

**ACADEMIC REGULATIONS, COURSE STRUCTURE  
AND DETAILED SYLLABUS**

**M.Tech (COMPUTER SCIENCE ENGINEERING)**

**FOR  
MASTER OF TECHNOLOGY TWO YEAR POST GRADUATE COURSE  
(Applicable for the batches admitted from 2015-2016)**

**R15**



**ANURAG GROUP OF INSTITUTIONS  
(AUTONOMOUS)  
SCHOOL OF ENGINEERING  
Venkatapur, Ghatkesar, Hyderabad – 500088**

## **R 15 - ACADEMIC REGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES**

Applicable for the students of M. Tech. (Regular) programme from the Academic Year **2015-16** and onwards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

### **1.0 ELIGIBILITY FOR ADMISSIONS**

Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

### **2.0 AWARD OF M. Tech. DEGREE**

- 2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years, failing which he shall forfeit his seat in M. Tech. programme.
- 2.2 The student shall register for all **88** credits and secure all the 88 credits.
- 2.3 The minimum instruction days in each semester are 90.

### **3.0 COURSES OF STUDY**

The following specializations are offered at present for the M. Tech. programme of study.

1. CAD/CAM
2. Computer Networks and Information Security
3. Computer Science
4. Computer Science and Engineering
5. Construction Management
6. Electrical Power Systems
7. Electronics and Communication Engineering
8. Embedded Systems
9. Machine Design
10. Power Electronics and Electrical Drives
11. Software Engineering
12. Structural Engineering
13. VLSI System Design
14. Wireless and Mobile communication

## **4 Course Registration**

- 4.1** A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.
- 4.2** Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.
- 4.3** A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).
- 4.4** If the Student submits ambiguous choices or multiple options or erroneous entries - during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.
- 4.5** Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

## **5 ATTENDANCE**

The programmes are offered on a unit basis with each subject being considered a unit.

- 5.1** Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if attendance is less than 75%.
- 5.2** Condonation of shortage of attendance in each subject up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee on genuine medical grounds and valid reasons on representation by the candidate with supporting evidence.
- 5.3** Shortage of Attendance below 65% in each subject shall not be condoned.
- 5.4** Students whose shortage of attendance is not condoned in any subject are not

eligible to write their end semester examination of that subject and their registration shall stand cancelled.

- 5.5 A prescribed fees shall be payable towards condonation of shortage of attendance.
- 5.6 A candidate shall get minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech Degree, The candidate shall complete all the academic requirements of the subjects, as per the course structure.
- 5.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission in to the same class.

## **6 EVALUATION**

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

- 6.1 For the theory subjects 60 marks shall be awarded for the performance in the Semester End Examination and 40 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other, immediately after the completion of Semester instructions. Each mid-term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (10 marks) consisting of 5 sub-questions carrying 2 marks each, and Part B with 3 questions to be answered out of 5 questions, each question carrying 10 marks. The details of the Question Paper pattern for End Examination (Theory) are given below:
- The Semester End Examination will be conducted for 60 marks. It consists of two parts. i).Part-A for 20 marks, ii). Part-B for 40 marks.
  - Part-A is a compulsory question consisting of 5 questions, one from each unit and carries 4 marks each.
  - Part-B to be answered 5 questions carrying 8 marks each. There will be two questions from each unit and only one should be answered.
- 6.2 For practical subjects, 60 marks shall be awarded for performance in the Semester End Examinations and 40 marks shall be awarded for day-to-day performance as Internal Marks.
- 6.3 The practical end semester examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed by the Principal from the panel of examiners recommended by Chairman, Board of Studies in respective Branches.

- 6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.
- 6.5 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Head of the Department shall be associated with the conduct of the Comprehensive Viva-Voce through a Committee. The Committee consisting of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Principal from the panel of 3 examiners recommended by Chairman, Board of Studies in respective Branches. There are no internal marks for the Comprehensive Viva-Voce and evaluates for maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.
- 6.6 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the Semester End Examination and a minimum aggregate of 50% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.
- 6.7 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to reappear for the Semester End Examination in that subject.
- 6.8 A candidate shall be given one chance to re-register for the subjects if the internal marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.
- 6.9 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the Semester End Examination in that subject. He shall re-register for the subject when next offered.

## **7 Examinations and Assessment - The Grading System**

- 7.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.
- 7.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
80% and above ( $\geq 80\%$ , $\leq 100\%$ )	O (Outstanding)	10
Below 80% but not less than 70% ( $\geq 70\%$ , $< 80\%$ )	A <sup>+</sup> ( Excellent)	9
Below 70% but not less than 60% ( $\geq 60\%$ , $< 70\%$ )	A ( Very Good)	8
Below 60% but not less than 55% ( $\geq 55\%$ , $< 60\%$ )	B <sup>+</sup> (Good)	7
Below 55% but not less than 50% ( $\geq 50\%$ , $< 55\%$ )	B ( Above Average)	6
Below 50% ( $< 50\%$ )	F (Fail)	0
Absent	Ab	0

- 7.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.
- 7.4 A student not appeared for examination then 'Ab' Grade will be allocated in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered.
- 7.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.
- 7.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.
- 7.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

**Credit Points (CP) = Grade Point (GP) x Credits .... For a Course**

- 7.8 The Student passes the Subject/ Course only when he **gets GP  $\geq 6$  (B Grade or above).**
- 7.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points ( $\Sigma$ CP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

$$\text{SGPA} = \left\{ \sum_{i=1}^N C_i G_i \right\} / \left\{ \sum_{i=1}^N C_i \right\} \text{ For each Semester,}$$

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C is the no. of Credits allotted to the ith Subject, and G represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i<sup>th</sup> Subject.

7.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

$$\text{CGPA} = \left\{ \sum_{j=1}^M C_j G_j \right\} / \left\{ \sum_{j=1}^M C_j \right\} \dots \text{ for all S Semesters registered}$$

**(ie., upto and inclusive of S Semesters,  $S \geq 2$ ),**

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the Semester S ( obviously  $M > N$  ), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C is the no. of Credits allotted to the jth Subject, and G represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

**7.11** For Calculations listed in Item 7.6 – 7.10, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations.

## **8. EVALUATION OF PROJECT/DISSERTATION WORK**

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

8.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.

8.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

8.3 After satisfying 8.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the

Project work.

- 8.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 8.5 A candidate shall submit his project status report in two stages at least with a gap of 3 months between them.
- 8.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.
- 8.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.
- 8.8 For Project work **Review I** in II Year I Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review I. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of PRC.
- 8.9 For Project work **Review II** in II Year II Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The PRC will examine the overall progress of the Project Work and decide the Project is eligible for final submission or not. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review II. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of PRC.
- 8.10 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external marks of 150 and the same evaluated by the External examiner appointed by the Institution. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.
- 8.11 If he fails to fulfill as specified in 8.10, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.
- 8.12 The thesis shall be adjudicated by one examiner selected by the Institution. For this, Chairmen, BOS of the respective departments shall submit a panel of 3 examiners, who are eminent in that field with the help of the concerned guide and senior faculty of the department.
- 8.13 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is un favourable again, the thesis shall be summarily rejected.
- 8.14 If the report of the examiner is favourable, Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the



external examiner who adjudicated the Thesis.

8.15 The Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination.

## **9. AWARD OF DEGREE AND CLASS**

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **88** Credits (with CGPA  $\geq 6.0$ ), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

### **9.2 Award of Class**

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

<b>Class Awarded</b>	<b>CGPA</b>
First Class with Distinction	$\geq 7.75$
First Class	$6.75 \leq \text{CGPA} < 7.75$
Second Class	$6.00 \leq \text{CGPA} < 6.75$

9.3 A student with final CGPA (at the end of the PGP)  $< 6.00$  will not be eligible for the Award of Degree.

## **10. WITHHOLDING OF RESULTS**

If the student has not paid the dues, if any, to the institution or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

## **11. TRANSITORY REGULATIONS**

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier or equivalent subjects at a time as and when offered.

11.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R15 Academic Regulations.

**GENERAL**

- 12.1 **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- 12.2 **Credit Point:** It is the product of grade point and number of credits for a course.
- 12.3 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”.
- 12.4 The academic regulation should be read as a whole for the purpose of any interpretation.
- 12.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the Decision of the Academic Council is final.
- 12.6 The Academic Council may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Academic Council.

## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm, computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the candidate is to be cancelled and sent to the controller of examinations, AGI.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination(including practical's and project work) already appeared and shall not

		be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any office relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subjects and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders. They will be handed over to the police and a police case is registered against them.

	misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulation in connection with forfeiture of seat.
8.	Posses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with college indulges in any malpractice or improper conduct mentioned in clause 6 to 8	Student of the college's expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeiture the seat.  Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all

		the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of the semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Malpractices committee, AGI for further action to award suitable punishment.	

**I YEAR I SEMESTER****COURSE STRUCTURE**

<b>Code</b>	<b>Subject Name</b>	<b>Int</b>	<b>Ext</b>	<b>Lectures</b>	<b>T/P/D</b>	<b>Credits</b>
Core Course I	Advanced Data Structures and Algorithms	40	60	4	0	4
Core Course II	Computer System Design	40	60	4	0	4
Core Course III	Advanced Operating Systems	40	60	4	0	4
Open Elective I	<b>Open Elective I</b> 1.Distributed Systems 2.Social Media Intelligence 3. Entrepreneurship	40	60	4	0	4
Core Elective -I	<b>Elective -I</b> 1.Software Process and Project Management 2.Natural Language Processing 3.Pattern Recognition	40	60	4	0	4
Core Elective II	<b>Elective -II</b> 1.Machine Learning 2.Parallel and Distributed Algorithms 3.Software Architecture and Design Patterns	40	60	4	0	4
Laboratory I	Advanced Data Structures and Algorithms Lab	40	60	0	4	2
Seminar I	Seminar	50	--	-	4	2
Total				24	8	28

**I YEAR II SEMESTER****COURSE STRUCTURE**

<b>Subject Code</b>	<b>Subject Name</b>	<b>Int</b>	<b>Ext</b>	<b>Lectures</b>	<b>T/P/D</b>	<b>Credits</b>
Core Course V	Advanced Network Programming	40	60	4	0	4
Core Course VI	Advanced Databases	40	60	4	0	4
Core Course VII	Web Services and Service Oriented Architecture	40	60	4	0	4
Open Elective II	<b>Open Elective II</b> 1. Grid and Cloud Computing 2. Computer Forensics 3. E-Commerce	40	60	4	0	4
Core Elective III	<b>Core Elective III:</b> Advanced Data Mining Storage Area Networks Database Security	40	60	4	0	4
Core Elective IV	<b>Core Elective IV:</b> Semantic Web and Social Networks Wireless Networks and Mobile Computing Information Retrieval Systems	40	60	4	0	4
Laboratory II	Web Services Lab	40	60	0	4	2
Seminar II	Seminar	50	--	-	4	2
	Total			24	8	28



## II Year I Semester

<b>Code</b>	<b>Subject Name</b>	<b>L</b>	<b>T/P/D</b>	<b>C</b>
	Comprehensive Viva	-	-	4
	Project Work Review I	-	24	12
	<b>Total</b>	<b>-</b>	<b>24</b>	<b>16</b>

## II Year II Semester

<b>Code</b>	<b>Subject Name</b>	<b>L</b>	<b>T/P/D</b>	<b>C</b>
	Project Work Review II		8	4
	Project Evaluation (Viva Voce)	-	16	12
	<b>Total</b>	<b>-</b>	<b>24</b>	<b>16</b>

**ANURAG GROUP OF INSTITUTIONS  
(AUTONOMOUS)**

**M. Tech – I Year – I Sem.**

<b>L</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>0</b>	<b>4</b>

**ADVANCED DATA STRUCTURES AND ALGORITHMS**

**Objectives:**

- The fundamental design, analysis, and implementation of basic data structures.
- Basic concepts in the specification and analysis of programs.
- Principles for good program design, especially the uses of data abstraction.
- Significance of algorithms in the computer field
- Qualities of a good solution

**UNIT I**

Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big Oh, Omega and Theta notations, Complexity Analysis Examples. Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists - insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, circular lists. Representation of single, two dimensional arrays, Sparse matrices and their representation.

**UNIT II**

Stack and Queue ADTs, array and linked list representations, infix to postfix conversion using stack, implementation of recursion, Circular queue-insertion and deletion, Dequeue ADT, array and linked list representations, Priority queue ADT, implementation using Heaps, Insertion into a Max Heap, Deletion from a Max Heap, java.util package- ArrayList, Linked List, Vector classes, Stacks and Queues in java.util, Iterators in java.util.

**UNIT III**

Searching-Linear and binary search methods, Hashing-Hash functions, Collision Resolution methods-Open Addressing, Chaining, Hashing in java.util-HashMap, HashSet, Hashtable. Sorting -Bubble sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort, comparison of sorting methods.

**UNIT IV**

Trees- Ordinary and Binary trees terminology, Properties of Binary trees, Binary tree ADT, representations, recursive and non recursive traversals, Java code for traversals, Threaded binary trees. Graphs- Graphs terminology, Graph ADT, representations, graph traversals/search methods-dfs and bfs, Java code for graph traversals, Applications of Graphs-Minimum cost spanning tree using Kruskal's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem.

**UNIT V**

Search trees- Binary search tree-Binary search tree ADT, insertion, deletion and searching operations, Balanced search trees, AVL trees-Definition and examples only,

Red Black trees - Definition and examples only, B-Trees-definition, insertion and searching operations, Trees in java.util- TreeSet, Tree Map Classes, Tries(examples only),Comparison of Search trees. Text compression-Huffman coding and decoding, Pattern matching-KMP algorithm.

### **TEXT BOOKS:**

1. Data structures, Algorithms and Applications in Java, S.Sahni, Universities Press.
2. Data structures and Algorithms in Java, Adam Drozdek, 3rd edition, Cengage Learning.
3. Data structures and Algorithm Analysis in Java, M.A.Weiss, 2nd edition, Addison-Wesley (Pearson Education).

### **REFERENCE BOOKS:**

1. Java for Programmers, Deitel and Deitel, Pearson education.
2. Data structures and Algorithms in Java, R.Lafore, Pearson education.
3. Java: The Complete Reference, 8th editon, Herbert Schildt, TMH.
4. Data structures and Algorithms in Java, M.T.Goodrich, R.Tomassia, 3rd edition, Wiley India Edition.
5. Data structures and the Java Collection Frame work, W.J.Collins, Mc Graw Hill.
6. Classic Data structures in Java, T.Budd, Addison-Wesley (Pearson Education).
7. Data structures with Java, Ford and Topp, Pearson Education.
8. Data structures using Java, D.S.Malik and P.S.Nair, Cengage learning.
9. Data structures with Java, J.R.Hubbard and A.Huray, PHI Pvt. Ltd.
10. Data structures and Software Development in an Object-Oriented Domain, J.P.Tremblay and G.A.Cheston, Java edition, Pearson Education.

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**COMPUTER SYSTEM DESIGN**

**Objectives:**

- To apply the fundamentals of Computer Systems Design and IT in devising IT solutions.
- To Design, simulate, and analyze digital hardware.
- To Interface between basic hardware and software computing systems.
- To Simulate and evaluate different computing architectures.

**UNIT I**

Computer structure - hardware, software, system software, Von-Neumann architecture - case study. IA -32 Pentium: registers and addressing, instructions, assembly language, program flow control, logic and shift/rotate instructions, multiply, divide MMX, SIMD instructions, I/O operations, subroutines. Input/output organization, interrupts, DMA, Buses, Interface circuits, I/O interfaces, device drivers in windows, interrupt handlers

**UNIT II**

Processing Unit: Execution of a complete instruction, multiple bus organization, hardwired control, micro programmed control.

Pipelining: data hazards, instruction hazards, influence on instruction sets, data path & control consideration, and RISC architecture introduction.

**UNIT - III**

Memory: types and hierarchy, model level organization, cache memory, performance considerations, mapping, virtual memory, swapping, paging, segmentation, replacement policies.

**UNIT - IV**

Processes and Threads: processes, threads, inter process communication, classical IPC problems, Deadlocks.

**UNIT - V**

File system: Files, directories, Implementation, Unix file system Security: Threats, intruders, accident data loss, basics of cryptography, user authentication.

**TEXT BOOKS:**

1. Computer Organization - Car Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.
2. Modern Operating Systems, Andrew S Tanenbaum 2<sup>nd</sup> edition Pearson/PHI

**REFERENCE BOOKS:**

1. Computer Organization and Architecture - William Stallings Sixth Edition, Pearson /PHI
2. Morris Mano- Computer System Architecture -3<sup>rd</sup> Edition-Pearson Education.
3. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7<sup>th</sup> Edition, John Wiley
4. Operating Systems - Internals and Design Principles Stallings, Fifth Edition-2005, Pearson Education/PHI

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**ADVANCED OPERATING SYSTEMS**

**Objectives:**

- To understand main components of Real time Operating system and their working
- To study the operations performed by OS as a resource manager
- To understand the scheduling policies of DOS
- To implement the working principles of OS
- To study different OS and compare their features

**UNIT I**

Real-time operating systems: Design issues, principles and case study.

**UNIT II**

Distributed operating system: Design issues, features and principles of working, case study.

**UNIT III**

Network operating system: Design issues, working principles and characteristic features, case study.

**UNIT IV**

Kernel development: Issues and development principles, case study.

**UNIT V**

Protection, privacy, access control and security issues, solutions.

**TEXT BOOKS:**

1. A. Silberschatz - Applied Operating System Concepts, Wiley, 2000.
2. Lubemir F Bic and Alan C. Shaw - Operating System Principles, Pearson Education, 2003.

**REFERENCE BOOKS:**

1. Operating Systems : Internal and Design Principles - Stallings, 6<sup>th</sup> ed., PE.
2. Modern Operating Systems, Andrew S Tanenbaum 3<sup>rd</sup> ed., PE.
3. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 7<sup>th</sup> ed.,, John Wiley
4. UNIX User Guide - Ritchie & Yates.
5. UNIX Network Programming - W.Richard Stevens ,1998, PHI.
6. The UNIX Programming Environment - Kernighan & Pike, PE.

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**DISTRIBUTED SYSTEMS**

**Objectives:**

- To explain what a distributed system is, why you would design a system as a distributed system, and what the desired properties of such systems are;
- To list the principles underlying the functioning of distributed systems, describe the problems and challenges associated with these principles, and evaluate the effectiveness and shortcomings of their solutions;
- To recognize how the principles are applied in contemporary distributed systems, explain how they affect the software design, and be able to identify features and design decisions that may cause problems;
- To design a distributed system that fulfills requirements with regards to key distributed systems properties (such as scalability, transparency, etc.), be able to recognize when this is not possible, and explain why;
- To build distributed system software using basic OS mechanisms as well as higher-level middleware and languages

**UNIT I**

Characterization of Distributed Systems- Introduction, Examples of Distributed systems, Resource sharing and web, challenges, System models- Introduction, Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication. Distributed objects and Remote Invocation-Introduction, Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.

**UNIT II**

Operating System Support- Introduction, OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture, Distributed File Systems-Introduction, File Service architecture, case study- SUN network file systems. Name Services-Introduction, Name Services and the Domain Name System, Case study of the Global Name Service, Case study of the X.500 Directory Service.

**UNIT III**

Peer to Peer Systems-Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore. Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. Coordination and Agreement - Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

**UNIT IV**

Transactions and Concurrency control - Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency controls. Distributed Transactions - Introduction, Flat and Nested

Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery, Replication-Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data.

#### **UNIT V**

Security - Introduction, Overview of Security techniques, Cryptographic algorithms, Digital signatures, Case studies-Kerberos, TLS, 802.11 WiFi. Distributed shared memory, Design and Implementation issues, Sequential consistency and Ivy case study, Release consistency and Munin case study, other consistency models, CORBA case studyIntroduction, CORBA RMI, CORBA Services.

#### **TEXT BOOKS:**

1. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Fourth Edition, Pearson Education.
2. Distributed Systems, S.Ghosh, Chapman & Hall/CRC, Taylor & Francis Group, 2010.

#### **REFERENCE BOOKS:**

1. Distributed Computing, S.Mahajan and S.Shah, Oxford University Press.
2. Distributed Operating Systems Concepts and Design, Pradeep K.Sinha, PHI.
3. Advanced Concepts in Operating Systems, M Singhal, N G Shivarathri, Tata McGraw-Hill Edition.
4. Reliable Distributed Systems, K.P.Birman, Springer.
5. Distributed Systems - Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, Pearson Education.
6. Distributed Operating Systems and Algorithm Analysis, R.Chow, T.Johnson, Pearson.
7. Distributed Operating Systems, A.S.Tanenbaum, Pearson education.
8. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani & Mukesh Singhal, Cambridge, 2010



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**SOCIAL MEDIA INTELLIGENCE**

**(OPEN ELECTIVE –I)**

**UNIT – I**

The Beginnings of Social Media Intelligence: What is Social Media monitoring? Anecdotal referencing of Social Media Comments, Text Mining, Some Simple Metrics, Using Social Media as Early Warning System. Fundamental of Opinion Formation: Affecting Opinion versus Biasing Expression, How Do We Form Opinions?, How Do Expectations Affect Opinion?, How Do Expertise and Knowledge Influence How We Form Opinions?, Opinion Formation in a Social Context, Bandwagon behavior and Information Cascades, Implications for Social Media Intelligence

**UNIT – II**

Why Do We Share our Opinions : Poster versus Lurkers, What Motivates Us to Post/, Posting Motivations and Selection effects, Implications for Social Media Intelligence. The Social effects of Strangers : How Does Social Context Affect Our Behavior?, How Influential is the Social Context/, How Does Social Context Affect Opinion Expression/, Bandwagon Behavior in Opinion expression, Differentiating Our opinions, Multiple Audience Effects, /can We Trust the Wisdom of Crowds.

**UNIT – III**

Opinion Ecosystems and the Evolution Within : Life Cycle Dynamics, Preference Mismatching and Sequential Dynamics, Social Dynamics, Are Social Media Communities the Cause of Opinion Radicalization ?, Online Echo Chambers, Implications for Social Media Monitoring and Metrics. Are Social Media Fragmenting the Population ? : Self-Organization, Birds of a Feather Flock Together, Geography No Longer Defines Our Communities, The influential Hypothesis, The New Influential, How Can We Identify Influentials, Influence in e-Commerce, Some Concluding Remarks.

**UNIT – IV**

Managing Social Media Communities for Better Social Media Intelligence: Creating an Inviting Environment, The Benefits of a Well-Managed Opinion Community (and the Costs of Not Managing the Community at All) Quality of Intelligence Depends on the Quality of the Opinion Community, Creating and Manipulating Buzz, Buzz Campaign or Fraud?, Identifying Fraudulent Opinions Cutting Through the Online Chatter : A New Paradigm for Marketing Research, Measure What Matters, Cast a Wide Net, Analyze the Text, Understand the biases, Establish Links to Performance metrics.

## **UNIT – V**

Intelligence Integration : Overview of Marketing Research Methods, Using Social Media for Marketing research, Tracking Brand Health, Understanding Market Structure, Social Shopping, Integration with Data from Other Parts of the Organization, Intelligence Dashboards. Building Social Media Intelligence into Our Strategies : How Can Social Media Intelligence Help Integrate an Organization's Strategy?, Multichannel Strategies, Rapid Response System, Integrated CRM, Leveraging Social Data, Seeding Strategies. Moving from Social Media monitoring to Social Media Intelligence : Social Media Intelligence today, Social Media Intelligence tomorrow, Building on the Science of Opinion, tapping into Opinion Ecosystems, Developing an Integrated Strategy.

### **REFERENCE:**

SOCIAL MEDIA INTELLIGENCE : by Wendly W.Moe, David A. Schweidel,  
Cambride University, edition 2014.

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**ENTREPRENEURSHIP  
(OPEN ELECTIVE –I)**

**Course Outcomes:**

Student will be able to:

1. Have the knowledge on various concepts of business management and approaches.
2. Understand and analyze the interconnections between the development of key functional areas of business organization and the management thought process.
3. Acquire team management skills and to become a competent leader, who possesses complex and integrated real world skills.
4. Be ethically conscious and socially responsible managers, capable of contributing to the development of the nation and quality of life.

**Unit-I:** Understanding Entrepreneurial Mindset- The revolution impact of entrepreneurship- The evolution of entrepreneurship- Approaches to entrepreneurship- Process approach- Twenty first century trends in entrepreneurship.

Case1: Ready, Aim, Fire Fire (B. Janakiram, M.Rizwana, page 212), Case2: Henry Ford, (B. Janakiram, M. Rizwana, page 214)

Case 3: From candle seller to CEO (Arya Kumar P.No. 48)

**Unit-II:** The individual entrepreneurial mind-set and Personality- The entrepreneurial journey- Stress and the entrepreneur- the entrepreneurial ego- Entrepreneurial motivations. Corporate Entrepreneurial Mindset-the nature of corporate entrepreneur-conceptualization of corporate entrepreneurship Strategy-sustaining corporate entrepreneurship.

Case : Globalizing Local Talent, (B. Janakiram, M. Rizwana, page 228).

**Unit-III:** Launching Entrepreneurial Ventures- opportunities identification-entrepreneurial Imagination and Creativity- the nature of the creativity process-Innovation and entrepreneurship. Methods to initiate Ventures- Creating new ventures-Acquiring an Established entrepreneurial venture- Franchising-hybrid-disadvantage of Franchising.

Case 1: Water, Water everywhere: but not a drop to drink, (Richard Blundel , Page 48).

Case 2: Critical Incident, Mark Robinson: Strategy Mapping Business (Richard Blundel, Page 48).

Case 3: Pets.com (Arya Kumar P.No. 88)

Case 4: creativity in start-ups (Arya Kumar P.No. 166)

Case 5: Opportunity – Earthmoving Industry (Arya Kumar P.No. 211)

**Unit-IV:** Legal challenges of Entrepreneurship-Intellectual property protection-Patents, Copyrights-Trademarks and Trade secrets-Avoiding trademark pitfalls. Formulation of the entrepreneurial Plan- The challenges of new venture start-ups, Poor financial Understanding-Critical factors for new venture development-The Evaluation process-Feasibility criteria approach.

Case 1: Victoria, Tomlinson; Network. (Richard Blundel, Page 99).

Case 2: Tim Lockett, Knowing your Customers & Suppliers (Richard Blundel Page128).

Case 3: Google (Arya Kumar P.No. 248)

Case 4: Tata Motors – Nano (Arya Kumar P.No. 279)

**Unit-V:** Strategic perspectives in entrepreneurship- Strategic planning-Strategic actions- strategic positioning-Business stabilization- Building the adaptive firms- Understanding the growth stage-Unique managerial concern of growing ventures.  
Case 1: To Lease or Not: A Cash flow Question (David H.Holt, Page 452).  
Case 2:- Public Sector - address seed capital (David H.Holt, Page 453).

**Text Books:**

1. D F Kuratko and T V Rao “Entrepreneurship- A South-Asian Perspective “Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit :[login.cengage.com](http://login.cengage.com))

Cases:

1. Arya Kumar “Entrepreneurship- creating and leading an entrepreneurial organization” Pearson 2012.
2. Richard Blundel” Exploring Entrepreneurship Practices and Perspectives, Oxford, 2011.
3. David H Holt” Entrepreneurship:New Venture Creation” PHI,2013.

**Journal:**

1. The Journal of Entrepreneurship, Entrepreneurship Development Institute of India, Ahmedabad,
2. Journal of Human Values: IIM Calcutta.

**Reference Books:**

1. Vasant Desai “Small Scale industries and entrepreneurship” Himalaya publishing 2012.
2. Rajeev Roy “Entrepreneurship” 2e, Oxford, 2012.
3. B.Janakiram and M.Rizwana” Entrepreneurship Development: Text & Cases, Excel Books, 2011.
4. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
5. Robert Hisrich et al “Entrepreneurship” 6<sup>th</sup> e, TMH, 2012.
6. Nandan H, Fundamentals of Entrepreneurship, PHI, 2013
7. Shejwalkar, Entrepreneurship Development, Everest, 2011
8. Khanka, Entrepreneurship Development, S.Chand, 2012

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**SOFTWARE PROCESS AND PROJECT MANAGEMENT  
(ELECTIVE - I)**

**Objectives:**

- Describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project.
- Compare and differentiate organization structures and project structures.
- Implement a project to manage project schedule, expenses and resources with the application of suitable project management tools.

**UNIT I**

Software Process Maturity

Software maturity Framework, Principles of Software Process Change, Software Process Assessment, The Initial Process, The Repeatable Process, The Defined Process, The Managed Process, The Optimizing Process.

Process Reference Models

Capability Maturity Model (CMM), CMMI, PCMM, PSP, TSP.

**UNIT II**

Software Project Management Renaissance Conventional Software Management, Evolution of Software Economics, Improving Software Economics, The old way and the new way. Life-Cycle Phases and Process artifacts Engineering and Production stages,

inception phase, elaboration phase, construction phase, transition phase, artifact sets, management artifacts, engineering artifacts and pragmatic artifacts, model based software architectures.

**UNIT III**

Workflows and Checkpoints of process Software process workflows, Iteration workflows, Major milestones, Minor milestones, Periodic status assessments. Process Planning Work breakdown structures, Planning guidelines, cost and schedule estimating process, iteration planning process, Pragmatic planning.

**UNIT IV**

Project Organizations

Line-of- business organizations, project organizations, evolution of organizations, process automation.

Project Control and process instrumentation. The seven core metrics, management indicators,

quality indicators, life-cycle expectations, Pragmatic software metrics, and metrics

automation.

## **UNIT V**

CCPDS-R Case Study and Future Software Project Management Practices

Modern Project Profiles, Next-Generation software Economics, Modern Process Transitions.

### **TEXT BOOKS:**

1. Managing the Software Process, Watts S. Humphrey, Pearson Education.
2. Software Project Management, Walker Royce, Pearson Education.

### **REFERENCE BOOKS:**

1. Effective Project Management: Traditional, Agile, Extreme, Robert Wysocki, Sixth edition, Wiley India, rp2011.
2. An Introduction to the Team Software Process, Watts S. Humphrey, Pearson Education, 2000
3. Process Improvement essentials, James R. Persse, O'Reilly, 2006
3. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, TMH, 2006
4. Applied Software Project Management, Andrew Stellman & Jennifer Greene, O'Reilly, 2006.
5. Head First PMP, Jennifer Greene & Andrew Stellman, O'Reilly, 2007
6. Software Engineering Project Management, Richard H. Thayer & Edward Yourdon, 2<sup>nd</sup> edition, Wiley India, 2004.
7. The Art of Project Management, Scott Berkun, SPD, O'Reilly, 2011.
8. Applied Software Project Management, Andrew Stellman & Jennifer Greene, SPD, O'Reilly, rp2011.
9. Agile Project Management, Jim Highsmith, Pearson education, 2004.

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**NATURAL LANGUAGE PROCESSING**

**(ELECTIVE-I)**

**Objectives:**

- To acquire basic understanding of linguistic concepts and natural language complexity, variability.
- To acquire basic understanding of machine learning techniques as applied to language.
- To implement N-grams Models.

**UNIT I**

Introduction and Overview What is Natural Language Processing, hands-on demonstrations. Ambiguity and uncertainty in language. The Turing test. Regular Expressions Chomsky hierarchy, regular languages, and their limitations. Finite-state automata. Practical regular expressions for finding and counting language phenomena. A little morphology. Exploring a large corpus with regex tools. Programming in Python An introduction to programming in Python. Variables, numbers, strings, arrays, dictionaries, conditionals, iteration. The NLTK (Natural Language Toolkit) String Edit Distance and Alignment Key algorithmic tool: dynamic programming, a simple example, use in optimal alignment of sequences. String edit operations, edit distance, and examples of use in spelling correction, and machine translation.

**UNIT II**

Context Free Grammars Constituency, CFG definition, use and limitations. Chomsky Normal Form. Top-down parsing, bottom-up parsing, and the problems with each. The desirability of combining evidence from both directions Non-probabilistic Parsing Efficient CFG parsing with CYK, another dynamic programming algorithms. Early parser. Designing a little grammar, and parsing with it on some test data. Probability Introduction to probability theory Joint and conditional probability, marginals, independence, Bayes rule, combining evidence. Examples of applications in natural language. Information Theory The "Shannon game"--motivated by language! Entropy, crossentropy, information gain. Its application to some language phenomena.

**UNIT III**

Language modeling and Naive Bayes

Probabilistic language modeling and its applications. Markov models. N-grams. Estimating the probability of a word, and smoothing. Generative models of language. Part of Speech Tagging and Hidden Markov Models, Viterbi Algorithm for Finding Most Likely HMM Path Dynamic programming with Hidden Markov Models, and its use for part-of-speech tagging, Chinese word segmentation, prosody, information extraction, etc.

## **UNIT IV**

Probabilistic Context Free Grammars Weighted context free grammars. Weighted CYK.

Pruning and beam search. Parsing with PCFGs A tree bank and what it takes to create one. The probabilistic version of CYK. Also: How do humans parse? Experiments with eye-tracking. Modern parsers. Maximum Entropy Classifiers The maximum entropy principle and its relation to maximum likelihood. Maximum entropy classifiers and their application to document classification, sentence segmentation, and other language tasks

## **UNIT V**

Maximum Entropy Markov Models & Conditional Random Fields

Part-of-speech tagging, noun-phrase segmentation and information extraction models that combine maximum entropy and finite-state machines. State-of-the-art models for NLP. Lexical Semantics Mathematics of Multinomial and Dirichlet distributions, Dirichlet as a smoothing for multinomial's.

Information Extraction & Reference Resolution- Various methods, including HMMs. Models of anaphora resolution. Machine learning methods for co reference.

### **TEXT BOOKS:**

1. "Speech and Language Processing": Jurafsky and Martin, Prentice Hall
2. "Statistical Natural Language Processing"- Manning and Schutze, MIT Press
3. "Natural Language Understanding". James Allen. The Benajmins/Cummings Publishing Company

### **REFERENCES BOOKS:**

1. Cover, T. M. and J. A. Thomas: Elements of Information Theory. Wiley.
2. Charniak, E.: Statistical Language Learning. The MIT Press.
3. Jelinek, F.: Statistical Methods for Speech Recognition. The MIT Press.
4. Lutz and Ascher - "Learning Python", O'Reilly



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**PATTERN RECOGNITION  
(ELECTIVE - I)**

**Objectives:**

- To implement pattern recognition and machine learning theories
- To design and implement certain important pattern recognition techniques
- To apply the pattern recognition theories to applications of interest
- To implement the entropy minimization, clustering transformation and feature ordering

**UNIT I**

**INTRODUCTION** - Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Examples of Automatic Pattern recognition systems, Simple pattern recognition model

**DECISION AND DISTANCE FUNCTIONS** - Linear and generalized decision functions, Pattern space and weight space, Geometrical properties, implementations of decision functions, Minimum-distance pattern classifications.

**UNIT II**

**PROBABILITY** - Probability of events: Random variables, Joint distributions and densities,

Movements of random variables, Estimation of parameter from samples. **STATISTICAL DECISION**

**MAKING** - Introduction, Baye's theorem, Multiple features, Conditionally independent features,

Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques,

characteristic curves, estimating the composition of populations. Baye's classifier for normal patterns.

**UNIT III**

**NON PARAMETRIC DECISION MAKING** - Introduction, histogram, kernel and window estimation, nearest neighbour classification techniques. Adaptive decision boundaries, adaptive discriminate functions, Minimum squared error discriminate functions, choosing a decision making techniques.

**CLUSTERING AND PARTITIONING** - Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering-Forg's algorithm, K-means's algorithm, Isodata algorithm.

**UNIT IV**

**PATTERN PREPROCESSING AND FEATURE SELECTION:**

Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection.

## **UNIT V**

### **SYNTACTIC PATTERN RECOGNITION & APPLICATION OF PATTERN RECOGNITION**

Introduction, concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc.,

#### **TEXT BOOKS:**

1. Gose. Johnsonbaugh. Jost. "Pattern recognition and Image Analysis", PHI.
2. Tou. Rafael. Gonzalez. "Pattern Recognition Principle", Pearson Education

#### **REFERENCE BOOKS:**

1. Richard Duda, Hart, David Stork, "Pattern Classification", John Wiley.
2. Digital Image Processing, M.Anji Reddy, Y.Hari Shankar, BS Publications.

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**MACHINE LEARNING  
(ELECTIVE -II)**

**Objectives:**

- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To understand the basic theory underlying machine learning.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To be able to read current research papers and understands the issues raised by current research.

**UNIT I**

**INTRODUCTION** - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering - Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias

**UNIT II**

Decision Tree learning - Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning Artificial Neural Networks - Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, utililayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks. Evaluation Hypotheses - Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms

**UNIT III**

Bayesian learning - Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm Computational learning theory - Introduction, Probability learning an approximately correct hypothesis, Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite ypothesis Spaces, The mistake bound model of learning - Instance-Based Learning- Introduction, k - Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning Genetic Algorithms - Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

## **UNIT IV**

Learning Sets of Rules - Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution

Analytical Learning - Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge

## **UNIT V**

Combining Inductive and Analytical Learning - Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators,

Reinforcement Learning - Introduction, The Learning Task, Q Learning, Non-Deterministic,

Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

## **TEXT BOOKS:**

1. Machine Learning - Tom M. Mitchell, - MGH
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)

## **REFERENCE BOOKS:**

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

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**PARALLEL AND DISTRIBUTED ALGORITHMS  
(ELECTIVE -II)**

**Objectives:**

- To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
- To study the main classes of parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.

**UNIT-I**

Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing

**UNIT-II**

Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples

**UNIT-III**

Pipelining- Techniques computing platform, pipeline programs examples

**UNIT-IV**

Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelism sharing data parallel programming languages and constructs, open MP

**UNIT-V**

Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms - sorting and numerical algorithms.

**TEXT BOOK:**

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2<sup>nd</sup> Edition.

**REFERENCE BOOK:**

1. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

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**SOFTWARE ARCHITECTURE AND DESIGN PATTERNS**

**(ELECTIVE -II)**

**Objectives:**

After completing this course, the student should be able to:

- To understand the concept of patterns and the Catalog.
- To discuss the Presentation tier design patterns and their affect on: sessions, client access, validation and consistency.
- To understand the variety of implemented bad practices related to the Business and Integration tiers.
- To highlight the evolution of patterns.
- To how to add functionality to designs while minimizing complexity
- To understand what design patterns really are, and are not
- To learn about specific design patterns.
- To learn how to use design patterns to keep code quality high without overdesign.

**UNIT I**

Envisioning Architecture

The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views.

Creating an Architecture

Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

**UNIT II**

Analyzing Architectures

Architecture Evaluation, Architecture design decision making, ATAM, CBAM.

Moving from one system to many Software Product Lines, Building systems from off the shelf components, Software architecture in future.

**UNIT III**

Patterns Pattern Description, Organizing catalogs, role in solving design problems, Selection and usage. Creational and Structural patterns

Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight.

**UNIT IV**

Behavioral patterns

Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.

## **UNIT V**

### Case Studies

A-7E - A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control - a case study in designing for high availability, Celsius Tech - a case study in product line development,

### **TEXT BOOKS:**

1. Software Architecture in Practice, second edition, Len Bass, Paul Clements & Rick Kazman, Pearson Education, 2003.
2. Design Patterns, Erich Gamma, Pearson Education, 1995.

### **REFERENCE BOOKS:**

1. Beyond Software architecture, Luke Hohmann, Addison wesley, 2003.
2. Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR, 2001
3. Software Design, David Budgen, second edition, Pearson education, 2003
4. Head First Design patterns, Eric Freeman & Elisabeth Freeman, O'REILLY, 2007.
5. Design Patterns in Java, Steven John Metsker & William C. Wake, Pearson education, 2006
6. J2EE Patterns, Deepak Alur, John Crupi & Dan Malks, Pearson education, 2003.
7. Design Patterns in C#, Steven John metsker, Pearson education, 2004.
8. Pattern Oriented Software Architecture, F.Buschmann & others, John Wiley & Sons.

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**ADVANCED DATA STRUCTURES AND ALGORITHMS LAB**

**Objectives:**

- The fundamental design, analysis, and implementation of basic data structures.
- Basic concepts in the specification and analysis of programs.
- Principles for good program design, especially the uses of data abstraction.

Sample Problems on Data structures:

1. Write Java programs that use both recursive and non-recursive functions for implementing the following searching methods:

- a) Linear search    b) Binary search

2. Write Java programs to implement the following using arrays and linked lists

- a) List ADT

3. Write Java programs to implement the following using an array.

- a) Stack ADT     b) Queue ADT

4. Write a Java program that reads an infix expression and converts the expression to postfix form.

(Use stack ADT).

5. Write a Java program to implement circular queue ADT using an array.

6. Write a Java program that uses both a stack and a queue to test whether the given string is a palindrome or not.

7. Write Java programs to implement the following using a singly linked list.

- a) Stack ADT    b) Queue ADT

8. Write Java programs to implement the deque (double ended queue) ADT using

- a) Array    b) Singly linked list     c) Doubly linked list.

9. Write a Java program to implement priority queue ADT.

10. Write a Java program to perform the following operations:

- a) Construct a binary search tree of elements.  
 b) Search for a key element in the above binary search tree.  
 c) Delete an element from the above binary search tree.

11. Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.

12. Write a Java program to implement Dijkstra's algorithm for Single source shortest path problem.

13. Write Java programs that use recursive and non-recursive functions to traverse the given binary tree in

- a) Preorder    b) Inorder     c) Postorder.

14. Write Java programs for the implementation of bfs and dfs for a given graph.



15. Write Java programs for implementing the following sorting methods:

- a) Bubble sort
- b) Insertion sort
- c) Quick sort
- d) Merge sort
- e) Heap sort
- f) Radix sort
- g) Binary tree sort

16. Write a Java program to perform the following operations:

- a) Insertion into a B-tree
- b) Searching in a B-tree

17. Write a Java program that implements Kruskal's algorithm to generate minimum cost spanning tree.

18. Write a Java program that implements KMP algorithm for pattern matching.

### **REFERENCE BOOKS:**

1. Data Structures and Algorithms in java, 3<sup>rd</sup> edition, A.Drozdek, Cengage Learning.
2. Data Structures with Java, J.R.Hubbard, 2<sup>nd</sup> edition, Schaum's Outlines, TMH.
3. Data Structures and algorithms in Java, 2<sup>nd</sup> Edition, R.Lafore, Pearson Education.
4. Data Structures using Java, D.S.Malik and P.S. Nair, Cengage Learning.
5. Data structures, Algorithms and Applications in java, 2nd Edition, S.Sahani, Universities Press.
6. Design and Analysis of Algorithms, P.H.Dave and H.B.Dave, Pearson education.
7. Data Structures and java collections frame work, W.J.Collins, Mc Graw Hill.
8. Java: the complete reference, 7<sup>th</sup> editon, Herbert Schildt, TMH.
9. Java for Programmers, P.J.Deitel and H.M.Deitel, Pearson education / Java: How to Program P.J.Deitel and H.M.Deitel , 8<sup>th</sup> edition, PHI.
10. Java Programming, D.S.Malik,Cengage Learning.
11. A Practical Guide to Data Structures and Algorithms using Java, S.Goldman & K.Goldman, Chapman & Hall/CRC, Taylor & Francis Group.

( Note: Use packages like java.io, java.util, etc)

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**ADVANCED NETWORK PROGRAMMING**

**Objectives:**

Computer network programming involves writing computer programs that enable processes to communicate with each other across a computer network.

Network programming is client-server programming Interprocess communication, even if it is bidirectional, cannot be implemented in a perfectly symmetric way: to establish a communication channel between two processes, one process must take the initiative, while the other is waiting for it. Therefore, network programming unavoidably assumes a client-server model: The process initiating the communication is a client, and the process waiting for the communication to be initiated is a server. The client and server processes together form a distributed system. In a peer-to-peer communication, the program can act both as a client and a server.

**UNIT - I**

Linux Utilities- File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking utilities, Filters, Text processing utilities and Backup utilities.

Bourne again shell(bash) - Introduction, pipes and redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples.

Review of C programming concepts-arrays, strings (library functions), pointers, function pointers, structures, unions, libraries in C.

**UNIT - II**

Files- File Concept, File types File System Structure, Inodes, File Attributes, file I/O in C using system calls, kernel support for files, file status information-stat family, file and record locking-lockf and fcntl functions, file permissions- chmod, fchmod, file ownership-chown, lchown , fchown, linkssoft links and hard links - symlink, link, unlink.

File and Directory management - Directory contents, Scanning Directories- Directory file APIs.

Process- Process concept, Kernel support for process, process attributes, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process.

**UNIT - III**

Signals- Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise , alarm, pause, abort, sleep functions. Interprocess Communication - Introduction to IPC mechanisms, Pipes- creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Introduction to message queues, semaphores and shared memory. Message Queues- Kernel support for messages, UNIX system V APIs for messages, client/server example.

Semaphores-Kernel support for semaphores, UNIX system V APIs for semaphores

## **UNIT - IV**

Shared Memory- Kernel support for shared memory, UNIX system V APIs for shared memory, client/server example.

Network IPC - Introduction to Unix Sockets, IPC over a network, Client-Server model, Address formats(Unix domain and Internet domain), Socket system calls for Connection Oriented -Communication, Socket system calls for Connectionless-Communication, Example-Client/Server Programs- Single Server-Client connection, Multiple simultaneous clients, Socket options -setsockopt, getsockopt, fcntl.

## **UNIT-V**

Network Programming in Java-Network basics, TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation details-Client-Server Application.

### **TEXT BOOKS:**

1. Unix System Programming using C++, T.Chan, PHI.(Units II,III,IV)
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.(Unit I)
3. An Introduction to Network Programming with Java, Jan Graba, Springer, rp 2010.(Unit V)
4. Unix Network Programming ,W.R. Stevens, PHI.(Units II,III,IV)
5. Java Network Programming,3<sup>rd</sup> edition, E.R. Harold, SPD, O'Reilly.(Unit V)

### **REFERENCE BOOKS:**

1. Linux System Programming, Robert Love, O'Reilly, SPD.
2. Advanced Programming in the UNIX environment, 2<sup>nd</sup> Edition, W.R.Stevens, Pearson Education.
3. UNIX for programmers and users, 3<sup>rd</sup> Edition, Graham Glass, King Ables, Pearson Education.
4. Beginning Linux Programming, 4<sup>th</sup> Edition, N.Matthew, R.Stones, Wrox, Wiley India Edition.
5. Unix Network Programming The Sockets Networking API, Vol.-I,W.R.Stevens, Bill Fenner, A.M.Rudoff, Pearson Education.
6. Unix Internals, U.Vahalia, Pearson Education.
7. Unix shell Programming, S.G.Kochan and P.Wood, 3<sup>rd</sup> edition, Pearson Education.
8. C Programming Language, Kernighan and Ritchie, PHI

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**ADVANCED DATABASES**

**Objectives:**

By the end of the course, you will know:

- History and Structure of databases
- How to design a database
- How to convert the design into the appropriate tables
- Handling Keys appropriately
- Enforcing Integrity Constraints to keep the database consistent
- Normalizing the tables to eliminate redundancies
- Querying relational data
- Optimizing and processing the queries
- Storage Strategies for easy retrieval of data through index
- Triggers, Procedures and Cursors ,Transaction Management
- Distributed databases management system concepts and Implementation

**UNIT I**

Database System Applications, Purpose of Database Systems, View of Data - Data Abstraction, Instances and Schemas, Data Models - the ER Model, Relational Model, Other Models-Database Languages - DDL,DML, Database Access from Applications Programs, Transaction Management,Data Storage and Querying, Database Architecture, Database Users and Administrators, ERdiagrams,. Relational Model: Introduction to the Relational Model - Integrity Constraints Over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design, Introduction to Views -Altering Tables and Views, Relational Algebra, Basic SQL Queries, Nested Queries, Complex Integrity Constraints in SQL, Triggers

**UNIT II**

Introduction to Schema Refinement - Problems Caused by redundancy, Decompositions – Problem related to decomposition, Functional Dependencies - Reasoning about FDS, Normal Forms - FIRST,SECOND, THIRD Normal forms - BCNF -Properties of Decompositions- Loss less- join Decomposition, Dependency preserving Decomposition, Schema Refinement in Data base Design -Multi valued Dependencies - FOURTH Normal Form, Join Dependencies, FIFTH Normal form.

**UNIT III**

Transaction Management: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions - Lock Based Concurrency Control, Deadlocks - Performance of Locking - Transaction Support in SQL.

Concurrency Control: Serializability, and recoverability - Introduction to Lock Management - Lock Conversions, Dealing with Dead Locks, Specialized Locking Techniques - Concurrency Control without Locking.

Crash recovery: Introduction to Crash recovery, Introduction to ARIES, the Log, and Other Recovery related Structures, the Write-Ahead Log Protocol, Check pointing, recovering from a System Crash, Media recovery.

## **UNIT IV**

Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing -Clustered Indexes, Primary and Secondary Indexes, Index data Structures - Hash Based Indexing, Tree based Indexing

Storing data: Disks and Files: -The Memory Hierarchy - Redundant Arrays of Independent Disks. Tree Structured Indexing: Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM) B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

Hash Based Indexing: Static Hashing, Extendable hashing, Linear Hashing, Extendable vs. Linear Hashing.

## **UNIT V**

Distributed databases: Introduction to distributed databases, Distributed DBMS architectures, Storing data in a distributed DBMS, Distributed catalog management, Distributed query processing Updating distributed data, Distributed transactions, Distributed concurrency control, Distributed recovery

### **TEXT BOOKS:**

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, TMH, 3<sup>rd</sup> Edition, 2003.
2. Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw hill, VI edition, 2006.
3. Fundamentals of Database Systems 5th edition. Ramez Elmasri, Shamkant B.Navathe, Pearson Education, 2008.

### **REFERENCE BOOKS:**

1. Introduction to Database Systems, C.J.Date, Pearson Education.
2. Database Management System Oracle SQL and PL/SQL, P.K.Das Gupta, PHI.
3. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning, 2008.
4. Database Systems, A Practical approach to Design Implementation and Management Fourth edition, Thomas Connolly, Carolyn Begg, Pearson education.
5. Database-Principles, Programming, and Performance, P.O'Neil&E.O'Neil, 2<sup>nd</sup> ed., ELSEVIER
6. Fundamentals of Relational Database Management Systems, S.Sumathi, S.Esakkirajan, Springer.
7. Introduction to Database Management, M.L.Gillenson and others, Wiley Student Edition.
8. Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.
9. Distributed Databases Principles & Systems, Stefano Ceri, Giuseppe Pelagatti, TMH.
10. Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez , Pearson Education, 2nd Edition.
11. Distributed Database Systems, Chhanda Ray, Pearson.
12. Distributed Database Management Systems, S.K.Rahimi and F.S.Haug, Wiley.

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**WEB SERVICES AND SERVICE ORIENTED ARCHITECTURE**

**Objectives:**

- To Understand Web Services and implementation model for SOA
- To Understand the SOA, its Principles and Benefits
- To Understand XML concepts
- To Understand paradigms needed for testing Web Services
- To explore different Test Strategies for SOA-based applications
- To implement functional testing, compliance testing and load testing of Web Services
- To Identify bug-finding ideas in testing Web Services

**UNIT I**

Evolution and Emergence of Web Services - Evolution of distributed computing. Core distributed computing technologies - client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, role of J2EE and XML in distributed computing, emergence of Web Services and Service Oriented Architecture (SOA). Introduction to Web Services - The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services.

**UNIT II**

Web Service Architecture - Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services. Describing Web Services - WSDL introduction, non functional service description, WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type, limitations of WSDL.

**UNIT III**

Brief Over View of XML - XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation. SOAP : Simple Object Access Protocol, Inter-application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP envelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a SOA, Reliable messaging, The enterprise Service Bus, SOA Development Lifecycle, SOAP HTTP binding, SOAP communication model, Error handling in SOAP.

**UNIT IV**

Registering and Discovering Services : The role of service registries, Service discovery, Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model, Interfaces, UDDI Implementation, UDDI with WSDL, UDDI specification, Service Addressing and Notification, Referencing and addressing Web Services, Web Services Notification.

**UNIT V**

SOA and web services security considerations, Network-level security mechanisms, Application-level security topologies, XML security standards, Semantics and Web Services, The semantic interoperability problem, The role of metadata, Service metadata, Overview of .NET and J2EE, SOA and Web Service Management, Managing Distributed System, Enterprise management Framework, Standard distributed management frameworks, Web service management, Richer schema languages, WS-Metadata Exchange.

**TEXT BOOKS:**

1. Web Services & SOA Principles and Technology, Second Edition, Michael P. Papazoglou.
2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India.
3. Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education.

**REFERENCE BOOKS:**

1. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.
2. Building web Services with Java, 2<sup>nd</sup> Edition, S. Graham and others, Pearson Education.
3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.
4. McGovern, et al., "Java web Services Architecture", Morgan Kaufmann Publishers, 2005.
5. J2EE Web Services, Richard Monson-Haefel, Pearson Education.

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**GRID AND CLOUD COMPUTING**

Objectives:

- To implement Basics, techniques and tools for Grid & Cloud Computing
- To understand any kind of heterogeneous resources over a network using open standards
- To implement the Service models

**UNIT-I**

System models for advanced computing -clusters of cooperative computing, grid computing and cloud computing; software systems for advanced computing-service oriented software and parallel and distributed programming models with introductory details, Features of grid and cloud platform.

**UNIT-II**

Cloud Computing services models and features in Saas, Paas and Iaas.

Service oriented architecture and web services; Features of cloud computing architectures and simple case studies.

**UNIT-III**

Virtualization- Characteristic features, Taxonomy Hypervisor, Virtualization and Cloud Computing, Pros and Cons of Cloud Computing, Technology Examples/Case Studies.

**UNIT-IV**

Cloud programming Environmental- Map Reduce Hadoop Library from Apache, Open Source Cloud Software Systems -Eucalyptus.

**UNIT-V**

Grid Architecture and Service modeling, Grid resource management, Grid Application trends.

**TEXT BOOKS:**

1. Distributed and Cloud Computing, Kaittwang Geoffrey C.Fox and Jack J Dongrra, Elsevier India 2012.
- 2.Mastering Cloud Computing- Raj Kumar Buyya, Christian Vecchiola and S.Tanurai Selvi, TMH, 2012.

**REFERENCE BOOKS:**

1. Cloud Computing, John W. Ritting House and James F Ramsome, CRC Press, 2012.
2. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2012.



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**COMPUTER FORENSICS  
(OPEN ELECTIVE - II)**

**Objectives:**

1. To understand the cyberspace
2. To understand the forensics fundamentals
3. To understand the evidence capturing process.
4. To understand the preservation of digital evidence.

**UNIT I**

Computer Forensics Fundamentals: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?.Types of Computer Forensics Technology : Types of Military Computer Forensic Technology, Types of Law Enforcement Computer Forensic Technology, Types of Business Computer Forensics Technology

**UNIT II**

Computer Forensics Evidence and Capture: Data Recovery: Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Case Histories.Evidence Collection and Data Seizure: Why Collect Evidence?, Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collecting and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody

**UNIT III**

Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting And Preserving Computer Forensic Evidence. Computer Image Verification and Authentication : Special Needs of Evidential Authentication, Practical Considerations, Practical Implementation

**UNIT IV**

Computer Forensics Analysis: Discovery of Electronic Evidence: Electronic Document Discovery: A Powerful New Litigation Tool, Identification of Data: Timekeeping, Time Matters,Forensic Identification and Analysis of Technical Surveillance Devices. Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files. Networks: Network Forensics Scenario, A Technical Approach, Destruction of Email, Damaging Computer Evidence, International Principles Against Damaging of Computer Evidence, Tools Needed for Intrusion Response to the Destruction of Data, Incident Reporting and Contact Forms.

## **UNIT V**

Current Computer Forensics Tools: Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software.

### **TEXT BOOKS:**

1. “Computer Forensics: Computer Crime Scene Investigation”, JOHN R. VACCA, Firewall Media. 2. “Guide to Computer Forensics and Investigations”<sup>4e</sup>, Nelson, Phillips Enfinger, Steuart, Cengage Learning.

### **REFERENCES:**

1. “Computer Forensics and Cyber Crime”, Marjie T Britz, Pearson Education.
2. “Computer Forensics”, David Cowen, Mc Graw Hill.
3. Brian Carrier , "File System Forensic Analysis" , Addison Wesley, 2005
4. Dan Farmer & Wietse Venema , "Forensic Discovery", Addison Wesley, 2005
5. Eoghan Casey , —Digital Evidence and Computer Crime —, Edition 3, Academic Press, 2011

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**E – COMMERCE  
(OPEN ELECTIVE - II)**

**Objectives:**

1. Identify the major categories and trends of e-commerce applications.
2. Identify the essential processes of an e-commerce system.
3. Identify several factors and web store requirements needed to succeed in e-commerce.  
Discuss the benefits and trade-offs of various e-commerce clicks and bricks alternatives.
4. Understand the main technologies behind e-commerce systems and how these technologies interact.
5. Discuss the various marketing strategies for an online business. Define various electronic payment types and associated security risks and the ways to protect against them.

**UNIT - I**

Electronic Commerce-Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E- Commerce organization applications. Consumer Oriented Electronic commerce - Mercantile Process models.

**UNIT – II**

Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. Inter Organizational Commerce - EDI, EDI Implementation, Value added networks.

**UNIT – III**

Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management. Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses.

**UNIT- IV**

Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research. Consumer Search and Resource Discovery - Information search and Retrieval, Commerce Catalogues, Information Filtering.

**UNIT - V**

Multimedia - key multimedia concepts, Digital Video and electronic Commerce, Desktop video processing, Desktop video conferencing.

**TEXT BOOK:**

1. Frontiers of electronic commerce – Kalakata, Whinston, Pearson.

**REFERENCES BOOKS:**

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal – Galgotia.
3. E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
4. Electronic Commerce – Gary P.Schneider – Thomson.

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**ADVANCED DATA MINING  
(ELECTIVE -III)**

**Objectives:**

- To develop the abilities of critical analysis to data mining systems and applications.
- To implement practical and theoretical understanding of the technologies for data mining
- To understand the strengths and limitations of various data mining models;

**UNIT-I**

Data mining Overview and Advanced Pattern Mining

Data mining tasks - mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis , outlier analysis; advanced pattern mining in multilevel, multidimensional space - mining multilevel associations, mining multidimensional associations, mining quantitative association rules, mining rare patterns and negative patterns.

**UNIT-II**

Advance Classification

Classification by back propagation, support vector machines, classification using frequent patterns, other classification methods - genetic algorithms, roughset approach, fuzzy set approach;

**UNIT-III**

Advance Clustering Density - based methods -DBSCAN, OPTICS, DENCLUE; Grid-Based methods - STING, CLIQUE; Exception - maximization algorithm; clustering High-Dimensional Data; Clustering Graph and Network Data.

**UNIT-IV**

Web and Text Mining

Introduction, web mining, web content mining, web structure mining, web usage mining, Text mining - unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering.

**UNIT-V**

Temporal and Spatial Data Mining

Introduction; Temporal Data Mining - Temporal Association Rules, Sequence Mining, GSP algorithm, SPADE, SPIRIT Episode Discovery, Time Series Analysis, Spatial Mining - Spatial Mining Tasks, Spatial Clustering. Data Mining Applications.

**TEXT BOOKS:**

1. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian pei, Morgan Kaufmann.
2. Data Mining Techniques - Arun K pujari, Universities Press.

**REFERENCE BOOKS:**

1. Introduction to Data Mining - Pang-Ning Tan, Vipin kumar, Michael Steinbach, Pearson.
2. Data Mining Principles & Applications - T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Elsevier.

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**STORAGE AREA NETWORKS  
(ELECTIVE-III)**

**Objectives:**

- To understand Storage Area Networks characteristics and components.
- To become familiar with the SAN vendors and their products
- To learn Fibre Channel protocols and how SAN components use them to communicate with each other
- To become familiar with Cisco MDS 9000 Multilayer Directors and Fabric Switches Thoroughly learn Cisco SAN-OS features.
- To understand the use of all SAN-OS commands. Practice variations of SANOS features

**UNIT I:** Introduction to Storage Technology

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

**UNIT II:** Storage Systems Architecture

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components , Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system

**UNIT III:** Introduction to Networked Storage

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IPSAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS fulfills the need, understand the appropriateness of the different networked storage options for different application environments

**UNIT IV:** Information Availability & Monitoring & Managing Datacenter

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime, Differentiate between business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures , Architecture of backup/recovery and the different backup/recovery topologies , replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

## **UNIT V: Securing Storage and Storage Virtualization**

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and filelevel virtualization technologies and processes

### Case Studies

The technologies described in the course are reinforced with EMC examples of actual solutions. Realistic case studies enable the participant to design the most appropriate solution for given sets of criteria.

### **TEXT BOOK:**

1. EMC Corporation, Information Storage and Management, Wiley.

### **REFERENCE BOOKS:**

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, "Building Storage Networks", Tata McGraw Hill ,Osborne, 2001.
3. Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

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**DATABASE SECURITY  
(ELECTIVE-III)**

**Objectives:**

- To learn the security of databases
- To learn the design techniques of database security
- To learn the secure software design

**UNIT I**

Introduction

Introduction to Databases Security Problems in Databases Security Controls  
Conclusions

Security Models -1

Introduction Access Matrix Model Take-Grant Model Acten Model PN Model Hartson and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases

**UNIT II**

Security Models -2

Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu's Model The Lattice Model for the Flow Control conclusion. Security Mechanisms

Introduction User Identification/Authentication Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria

**UNIT III**

Security Software Design

Introduction A Methodological Approach to Security Software Design Secure Operating System Design Secure DBMS Design Security Packages Database Security Design

**UNIT IV**

Statistical Database Protection & Intrusion Detection Systems

Introduction Statistics Concepts and Definitions Types of Attacks Inference Controls evaluation Criteria for Control Comparison .Introduction IDES System RETISS System ASES System Discovery



## **UNIT V**

Models For The Protection Of New Generation Database Systems -1

Introduction A Model for the Protection of Frame Based Systems A Model for the Protection of ObjectOriented Systems SORION Model for the Protection of Object-Oriented Databases

Models For The Protection Of New Generation Database Systems -2

A Model for the Protection of New Generation Database Systems: the Orion Model Jajodia and Kogan's Model A Model for the Protection of Active Databases Conclusions

### **TEXT BOOKS:**

1. Database Security and Auditing, Hassan A. Afyouni, India Edition, CENGAGE Learning, 2009.
2. Database Security, Castano, Second edition, Pearson Education.

### **REFERENCE BOOK:**

1. Database security by alfred basta, melissa zgola, CENGAGE learning.

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**SEMANTIC WEB AND SOCIAL NETWORKS**

**(ELECTIVE -IV)**

**Objectives:**

- To learn Web Intelligence
- To learn Knowledge Representation for the Semantic Web
- To learn Ontology Engineering
- To learn Semantic Web Applications, Services and Technology
- To learn Social Network Analysis and semantic web

**UNIT -I:** Web Intelligence

Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

**UNIT -II:** Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web -Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

**UNIT-III:** Ontology Engineering

Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

**UNIT-IV:** Semantic Web Applications, Services and Technology

Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,

**UNIT-V:** .Social Network Analysis and semantic web

What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis - Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

**TEXT BOOKS:**

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

## **REFERENCE BOOKS:**

- 1.Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies, R.Studer, P.Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
3. Information Sharing on the semantic Web - Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor, O'Reilly, SPD.

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**WIRELESS NETWORKS AND MOBILE COMPUTING  
(ELECTIVE -IV)**

**Objectives:**

The main objective of this course is to provide the students with the competences required for understanding and using the communications component of an universal communications environment. Students will be provided, in particular, with the knowledge required to understand

- emerging communications networks,
- their computational demands,
- the classes of distributed services and applications enabled by these networks, and
- the computational means required to create the new networks and the new applications.

**UNIT I**

**WIRELESS NETWORKS:** Wireless Network, Wireless Network Architecture, Wireless Switching Technology, Wireless Communication problem, Wireless Network Reference Model, Wireless Networking Issues & Standards. **MOBILE COMPUTING:** Mobile communication, Mobile computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Mobility Management

**UNIT II**

**WIRELESS LAN:** Infra red Vs radio transmission, Infrastructure and Ad-hoc Network, IEEE 802.11: System Architecture, Protocol Architecture, 802.11b, 802.11a, Newer Developments, HIPERLAN 1, HIPERLAN 2, Bluetooth : User Scenarios, Architecture.

**UNIT III**

**GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS (GSM):** Mobile Services, System Architecture, Protocols, Localization & Calling, Handover, Security. **GPRS:** GPRS System Architecture, **UMTS:** UMTS System Architecture. **LTE:** Long Term Evolution

**UNIT IV**

**MOBILE NETWORK LAYER:** Mobile IP: Goals, Assumptions, Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol (DHCP)

**UNIT V**

**MOBILE TRANSPORT LAYER:** Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP, TCP over 2.5G/3G Wireless Networks.

**TEXT BOOKS:**

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2008.
2. Dr. Sunilkumar, et al "Wireless and Mobile Networks: Concepts and Protocols", Wiley India.
3. Raj Kamal, "Mobile Computing", OXFORD UNIVERSITY PRESS.

**REFERENCE BOOKS:**

1. Asoke K Talukder, et al, "Mobile Computing", Tata McGraw Hill, 2008.
2. Matthew S.Gast, "802.11 Wireless Networks", SPD O'REILLY.
3. Ivan Stojmenovic, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2007.
4. Kumkum Garg, "Mobile Computing", Pearson.
5. Handbook of Security of Networks, Yang Xiao, Frank H Li, Hui Chen, World Scientific, 2011.

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**INFORMATION RETRIEVAL SYSTEMS  
(ELECTIVE -IV)**

**Objectives:**

On completion of this course you should have gained a good understanding of the foundation concepts of information retrieval techniques and be able to apply these concepts into practice. Specifically, you should be able to:

- To use different information retrieval techniques in various application areas
- To apply IR principles to locate relevant information large collections of data
- To analyze performance of retrieval systems when dealing with unmanaged data sources
- To implement retrieval systems for web search tasks.

**UNIT I**

Boolean retrieval. The term vocabulary and postings lists. Dictionaries and tolerant retrieval. Index construction. Index compression.

**UNIT II**

Scoring, term weighting and the vector space model. Computing scores in a complete search system. Evaluation in information retrieval. Relevance feedback and query expansion.

**UNIT III**

XML retrieval. Probabilistic information retrieval. Language models for information retrieval. Text classification. Vector space classification.

**UNIT IV**

Support vector machines and machine learning on documents, Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing.

**UNIT V**

Web search basics. Web crawling and indexes, Link analysis.

**TEXT BOOK:**

1. Introduction to Information Retrieval , Christopher D. Manning and Prabhakar Raghavan and Hinrich Schütze, Cambridge University Press, 2008.

**REFERENCE BOOKS:**

1. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T Maybury, Springer.
2. Modern Information Retrieval, Ricardo Baeza-Yates, Pearson Education, 2007.
3. Information Retrieval: Algorithms and Heuristics, David A Grossman and Ophir Frieder, 2<sup>nd</sup> Edition, Springer, 2004.
4. Information Retrieval Data Structures and Algorithms, William B Frakes, Ricardo Baeza-Yates, Pearson Education, 1992.
5. Information Storage & Retrieval, Robert Korfhage, John Wiley & Sons.

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**WEB SERVICES LAB**

**Objectives:**

- To implement the technologies like WSDL, UDDI.
- To learn how to implement and deploy web service client and server

List of Programs:

1. Write a program to implement WSDL Service (Hello Service . WSDL File)
2. Write a program the service provider can be implement a single get price(), static bind() and get product operation.
3. Write a program to implement the operation can receive request and will return a response in two ways.
  - a) One-Way operation
  - b) Request - Response
4. Write a program to implement to create a simple web service that converts the temperature from Fahrenheit to Celsius (using HTTP Post Protocol)
5. Write a program to implement business UDDI Registry entry
6. Write a program to implement
  - a) Web based service consumer
  - b) Windows application based web service consumer