, Validating Dimensions, Altering Dimensions, Deleting Dimensions, Using the Dimension Wizard **Overview of Extraction, Transformation, and Loading:** Overview of ETL, ETL Tools

Unit 4: Managing the Warehouse Environment: Overview of Extraction, Transformation and Loading, Extraction in Data Warehouses Transportation in Data Warehouses, Loading and Transformation, Maintaining the Data Warehouse, Change Data Capture, Summary Advisor **Loading and Transformation:** Overview of Loading and Transformation in Data Warehouses, Loading Mechanisms, Transformation Mechanisms, Loading and Transformation Scenarios **Maintaining the Data Warehouse:** Using Partitioning to Improve Data Warehouse Refresh, Optimizing DML Operations During Refresh, Refreshing Materialized Views, Using Materialized Views with Partitioned Tables

Unit 5: Change Data Capture: About Change Data Capture, Installation and Implementation, Security, Columns in a Change Table, Change Data Capture Views, Synchronous Mode of Data Capture, Publishing Change Data, Managing Change Tables and Subscriptions, Subscribing to Change Data, Export and Import Considerations **Summary Advisor:** Overview of the Summary Advisor in the DBMS_OLAP Package, Using the Summary Advisor, Estimating Materialized View Size, Is a Materialized View Being Used Summary Advisor Wizard. **Warehouse Performance:** Schema Modeling Techniques, SQL for Aggregation in Data Warehouses, SQL for Analysis in Data Warehouses, OLAP and Data Mining, Using Parallel Execution, Query Rewrite **SQL for Aggregation in Data Warehouses:** Overview of SQL for Aggregation in Data Warehouses, ROLLUP Extension to GROUP BY, CUBE Extension to GROUP BY, GROUPING Functions, GROUPING SETS Expression, Composite Columns, Concatenated Groupings, Considerations when Using Aggregation, Computation Using the WITH Clause

Reference Books:

1. Kimball, Reeves Ross, Thornthwaite, The Data Warehouse Lifecycle Toolkit, John Wiley & Sons, 1998.
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Elsevier Second edition.
3. Arun K Pujari, Data Mining Techniques, University Press, Tenth edition 2006, ISBN 81 7371 380 4
4. Oracle9i Data Warehousing Guide Release 2 (9.2) Part Number A96520-01 by Oracle Press.

Lab Exercise: CSC564 Practical based on CSC528:

There should be minimum 10 lab assignments on the topics discussed in the course.

- Data Modeling Trade-Offs
- Extraction, Transformation, and Load
- Aggregate Selection and Navigation
- Select a mini project and do following excersie on it :-
  1. Dimensional Fact Modelling (dfm)
  2. Aggregation Path Array (apa)
  3. Logical Modelling (log)

Course Outcomes:

On successful completion of this course, the learner will be able to

- Describe the fundamental concepts, benefits and problem areas associated with data warehousing
- Describe the various architectures and main components of a data warehouse.
- Will be able model data and design as per the application need

2. Biometrics and Security Systems

Course Code	**CSC529**	**Course Title**	**Biometrics and Security**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: The student must have knowledge of image processing, pattern recognition, and neural networks

Course Objectives:

1. The aim of this course is to introduce the principles of biometric authentication.
2. The course will study those biometric characteristics which have commercial implementations, as well as emerging techniques, discussing hopes and fears related to the presented modalities.
3. Important part of this course will be devoted to the security of biometrics (in particular liveness detection) and secure biometric implementations.
4. The course will show how to apply statistics for biometric reliability evaluation.
5. Each lecture will refer to selected examples of real systems and applications.

Course Outline:

Unit 1: Introduction: Biometric fundamentals Biometric technologies Biometrics Vs. traditional techniques

Unit 2: Characteristics of a good biometric system, Benefits of biometrics Key biometric

Unit 3: Physiological Biometrics: scan Hand Scan, Retina strengths and weaknesses.

Unit 4: Leading technologies: Finger-scan – Facial-scan – Iris-scan – Voice-Scan - components, working principles, competing technologies

Unit 5: Automated Biometric System and Behavioral Biometrics: Automated fingerprint

Reference Books:

1. Paul Reid, Biometrics for Network Security, Pearson Education, New Delhi, 2004.
2. John R Vacca, Biometric Technologies and Verification Systems, Elsevier Inc, 2007.
3. Anil K Jain, Patrick Flynn, Arun A Ross, Handbook of Biometrics , Springer, 2008

Lab Exercise: CSC565 Practical based on CSC529:

Lab exercise will be cover practicals assignment from each unit.

1. Aggregation Path Array (apa)
2. Logical Modelling (log)

Course Outcomes:

- The aim of this course is to introduce the principles of biometric authentication.
- The course will study those biometric characteristics which have commercial implementations, as well as emerging techniques, discussing hopes and fears related to the presented modalities.
- Important part of this course will be devoted to the security of biometrics (in particular liveness detection) and secure biometric implementations.
- The course will show how to apply statistics for biometric reliability evaluation.
- Each lecture will refer to selected examples of real systems and applications.

3. Cloud Computing

Course Code	**CSC530**	**Course Title**	**Cloud Computing**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Programming languages like Java, Python etc. and Computer Network

Course Objective:

1. Cloud computing is recognized as one of the top five emerging technologies that will have a major impact on the quality of science and society over the next 20 years, its knowledge will help position our readers at the forefront of the field.

Course Outline:

Unit 1: Introduction: Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies. Principles of Parallel and Distributed Computing: Eras of Computing, Parallel vs. Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing.

Unit 2: Virtualization: Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples (Xen, VMWare, Microsoft Hyper-V).

Unit 3: Cloud Computing Architecture: Cloud Reference Model, Cloud Reference Model (Public, Private, Hybrid, Community), Economics of the Cloud, Open Challenges. Aneka: Cloud Application Platform: Framework Overview of Aneka, Anatomy of the Aneka Container, Building Aneka Clouds, Cloud Programming and Management.

Unit 4: Concurrent Computing: Thread Programming: Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, Multithreading with Aneka, Programming Applications with Aneka Threads. High-Throughput Computing:

Task Programming: Task Computing, Task-based Application Models, Aneka Task- Based Programming

Unit 5: Data Intensive Computing: Map-Reduce Programming: Data-Intensive Computing, Technologies for Data-Intensive Computing, Aneka MapReduce Programming

Book:

1. Buyya R., Vecchiola C., Selvi S. T., Mastering Cloud Computing, Mc-Graw Hill Education (India), 2013

Reference Books:

1. Rittinghouse J. W., Ransome J. F., Cloud Computing-Implementation, Management, and Security, CRC Press, 2010
2. Shroff G, Enterprise Cloud Computing-Technology, Architecture, Applications, Cambridge University Press, 2010.
3. Antonopoulos N, Gillam L, Cloud Computing -Principles, Systems and Applications, Springer, 2010

Lab Exercise: CSC566 Practical based on CSC530:

Lab exercise will be cover practicals assignment from each unit.

Course Outcome:

- At Course Completion they will be expert developers required to create Cloud applications and services.

4. Decision Support System

Course Code	**CSC531**	**Course Title**	**Decision Support System**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: To aware about classification mechanism.

Course Objective:

1. To design and implement the logic based frameworks for Decision Support and Intelligent systems.

Course Outline:

Unit 1: Decision Support and Business Intelligence: Business Intelligence using Excel, Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision **Managerial** Support, The **Decision** Concept **Support,** of Decision **Implementing** Support **Computer** Systems**-Based**(DSS), **Managerial** A Framework **Decision** for Business Support Intelligence (BI), A Work System View of Decision Support, The Major Tools and Techniques Systems, **Computerized Decision Support, Decision Making, Systems, Modeling, and Support:** Decision Making: Introduction and Definitions, Models, Phases of the Decision Making Process, Making: The Intelligence Phase, The Design Phase, The Choice Phase, The implementation Phase, How Decisions are Supported in each phase?

Unit 2: Decision Support Systems: Concepts, Methodologies, and Technologies: An Overview: Opening Vignette: Decision Support Subsystem, Cures The for User Healthcare, Interface DSS Dialog Configurations, Subsystem, DSS The Description, Knowledge DSS- Based Characteristics Management and Capabilities, Components of DSS, The Data Management Subsystem, The Model Subsystem, The User, DSS Hardware, DSS. **Knowledge Management:** Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approached to Knowledge Management, Information Technology in Knowledge Management, Knowledge Management Classification

Unit 3: Modeling and Analysis: Modeling for Decision Making, MSS Modeling, Static and Dynamic Models, Certainty ,Uncertainty, and Risk, MSS Modeling with Spreadsheets, Decision**, What** Analysis**-IF,** with Decision Tables and Decision Trees, The Structure of Mathematical Models for Decision Support, Mathematical Programming Optimization, Multiple Goals, Sensitivity Analysis and Goal Seeking Problem Solving Search Methods, Simulation, Visual Interactive Simulation, Quantitative Software Packages and Model, Base Management. **Business Intelligence Special Introductory Section: The Essentials of Business Intelligence:** The Origins and Drivers of Business Intelligence, The General Process of Intelligence Creation and Use, The Major Characteristics of Business Intelligence, Towards Competitive Intelligence and Advantage, The Typical Data Warehouse and BI User Community, Successful BI Implementation, Structure and Components of BI, Conclusion: Today and Tomorrow **Business Analytics and Data Visualization: Operations with BI, The Business Analytics Field-An Advanced** Overview, **Business** On Analytical **Analytics,** Processing **Data Visualization,** (OLAP), Reporting **Geographic** and **Information** Queries,

Multidimensionality, **Systems, Real-Time** Business Intelligence, Automated Decision Support, and Competitive Intelligence, Business Analytics and the Web: Web Intelligence and Web Analytics, Usage, Benefits, and Success of Business Analytics **Data, Text, and Web Mining:** Data Mining Concepts and Applications, Data Mining Techniques and Tools, Data Mining Process, Text Mining, Web Mining **Neural Networks for Data Mining:**, Basic Concepts of Neural Networks, Learning in Artificial Neural Networks, Developing Neural Network Systems, A Sample Neural Network Project, Other Neural Networks Paradigms, Applications of Neural Networks, A Neural Network Software Demonstration **Business Performance Management:** Business Performance Management Overview, Strategize: Performance Measurement, Bpm Methodologies, Bpm Architecture and Applications, Performance Dashboards, Business Activity Monitoring (BAM)

Unit 4: Collaboration, Communication, Group Support Systems, and Knowledge Management Collaborative Computing Supported Technologies and Group Support Systems: GSS, Making Decisions in Groups: Characteristics, Process, Benefits, and Dysfunctions, Supporting Group work with Computerized Systems, Tools for Indirect Support of Decision Making, Integrated Groupware Suites, Direct Computerized Support for Decision Making: From GDSS to GSS, Products and Tools for GDSS/GSS and Successful, Implementation, Planning, Design, and the Project Management, Creativity, Idea Generation and Computerized Support

Unit 5: Case-based Reasoning, Genetic Algorithms Fundamentals, Developing Genetic.

Book:

1. Decision Support and Business Intelligence Systems, Turban, Pearson Education

Reference Books:

1. Decision Support Systems, George M. Marakas, 2nd Edition, Pearson Education
2. Decision Support Systems, Janakiraman V. S. and Sarukesi. K., Prentice Hall of India
3. Decision Support System and Management, Lofti, McGraw Hill Inc., International Edition, New Delhi.

Lab Exercise: CSC567 Practical based on CSC531

At least two experiments should be carried out on each unit.

Course Outcomes:

1. At the end of this course the student is aware of handling various activities in business through various decisions with various techniques using computer.

5. Remote Sensing and GIS

Course Code	**CSC532**	**Course Title**	**Remote Sensing and GIS**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: To learn this course basic knowledge of Digital Image processing, Digital Signal Processing, Matrix manipulations, Mathematics and Statistical Techniques is must.

Course Objectives:

The course is designed to fulfill the following objectives

1. To acquire skills in storing, managing digital data for planning and development.
2. To provide exposure to students in gaining knowledge on basic concepts and applications leading to modeling of natural resources management using Remote Sensing

Course Outline:

Unit 1: Introduction: Map as Model , Spatial Elements, Terminology, Classification of Maps, Map Scale, Spatial Referencing System, Map Projections, Grouping of Map Projections. Introduction to Remote Sensing? Electromagnetic Radiation, Electromagnetic Spectrum, Interactions with the Atmosphere, Radiation – Target, Passive vs. Active Sensing, Characteristics of Images.

Unit 2: Sensors: On the Ground, In the Air, In Space, Satellite Characteristics, Pixel Size, and Scale, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Geometric Distortion, Weather Satellites, Land Observation Satellites, Marine Observation Satellites.

Unit 3: Fundamentals of GIS: Introduction, Roots of GIS, Overview of Information System, Contribution Disciplines, GIS Definitions and Terminology, GIS Queries, GIS Architecture, Theoretical Models of GIS, Theoretical Framework for GIS, GIS Categories, Levels/Scales of Measurement. **GIS Data Management:** Introduction, Data Base Management Systems, GIS Data File Management, Database Models, Storage of GIS Data, Object Based Data Models, Organizational Strategy of DBMS in GIS.

Unit 4: Data Quality Issues: Introduction, Components of Data Quality. **Accuracy:** Precision and Resolution, Completeness, Sources of Error in GIS.

Unit 5: Image Analysis: Introduction, Visual interpretation, Digital processing, Preprocessing, Enhancement, Transformations, Classification, Integration of Remote Sensing and GIS

Books:

1. Fundamentals of Remote sensing Tutorial, natural resources Canada.
2. M. Anji Reddy, Remote Sensing and Geographical Information Systems BSP BS Publication.
3. Campbell, James B. 2011. Introduction to Remote Sensing, 5th edition. New York. The Guilford Press. ISBN 978-1609181765.

References Books:

1. Decision Support Systems, George M. Marakas, 2nd Edition, Pearson Education
2. Decision Support Systems, Janakiraman V. S. and Sarukesi. K., Prentice Hall of India
3. Decision Support System and Management, Lofti, McGraw Hill Inc., International Edition, New Delhi.

Lab Exercise: CSC568 Practical based on CSC532:

At least two experiments should be carried out on each unit.

Course Outcomes:

1. At Course Completion Students can go for research in Remote Sensing and GIS or work in industry allied in this field.

6. Human Computer Interface

Course Code	**CSC533**	**Course Title**	**Human Computer Interface**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Problem Solving and Object Oriented Technologies.

Course Objectives:
By taking courses in HCI, we expect students to have gained an understanding of the following:

1. The scope of issues affecting human-computer interaction.
2. The importance of the user interface to motivate the study of topics like HCI and user interfaces.
3. The impact of good and bad user interfaces.
4. The diversity of users and tasks (applications) and their impact on the design of user interfaces.
5. The limits of knowledge of individuals developing HCI systems.
6. The need to work with others, skilled in diverse areas such as software engineering, human factors, technical communication, statistics, graphic design, etc.
7. Cost/benefit trade-offs in HCI design.
8. Different system development lifecycles including those particularly applicable to HCI systems (e.g., iterative design, implementation, evaluation, and prototyping).
9. How HCI concerns can be incorporated into systems development lifecycles.
10. The need to evaluate system usability (e.g., someone will evaluate usability even if not the developer, and, in some cases, not evaluating constitutes professional misconduct).
11. The existence of design, implementation, and evaluation tools for developers with diverse needs and technical expertise.

Course Outline:
Unit 1: The human, The computer, The interaction Paradigms.

Unit 2: Interaction design, basics HCI in the software process Design rules Implementation support.

Unit 3: Evaluation techniques Universal design User support Cognitive models.

Unit 4: Socio-organizational issues and stakeholder requirements, Communication and collaboration models Task analysis, Dialogue notations and design

Unit 5: Models of the system, Modeling rich interaction Groupware, Ubiquitous computing and augmented realities, Hypertext, multimedia, and the World Wide Web.

Books:

1. Human Computer Interaction 3e - Dix, Finlay, Abowd, Beale.
2. Readings in Human Computer Interaction: Towards the Year 2000: 2nd Edition; Ronald Baecker, Jonathan Grudin, William Buxton, Saul Greenberg.
3. William M. Newman and Michael G. Lamming, Interactive System Design, Addison-Wesley (1995) (0-201-63162-8).
4. Jakob Nielsen, Designing Web Usability: The Practice of Simplicity, New Riders, 1st Ed(Dec 1999) (1-562-05810-X).
5. Jenny Preece - Yvoone Rogers, Helen Sharp, David Benyon, Simon Holland and Tom Carey, Human-Computer Interaction, Addison-Wesley (1994) (0-201-62769-8).

Lab Exercise: CSC569, Practical based on CSC533:

There should be minimum 10 lab assignment on the topics discussed in the course.

Course Outcomes:

On completion of this course according to course goals, the student should be able to:

2. Understand the basics of human and computational abilities and limitations.
3. Understand basic theories, tools and techniques in HCI.
4. Understand the fundamental aspects of designing and evaluating interfaces.
5. Practice a variety of simple methods for evaluating the quality of a user interface.
6. Apply appropriate HCI techniques to design systems that are usable by people.

7. Computer Vision

Course Code	**CSC534**	**Course Title**	**Computer Vision**
Number of Credits	**3 Credits (TH)** **2 Credits (PR)**	**Internal**	**20%**
Total Contact Hours	**3 Hrs. (TH/Week)** **4 Hrs. (PR/Week)**	**External (Semester/Term End Exam)**	**80%**

Prerequisite: Problem Solving and Object Oriented Technologies.

Course Objective:

1. To provide the mechanics for atomization of computer recognition system based on analysis of pattern.

Course Outline:

Unit 1: Image formation: Camera models, Light and color, Linear filters and edges, Feature extraction (corners and blobs).

Unit 2: Grouping and fitting: Hough transform, RANSAC, Alignment.

Unit 3: Geometric vision: Camera calibration Epipolar geometry, Two-view and multi-view stereo, Structure from motion

Unit 4: Recognition: Bags of features, Generative and discriminative models, Face detection and recognition

Unit 5: Miscellaneous: Segmentation, Optical flow Tracking

Textbook:

1. Computer Vision: A Modern Approach by David Forsyth and Jean Ponce http://luthuli.cs.uiuc.edu/~daf/book/book.html

Useful Resource:

1. http://www.cs.unc.edu/~lazebnik/research/spring08/

Tutorials, Review Materials:

1. MATLAB tutorial (via David Kriegman and Serge Belongie)
2. **More MATLAB tutorials:**basic operations, programming, working with images (via Martial Hebert at CMU)
3. Linear algebra review (via David Kriegman) Random variables review (via David Kriegman)

General References:

1. Draft chapters of Forsyth and Ponce http://decsai.ugr.es/mia/complementario/t1/book3chaps.html
2. Computer Vision: Algorithms and Applications -- a textbook in progress by Richard Szeliski http://research.microsoft.com/en-us/um/people/szeliski/book/
3. Ballardand Brown's historictextbook http://homepages.inf.ed.ac.uk/rbf/BOOKS/BANDB/bandb.htm

4. CVOnline -- Compendium of Computer Vision http://homepages.inf.ed.ac.uk/rbf/CVonline/
5. ICCV 2005/CVPR 2007 Short Course on Object Recognition -- by Fei-Fei Li, Rob Fergus, and Antonio Torralba, http://people.csail.mit.edu/torralba/shortCourseRLOC/

MATLAB Reference:

1. MATLAB guide from Mathworks http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.html
2. MATLAB image processing toolbox, http://www.mathworks.com/access/helpdesk/help/toolbox/images/images.shtml

The Real World:

1. The Computer Vision Industry -- maintained by David Lowe, http://www.cs.ubc.ca/spider/lowe/vision.html

Lab Exercise: CSC570 Practical based on CSC534:

At least two experiments should be carried out on each unit.

Course Outcome:

- At Course Completion Students can go for research in computer vision or work in atomization industry.

Service Course

The Department of Computer Science and Information Technology provides the following service course for the students of the parent department and other departments of the university.

Communication Skill

Course Code	**CSC541**	**Course Title**	**Communication Skill**
Number of Credits	**4 Credits (TH)**	**Oral**	**50%**
Total Contact Hours	**4 Hrs. (TH/Week)**	**Written (Semester/Term Exam)**	**50%**

Prerequisite: No specific prerequisite is needed for this course.

Course Objectives:

- To make student well versatile in profession and technical communication skills

Course Outline:

Sr. No.	Practical	Theory	Duration In Hours
1	**Development of Proficiency in English :** • Practice on oral and spoken, accent, pitch, amplitude, intonation, and pause. • Etiquettes while speaking • Analysis of pictorial expression	• Components of effective communication • Objectives of communication skills and its types • Nonverbal communication and its importance ✓ Facial expression ✓ Posture ✓ Gestures ✓ Eye contact ✓ Dress code	Theory : 3 Pract : 3 Total : 6
2	**Development of skills for** • Making of sentences • Correction of errors in sentence • Leave application	**Basic Grammar** • Parts of speech • Synonyms and Antonyms • Vocabulary enhancement	Theory : 3 Pract : 3 Total : 6
3	**Presentation Skills** • Slide preparation • Emphasis on how to read them • Time management	**Four Methods** • Introduction • Presentation • Evaluation • Conclusion / Summarization	Theory : 2 Pract : 3 Total : 5
4	**Speech strategies** • Planning • Practice • Stage daring • Building self confidence	**Methods** • How to read audience • How to pay attention to body language • How to catch audience	Theory : 2 Pract : 2 Total : 4
5	**Co-ordination Skills** • How to participate in: ✓ Group discussion	**Concept and difference between :** • Group discussion • Debate	Theory : 3 Pract : 7 Total : 10

	✓ Debate ✓ Negotiation ✓ Argument	• Negotiation • Argument	
6	**Bench to benchmark** • E mail writing • Resume / CV writing • Mock interviews	**Bench to benchmark** • Protocols for : ✓ Writing E mail ✓ Resume ✓ Memo ✓ Interview Skills	Theory : 2 Pract : 2 Total : 4
7	**Soft Skills** • Problem solving • Decision making • Dealing with Society effectively • Conflict resolution	**Soft Skills** • Introduction to soft skills • Empathy • Ideas for leadership	Theory : 2 Pract : 2 Total : 4

Course Outcomes:

- Express themselves well verbally and improve academic and technical level of writing.
- Present ideas in a clear and effective manner
- Make the student ready for facing interviews and improve their professional personality.

Program Outcomes(POs)

And

Program Specific Outcomes (PSOs)

1. M.Sc Computer Science

1. An ability to apply knowledge of Computer science for developing solutions to complex scientific problem of societal and industrial needs.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. Demonstrate an in depth and comprehensive understanding of Computer Science.
4. To provide students with a solid foundation in mathematics, engineering, basic science fundamentals required to solve computing problems.
5. To prepare students to excel in Computer Science and Engineering program through quality education enabling them to succeed in computing industry profession.
6. An ability to identify, formulate, research literature towards analysis of complex computer science problems reaching substantiated conclusion using principals of Artificial Intelligence, Machine Learning, Computer Vision and Knowledge Discovery.
7. An ability to use the techniques, skills and modern tools necessary for performing computer science research.
8. Broad understanding of ethical and technological applications in the context of global and societal realities along with contemporary issues.
9. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
10. An ability to identify opportunities for establishing an enterprise.
11. Have an enhanced ability to apply the knowledge learned to solve technical problems that arise in research they conduct or supervise.

Program Articulation Matrix For Computer Science

Sr.No	Course Outcomes (CO) Sem	Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	I	CSC402	Research Methodology	Y										
2	I	CSC403	Advance Operating System		Y									
3	I	CSC404	Data Structure and Algorithms		Y	Y								
4	I	CSC405	Discrete Mathematical Structure			Y	Y							
5	I	CSC406	Programming in Core Java					Y						
6	II	CSC407	Research Project Review Writing						Y					
7	II	CSC408	Relational DBMS & SQL							Y	Y			
8	II	CSC409	Software Engineering and CASE Tools			Y	Y							
9	II	CSC410	Compiler Design									Y		
10	II	CSC411	Advance Java										Y	
11	II	CSC412	Computer System Architecture											Y
12	III	CSC501	Advance Computer Networks										Y	
13	III	CSC502	Computer Graphics											Y
14	III	CSC525	Elective1-Data Mining											Y
15	IV	CSC503	Pattern Recognition							Y	Y			
16	IV	CSC528	Elective-II Data Warehousing							Y				Y

IQAC Cell

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

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