

# **ACADEMIC REGULATIONS**

## **COURSE STRUCTURE**

**CHOICE BASED CREDIT SYSTEM**

**MLR15**

**COMPUTER SCIENCE & ENGINEERING**

for

**Master of Technology (M.Tech)**

M. Tech. - Regular Two Year Degree Program  
(For batches admitted from the academic year 2015 - 2016)



**MLR** Institute of Technology

**(Autonomous)**

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## FOREWORD

The autonomy is conferred on MLR Institute of Technology by UGC based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system and monitoring mechanism**, independent of the affiliating University but under its observance.

MLR Institute of Technology is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the college to order to produce quality engineering graduates to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications, if needed, are to be sought, at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the college and brighter prospects of engineering graduates.

**PRINCIPAL**

**M. Tech. - Regular Two Year Degree Program  
(For batches admitted from the academic year 2015 - 16)**

For pursuing two year post graduate Masters Degree Programme of study in Engineering (M.Tech) offered by M L R Institute of Technology under Autonomous status and herein referred to as MLRIT (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2015-16 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for M L R Institute of Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, M L R Institute of Technology shall be the Chairman, Academic Council.

**1. ADMISSION**

**Admission into first year of two year M. Tech. degree Program of study in Engineering:**

**Eligibility:**

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. However, he is permitted to write the examinations for two more years after two academic years of course work, 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 COURSESOFASTUDY**

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

1. Aerospace Engineering
2. CAD/CAM
3. Computer Science and Engineering
4. Digital Systems & Computer Electronics
5. Embedded Systems
6. Thermal Engineering
7. Software Engineering

**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 his 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.
- 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 fee shall be payable towards condonation of shortage of attendance
- 5.6 A Candidate shall put in a minimum required attendance at least three (3) theory subjects in I Year I semester for promoting to I Year II 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.

- For the theory subjects 70 marks shall be awarded for the performance in the Semester End Examination and 30 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.

### Sessional Examinations

- Subjective Paper shall contain three questions. Question 1 & 2 with internal choice from unit-I, question 3 & 4 with internal choice from unit-II and question 5 having a, b questions with internal choice from first half part of unit-III for I-MID examinations. For II-MID 1 & 2 questions from unit-4, questions 3 & 4 from unit-5 and question no 5 from remaining half part of unit-3.

The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

- The Semester End Examination will be conducted for 70 marks examination shall be conducted for a total duration of 180 minutes. Question paper Consists of Part –A and Part-B with the following.
- 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 10 marks each. There will be two questions from each unit and only one should be answered.

- 6.1 For practical subjects, 70 marks shall be awarded for performance in the Semester End Examinations and 30 marks shall be awarded for day-to-day performance as Internal Marks.
- 6.2 For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Principal of the College and the same to be informed to the Chief Controller of Examination in two weeks before for commencement of the lab end examinations.
- 6.3 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 fulfil minimum marks, he has to reappear during the supplementary examinations.
- 6.4 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 Director of Evaluation. For this, the Principal of the College shall submit a panel of 3 examiners. 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 fulfil minimum marks, he has to reappear during the supplementary examinations.
- 6.5 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.
- 6.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to re appear for the Semester End Examination in that subject.
- 6.7 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:

<b>% of Marks Secured (Class Intervals)</b>	<b>Letter Grade (UGC Guidelines)</b>	<b>Grade Points</b>
80% and above ( ≥ 80% , ≤ 100% )	O (Outstanding)	10
Below 80% but not less than 70% ( ≥ 70% , < 80% )	A <sup>+</sup> (Excellent)	9
Below 70% but not less than 60% ( ≥ 60% , < 70% )	A (Very Good)	8
Below 60% but not less than 55% ( ≥ 55% , < 60% )	B <sup>+</sup> (Good)	7
Below 55% but not less than 50% ( ≥ 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  6 (B Grade or above).



7.9 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/Course (excluding Mandatory non-credit Courses). Then 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**

7.10 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

**SGPA =  $\{ \sum_{i=1}^N C_i G_i \} / \{ \sum_{i=1}^N C_i \}$  .... 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),  $C_i$  is the no. of Credits allotted to that ix Subject, and  $G_i$  represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith Subject.

7.11 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

**CGPA =  $\{ \sum_{j=1}^M C_j G_j \} / \{ \sum_{j=1}^M C_j \}$  ... 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 1<sup>st</sup> 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),  $C_j$  is the no. of Credits allotted to the jth Subject, and  $G_j$  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.

7.12 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 After approval from the PRC, the soft copy of the thesis should be submitted to the University for ANTI-PLAGIARISM for the quality check and the plagiarism report should be included in the final thesis. If the copied information is less than 24%, then only thesis will be accepted for submission.
- 8.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College
- 8.9 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 during the supplementary examination.
- 8.10 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 during the supplementary examination.
- 8.11 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 University. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.
- 8.12 If he fails to fulfill as specified in 8.11, 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.
- 8.13 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 3 examiners, eminent in that field, with the help of the guide concerned and Head of the Department.
- 8.14 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.
- 8.15 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.
- 8.16 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:

Class Awarded	CGPA
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 college 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 with held 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 MLR15 Academic Regulations.

**13. 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 Principal is final.

12.6 The University 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 University.

**MALPRACTICES RULES  
DISCIPLINARY ACTION FOR /IMPROPER CONDUCT IN EXAMINATIONS**

<b>S. No</b>	<b>Nature of Malpractices/Improper conduct</b>	<b>Punishment</b>
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 Principal.
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 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 performance in that subject and all the other subjects the candidate 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 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 Addl. Controller of examinations / 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 addl. Controller of examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the addl. Controller of examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of 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.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject 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.
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 candidate 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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	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 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	Student of the colleges expulsion from the

	the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	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 for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits 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 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 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 that 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 principal for further action to award suitable punishment.	

# COURSE STRUCTURE

I Semester								
Code	Course Title	Periods per Week			Credits	Scheme of Examination Maximum Marks		
		L	T	P		Internal	External	Total
B15801	Data Structures and Algorithms	3	-	-	3	30	70	100
B15802	Advanced Operating Systems	3	-	-	3	30	70	100
B15803	Database Internals	3	-	-	3	30	70	100
	<b>Core Elective - 1</b>	3	-	-	3	30	70	100
	<b>Core Elective - 2</b>	3	-	-	3	30	70	100
	<b>Open Elective-1</b>	3	-	-	3	30	70	100
B15804	Data Structures and Algorithms Lab	-	-	4	2	30	70	100
B15805	Seminar-1	-	-	4	2	50	-	50
<b>TOTAL</b>		18		8	22	260	490	750

II Semester								
Code	Course Title	Periods per Week			Credits	Scheme of Examination Maximum Marks		
		L	T	P		Internal	External	Total
B15812	Web Services and Service Oriented Architecture	3	-	-	3	30	70	100
B15813	Advanced Computer Networks	3	-	-	3	30	70	100
B15814	Cloud Computing	3	-	-	3	30	70	100
	<b>Core Elective – 3</b>	3	-	-	3	30	70	100
	<b>Core Elective – 4</b>	3	-	-	3	30	70	100
	<b>Open Elective - 2</b>	3	-	-	3	30	70	100
B15815	Web Services Lab	-	-	4	2	30	70	100
B15816	Seminar-II	-	-	4	2	50	-	50
<b>TOTAL</b>		18		8	22	260	490	750

III Semester								
Code	Course Title	Periods per Week			Credits	Scheme of Examination Maximum Marks		
		L	T	P		Internal	External	Total
B15823	Comprehensive Viva-Voce	-	-	-	4	-	100	100
B15824	Project Work and Review-I	-	-	-	18	50	-	50
<b>TOTAL</b>					22	50	100	150

<b>IV Semester</b>								
<b>Code</b>	<b>Course Title</b>	<b>Periods per Week</b>			<b>Credits</b>	<b>Scheme of Examination Maximum Marks</b>		
		<b>L</b>	<b>T</b>	<b>P</b>		<b>Internal</b>	<b>External</b>	<b>Total</b>
B15825	Project Work and Review-II	-	-	-	6	50	-	50
B15826	Project Evaluation (Viva-voce)	-	-	-	16	-	150	150
<b>TOTAL</b>					22	50	150	200

<b>OPEN ELECTIVES</b>			
<b>OE1</b>		<b>OE2</b>	
B15830	Big Data Analytics	B15833	Bioinformatics
B15831	Storage Area Networks	B15834	Web Mining
B15832	Fundamentals of Web Design	B15835	Semantic Web & Social Networks
<b>CORE ELECTIVE</b>			
<b>CE1</b>		<b>CE2</b>	
B15806	Android Application Development	B15809	Data Warehousing and Mining
B15807	Distributed Databases	B15810	Pattern Recognition
B15808	High Speed Networks	B15811	Internet of Things
<b>CE3</b>		<b>CE4</b>	
B15817	Software Architecture and Design Patterns	B15820	Software Process and Project Management
B15818	Information Retrieval Systems	B15821	Distributed Computing
B15819	Wireless networks and Mobile Computing	B15822	Soft Computing





**M.Tech I SEM****DATA STRUCTURES AND ALGORITHMS**

**Course Overview:** This course will focus on data structures with their performance analysis and various algorithms used in problem solving. These data structures and algorithms are implemented using Java.

**Course Objectives:**

- I. The fundamental design, analysis, and implementation of basic data structures.
- II. Basic concepts in the specification and analysis of programs.
- III. Principles for good program design, especially the uses of data abstraction.
- IV. Significance of algorithms in the computer field
- V. Various aspects of algorithm development
- VI. Qualities of a good solution

**Course Outcomes:** At the end of the course students will be able to

1. Analyze the performance of various data structures
2. Select a suitable data structure for a given problem statement
3. Utilize the classes of Collection framework in implement various data structures

**SYLLABUS****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, Abstract Data Type (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



**ADVANCED OPERATING SYSTEMS**

**Course Overview:** This course will focus on data various types of operating systems used in different kinds of applications, characteristics, design issues and case studies.

**Course Objectives:**

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

**Course Outcomes:** At the end of this course students will able to

1. Identify the challenges in designing Real time operating systems
2. Compare and Select a operating system as per the requirement
3. Identify and design solution to the security challenges in operating systems

**SYLLABUS**

**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, 6th ed., PE.
2. Modern Operating Systems, Andrew S Tanenbaum 3rd ed., PE.
3. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 7th ed., John Wiley
4. UNIX User Guide – Ritchie & Yates.
5. UNIX Network Programming - W.RichardStevens ,1998, PHI.
6. The UNIX Programming Environment – Kernighan & Pike, PE.

**DATABASE INTERNALS**

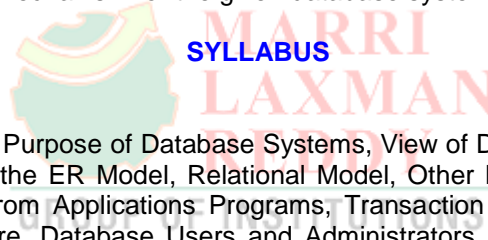
**Course Overview:** Database internals subject will focus on the database design challenges, storage and indexing, memory allocation for tables, table space, normalization and transaction management issues

**Course Objectives:**

- I. By the end of the course, you will know:
- II. History and Structure of databases
- III. How to design a database
- IV. How to convert the design into the appropriate tables
- V. Handling Keys appropriately
- VI. Enforcing Integrity Constraints to keep the database consistent
- VII. Normalizing the tables to eliminate redundancies
- VIII. Querying relational data
- IX. And processing the queries
- X. Storage Optimizing Strategies for easy retrieval of data through index
- XI. Triggers, Procedures and Cursors, Transaction Management
- XII. Distributed databases management system concepts and Implementation

**Course Outcomes:** At the end of the course students will able to:

1. Design a database for a given set of requirements using ER Modeling
2. Apply normalization for effective database design
3. Analyze various transaction management issues and handle failures if any
4. Select the crash recovery mechanism for the given database system



**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, ER diagrams,. 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 Deadlocks, 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, 3rd 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, RamezElmasri, ShamkantB.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, 2nd 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.

**ANDROID APPLICATION DEVELOPMENT  
(CORE ELECTIVE - I)**

**Course Overview:** this course will primarily focuses on the mobile application development using ANDROID platform and also the database connectivity using SQLite

**Course Objectives:**

- I. To demonstrate their understanding of the fundamentals of Android operating systems
- II. To demonstrate their skills of using Android software development tools
- III. To demonstrate their ability to develop software with reasonable complexity on mobile platform
- IV. To demonstrate their ability to deploy software to mobile devices
- V. To demonstrate their ability to debug programs running on mobile devices

**Course Outcomes:** At the end of the course students will be able to:

1. Make use of Android studio to develop apps
2. Apply layouts and create multi screen activities
3. Apply SQLite database and store data in to database, also retrieve the data

**SYLLABUS**

**UNIT - I**

**Introduction to Android Operating System:** Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools  
Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes  
Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

**UNIT - II**

**Android User Interface:** Measurements – Device and pixel density independent measuring units Layouts – Linear, Relative, Grid and Table Layouts  
User Interface (UI) Components – Editable and non editable Text views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers  
Event Handling – Handling clicks or changes of various UI components  
Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

**UNIT - III**

**Intents and Broadcasts:** Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS  
Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity  
Notifications – Creating and Displaying notifications, Displaying Toasts

**UNIT - IV**

**Persistent Storage:** Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference  
Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)



**UNIT - V**

**Advanced Topics:** Alarms – Creating and using alarms

Using Internet Resources – Connecting to internet resource, using download manager

Location Based Services – Finding Current Location and showing location on the Map, updating location

**TEXT BOOKS**

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox) , 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

**REFERENCE**

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013



**DISTRIBUTED DATABASES  
(CORE ELECTIVE-I)**

**Course Overview:** To teach principles of Distributed databases, design of Distributed database, architecture design and database administration.

**Objectives:**

- I. To impart the Distributed databases management system concepts.
- II. To emphasize Integrity Constraints to keep the database consistent
- III. To facilitate normalization of tables to eliminate redundancies
- IV. To inculcate storage strategies for easy retrieval of data through index

**Course Outcomes:**

1. Apply the concepts of transparency in Distributed databases
2. Design a database to sustain distributed transactions
3. Use of checkpoints to identify any inconsistency
4. Apply the concepts of interoperability to the database

**SYLLABUS**

**UNIT - I**

Features of Distributed versus Centralized Databases, Principles of Distributed Databases, Levels Of Distribution Transparency, Reference Architecture for Distributed Databases, Types of Data Fragmentation, Integrity Constraints in Distributed Databases, Distributed Database Design

**UNIT - II**

Translation of Global Queries to Fragment Queries, Equivalence transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries. Optimization of Access Strategies, a Framework for Query Optimization, Join Queries, General Queries

**UNIT - III**

The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, and Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

**UNIT - IV**

Reliability, Basic Concepts, Non blocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection

**UNIT - V**

Architectural Issues, Alternative Client/Server Architectures, Cache Consistency, Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution, Transaction Management, Transaction Management in Object DBMSs, Transactions as Objects Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues Transaction Management Transaction and Computation Model, Multi database Concurrency Control, Multi database Recovery, Object Orientation and Interoperability, Object Management Architecture CORBA and Database interoperability, Distributed Component Object Model, COM/OLE and Database Interoperability, PUSH-Based Technologies

**TEXT BOOKS:**

1. Distributed Databases Principles & Systems, Stefano Ceri, Giuseppe Pelagatti, TMH.
2. Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez , Pearson Education, 2nd Edition. 19

**REFERENCE BOOKS:**

1. Distributed database systems by Chhanda Ray from Pearson Education, 2009
2. Principles of Distributed database systems by Tamer and Ozsu from Pearson, 2006.



**HIGH SPEED NETWORKS  
(CORE ELECTIVE -1)**

**Course Overview:** Introduces the concepts of modern network components and implementation of high speed networks.

**Course Objectives:**

- I. To introduce the high speed networks those have spurred the development of new applications.
- II. To identify the design issues related to the Internet protocol (IP), entire TCP/IP protocol suite and network technologies dominating the high-speed scene.

**Course Outcomes:** At the end of the course students will able to

1. Identify the key concepts of high speed networks
2. Use network components to create Virtual LAN's
3. Identify the business needs where high speed networks can impact

**SYLLABUS**

**UNIT - I**

**Switching and Data Transmission:** ISO-OSI reference model. TCP/IP reference model, Circuit-switched networks, Datagram networks, Virtual-circuit networks, Structure of a switch, Telephone network, Dial-up modems, Digital Subscriber line, Cable TV networks

**Data Link Layer: Error Detection and Correction:** Introduction, Block coding, Linear Block codes, Cyclic codes, Checksum - **Data Link Control:** Framing, Flow and Error control, Protocols, Noiseless channels, Noisy channels, HDLC, Point-to-Point Protocol

**UNIT - II**

**Multiple Accesses:** Random Access, Controlled Access, Channelization – **Connecting Devices:** Connecting LANs, Backbone Networks, and Virtual LANs.

**High Speed Networks : Frame Relay:** Packet-Switching Networks, Frame Relay Networks – **Asynchronous Transfer Mode (ATM) :** ATM Protocol Architecture, ATM Logical Connections, ATM Cells, ATM Service Categories, ATM Adaptation Layer (AAL)-**High-Speed LANs :** The Emergence of High-Speed LANs, Ethernet, Fiber Channel, Wireless LANs.

**UNIT - III**

**Network Layer: Logical Addressing:** IPv4 Addresses, IPv6 Addresses, - **Internet Protocol:** Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6 - **Network Delivery - Routing:** Forwarding, Unicast Routing Protocols, Multicast Routing Protocols **Transport Layer and Application Layer: Protocols:** Process-to-Process delivery, User Datagram Protocol (UDP), TCP, SCTP -**Congestion control:** Data traffic, Congestion, Congestion control, Quality of Service

**UNIT - IV**

**Domain Name System:** Name space, Domain Name Space, Distribution of Name Space, DNS in the internet, Resolution, DNS messages, E-mail

**Needs and Goals for Network Design : Analyzing Business Goals and Constraints:** Using a Top-Down Network Design Constraints, Analyzing Business Goals, Analyzing Business constraints – **Analyzing Technical Goals & Tradeoffs:** Scalability, Availability, Network Performance, Security, Manageability, Usability, adaptability, Affordability, Making Network Design Tradeoffs – **Characterizing Network Traffic:** Characterizing Traffic Flow, Traffic Load, Traffic behaviour, Quality of Service Requirements

**UNIT - V**

**Logical Network Design: Designing Network Design:** Hierarchical Network Design, Redundant Network Design Topologies, Modular Network Design, Designing a Campus Network Design Topology, Designing the Enterprise Edge Topology, Secure Network Design Topologies

**Designing Models for Addressing and Naming:** Guidelines for Assigning Network Layer Addresses, Using a Hierarchical Model for Assigning Addresses, Designing a Model for Naming.

**Selecting Switching and Routing Protocols**

Selecting Bridging & Switching Protocols, Spanning Tree Protocol Enhancements – **Selecting Routing Protocols:** Characterizing Routing protocols, IP Routing, Novell NetWare Routing, Using Multiple Routing Protocols in an Internet work

**TEXT BOOKS:**

1. Data Communications and Networking, *Behrouz A. Forouzan*, Fourth Edition, Tata McGraw Hill
2. High Speed Networks and Internets – Performance and Quality of Service, *William Stallings*, Second Edition, Pearson Education.
3. Top-Down Network Design, *Priscilla Oppenheimer*, Second Edition, Pearson Education (CISCO Press)

**REFERENCE BOOKS:**

1. Guide to Networking Essentials, *Greg Tomsho, Ed Tittel, David Johnson*, Fifth Edition, Thomson.
2. Computer Networks, *Andrew S. Tanenbaum*, Fourth Edition, Prentice Hall.
3. An Engineering Approach to Computer Networking, *S.Keshav*, Pearson Education.
4. Campus Network Design Fundamentals, *Diane Teare, Catherine Paquet*, Pearson Education (CISCO Press)
5. Computer Communications Networks, Mir, Pearson Education.



**DATA WAREHOUSING AND MINING  
(CORE ELECTIVE –II)**

**Course Overview:**

This course helps the students to understand the overall architecture of a data warehouse and methods for data gathering and data pre-processing using OLAP tools. The different data mining models and techniques will be discussed in this course. Data mining and data warehousing applications in bioinformatics will also be explored.

**Course Objectives:**

- I. To teach the basic principles, concepts and applications of data warehousing and data mining
- II. To introduce the task of data mining as an important phase of knowledge recovery process
- III. To familiarize Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment
- IV. To impart knowledge of the fundamental concepts that provide the foundation of data mining

**Course Outcomes:**

After undergoing the course, Students will be able to understand

1. Design a data mart or data warehouse for any organization
2. Develop skills to write queries using DMQL
3. Extract knowledge using data mining techniques
4. Adapt to new data mining tools.
5. Explore recent trends in data mining such as web mining, spatial-temporal mining

**SYLLABUS**

**UNIT - I**

**Introduction:** Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Issues in Data Mining.

**Data Preprocessing:** Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

**UNIT - II**

**Data Warehouse and OLAP Technology for Data Mining:** Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Usage of Data Warehousing Online Analytical Processing and Mining

**Data Cube Computation:** Efficient Methods for simple Data Cube Computation (Full Cube, Iceberg Cube, Closed Cube and Shell Cube), Discovery Driven exploration of data cubes, Attribute-Oriented Induction for data characterization and its implementation

**UNIT - III**

**Mining Frequent Patterns, Associations and Correlations:** Basic Concepts, The Apriori algorithm for finding frequent item sets using candidate generation, Generating association rules from frequent item sets, Mining frequent item sets without candidate generation, Mining various kinds of Association Rules, Correlation Analysis

**UNIT - IV**

**Classification and Prediction:** Description and comparison of classification and prediction, preparing data for Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation Prediction, linear and non-linear regression, evaluating accuracy of a Classifier or a Predictor

**UNIT - V**

**Cluster Analysis:** Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, k-means and k-medoids methods, CLARANS, Agglomerative and divisive hierarchical clustering, chameleon dynamic modelling, clustering based on density distribution function, wavelet transformation based clustering, conceptual Clustering, Constraint-Based Cluster Analysis, Outlier Analysis.

**TEXT BOOKS:**

1. Data Mining – Concepts and Techniques - Jiawei Han, Micheline Kamber and Jian Pei, 3<sup>rd</sup> edition, Morgan Kaufmann Publishers, ELSEVIER.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.

**REFERENCE BOOKS:**

1. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.
2. Insight into Data Mining, K.P.Soman, S.Diwakar, V.Ajay, PHI, 2008.
3. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition
4. The Data Warehouse Life cycle Tool kit – Ralph Kimball Wiley student edition
5. Building the Data Warehouse by William H Inmon, John Wiley & Sons Inc, 2005.
6. Data Mining Introductory and advanced topics –Margaret H Dunham, Pearson education
7. Data Mining Techniques – Arun K Pujari, 2nd edition, Universities Press.
8. Data Mining, V.Pudi and P.Radha Krishna, Oxford University Press.
9. Data Mining: Methods and Techniques, A.B.M Shawkat Ali and S.A.Wasimi, Cengage Learning.
10. Data Warehouse 2.0, The Architecture for the next generation of Data Warehousing, W.H.Inmon, D.Strauss, G.Neushloss, Elsevier, Distributed by SPD.





**PATTERN RECOGNITION  
(CORE ELECTIVE –II)**

**Course Overview:** This course focuses on challenges in pattern recognition, principles of pattern recognition and design fundamentals.

**Course Objectives:**

- I. To impart pattern recognition and machine learning theories
- II. To facilitate in design of certain important pattern recognition techniques
- III. To emphasize the applications of pattern recognition

**Course Outcomes:**

1. Identify the areas where pattern recognition can be applied
2. Apply pattern recognition in decision making in several real time problems

**SYLLABUS**

**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 scon, Finger prints, etc.,

**TEXT BOOKS:**

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

**INTERNET OF THINGS  
(CORE ELECTIVE –II)**

**Course Overview:** To impart necessary skills and knowledge of Internet of Things and components used in developing IoT based applications.

**Course Objectives:**

- I. To introduce the terminology, technology and its applications
- II. To introduce the concept of M2M (machine to machine) with necessary protocols
- III. To introduce the Python Scripting Language which is used in many IoT devices
- IV. To introduce the Raspberry PI platform, that is widely used in IoT applications
- V. To introduce the implementation of web based services on IoT devices

**Course Outcomes:** At the end of the course students will be able to

1. Identify the applications of IoT
2. Use Raspberry PI platform in designing IoT based applications
3. Create real time applications that can be used in domestic and health care applications
4. Convert things into smart things.

**SYLLABUS**

**UNIT - I**

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

**UNIT - II**

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

**UNIT - III**

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling  
Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

**UNIT - IV**

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, and reading input from pins.

**UNIT - V**

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs  
Web server – Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API

**TEXT BOOK:**

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

**DATA STRUCTURES AND ALGORITHMS LAB**

**Objectives:**

- I. The fundamental design, analysis, and implementation of basic data structures.
- II. Basic concepts in the specification and analysis of programs.
- III. 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 d) Merge sort g) Binary tree sort  
b) Insertion sort e) Heap sort  
c) Quick sort f) Radix 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, 3rd edition, A.Drozdek, Cengage Learning.
2. Data Structures with Java, J.R.Hubbard, 2nd edition, Schaum's Outlines, TMH.
3. Data Structures and algorithms in Java, 2nd 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, 7th 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 , 8th 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



**M.Tech II SEM**  
**WEB SERVICES AND SERVICE ORIENTED ARCHITECTURE**

**Objectives:**

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

**SYLLABUS**

**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, 2nd 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 Wer Services, Richard Monson-Haefel, Pearson Education



**ADVANCED COMPUTER NETWORKS****Course Overview:**

This course is to provide students with an overview of the concepts and fundamentals of advanced computer networks and management. Primary focus would be on the components used and the protocols. This course provides a broad range of understanding on the functional and performance issues in a computer network and its management.

**Course Objectives:**

- I. To review the computer networking concepts
- II. To impart concepts of advanced computer networking.
- III. To introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- IV. To facilitate students in gaining expertise in some specific areas of networking such as the design and maintenance of individual networks.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to:

1. Apply Data Communications System and its components.
2. Identify the different types of network topologies and protocols.
3. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
4. Identify the different types of network devices and their functions within a network

**SYLLABUS****UNIT I: Review**

**Computer Networks and the Internet:** History of Computer Networking and the Internet, Networking Devices, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones.

**Networking Models:** 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM.

**UNIT II: Network Routing**

**Routing and its concepts:** Structure of a Router, Basic Router Configuration, Building a Routing Table, Static Routing, Dynamic Routing – Distance Vector Routing Protocol (RIPv1, RIPv2, EIGRP), Link State Routing Protocols (OSPF).

**UNIT III: LAN Switching**

**Switching and its concepts:** Structure of a Switch, Basic Switch Configuration, Virtual LANs (VLANs), VLAN Trunking Protocol (VTP), Spanning Tree Protocol (STP), Inter-VLAN Routing.

**UNIT IV: Wide Area Networks (WANs)**

Introduction to WANs, Point-to-Point Protocol (PPP) concepts, Frame Relay concepts, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), IPv6.

**UNIT V: Network Programming using Java**

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. Computer Networking: A Top-Down Approach Featuring the Internet, *James F. Kurose, Keith W. Ross*, Fifth Edition, Pearson Education, 2012.
2. Network Fundamentals, Mark Dye, Pearson Education.
3. Routing Protocols & Concepts, Rick Graziani, Pearson Education.

4. LAN Switching & Wireless, Wayne Lewis, Pearson Education.
5. Accessing the WAN, Bob Vachon, Pearson Education.
6. An Introduction to Network Programming with Java, Jan Graba, Springer, rp 2010.

**REFERENCE BOOKS:**

1. Computer Networks: A Systems approach, *Larry L. Peterson & Bruce S. Davie*, Fifth edition, Elsevier, rp2012.
2. Computer Networks: A Top-Down Approach, *Behrouz A. Forouzan, Firoz Mosharaf*, Tata McGraw Hill, 2012.
3. Java Network Programming,3rd edition, *E.R. Harold*, SPD, O'Reilly.(Unit V)
4. An Engineering Approach to Computer Networking, *S.Keshav*, Pearson Education, 1997.
5. Computer Networks: Principles, Technologies And Protocols For Network Design, *Natalia Olifer, Victor Olifer*, Wiley India, 2006.
6. Computer Networks, *Andrew S. Tanenbaum*, Fifth Edition, Prentice Hall.
7. Computer and Communication Networks, *Nader F. Mir*, Pearson Education, 2007
8. Data Communications and Networking, *Behrouz A. Forouzan*, Fourth Edition, Tata McGraw Hill, 2007.
9. Computer Networks, *Bhushan Trivedi*, Oxford University Press, 2011.
10. Fundamentals of Business Data Communications, *Jerry FitzGerald and Alan Dennis*, Tenth Edition, Wiley, 2009.
11. Internetworking with TCP/IP: Principles, Protocols and Architecture, Volume 1, *Douglas E. Comer*, 4th edition, PHI, 2005.
12. Next-Generation Internet: Architectures and Protocols, Byrav Ramamurthy et al, Cambridge, 2011.





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## CLLOUD COMPUTING

### Course Overview:

The course is designed to give introduction to modern distributed computing. It describes in detail, methods of accessing computing resource across the internet. The course will also explain the relevance of these forms of computing to business models for enterprises that require large amounts of computation but do not necessarily wish to purchase and maintain large amounts of specialist computing systems.

### Course Objectives:

- I. To inculcate the concepts of distributed computing
- II. To familiarize the concepts of cloud computing and services
- III. To explain cloud platform and types of cloud
- IV. To explain resource management in cloud

### Course Outcomes:

Student who successfully completes this course should be able to

1. Understand the fundamental principles of distributed computing
2. Create virtual machines and virtual templates.
3. Create Cloud platform using Virtual machines
4. Identify suitable business models of cloud computing

## SYLLABUS

### UNIT-I

**INTRODUCTION:** Introduction to middleware technologies and its classification

**DISTRIBUTED SYSTEM MODELS AND ENABLING TECHNOLOGIES:** Scalable Computing Service over the Internet, the Age of Internet Computing, Computing Trends and New Paradigms, Internet of Things and Cyber-Physical Systems. System Models for Distributed and Cloud Computing, Clusters of Cooperative Computers, Grid Computing Infrastructures, Peer-to-Peer Network Families, Cloud Computing over the Internet. Software Environments for Distributed Systems and Clouds, Service-Oriented Architecture (SOA), Distributed Operating Systems and Software Tools, Parallel/Distributed Programming Models. **Performance, Security and Energy-Efficiency:** Performance Metrics and Scalability Analysis, Fault-Tolerance and System Availability, Network Threats and Data Integrity, Energy-Efficiency in Distributed Computing.

### UNIT - II

**DESIGN OF CLOUD COMPUTING PLATFORMS:** Cloud Computing and Service Models; Public, Private and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies, Infrastructure-as-a-Service (IaaS) Model, Platform -and Software-as-a-Service (Paas, SaaS). **Architecture Design Of Compute And Storage Clouds:** A Generic Cloud Architecture Design, Layered Cloud Architectural development, Virtualization Support and Disaster Recovery, Architectural Design Challenges. **Public Cloud Platforms:** Google Application Engine (GAE), Amazon Web Service (AWS) and Windows Azure; Public Clouds and Service Offerings, Google Application Engine (GAE), Amazon Web Service (AWS), Microsoft Windows Azure. **Inter- Cloud Resource Management:** Extended Cloud Computing Services, Resource Provisioning and Platform Deployment, Virtual Machine Creation and Management, Global Exchange of Cloud Resources. **Cloud Security and Trust Management:** Cloud Security Defence Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data centres.

### UNIT - III

**SERVICE ORIENTED ARCHITECTURES: Services and Service Oriented Architectures:** REST and Systems of Systems, Services and Web Services, Enterprise Multi-tier Architecture, Grid Services and OGSA, Other Service Oriented Architectures and Systems. **Message-Oriented Middleware:** Enterprise Bus, Publish-Subscribe Model and Notification, Queuing and Messaging Systems, Cloud and Grid Middleware applications. **Discovery, Registries, Metadata and Databases:** UDDI and Service Registries,

Databases and Publish-Subscribe, Metadata catalogues, Semantic Web and Grid, Job Execution Environments and Monitoring. **Workflow in Service-Oriented Architectures:** Basic Concepts of Workflow, Workflow Standards, Workflow Architecture and Specification, Workflow Execution Engine.

#### UNIT - IV

**CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS:** Features of Cloud and Grid Platforms; Cloud Capabilities and Platform Features, Traditional Features Common to Grids and Clouds, Data Features and Databases, Programming and Runtime Features. Parallel and Distributed Programming Paradigms; Parallel Computing and Programming Paradigms, Map Reduce, Twister and Iterative Map Reduce, Hadoop Library from Apache, Mapping Applications to Parallel and Distributed Systems. **Programming Support of Google App Engine:** Programming the Google App Engine, Google File System (GFS), Big table, Google's NOSQL system, Chubby, Google's Distributed Lock service. **Programming on Amazon AWS and Microsoft Azure:** Programming on Amazon EC2, Amazon Simple Storage Service S3, Amazon Elastic Block Store EBS and Simple DB, Microsoft Azure programming support.

**EMERGING CLOUD SOFTWARE ENVIRONMENTS:** Open Source Eucalyptus and Nimbus, Open Nebula, Sector/Sphere and Open Stack, Manjrasoft Aneka Cloud and Appliances.

#### UNIT - V

**GRID COMPUTING SYSTEMS AND RESOURCE MANAGEMENT:** Grid Architecture and Service Modeling; Grid History and service families, CPU Scavenging and Virtual super computers, OGSA, Data intensive Grid service models.

**GRID RESOURCE MANAGEMENT AND BROKERING:** Resource Management and Job Scheduling, Grid Resource Monitoring with CGSP, Service Accounting and Economy Model, Grid Resource Brokering with Grid bus. Software and Grid Computing; Open-Source Grid Middleware Packages, The Globus Toolkit Architecture (GT4), Containers and Resource/Data Management. Grid Application Trends and security measures; Trust models for grid security enforcement, Authentication and Authorization methods, GSI. On-Line Social and Professional Networking; Online Social Network Characteristics, Graph-Theoretic Analysis of Social networks, Communities and Applications of Social Networks, **Facebook:** The World's Largest Content-Sharing Network, Twitter for Micro blogging, News and Alert Services.

#### TEXT BOOKS:

1. Kai Hwang, Jack Dongarra, Geoffrey Fox (2011), *Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*, Morgan Kaufman Publishers, India.

#### REFERENCE BOOKS:

1. Joshy Joseph, Craig Fellenstein(2007), *Grid Computing*, IBM Press, India.
2. Prabhu(2007), *Grid and Cluster Computing*, Prentice Hall of India, New Delhi.
3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter(2010), *Cloud Computing, A Practical Approach*, McGraw Hill Edition, New Delhi.

**SOFTWARE ARCHITECTURE AND DESIGN PATTERNS  
(CORE ELECTIVE –III)**

**Course Overview:**

This course emphasises on software architecture and application of design patterns. Various types of design patterns are taught. Focus will be on architectural requirements followed by system design. This course helps in learning software design in a real world perspective.

**Course Objectives:**

- I. To describe the architectural issues and importance of design patterns
- II. To explain various design patterns

**Course Outcomes:** At the end of the course student will be able to:

1. Analyze the requirements and generate possible architectural designs
2. Apply design patterns in designing a software

**SYLLABUS**

**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**

**Behavioural 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.

**INFORMATION RETRIEVAL SYSTEMS  
(CORE ELECTIVE –III)**

**Course Overview:**

This course is designed to learn about the techniques used to retrieve useful information from repositories such as the Web. The course first introduces standard concepts in information retrieval such as documents, queries, collections, and relevance. Efficient indexing, to allow for the quick identification of candidate answer documents, is considered. To find the best answers, a range of querying approaches (such as Boolean and Ranked retrieval) are studied. The course then covers a selection of application areas such as music search, document summarization, cross-lingual retrieval, and image retrieval.

**Course Objectives:**

- I. To impart the important concepts, algorithms, and data/file structures that are
- II. To facilitate design, and implementation of Information Retrieval (IR) systems.

**Course Outcomes:**

On completion of this Course the student shall be able to

1. Recognize the Boolean Model, Vector Space Model, and Probabilistic Model.
2. Use retrieval utilities.
3. Analyse different formatting tags

**SYLLABUS**

**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.

**WIRELESS NETWORKS AND MOBILE COMPUTING  
(CORE ELECTIVE –III)**

**Course Overview:** introduces basics of wireless networks, protocols and mobile computing paradigms. Also introduces various generations of mobile networks.

**Course Objectives:**

- I. To familiarize the basic concepts of wireless networks, architectures and switching mechanisms
- II. To inculcate protocols used in wireless networks
- III. To emphasize GSM architectures which provides mobile services

**Course Outcomes:** At the end of the course students will be able to

1. Identify the working of wireless networks and mobile devices
2. Identify the services offered by mobile networks
3. Differentiate various generations of mobile networks

**SYLLABUS**

**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, Tunnelling 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.

**SOFTWARE PROCESS AND PROJECT MANAGEMENT  
(CORE ELECTIVE –IV)**

**Course Overview:** Introduces modern practices of software project management, software economics and workflows using case studies.

**Course Objectives:**

- I. To familiarize the principles of software process and project management
- II. To inculcate software economics and CMM models
- III. To demonstrate the usage of workflows and check points in assessing project milestones

**Course Outcomes:** At the end of the course students will able to:

1. Identify artifacts of various stages of software development
2. Use of periodic status assessment in risk mitigation
3. Apply optimization process to design effective and efficient product

**SYLLABUS**

**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 Managent, Richard H. Thayer & Edward Yourdon, 2nd 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.





**DISTRIBUTED COMPUTING  
(CORE ELECTIVE –IV)**

**Course Overview:** Introduces the concepts of distributed computing and various paradigms of distributed computing and trade-offs.

**Course Objectives:**

- I. To introduce evolution of distributed computing paradigm
- II. To familiarize various concepts and models of distributed computing
- III. To demonstrate the usage of distributed computing in designing high availability applications

**Course Outcomes:** At the end of the course students will able to:

1. Identify strengths and weaknesses of distributed computing
2. Decide whether distributed computing can be applied for a given problem or not
3. Apply Grid computing for carrying out collaborative work
4. Differentiate parallel computing and grid computing models

**SYLLABUS**

**UNIT - I**

**Introduction**

The different forms of computing, The strengths and weaknesses of Distributed computing, Operating system concepts relevant to distributed computing, the architecture of distributed applications. Paradigms for Distributed Applications, choosing a Paradigm for an application (trade-offs).

**UNIT - II**

**Cluster Computing**

Parallel computing overview, cluster computing – Introduction, Cluster Architecture, parallel programming models and Paradigms, Applications of Clusters.

**UNIT - III**

**Grid Computing**

Introduction, Grid Computing Anatomy – Architecture, Architecture and relationship to other Distributed Technologies, Grid computing road map. Merging the Grid services Architecture with the Web Services Architecture.

**UNIT - IV**

Open Grid Service Architecture – Introduction, Architecture and Goal, Sample Use cases: Commercial Data Centre, National Fusion Collaboratory, Online Media and Entertainment. OGSA platform Components, Open Grid Services Infrastructure.

**UNIT - V**

Globus GT 3 Toolkit – Architecture, Programming Model, A sample implementation, High Level services, OGSI.NET Middleware Solutions.

**TEXT BOOKS:**

1. Grid Computing, Joshy Joseph & Craig Fellenstein, Pearson education, 2004
2. Distributed Computing, Principles and Applications, M.L.Liu, Pearson Education, 2004
3. High Performance Cluster Computing, Rajkumar Buyya, Pearson education.

**REFERENCE BOOKS:**

1. Grid Computing – Making the global infrastructure a reality, Fran Berman, Geoffrey C Fox, Anthony J G Hey, Wiley India, 2010.
2. A Networking Approach to Grid Computing, D.Minoli, Wiley & sons, 2006.
3. Grid Computing: A Practical Guide to Technology and Applications, A.Abbas, Firewall Media, 2008.



**SOFT COMPUTING  
(CORE ELECTIVE –IV)**

**Course Overview:** This course is intended to provide an overview of neural networks and fuzzy logic, application of fuzzy logic and genetic algorithms.

**Course Objectives:**

- I. To introduce the terminology, neural networks, artificial intelligence and fuzzy logic
- II. To introduce the concept feedback neural networks
- III. To demonstrate the usage of fuzzy logic in designing solutions to many critical problems like control of Blood Pressure.

**Course Outcomes:** At the end of the course students will able to:

1. Identify basic functional units of neural networks and its characteristics
2. Analyze the importance of fuzzy logic in complex problem solving and deriving fuzzy solutions
3. Apply Fuzzy logic in creating solutions to problems where the requirements change dynamically

**SYLLABUS**

**UNIT - I**

**BASICS OF ARTIFICIAL NEURAL NETWORK:** Characteristics of Neural Networks, Structure and working of a biological neural network, Artificial neural network: terminology, models of neurons: McCulloch Pitts model, Perceptron model, Adaline model, topology, Basic learning laws.

**FUNCTIONAL UNITS FOR ANN FOR PATTERN RECOGNITION TASK:** Pattern recognition problem, Basic functional units, PR by functional units.

**UNIT - II**

**FEEDFORWARD NEURAL NETWORKS:**

**SUPERVISED LEARNING - I:** Perceptrons - Learning and memory, Learning algorithms, Error correction and gradient decent rules, Perceptron learning algorithms.

**SUPERVISED LEARNING-II:** Back propagation, Multilayered network architectures, Back propagation learning algorithm, Example applications of feed forward neural networks.

**UNIT - III**

**FEEDBACK NEURAL NETWORKS & SELF ORGANIZING FEATURE MAP:** Introduction, Associative learning, Hopfield network, Error performance in Hopfield networks, simulated annealing, Boltzmann machine and Boltzmann learning, state transition diagram and false minima problem, stochastic update, simulated annealing, Boltzmann machine, bidirectional associative memory, bam stability analysis. Self organization, generalized learning laws, competitive learning, vector quantization, self organizing feature map, applications of self organizing feature map.

**UNIT - IV**

**FUZZY LOGIC:** Fuzzy set theory, crisp sets, operations on crisp set, fuzzy sets, fuzzy versus crisp, operations, fuzzy relations, crisp relations, properties. Fuzzy logic Application: Fuzzy Control of Blood Pressure.

**UNIT - V**

**FUZZY LOGIC IN DATABASE AND INFORMATION SYSTEMS:** Fuzzy Information, Fuzzy Logic in database Systems, Fuzzy Relational data Models, operations in Fuzzy Relational data Models, Design theory for Fuzzy Relational databases, Fuzzy information Retrieval and Web search, Fuzzy Object Oriented databases.

**GENETIC ALGORITHMS:** Introduction to Genetic Algorithms, Evolutionary Algorithms.

**TEXT BOOKS:**

1. Satish Kumar (2004), *Neural Networks A classroom Approach*, Tata McGraw Hill Publication, New Delhi.
2. Lotfi A. Zadeh(1997), *Soft computing and Fuzzy Logic*, World Scientific Publishing Co., Inc. River Edge, NJ, USA.

**REFERENCE BOOKS:**

1. B. Yegnanarayana (2006), *Artificial Neural Networks*, Prentice Hall of India, New Delhi, India.
2. John Yen, Reza Langari(2006), *Fuzzy Logic*, Pearson Education, New Delhi, India.



**WEB SERVICES LAB**

**Objectives:**

- I. To implement the technologies like WSDL, UDDI.
- II. 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



**BIG DATA ANALYTICS  
(OPEN ELECTIVE-I)**

**Course Overview:** Data analysis is the process of data analyzing and extracting useful information which can help in making useful business decisions. As part of this course Big Data tools and Data Visualization tools are introduced.

**Course Objectives:**

- I. To introduce the terminology, technology and its applications
- II. To introduce the concept of Analytics and Visualization
- III. To demonstrate the usage of various Big Data tools and Data Visualization tools

**Course Outcomes:** At the end of the course students will able to:

1. Identify basic terminology of HADOOP, SPARK, IMPALA etc
2. Analyze the importance of Analytics in business perspective
3. Apply Big Data tools and Visualization tools

**SYLLABUS****UNIT - I**

Big Data Analytics: What is big data, History of Data Management; Structuring Big Data ; Elements of Big Data ; Big Data Analytics; Distributed and Parallel Computing for Big Data; Big Data Analytics: What is Big Data Analytics, What Big Data Analytics Isn't, Why this sudden Hype Around Big Data Analytics, Classification of Analytics, Greatest Challenges that Prevent Business from Capitalizing Big Data; Top Challenges Facing Big Data; Why Big Data Analytics Important; Data Science; Data Scientist; Terminologies used in Big Data Environments; Basically Available Soft State Eventual Consistency (BASE); Open source Analytics Tools;

**UNIT - II**

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics; Points to Consider during Analysis; Developing an Analytic Team; Understanding Text Analytics; Analytical Approach and Tools to Analyze Data: Analytical Approaches; History of Analytical Tools; Introducing Popular Analytical Tools; Comparing Various Analytical Tools.

**UNIT - III**

Understanding Map Reduce Fundamentals and HBase : The Map Reduce Framework; Techniques to Optimize Map Reduce Jobs; Uses of Map Reduce; Role of HBase in Big Data Processing; Storing Data in Hadoop: Introduction of HDFS, Architecture, HDFC Files, File system types, commands, org.apache.hadoop.io package, HDF, HDFS High Availability; Introducing HBase, Architecture, Storing Big Data with HBase , Interacting with the Hadoop Ecosystem; HBase in Operations-Programming with HBase; Installation, Combining HBase and HDFS;

**UNIT - IV**

Big Data Technology Landscape and Hadoop : NoSQL, Hadoop; RDBMS versus Hadoop; Distributed Computing Challenges; History of Hadoop; Hadoop Overview; Use Case of Hadoop; Hadoop Distributors; HDFC (Hadoop Distributed File System), HDFC Daemons, read, write, Replica Processing of Data with Hadoop; Managing Resources and Applications with Hadoop YARN.

**UNIT - V**

Social Media Analytics and Text Mining: Introducing Social Media; Key elements of Social Media; Text mining; Understanding Text Mining Process; Sentiment Analysis, Performing Social Media Analytics and Opinion Mining on Tweets;

Mobile Analytics: Introducing Mobile Analytics; Define Mobile Analytics; Mobile Analytics and Web Analytics; Types of Results from Mobile Analytics; Types of Applications for Mobile Analytics; Introducing Mobile Analytics Tools;

**TEXT BOOKS**

1. BIG DATA and ANALYTICS, Seema Acharya, Subhasinin Chellappan, Wiley publications.
2. BIG DATA, Black Book™, DreamTech Press, 2015 Edition.
3. BUSINESS ANALYTICS 5e, BY Albright |Winston

**REFERENCE BOOKS:**

1. Rajiv Sabherwal, Irma Becerra- Fernandez,” Business Intelligence –Practice, Technologies and Management”, John Wiley 2011.
2. Lariss T. Moss, ShakuAtre, “ Business Intelligence Roadmap”, Addison-Wesley It Service.
3. Yuli Vasiliev, “ Oracle Business Intelligence : The Condensed Guide to Analysis and Reporting”, SPD Shroff, 2012.



**STORAGE AREA NETWORKS  
(OPEN ELECTIVE-I)**

**Course Overview:** Conventional databases are not sufficient to hold voluminous information that is being generated today by virtue of social media. To store this huge amount of data even storage can be allocated in different geographical locations leading to a concept called storage area networks.

**Course Objectives:**

- I. To teach Storage Area Networks characteristics and components.
- II. To familiarize with the SAN vendors and their products
- III. To familiarize with Cisco MDS 9000 Multilayer Directors and Fabric Switches
- IV. To explain Cisco SAN-OS features.
- V. To emphasize the use of all SAN-OS commands. Practice variations of SANOS features

**Course Outcomes:** At the end of the course students will be able to

1. Identify the solutions of data storage challenges using SAN
2. Identify the characteristics and requirements to implements SAN
3. Use of SAN Protocols
4. Implement various levels of RAID

**SYLLABUS**

**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 centre 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 fulfils the need, understand the appropriateness of the different networked storage options for different application environments

**UNIT IV: Information Availability & Monitoring & Managing Data centre**

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 centre, Industry standards for data centre monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data centre

**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.



**INTRODUCTION TO WEB MARKUP LANGUAGES  
(OPEN ELECTIVE-I)**

**Course Overview:** This course will impart basic skills of web page development and fundamental operations of cloud computing.

**Course Objectives:**

- I. To inculcate basic of web page design using HTML tags.
- II. To teach frames and div tags to partition webpage.
- III. To facilitate students in applying styles to web content
- IV. To demonstrate cloud storage using blue mix.

**Course Outcomes:** At the end of this course students will be able to

1. To develop static web pages using HTML tags.
2. To add styles to text and other controls using CSS
3. To create forms to collect input from web users.
4. To access blue mix cloud to upload HTML files.
5. To compare various search engines.

**SYLLABUS**

**UNIT - I**

History of Internet, World Wide Web (WWW), WWW vs. Internet. Introduction to HTML, Differences between HTML and HTML5, Structure of HTML document. Tag, Attributes, Elements.  
Basic HTML Tags: Working with Text, comments, Headings, Paragraphs, line break, preformatting tags.

**UNIT - II**

Lists, Tables, Links, Marquee tags, Images and Multimedia audio & video tags, Frames, Frameset, div tag, iframe, Forms, attributes of forms, request methods, input types.

**UNIT - III**

HTML DOM: Document, Window, Navigator, Screen, History, Location objects.  
Overview of CSS. Types of CSS: Inline Style sheet, embedded style sheets, External style sheets.

**UNIT - IV**

Background and Colour gradients in CSS, Font and Text Styles, List, Table layouts, Effects, Frames in CSS.

**UNIT - V**

Introduction to Cloud Computing including benefits, challenges, and risks, Cloud Computing Models including Infrastructure/Platform/Software – as-a-service, Public cloud, private cloud and hybrid clouds. Uploading files to Cloud.

**TEXT BOOK**

1. Text Book: HTML 5 BLACK BOOK author: Kogent Learning Solutions Inc. DREAMTECH PRESS.

**REFERENCES**

1. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics Fourth Edition, Jennifer Niederst Robbins O'Reilly publications
2. Mastering cloud computing by Rajkumar Buyya



**BIOINFORMATICS**  
(OPEN ELECTIVE –II)

**Course Overview:** Deals with various aspects and technologies that are used in health care domain to construct health care devices which are functionally critical and non fault tolerant.

**Course Objectives:**

- I. To describe elementary protocols of networks
- II. To familiarize the concept of homology
- III. To facilitate in understanding DNA mapping, sequence mapping , molecular modeling etc.

**Course Outcomes:** At the end of the course students will be able to

1. Apply shotgun and sanger method for DNA mapping
2. Use heuristic algorithms and dynamic programming in PAM matrices
3. Identify the key concepts biological databases

**SYLLABUS**

**UNIT - I**

**INTRODUCTION TO BIOINFORMATICS:** Scope of bioinformatics, elementary commands and protocols, FTP, Telnet, HTTP, primer on information theory.

**INTRODUCTION TO HOMOLOGY:** Introduction to homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace).

**UNIT - II**

**SPECIAL TOPICS IN BIOINFORMATICS:** DNA mapping and sequencing, Map alignment, large scale sequencing methods, Shotgun and Sanger method.

**UNIT - III**

**SEQUENCE ALIGNMENT AND DYNAMIC PROGRAMMING:** Heuristic alignment algorithms, Global sequence alignments- Needleman-Wunsch algorithm, Smith-Waterman algorithm - local sequence alignments, Amino acid substitution matrices- PAM and BLOSUM.

**UNIT - IV**

**PRIMARY DATABASE AND THEIR USE:** Introduction to biological databases, organization and management of databases, Searching and retrieval of information from the World Wide Web, Structure databases - PDB (Protein Data Bank), Molecular Modeling Databases (MMDB), primary databases- NCBI, EMBL, DDBJ.

**SECONDARY DATABASES:** Introduction to secondary databases- organization and management of databases Swissprot, PIR, KEGG.

**UNIT - V**

**BIOCHEMICAL DATA BASES:** Introduction to biochemical databases, organization and management of databases, KEGG, EXGESCY, BRENDA, WIT.

**TEXT BOOKS:**

1. Hooman H. Rashidi, Lukas K. Buehler (2005), Bioinformatics Basics, Applications in Biological Science and Medicine, 2<sup>nd</sup> edition, CRC Press, Taylor and Francis Group, USA.
2. David W. Mount (2005), Bioinformatics- Sequence and Genome Analysis, 2<sup>nd</sup> edition, Cold Spring Harbor Laboratory Press, New York.

**REFERENCE BOOKS:**

1. Harshawardhan P. Bal (2005), Bioinformatics Principles and Applications, Tata McGraw Hill, New Delhi.
2. Cynthia Gibbs, Per Jamberk(2001), Developing Bioinformatics Skills, Cold Spring Harbor Laboratory Press, New York.

**WEB MINING  
(OPEN ELECTIVE-II)**

**Course Overview:** Web mining is course which will focus on various aspects of data mining in web by applying association rules and pattern matching algorithms. Supervised and unsupervised learning can happen using decision trees and useful information can be retrieved to make business decisions.

**Course Objectives:**

- I. To describe web mining and understand the need for web mining
- II. To differentiate between Web mining and data mining
- III. To understand the different application areas for web mining
- IV. To understand the different methods to introduce structure to web-based data
- V. To describe Web mining, its objectives, and its benefits
- VI. To understand the methods of Web usage mining

**Course Outcomes:** At the end of the course students will be able to

1. Apply association rules and sequential patterns in web mining
2. Use decision trees, in deriving useful business related information
3. Identify the key concepts in web crawling
4. Analyze social networks

**SYLLABUS**

**UNIT - I**

Introduction to Web Data Mining and Data Mining Foundations Introduction – World Wide Web(WWW), A Brief History of the Web and the Internet, Web Data Mining-Data Mining, Web Mining. Data Mining Foundations – Association Rules and Sequential Patterns – Basic Concepts of Association Rules, Apriori Algorithm- Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports – Extended Model, Mining Algorithm, Rule Generation, Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP, Mining Sequential Patterns on PrefixSpan, Generating Rules from Sequential Patterns.

**UNIT - II**

Supervised and Unsupervised Learning Supervised Learning - Basic Concepts, Decision Tree Induction – Learning Algorithm, Impurity Function, Handling of Continuous Attributes, Classifier Evaluation, Rule Induction – Sequential Covering, Rule Learning, Classification Based on Associations, Naïve Bayesian Classification , Naïve Bayesian Text Classification - Probabilistic Framework, Naïve Bayesian Model . Unsupervised Learning – Basic Concepts , K-means Clustering – K-means Algorithm, Representation of Clusters, Hierarchical Clustering – Single link method, Complete link Method, Average link method, Strength and Weakness.

**UNIT - III**

Information Retrieval and Web Search Basic Concepts of Information Retrieval, Information Retrieval Methods - Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Preprocessing – Stopword Removal, Stemming, Web Page Preprocessing, Duplicate Detection, Inverted Index and Its Compression – Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing – Singular Value Decomposition, Query and Retrieval, Web Search, Meta Search, Web Spamming.

**UNIT - IV**

Link Analysis and Web Crawling Link Analysis - Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, Community Discovery-Problem Definition, Bipartite Core Communities, Maximum Flow Communities, Email Communities. Web Crawling – A Basic Crawler Algorithm- Breadth First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused

Crawlers, Topical Crawlers, Crawler Ethics and Conflicts.

**UNIT - V**

Opinion Mining and Web Usage Mining Opinion Mining - Sentiment Classification – Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization – Problem Definition, Object feature extraction, Feature Extraction from Pros and Cons of Format1, Feature Extraction from Reviews of Format 2 and 3, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam. 14

Web Usage Mining - Data Collection and Preprocessing- Sources and Types of Data, Key Elements of Web usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web usage Patterns -Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigation Patterns.

**TEXT BOOK:**

1. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications)

**REFERENCES BOOKS:**

1. Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications)
2. Web Mining:: Applications and Techniques by Anthony Scime
3. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti



**SEMANTIC WEB AND SOCIAL NETWORKS**  
(OPEN ELECTIVE-II)

**Course Overview:** In this Information age, web plays a significant role in information sharing. The success of web is due to its response time. The search engines will parse the users request and retrieves information from various places. The search engines generally may not retrieve the required data. Hence to make search more meaningful and retrieve only the required information, semantic web and ontology concepts are used.

**Course Objectives:**

- I. To impart concepts of Web Intelligence
- II. To teach Knowledge Representation for the Semantic Web
- III. To impart basics of Ontology Engineering
- IV. To familiarize Semantic Web Applications, Services and Technology
- V. To facilitate students in Social Network Analysis.

**Course Outcomes:** At the end of the course students will be able to

1. Differentiate web and intelligent web applications
2. Identify the concepts of Ontology and Artificial Intelligence in semantic web applications
3. Apply Ontology and Semantic web search techniques to make web more intelligent

**SYLLABUS**

**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, elearning, 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 LuChapman 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

