ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.Tech

COMPUTER SCIENCE & ENGINEERING

(Applicable for the Batches Admitted from 2019 - 2020)

R-19

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

Kotappakonda Road, Yellamanda (P),
Narasaraopet - 522 601, Guntur Dist.,
Andhra Pradesh, INDIA.

Narasaraopeta Engineering College (Autonomous)

Kotappakonda Road, Yellamanda (P.O), Narasaraopet- 522601, Guntur District, AP.
Sponsored by Gayatri Educational Development Society, Narasaraopet.
Approved by AICTE, New Delhi & Permanently affiliated to JNTUK, Kakinada. Code: 47.
Twice Accredited by NBA & NAAC with "A" Grade; ISO 9001:2008 Certified Institution.
Phone: 08647239905 Website: www.nrtenggcollege.com Email: nrtec_principal@yahoo.com

R19 M.Tech

ACADEMIC REGULATIONS

ACADEMIC REGULATIONS - 2019 FOR M.TECH

(Effective for the students admitted into I year from the Academic Year 2019-20 and onwards)

1. QUALIFICATION FOR ADMISSION

Admission to the above program 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 GATE/PGECET or on the basis of any other order of merit as approved by the Government from time to time.

2. AWARD OF M.TECH. DEGREE

A student will be declared eligible for the award of the M. Tech. Degree, if he fulfils the following academic requirements.

(a) Pursue a course of study for not less than two academic years and not more than four academic years.

(b) The candidate registers for 80 credits and secure all 80 credits.

3. COURSES OF STUDY

The following courses of study are offered at present as specializations in the M.Tech. courses with English as medium of instruction.

S. No.	Specialization Code	Abbreviation
01	06 - DSCE	Digital Systems and Computer Electronics
02	15 - MD	Machine Design
03	21 - TE	Thermal Engineering
04	38 - DECS	Digital Electronics and Communication Systems
05	42 - P&ID	Power and Industrial Drives
06	58 - CSE	Computer Science and Engineering
07	87 - SE	Structural Engineering

And any other course as approved by the authorities from time to time.

4. STRUCTURE OF THE PROGRAMME

Semester	Credits
I M.TECH I SEM	21
I M.TECH II SEM	21
II M.TECH III SEM	38
II M.TECH IV SEM	
TOTAL	80

Each course is normally assigned a certain number of credits as follows:

- 3 credits for 4 lecture periods.
- 3 credits for 6 laboratory periods per week.
- 1 credit for seminar.
- 2 credits for comprehensive viva
- 35 credits for project work.

5. DISTRIBUTION AND WEIGHTAGE OF MARKS

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for theory / practical / seminar / comprehensive viva on the basis of internal evaluation and end semester examinations.

5.1 THEORY

All theory subjects consisting of 6 units in each subject, the assessment shall be for 40 marks through internal evaluation and 60 marks through external end semester examination of 3 hours duration.

5. 1.a. INTERNAL EVALUATION

The internal evaluation will be based on two cycle tests conducted in each semester. The 40 internal marks will be awarded as 75% of the best cycle and 25% of the least cycle examinations, where each cycle of examination contain
Descriptive test - 30 Marks
Assignment test - 10 Marks

Each descriptive test question paper contains3 questions one from each unit covering syllabus from 3 units (first 3 units for first cycle and the remaining 3 units for second cycle). The student has to answer all the three questions (3X10M=30M).The descriptive examination will be conducted for1½ hour duration.

In Assignment Tests 5 or 6 questions will be declared in the class room at least one week in advance. In the test, two questions (one from each unit) will be given at random to each student and the student has to answer it.
The Assignment Test-1 will be conducted for 10 marks covering the syllabus from 1st& 2ndunits.The Assignment Test-2 will be conducted for 10 marks from 4th& 5th units.

5.1.b. EXTERNAL EVALUATION

The question paper comprises of 8 questions, there should be one from each unit. Student has to answer 5 questions out of 8, each question carry 12marks (5X12=60). The duration of end theory examination is 3 hours.

5.2 PRACTICALS

For practical subjects evaluation is as follows during the semester

5.2.a. INTERNAL EVALUATION

There shall be continuous evaluation during the semester for 40 internal marks. The internal marks shall be awarded as follows:

Record	- 10 Marks
Day-to-day work	- 15 Marks
Internal Lab Test	- 15Marks

5.2.b. EXTERNAL EVALUATION

For practical subjects there shall be an external examination at the end of the semester for 60 marks in the presence of external examiner.

5.3 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 end semester examination and a minimum of 50% of the total marks in the end semester examination and internal evaluation taken together.

5.4 SEMINAR

For seminar, a student under the supervision of a faculty member shall collect the literature on an advanced topic related to his specialization and review the literature then submit it to the department in a report form during the third semester and shall make an oral presentation before the departmental review committee consisting of the supervisor and head of the department / a senior faculty member. There shall be an internal evaluation for 100 marks in the form of viva voce examination and assessment of report and its presentation. There will be NO external evaluation. A candidate shall be deemed to have secured the minimum academic requirement in seminar, if he secures a minimum of 50% of marks in the examination.

If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register and he has to submit a fresh report and appear for the evaluation by the committee.

5.5 COMPREHENSIVE VIVA-VOCE

Comprehensive viva voce examination is conducted during the 3rd semester in all the subjects of first & second semesters of the course by a committee consisting of two senior faculty members of the department. There will be NO external evaluation.

A candidate shall be deemed to have secured the minimum academic requirement in seminar, if he secures a minimum of 50% of marks in the examination.

If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register and undergo viva voce examination.

5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.3) he has to re-appear for the end semester examination in that subject.
A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate is less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-register subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks in the previous attempt stand cancelled. For re-registration the candidates have to apply to the college by paying the requisite fee and get approval from the authorities before the beginning of the semester in which re-registration is required.

5.7 In case the candidate secures less than the required attendance in any re-registered subject(s), he shall not be permitted to write the End examination in that subject. He shall again re-register the subject when next offered.

5.8 Laboratory examinations must be conducted with two examiners, one of them being the laboratory class teacher or teacher of the respective college and the second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective departments.

5.9 PROJECT WORK

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

5.9.1.A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members.

5.9.2.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.

5.9.3.After satisfying 5.9.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The students can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

5.9.4.If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (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.

5.9.5.A candidate shall submit his status report in two stages at least with a gap of 3 months between them.

5.9.6.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 theory and practical subjects with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

5.9.7.Three copies of the Project Thesis certified by the supervisor shall be submitted to the College.

5.9.8.The thesis shall be adjudicated by one examiner selected by the authorities. For this, the HOD of the concerned dept. shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned.

5.9.9.If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the authorities.

5.9.10.If the report of the examiner is favourable, viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis. The Board shall jointly report the candidate's work as one of the following: Grade O(Outstanding)/ Grade A(Excellent)/Grade B(Very Good) /Grade

C(Good)/ Grade D(Pass)/ Grade F(Fail).

The Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination.

5.9.11. If the report of the viva-voce is Grade F, the candidate shall retake the viva-voce examination only after three months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the authorities.

6. ATTENDANCE REQUIREMENTS:

(i) A student shall be eligible to appear for the end examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

(ii) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester for genuine medical reasons and shall be approved by a committee duly appointed by the college. A fee stipulated by the college shall be payable towards condonation of shortage of attendance. However the number of condonations is restricted to two for the entire course.

(iii) A student who is short of attendance in a semester may seek re-admission into that semester when offered next time, within 4 weeks from the date of commencement of class work.

(iv) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for re-admission into the same class.

7. COURSE PATTERN:

(i) The entire course of study is of two academic years and every year will have TWO Semesters.

(ii) A student is eligible to appear for the end examination in a subject, but absent for it or has failed in the end examinations may appear for that subject in supplementary examinations, when conducted next.

(iii) When a student is detained due to shortage of attendance, he may be re-admitted in to the same semester/year in which he has been detained.

8. METHOD FOR AWARDING OF GRADE POINTS FOR A SUBJECT:

Theory/ Laboratory / Seminar/ Comprehensive viva/ Project (% of marks in a subject)	Corresponding Grade Points	Letter Grade
91 - 100	10	O (Outstanding)
81 - 90	9	A (Excellent)
71 - 80	8	B (Very Good)
61 - 70	7	C (Good)
51 - 60	6	D (Pass)
< 50	0	F (Fail)

9. Criteria for award of grades/division.

9.1 Calculation of Semester Grade Point Average (SGPA)* for semester

The performance of each student at the end of each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

$$\text{SGPA} = \frac{\sum (CR \, X \, GP)}{\sum CR}$$

Where CR= Credits of a subject
GP = Grade Points awarded for a subject
*SGPA is calculated for a candidate who passed all the subjects in that semester.

9.2 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

$$\text{CGPA} = \frac{\sum (CR \, X \, GP)}{\sum CR}$$

Where CR = Credits of a subject
GP = Grade Points awarded for a subject

- The SGPA and CGPA shall be rounded off to 2 decimal point and reported in the transcripts.
- Equivalent percentage = (CGPA – 0.75) x 10

9.3 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of M.Tech Degree and shall be placed in one of the following classes:

CGPA	Class
≥ 7.75	First Class with Distinction (Provided all the subjects should pass in the first attempt)
≥ 6.75	First Class (with subject failures)
≥ 5.75 & < 6.75	Second Class

10. REVALUATION:

1. Student can submit the application for revaluation, along with the prescribed fee for revaluation of his answer script(s) of theory subject(s) as per the notification issued by the Controller of Examinations.

2. The Controller of Examinations shall arrange for revaluation of such answer script(s).

3. An External examiner, other than the first examiner shall revaluate the answer script(s).

11. MINIMUM INSTRUCTION DAYS:

The minimum instruction days for each semester shall be 90 working days.

12. There shall be no branch transfer after the completion of admission process.

13. 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 such student will be kept withheld. His degree will be withheld in such cases.

14. TRANSITORY REGULATIONS

Discontinued or detained candidates are eligible for readmission as and when next offered.

A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the subjects in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such subjects in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

14.1 A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of first year shall join the autonomous batch of first year first semester. Such students shall study all the subjects prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

14.2 A student who is following JNTUK curriculum, detained due to shortage of attendance at the end of the second semester of first year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

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MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT INEXAMINATIONS

- The Principal shall refer the cases of Malpractices in Internal Assessment Test and Semester end examinations to a malpractice prevention committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the students based on the recommendations of the committee.

- Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder:

	Nature of Malpractices/ Improper conduct	**Punishment**
	If the candidate:	
1(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	Expulsion from the examination hall and cancellation of the performance in that subject only.
1(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 college.
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 practicals 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 classwork and all college 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 classwork and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-incharge 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 officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of 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	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.

	the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the 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 classwork and all college 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 the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6to 8.	Student of the college 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. 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	Cancellation of the performance in that subject and all other subjects the

	during special scrutiny.	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 college for further action to award suitable punishment.	

OTHER MATTERS:

1. Physically challenged candidates who have availed additional examination time and a scribe during their UG / PGECET examinations will be given similar concessions on production of relevant proof / documents.

2. The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the departments shall be reported to the Academic Council for ratification.

GENERAL:

1. The academic council may, from time to time, revise, amend or change the regulations, schemes of examinations and / or syllabi.
2. Wherever the words ‘’he’’ ‘’him’’ ‘’his’’, occur in the regulations, they include ‘’she’’, ’’her’’, ’’hers’’.
3. The academic regulation should be read as a whole for the purpose of any interpretation.
4. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the principal is final.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M. Tech (R-19) COURSE STRUCTURE

I M.Tech (R-19)- I SEMESTER

S. NO.	NAME OF THE SUBJECT	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
1	Advanced Data Structures and Algorithm Analysis	3	-	-	40	60	100	3
2	Computer Organization and Operating Systems	3	-	-	40	60	100	3
3	Database Management Systems	3	-	-	40	60	100	3
4	Mathematical Foundations of Computer Science	3	-	-	40	60	100	3
5	Computer Networks	3	-	-	40	60	100	3
6	Advanced Software Engineering	3	-	-	40	60	100	3
7	Data Structures and Database Management Systems Lab	-	-	6	40	60	100	3
	Total	18	0	6	280	420	700	21

L: Lecture

T: Tutorial

P: Practical

I M.Tech (R-19) - II SEMESTER

S. NO.	NAME OF THE SUBJECT	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
1	Block Chain Technologies	3	-	-	40	60	100	3
2	Foundations of data Science	3	-	-	40	60	100	3
3	Artificial Intelligence and Machine Learning	3	-	-	40	60	100	3
4	Service Oriented Architecture	3	-	-	40	60	100	3
5	**Professional Elective - I** Mobile Computing Big Data Analytics Internet of Things High Performance Computing	3	-	-	40	60	100	3
6	**Professional Elective - II** Cloud Computing Deep Learning Data Mining and Data warehousing Functional Programming	3	-	-	40	60	100	
7	Data Science Lab	-	-	6	40	60	100	3
	Total	18	0	6	280	420	700	21

II M. Tech (R-19) – III & IV SEMESTERS

S. NO.	NAME OF THE SUBJECT	Total Marks	Credits
1	Seminar	100	1
2	Comprehensive Viva-Voce	100	2
3	Project	-	35
	Total	**200**	**38**

I M.Tech (R-19)- I SEMESTER

S. NO.	NAME OF THE SUBJECT	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
1	Advanced Data Structures and Algorithm Analysis	3	-	-	40	60	100	3
2	Computer Organization and Operating Systems	3	-	-	40	60	100	3
3	Database Management Systems	3	-	-	40	60	100	3
4	Mathematical Foundations of Computer Science	3	-	-	40	60	100	3
5	Computer Networks	3	-	-	40	60	100	3
6	Advanced Software Engineering	3	-	-	40	60	100	3
7	Data Structures and Database Management Systems Lab	-	-	6	40	60	100	3
	Total	18	0	6	280	420	700	21

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH01	**ADVANCED DATA STRUCTURES AND ALGORITHM ANALYSIS**						

COURSE OBJECTIVE:

- This course provides a comprehensive knowledge of data structures like Linked List, Priority Queues, Tree, Graph and ability to implement the same in software applications.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO 1: Compare and Contrast various basic of data structures [K2]
CO 2: Interpret various sorting, searching and basic operations on Tree & Graph [K2].
CO 3: Illustrate variety of advanced Abstract Data Type (ADT) & Hashing technique [K2]
CO 4: Compare AVL tree, splay tree, B tree and B+ trees [K2].
CO 5: Apply fundamental algorithms and data structures to real-world problems.

SYLLABUS:

UNIT-I

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT-II

Searching-Linear and Binary Search Methods. Sorting-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage Structures and Traversals.

UNIT-III

Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing-Linear Probing, Double Hashing.

UNIT-IV

Priority queues- Definition, ADT, Realising a Priority Queue Using Heaps, Definition, Insertion and Deletion.

UNIT-V

Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

UNIT-VI

Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations, Insertion, Deletion and Searching.
Search Trees- Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

TEXT BOOKS:

1. Richard F.Gilberg, Behrouz A. Forouzon, “Data Structures: A PseudoCode Approach With C”, 2/e, Cengage.
2. Sartaj Sahni, “Data Structures, Algorithms and Applications in java”, 2/e, University Press.

REFERENCE BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis”, 2/e, Pearson.
2. Adam Drozdek, “Data Structures and Algorithms”, 3/e, , Cengage.
3. N.B.Venkateswarulu, E. V. Prasad, S Chand & Co, “C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples”, 2009.
4. Heilman, “Data Structures, Algorithm and OOP”, TMH.
5. Cormen, “Introductions to Algorithms”, 2/e, PHI, 2001.
6. Horowitz, Sahni, Rajasekaran, “Fundamentals of Computer Algorithms”, 2/e, University Press.
7. Dave, “Design and Analysis” , Pearson, 2008.
8. Panneerselvam, “Design and Analysis Algorithms”, PHI,2007.
9. Seymour Lipschutz, Schaum’s Outlines “Data Structures”, TMH

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH02	**COMPUTER ORGANIZATION & OPERATING SYSTEMS**						

COURSE OBJECTIVE:

- Comprehensive knowledge of computer system including the analysis and design of components of the system.
- Describes different parameters of a memory system, organization and mapping of various types of memories.
- Illustrates algorithms for basic arithmetic operations using binary representation.
- Describes the means of interaction of devices with CPU, their characteristics and operating modes.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Interpret the computer system from user's perspective and can explain how Arithmetic Logic Unit works [K2].
CO 2: Interpret various Micro operations of control unit of CPU [K2].
CO 3: Interpret various cache memory mapping and I/O interface devices [K2].
CO 4: Explain operating system overview and process management concepts and distinguish various CPU scheduling algorithms [K2].
CO 5: Distinguish various deadlock handling mechanisms [K4].
CO 6: Compare and contrast various memory management techniques, disk scheduling algorithms. [K2].

SYLLABUS:

UNIT - I

Introduction: Types of Computers, Functional units of Basic Computer (Block diagram of Micro Computer).

Register Transfer and Micro-operations: Register Transfer language, Register Transfer, Bus and memory transfers - Three-State Bus Buffers, Memory Transfer; Arithmetic micro operations, Binary Adder, Binary Adder-Subtractor, Binary Incrementer, Arithmetic Circuit; Logical micro operations-List of Logic Microoperations, Hardware Implementation, Some Applications; Shift micro operations-Hardware Implementation, Arithmetic logic shift unit.

UNIT - II

Central Processing Unit: Instruction formats – Three Address Instructions, Two Address Instructions, One Address Instructions, Zero Address Instructions, RISC Instructions, Addressing modes – Numerical Example, Data Transfer and manipulation – Data Transfer Instructions, Data Manipulation Instructions, Arithmetic Instructions, Logical and Bit Manipulation Instructions, Shift Instructions, Program control – Status Bit Conditions, Conditional Branch Instructions, Subroutine Call and Return, Types of Interrupts, Reduced Instruction Set Computer – CISC Characteristics, RISC Characteristics.

UNIT - III

Input-Output Organization: Example of I/O Interface, Asynchronous data transfer – Strobe Control, Handshaking, Asynchronous Serial Transfer, Modes of Transfer – Example of Programmed I/O, Interrupt Initiated I/O, Priority Interrupts – Daisy Chaining Priority, Direct memory Access – DMA Controller, DMA Transfer.

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UNIT-IV

Overview of Operating System: Introduction, Operating Systems Services and Functions, Systems Calls and Types.

Process Management: Process, Process States , Process Control Block, Process Scheduling, Process Scheduling Concepts, CPU Scheduling Algorithms.

UNIT-V

Principles Of Deadlock Deadlock System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Detection and Avoidance, Recovery Form Deadlock.

UNIT- VI

Memory Management Strategies & Virtual Memory Management : Concepts, Swapping, Paging, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms.

Secondary-storage structures & I/O systems: Disk Structure, Disk Scheduling.

TEXT BOOKS:

1. M. Morris Mano, "Computer System Architecture", Third Edition, Pearson.2008 (UNITS: I, II, III).
2. Operating System Principles,7/E, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, WILEY INDIA publications. (UNITS: IV, V, VI)
3. Operating Systems, 6/e, William Stallings, PHI/Pearson.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw Hill, 5/e, 2002.
2. William Stallings, "Computer Organization and Architecture", Pearson 6/e, 2006.
3. Andrew S. Tanenbaum, "Structured Computer Organization" , Pearson, 4/e, 2005.
4. Sivarama P. Dandamudi, "Fundamentals of Computer Organization and Design", Springer, 2006
5. Operating Systems, 2/e, Dhamdhre

ADDITIONAL RESOURCES:

1. nptel.ac.in/courses/106106092
2. nptel.ac.in/courses/106103068

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH03	**DATABASE MANAGEMENT SYSTEMS**						

COURSE OBJECTIVE:

- Provides students with theoretical knowledge and practical skills in the design, use of databases and database management systems in information technology applications

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1 : Classify various Data models, Architectures and their implications [K2].
CO2 : Analyze DB design methodology and normalization process [K4].
CO3 : Interpret how queries are being processed and executed in RDBMS [K2].
CO4 : Compare and Contrast the various transaction and concurrency management techniques [K2].
CO5 : Analyze various file organizations and indexing techniques [K4].

SYLLABUS:

UNIT - I

Introduction: Database system, Characteristics - Database vs. File System; Database Users - Actors on Scene, Workers behind the scene; Advantages of Data base systems, and Database applications. Brief introduction of different Data Models Hierarchical, Network and Relational; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system Environment, Centralized and Client Server architecture for the database.

UNIT - II

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, Key constraints - Key constraints for Ternary Relationships, participation constraints, class hierarchies, Aggregation; sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values - Comparisons Using Null Values, Logical Connectives AND, OR, and NOT, Impact on SQL Constructs, Disallowing Null Values; Integrity constraints in SQL - Domain constraints, Entity constraints, Referential integrity constraints, Assertions.

UNIT - III

Basic SQL: Form of a basic SQL Query, Examples of Basic SQL Queries, Expressions and Strings in the SELECT Command, Simple Database schema, data types, table definitions, different DML operations, basic SQL querying using where clause, arithmetic & logical operations, SQL functions - Date and Time, Numeric, String conversion.

SQL : Creating tables with relationship, implementation of key and integrity constraints, nested queries, correlated Nested Queries, set-Comparison Operators, sub queries, grouping, aggregate operators, ordering, implementation of different types of joins, view - updatable and non-updatable; relational set operations, SQL constructs that grant access or revoke access from user or user groups.

UNIT - IV

Schema Refinement (Normalization): Problems Caused by Redundancy, Decompositions, Problems Related to Decomposition, Functional dependency, Properties of Functional dependency, Normal forms based on functional dependency - 1NF, 2NF and 3NF, concept of surrogate key, Boyce-Codd normal formBCNF, 4NF; Properties of Decompositions - Lossless join decomposition and dependency preserving decomposition.

UNIT - V

Transaction Management and Concurrency Control: Transaction - Single-User versus Multiuser Systems; Transactions, Database Items, Read and Write Operations, Transaction States and Additional Operations, The System Log, Commit Point of a Transaction, properties of transactions, Characterizing Schedules Based on Serializability ; Lock based Concurrency Control ; Concurrency Control Based on Timestamp Ordering .

UNIT - VI

Indexing Files:, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Types of Single-Level Ordered Indexes - Primary Indexes, Clustering Indexes, Secondary Indexes; Multilevel Indexes, Dynamic Multilevel Indexes Using B+Trees.

TEXT BOOKS:

1. Raghuram Krishnan, Johannes Gehrke , “Database Management Systems”, TMH, 3/e, , 2003.
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, PEA, 6/e, 2010,

REFERENCE BOOKS:

1. Silberschatz, Korth, “Database System Concepts”. TMH, 5/e, 2006.
2. C J Date, “Introduction to Database Systems”, PEA, 8/e, 2006.
3. NarainGehani, “The Database book principles & practice using Oracle/MySql”, University Press, 2006.

ADDITIONAL RESOURCES:

1. nptel.ac.in/courses/106106093
2. nptel.ac.in/courses/106104135

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH04	**MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**						

COURSE OBJECTIVE:

- The course provides with the basic mathematical implication for computer science, applications of mathematics in computer science.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1 : Acquire knowledge on statements, inferences, predicates.

CO2 : Perform operations on discrete structures such as sets, functions and relations

CO3 : Understand graphs and trees and their representation, types and variants and understand the algebraic structures, group theory, and Binomial theorem.

CO4 : Solve problems involving recurrence relations and generating functions.

SYLLABUS:

UNIT - I

Mathematical Logic: Statements and Notation, Connectives and Truth Tables-Negation, Conjunction, Disjunction, Conditional Statements, BiConditional Statements, Well-formed Formulas, Tautologies, Equivalence Formulas, Duality Law, Tautological Implications, Functionally Complete Set of Connectives, Other Connectives; Normal Forms, Theory of Inference for Statement Calculus.

UNIT - II

Predicate calculus: Predicates and Quantifiers-Predicates, Statement Function, Variables and Quantifiers, Free Bound Variables; Inference Theory of Predicate Calculus, Exercises.
Mathematical Induction: Principle of Mathematical Induction, Exercises.

UNIT - III

Set Theory and Relations: Set Theory, Principle of Inclusion and Exclusion, Relations, Relation Matrix and Digraph, Equivalence Relations, Covering and Partition of a Set, Compatibility and Partial Ordering Relations.
Functions: Bijective Functions, Types of Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions.

UNIT - IV

Graph Theory – I: Basic Concepts of Graphs, Sub graphs, Isomorphism, Paths and Circuits, Eulerian and Hamiltonian Graphs, Representation of graphs. (Problems and Theorems without proofs)
Graph Theory – II: Planar Graphs, Euler's Formula, Graph Coloring and Covering, Chromatic Number. (Problems and Theorems without proofs)
Trees: Trees and their Properties, Isomorphism of Trees, Directed trees, Binary Trees, Decision Trees, Spanning Trees-Properties, Algorithms for Spanning trees and Minimum Spanning Tree.

UNIT - V

Lattice: Lattices, Algebraic Systems, Properties of Binary operations, Semi groups and monoids, Groups.

Combinatorics: Basic Counting Principles, Permutations and Combinations- Permutations, Combinations, Pigeonhole Principle and its Application, Restricted Combinations.

Binomial Theorem: Binomial and Multinomial Coefficients, Generating Functions of Permutations and Combinations, Principle of Inclusion and Exclusion.

UNIT - VI

Recurrence Relation: Generating Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving linear homogeneous recurrence Relations by substitution, generating functions and The Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations.

TEXT BOOKS:

1. Mathematical Foundation for Computer Science, S.Santha, E.V. Prasad, T. U. Series

First Edition, Cengage Learning, 2011 (Units: I, II, III, IV & V).

2. Discrete Mathematics for Computer Scientists & Mathematicians, 2/e, Mott, Kandel, Baker, PHI, 2003 (Units: IV, V & VI)

REFERENCE BOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science, Tremblay, Manohar, 1/e, TMH, 1997.
2. Discrete Mathematics and its Applications with combinatorics and graph theory, 7/e, Rosen, TMH, 2012.

ADDITIONAL RESOURCES:

1. nptel.ac.in/courses/106106094
2. nptel.ac.in/courses/106108054 (Graph Theory)

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH05	**COMPUTER NETWORKS**						

COURSE OBJECTIVE:

- To provide knowledge on the fundamental concepts of the Computer Networks and problem solving techniques on Networks.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO 1: Summarize basic concepts of Data Communication and Networking [K2].
CO 2: Interpret design issues of data link layer [K2].
CO 3: Make use of data link layer services to provide well defined interface[K3].
CO 4: Analyze different routing protocols [K4].
CO 5: Illustrate the essential principles of different transport layer protocols [K2].
CO 6: Summarize various application layer protocols [K2].

SYLLABUS:

UNIT – I

Introduction: OSI Overview, TCP/IP and Other Network Models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies, WAN, LAN, MAN.

UNIT – II

Data Link Layer: Design Issues- Framing, Services Provided to Network Layer, Flow Control, Error Control, Error Detection and Correction-CRC, Checksum-Idea, One's Complement, Hamming code. **IEEE Standards:** 802.3 - Frame Format, 802.11 - Frame Format.

UNIT – III

Elementary Data Link Layer Protocols: Simplex Protocol, Simplex Stop and Wait, Simplex Protocol for Noisy Channel.
Sliding Window Protocol: One Bit, Go Back N, Selective Repeat-Stop And Wait Protocol, Examples Of Data Link Protocols- HDLC, PPP.
Medium Access Control Sub Layer: Chanel Allocation Problem, ALOHA, Carrier Sense Multiple Access (CSMA), CSMA With Collision Detection, CSMA With Collision Avoidance, Collision Free Protocols: Limited Contention Protocols, Wave Length Division Multiple Access Protocol, Bridges.

UNIT – IV

Network Layer: Network Layer Design Issues- Store And Forward Packet Switching, Service Provided to Transport Layer, Connection Oriented and Connection Less Service, Comparison of Virtual Circuit and Datagram Subnets.
Routing Algorithms: Optimality Principle, Shortest Path Routing, Flooding, Hierarchical Routing, Broad Cast, Multi Cast, Distance Vector Routing, Link State Routing.
Network Layer in Internet: IP Protocol, IP Address, IPv4 frame format.

UNIT –V

Transport Layer: The Transport Services- Services Provided to the Upper Layer, Transport Service Primitives, Berkeley Sockets, Elements of Transport Protocol-Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Crash Recovery.
The Internet Transport Protocols: TCP and UDP.

UNIT –VI

Application Layer: DNS(Domain Naming System)-DNS Namespace, Name Servers., Electronic Mail-Architecture And Services, The User Agent, Message Format-MIME, Sending and Receiving E-mail, Message Transfer- SMTP, Final Delivery-POP3, IMAP.
The World Wide Web- Architecture Overview, URL, HTTP.

TEXT BOOKS:

1. Andrew S Tanenbaum , "Computer Networks", Pearson Education/PHI, 4th Edition.
2. Behrouz A.Forouzan , "Data Communications and Networks", TMH, Third Edition.

REFERENCES:

1. S.Keshav, "An Engineering Approach to Computer Networks", Pearson Education, 2nd Edition,
2. W.A. Shay, Thomson, "Understanding Communications and Networks", 3rd Edition,

ONLINE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc18_cs38
2. https://in.udacity.com/course/computer-networking--ud436
3. https://www.class-central.com/subject/computer-networking
4. https://www.youtube.com/watch?v=3DZLItfbqtQ&list=PL32DBC269EF768F74

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE: 19MCS1TH06	**ADVANCED SOFTWARE ENGINEERING**						

COURSE OBJECTIVE:

- To study about the concepts of object oriented software engineering

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO1 : Explain the fundamentals of Software Engineering Methodologies [K2].
CO2 : Outline the software prototyping, analysis and design [K2].
CO3 : Demonstrate the various OO Design models and Testing Objects [K2].
CO4 : Apply the Software Testing and maintenance approaches for quality software development. [K3].

SYLLABUS:

UNIT I:

Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges.
Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models- Process, use, applicability and Advantages/limitations

UNIT II:

Requirements Engineering: Software Requirements, Requirements engineering Process, Requirements elicitation, Requirements Analysis, Structured Analysis, Data Oriented Analysis, Object oriented Analysis, Prototyping Analysis, Requirements Specification, Requirements Validation, Requirement Management.

UNIT III:

Software Design: Software Design Process, Characteristics of Good Software Design, Design Principles, Modular Design, Design Methodologies, Structured Design, Structured Design Methodology, Transform Vs Transaction Analysis, Object Oriented Analysis and Design Principles

UNIT IV:

Implementation: Coding Principles, Coding Process, Code verification, Code documentation
Software Testing: Testing Fundamentals, Test Planning, Black Box Testing, White Box Testing, Levels of Testing, Usability Testing, Regression testing, Debugging Approaches

UNIT V:

Software Project Management: Project Management Essentials, What is Project management, Software Configuration Management, Software Metrics and measurements, Project Size Estimation, Effort Estimation Techniques

UNIT VI:

Software Quality: Software Quality Factors, Verification & Validation, Software Quality Assurance, Capability Maturity Model (CMM)
Software Maintenance: Software maintenance, Maintenance Cost, Reengineering, Software Reuse.

TEXT BOOKS:

1. Software Engineering, concepts and practices, Ugrasen Suman, Cengage learning
2. Software Engineering, 8/e, Sommerville, Pearson.
3. Software Engineering, 7/e, Roger S. Pressman, TMH

REFERENCE BOOKS:

1. Software Engineering, A Precise approach, Pankaj Jalote, Wiley
2. Software Engineering principles and practice, W S Jawadekar, TMH
3. Software Engineering concepts, R Fairley, TMH

I M.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	6	40	60	100	3
SUBJECT CODE: 19MCS1LB01	**DATA STRUCTURES & DATABASE MANAGEMENT LAB**						

COURSE OUTCOMES:

After the completion of this course the student should be able to

CO1: Analyse Sorting Techniques and Explain elementary data structures such as Stacks, Queues Linked lists and Trees

CO2: Analyse and Apply SQL commands like DDL, DML, and DCL to perform different Database operations

CO3: Summarise PL/SQL Basic Programs, block, and control statements

LIST OF EXPERIMENTS

WEEK - 1

a) Write a C program to implement Bubble sort.

b) Write a C program to implement Insertion sort.

c) Write a C program to implement Selection sort.

WEEK - 2

a) Write a C program to implement Quick sort.

b) Write a C program to implement Merge sort.

c) Write a C program to implement Heap sort.

WEEK - 3

a) Write a C program to implement Stack operations using arrays and

b) Write a C program to implement Queue operation using arrays.

c) Write a C program to convert infix expression into postfix expression using Stack.

WEEK - 4

a) Write a C program to implement Stack operation using Linked list.

b) Write a C program to implement Queue operations using Linked lists.

WEEK - 5

a) Write a C program to implement the following operations on a singly linked using functions

i) Insertion ii) Deletion iii) Displaying iv) Reversing

b) Write a C program to implement following Operations a Binary Search Tree

i) Create ii) Insert iii) Delete

WEEK - 6

Creation, altering and droping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.

WEEK - 7

Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.

WEEK - 8

Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.

Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)

WEEK - 9

Creation of simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found) ii)Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.

WEEK - 10

Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

I M.Tech (R-19) - II SEMESTER

S. NO.	NAME OF THE SUBJECT	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
1	Block Chain Technologies	3	-	-	40	60	100	3
2	Foundations of data Science	3	-	-	40	60	100	3
3	Artificial Intelligence and Machine Learning	3	-	-	40	60	100	3
4	Service Oriented Architecture	3	-	-	40	60	100	3
5	**Professional Elective - I** Mobile Computing Big Data Analytics Internet of Things High Performance Computing	3	-	-	40	60	100	3
6	**Professional Elective - II** Cloud Computing Deep Learning Data Mining and Data warehousing Functional Programming	3	-	-	40	60	100	
7	Data Science Lab	-	-	6	40	60	100	3
	Total	18	0	6	280	420	700	21

I M.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**BLOCKCHAIN TECHNOLOGIES**						

COURSE OBJECTIVES:

- To understand the concepts of Block Chain, Block Chain networks and Security of Bitcoins.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO 1: Interpret the working procedure of Bitcoins [K2].
CO 2: Analyze the Transactions in Bitcoin Network [K4].
CO 3: Analyze the Block Chain and Bitcoin Network [K4].
CO 4: Analyze the Mining and Consensus in Block Chain [K4].

SYLLABUS:

UNIT-I

Introduction: What is Bitcoin?, History of Bitcoin, Bitcoin Uses, Users and Their Stories ,Getting Started, Quick Start Getting your first bitcoins, Sending and receiving bitcoins.
How Bitcoin Works: Transactions, Blocks, Mining, and the Block chain, Bitcoin Overview, Bitcoin Transactions, Common Transaction Forms, Constructing a Transaction, Getting the right inputs, Creating the outputs, Adding the transaction to the ledger, Bitcoin Mining, Mining transactions in blocks, Spending the transaction

UNIT-II

Keys, Addresses, Wallets: Generating a public key, Bitcoin Addresses-Base58 and Base58Check Encoding, Key Formats .Wallets -Non-Deterministic (Random) Wallets Deterministic (Seeded) Wallets, Mnemonic Code Words, Hierarchical Deterministic Wallets (BIP0032/BIP0044) . Advanced Keys and Addresses - Encrypted Private Keys (BIP0038), Pay To Script Hash (P2SH) and Multi-Sig Addresses, Vanity Addresses, Paper Wallets.

UNIT-III

Transactions: Introduction, Transaction Lifecycle - Creating Transactions, Broadcasting Transactions to the Bitcoin Network, Propagating Transactions on the Bitcoin Network, Transaction Structure, Transaction Outputs and Inputs - Transaction Outputs, Transaction Inputs, Transaction Fees, Adding Fees to Transactions. Transaction Chaining and Orphan Transactions, Transaction Scripts and Script Language - Script Construction (Lock + Unlock), Scripting Language, Turing Incompleteness, Stateless Verification. Standard Transactions - Pay to Public Key Hash (P2PKH), Pay-to-Public-Key, Multi-Signature, Data Output (OP_RETURN) ,Pay to Script Hash (P2SH).

UNIT-IV

The Bitcoin Network: Peer-to-Peer Network Architecture , Nodes Types and Roles , The Extended Bitcoin Network , Network Discovery , Full Nodes , Exchanging “Inventory” ,Simplified Payment Verification (SPV) Nodes , Bloom Filters , Bloom Filters and Inventory Updates , Transaction Pools , Alert Messages.

UNIT-V:

Bitcoin Security: Security principles - Developing Bitcoin Systems Securely, The Root of Trust. User Security Best Practices - Physical Bitcoin Storage , Hardware Wallets , Balancing Risk (loss vs. theft) ,Diversifying Risk , Multi-sig and Governance , Survivability , Conclusion.

The Block chain: Introduction, Structure of a Block, Block Header, Block Identifiers - Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Block chain, Merkle Trees, Merkle Trees and Simplified Payment Verification (SPV).

UNIT-VI:

Mining and Consensus: Introduction - Bitcoin Economics and Currency Creation. De-centralized Consensus ,Independent Verification of Transactions, Mining Nodes , Aggregating Transactions into Blocks- Transaction Age, Fees, and Priority ,The Generation Transaction ,Coinbase Reward and Fees ,Structure of the Generation Transaction , Coinbase Data .Constructing the Block Header , Mining the Block - Proof-of-Work Algorithm , Difficulty Representation , Difficulty Target and Re-Targeting .Successfully Mining the Block , Validating a New Block ,Assembling and Selecting Chains of Blocks -Blockchain Forks .Mining and the Hashing Race - The Extra Nonce Solution ,Mining Pools . Consensus Attacks

TEXT BOOKS:

1. Andreas M. “Antonopoulos Mastering bitcoin: unlocking digital crypto-currencies”, 2nd edition, O’Reilly publishers**.**

REFERENCE BOOKS:

1. Andreas M. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 1st Edition, O’RIELLY publications.
2. Nitin Gaur, Luc Desrosiers, Venkatraman Ramakrishna, Petr Novotny, Salman A. Baset, Anthony O'Dowd, “Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric and Composer”.
3. Brenn Hill, Samanyu Chopra, Paul Valencourt, “Blockchain Quick Reference: A guide to exploring decentralized blockchain application development”
4. Steve Hoberman, “Blockchainopoly: How Blockchain Changes the Rules of the Game”.
5. Andreas Antonopoulos and Gavin Wood, “Mastering Ethereum: Building Smart Contracts and DApps Book.
6. Bashar Almunyyer Abdallah Daodiah, Bashar Almunyyer, Abdallah Daodiah, “Blockchain Technology - Smart Contract.

I M.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**FOUNDATIONS OF DATA SCIENCE**						

COURSE OBJECTIVE:

- This course provides a comprehensive knowledge of data science and analytics techniques using Python. With this students will learn the essential concepts of Python programming and gain deep knowledge in data analytics and data visualization.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO 1: Apply principles of NumPy and Pandas to the analysis of data. [K3]
CO 2: Make use of various file formats in loading and storage of data. [K3]
CO 3: Identify and apply the need and importance of pre-processing techniques [K3].
CO 4: Show the results and present them in a pictorial format [K2].

SYLLABUS:

UNIT-I

What is Data science?, The Data science process, A data scientist role in this process, NumPy Basics: The NumPy ndarray: A Multidimensional Array Object(Creating ndarrays ,Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes), Universal Functions:(Fast Element-wise Array Functions), Data Processing Using Arrays(Expressing Conditional Logic as Array Operations , Mathematical and Statistical Methods , Methods for Boolean Arrays , Sorting , Unique and Other Set Logic), File Input and Output with Arrays (Storing Arrays on Disk in Binary Format, Saving and Loading Text Files)

UNIT-II

Getting Started with pandas: Introduction to pandas Data Structures(Series,DataFrame,Index Objects), Essential Functionality(Reindexing,Dropping entries from an axis, Indexing, selection, and filtering, Arithmetic and data alignment, Sorting and ranking, Axis indexes with duplicate values), Summarizing and Computing Descriptive Statistics(Correlation and Covariance, Unique Values, Value Counts, and Membership), Handling Missing Data(Filtering Out Missing Data, Filling in Missing Data), Hierarchical Indexing(Reordering and Sorting Levels, Using a DataFrame's Columns).

UNIT-III

Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format(Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping), Binary Data Formats(Using HDF5 Format, Reading Microsoft Excel Files),Interacting with HTML and Web APIs, Interacting with Databases(Storing and Loading Data in MongoDB).

UNIT-IV

Data Wrangling: Clean, Transform, Merge, Reshape:Combining and Merging Data Sets(Database-style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap), Reshaping and Pivoting(Reshaping with Hierarchical Indexing, Pivoting "long" to "wide" Format), Data Transformation(Removing Duplicates, Transforming Data Using a Function or

Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers)

UNIT-V

Plotting and Visualization: A Brief matplotlib API Primer (Figures and Subplots,Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File), Plotting Functions in pandas (Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots)

UNIT-VI

Data Aggregation and Group Operations: GroupBy Mechanics(Iterating Over Groups, Selecting a Column or Subset of Columns, Grouping with Dicts and Series, Grouping with Functions, Grouping by Index Levels) Data Aggregation(Column-wise and Multiple Function Application, Returning Aggregated Data in "unindexed" Form), Group-wise Operations and Transformations(Apply: General split-apply-combine, Quantile and Bucket Analysis, Example: Filling Missing Values with Group-specific Values, Example: Random Sampling and Permutation, Example: Group Weighted Average and Correlation, Example: Group-wise Linear Regression)

TEXT BOOKS:

1. Wes McKinney, "Python for Data Analysis", O'REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.

REFERENCE BOOKS:

1.Rachel Schutt & O'neil, "Doing Data Science", O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.
2.Joel Grus, "Data Science from Scratch", O'REILLY, 1st edition, April 2015

I M.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**						

COURSE OBJECTIVES:

The objectives of this course are

- Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic and learning.
- The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.
- To introduce students to the basic concepts and techniques of Machine Learning.
- Familiarity with a set of well-known supervised learning algorithms.
- The ability to implement some basic machine learning algorithms.

COURSE OUTCOMES:

At the end of this course, the student should be able to

CO 1: Outline the fundamentals of artificial intelligence and Machine Learning. [K2]
CO 2: Analyze different search techniques and predicate logic in artificial Intelligence. [K4]
CO 3: Interpret knowledge representation and symbolic reasoning using different rules. [K2]
CO 4: Compare and contrast different dominant Machine Learning Algorithms for classification [K2].

SYLLABUS

UNIT I

Introduction to AI, Problems, Problem Spaces and Search: Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics, Issues in the Design of Search Programs.

UNIT II

Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction.

UNIT III

Knowledge Representation Using Predicate Logic: Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution Representing.
Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge. Weak slot and-filler structures: Semantic Nets, Frames

UNIT IV

Machine learning Introduction: Well -posed Learning problems. Designing a Learning System: Choosing the Training Experience, Choosing the Target Function, Choosing a Representation for the Target function, choosing a Function Approximation Algorithm, The final Design. Perspective and Issues in Machine Learning: Issues in Machine Learning.

UNIT V

Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning. The Basic Decision Tree Learning Algorithm: Which attribute is the Best classifier, an illustrative example, Hypothesis Space Search in Decision Tree Learning Inductive Bias in Decision Tree.

UNIT VI

Artificial Neural Networks: Introduction Neural Network Representations, Appropriate Problems for Neural Network Learning, Perceptrons, Multi-Layer Networks and BACK PROPAGATION Algorithm, Remarks on the BACK PROPAGATION Algorithm, An IIustrative Example: Advanced Topics in Artificial Neural Networks

TEXT BOOKS

1. Elaine Rich & Kevin Knight, 'Artificial Intelligence', 3rd Edition, Tata McGraw Hill Edition, Reprint (2008) (Unit 1,2,3).
2. Tom M. Mitchell "Machine Learning", McGraw Hill,1997 (Unit 4,5,6).

REFERENCE BOOKS

1. Russel and Norvig, 'Artificial Intelligence', Pearson Education, PHI, (2003).
2. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, (2010).

WEB REFERENCES

1. https://www.coursera.org/learn/machine-learning
2. https://www.simplilearn.com/big-data-and-analytics/machine-learning
3. https://www.appliedaicourse.com/course/applied-ai-course-online
4. http://nptel.ac.in/courses/106105152

I M.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**SERVICE ORIENTED ARCHITECTURE**						

COURSE OBJECTIVES:

- Understand the concepts of Service Oriented Architecture along with the evolution of SOA
- Be aware of the key issues facing many organizations, especially dealing with integration among systems and providing architectural abstractions to them
- Integrate SOA technologies with Web Services paradigms.
- Know related technologies and implementation basics of SOA.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO 1: Outline primary concepts of SOA
CO 2: Interpret the integration of SOA technological points with Web Services.
CO 3: Make use of SOA in development cycle of Web Services.
CO 4: Compare and contrast SOA architecture with other architectures.
CO 5: Analyze web service framework with respect to SOA.
CO 6: Identify advanced concepts of service composition, Orchestration and Choreography

SYLLABUS:

UNIT - I

Introducing SOA: Fundamental SOA, Characteristics of contemporary SOA, Misperception about SOA, Tangible benefits of SOA.

UNIT - II

The Evolution of SOA: An SOA timeline, Continuing evolution of SOA, Roots of SOA.

UNIT - III

Web Services and Primitive SOA: Web Services framework, Services (Web services: Definition, Architecture and standards), Service descriptions with WSDL, Messaging with SOAP, UDDI.

UNIT - IV

Web Services and Contemporary SOA (I: Activity Management and Composition): Message exchange patterns, Coordination, Atomic transactions, Business activities, Orchestration, Choreography.

UNIT - V

Web Services and Contemporary SOA (II: Advanced Messaging, Metadata, and Security): Addressing, Reliable messaging, Correlation, Polices

UNIT - VI

Web Services and Contemporary SOA (II: Advanced Messaging, Metadata, and Security): Metadata exchange, Security, Notification and eventing

TEXT BOOK:

1. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson education.

REFERENCES BOOKS:

1. Mark D Hansen, “SOA using Java Web Services”, Prentice Hall Publication.
2. Michael Rosen & et el., “Applied SOA”, Wiley Publication.
3. Roshen, “ SOA based Enterprise Integration”, TMH Publication.
4. Muninder Singh & Michael Huhns, “Service Oriented Computing”. Wiley Publication.
5. B. V. Kumar, Prakash Narayan & Tony Ng, “Implementing SOA Using Java EE”

ONLINE REFERENCES:

1. https://www.coursera.org/learn/service-oriented-architecture
2. https://www.youtube.com/watch?v=A3_QlYJRVvk
3. https://www.youtube.com/watch?v=PZfYM48Gnj8&list=PL_uaeekrhGzK2FapcTxvuuXOwCPSZvFn3

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**MOBILE COMPUTING**						

COURSE OBJECTIVES:

- To make the student understand the concept of mobile computing paradigm, its applications and limitations.
- To understand the typical mobile networking infrastructure through GSM
- To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer
- To understand the ad hoc networks and related concepts.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO1: Interpret the applications and architecture of Mobile Computing and multiplexing techniques [K2].
CO2: Analyze the Mobile IP issues [K4].
CO3: Analyze the various Mobile TCP Variants [K4].
CO4: Analyze the various routing protocols in MANET [K4].

UNIT–I

Mobile Computing: Architecture of Mobile Computing, Mobile Computing Applications, Limitations of Mobile Computing
GSM: Services, System Architecture, Radio Interfaces, Protocols, Localization& Calling, Handover, Security, New Data Services, GPRS.

UNIT–II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

UNIT–III

Mobile Network Layer: Mobile IP- Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, Dynamic Host Configuration Protocol (DHCP).

UNIT-IV

Mobile Transport Layer : Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT-V

Mobile Ad hoc Networks (MANETs): Introduction, Characteristics, Applications & Challenges of a MANET, Routing - Proactive, Reactive and Hybrid Routing Algorithms (DSR, AODV, DSDV, OLSR & ZRP).

UNIT-VI

Operating Systems for Mobile Computing: Issues related to Mobile Computing Systems, Features of Mobile Operating Systems - Apple iOS, Blackberry OS, Android, Windows Phone, Symbian OS

TEXT BOOKS:

2. Jochen Schiller, "Mobile Communications", Addison-Wesley, 2nd edition, 2004.
3. Rajkamal, "Mobile computing" Second Edition ,Oxford University Press

REFERENCE BOOKS:

1. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028.
2. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden ,Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005.
3. Hansmann, Merk, Nicklous, Stober, "Principles of Mobile Computing", Springer, second edition, 2003.
4. MartynMallick, "Mobile and Wireless Design Essentials", Wiley DreamTech, 2003

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**BIG DATA ANALYTICS**						

COURSE OBJECTIVE:

- Optimize business decisions and create competitive advantage with Big Data analytics.
- Derive business benefit from unstructured data.
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
- To introduce programming tools PIG & HIVE in Hadoop echo system.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO1: Interpret the architectural elements of big data and Hadoop framework [K2].
CO2: Analyze various big data applications using map reduce programming module [K4].
CO3: Analyze Spark capabilities such as distributed datasets, in-memory caching, and the interactive shell [K4].
CO4: Summarize Spark's powerful built-in libraries, including Spark SQL, Spark Streaming [K2].
CO5: Analyze Hadoop data with PIG and Hive [K4].

SYLLABUS:

UNIT-I

Starting Hadoop: -Google File System, -The building blocks of Hadoop: Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker. -Setting up SSH for a Hadoop cluster: Define a common account, Verify SSH installation, Generate SSH key pair, Distribute public key and validate logins. - Running Hadoop: Local (standalone) mode, Pseudo-distributed mode, Fully distributed mode.

UNIT-II

MapReduce: -A Weather Dataset: Data Format, -Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce: A test run, The old and the new Java MapReduce APIs. Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner.

UNIT-III

Programming with RDDs: What Is Apache Spark, RDD Basics, Creating RDDs, RDD Operations, Passing Functions to Spark, Common Transformations and Actions, Persistence (Caching). (through Scala)

Loading and Saving Your Data: File Formats, File systems, Structured Data with Spark SQL, Databases (through Scala)

UNIT-IV

Spark SQL: Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-Defined Functions Working with Key/Value Pairs: Creating Pair RDDs, Transformations on Pair RDDs, Actions Available on Pair RDDs (through Scala)

UNIT-V

Pig: Hadoop Programming Made Easier: -Admiring the Pig Architecture, -Going with the Pig Latin Application Flow, -Working through the ABCs of Pig Latin: Uncovering Pig Latin structures, Looking at Pig data types and syntax. -Evaluating Local and Distributed Modes of Running Pig Scripts, -Checking out the Pig Script Interfaces, -Scripting with Pig Latin

UNIT-VI

Applying Structure to Hadoop Data with Hive: -Saying Hello to Hive, -Seeing How the Hive is Put Together, -Getting Started with Apache Hive, -Examining the Hive Clients: The Hive CLI client, The web browser as Hive client, SQuirreL as Hive client with the JDBC Driver. -Working with Hive Data Types, -Creating and Managing Databases and Tables: Managing Hive databases, Creating and managing tables with Hive. -Seeing How the Hive Data Manipulation Language Works: LOAD DATA examples, INSERT examples, Create Table As Select (CTAS) examples. - Querying and Analyzing Data: Joining tables with Hive, Improving your Hive queries with indexes, Windowing in HiveQL, Other key HiveQL features.

TEXT BOOKS:

1. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
2. Learning Spark by Matei Zaharia, Holden Karau, Andi Konwinski, Patric Wendell, O'Reilly Media, 2015.
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

REFERENCE BOOKS:

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, SrinathPerera, ThilinaGunarathne.

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**INTERNET OF THINGS**						

COURSE OBJECTIVES:

- To present interconnection and integration of the physical world and the cyber space.
- To demonstrate applications of Internet of Things
- To educate building blocks and characteristics of Internet of Things
- To introduce communication protocols used in Internet of Things
- To impart knowledge on design & develop IoT devices

COURSE OUTCOMES:

After completion of this course, the students will be able to:
CO1: Examine the application areas of IoT
CO2: Illustrate revolution of Internet in Mobile Devices, Cloud & Sensor Networks
CO3: Examine communication protocols used in IoT
CO4: Make use of python programming to implement Internet of Things
CO5: Design IoT applications using Raspberry Pi

SYLLABUS:

UNIT- I:

Introduction & Concepts: Introduction to Internet of Things, Physical design of IoT, Logical design of IoT, IoT enabling Technologies, IoT levels.

UNIT- II:

Domain Specific IOT's: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

UNIT- III:

IOT & M2M: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization.

UNIT- IV:

M2M & System Management with NETCONF-YANG: Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG.

UNIT- V:

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, and Programming with Python.

UNIT- VI: Python Web Application Framework

Python web application framework – Django, Designing a Restful web API.

TEXT BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things A Hands-On- Approach, 2014.

REFERENCE BOOKS:

1. Matt Richardson & Shane Wallace, Getting Started with Rasperry Pi, O'Reilly (SPD), 2014.
2. Adrian McEwen, Designing the Internet of Things, Wiley Publishers, 2013.
3. Daniel Kellmereit, The Silent Intelligence: The Internet of Things, 2013.

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**HIGH PERFORMANCE COMPUTING**						

COURSE OBJECTIVES:

- To learn about approaches used in high performance computing.
- To learn about techniques and methods to scale up scientific applications.
- To design advanced modern computing systems.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1: Interpret the terminology of high performance computing.
CO 2: Make use of MPI based parallel programs in distributed Memory architectures.
CO 3: Analyze parallel programs using Pthreads and OpenMP.
CO 4: Summarize the concept of GP-GPU.

SYLLABUS:

UNIT - I

Introduction to Parallel hardware and software, need for high performance systems and Parallel Programming, SISD, SIMD, MISD, MIMD models, Performance issues.

UNIT - II

PThreads, Thread Creation, Passing arguments to Thread function, Simple matrix multiplication using Pthreads.

UNIT - III

Pthreads: Critical sections, mutexes, semaphores, barriers and conditional variables, locks, thread safety, simple programming assignments.

UNIT - IV

Open MP Programming: introduction, reduction clause, parallel for-loop scheduling, atomic directive, critical sections and locks, private directive, Programming assignments, n body solvers using openMP.

UNIT - V

Introduction to MPI programming: MPI primitives such as MPI_Send, MPI-Recv, MPI_Init, MPI-Finalize, etc., Application of MPI to Trepizoidal rule, Parallel Quick sorting algorithm

UNIT - VI

Introduction to GPU computing, Graphics pipelines, GPGPU, Data Parallelism and CUDA C Programming, CUDA Threads Organization, Simple Matrix multiplication using CUDA, CUDA memories.

TEXT BOOKS:

1. An Introduction to Parallel Programming, Peter S Pacheco, Elsevier, 2011
2. Programming Massively Parallel Processors, Kirk & Hwu, Elsevier, 2012

REFERENCE BOOKS:

1. CUDA by example: An introduction to General Purpose GPU Programming, Jason,Sanders, Edward Kandrit, Perason, 2011
2. CUDA Programming, Shame Cook, Elsevier
3. High Performance Heterogeneous Computing, Jack Dongarra, Alexey & Lastovetsky , Wiley
4. Parallel computing theory and practice, Michel J.Quinn, TMH

ONLINE REFERENCES:

1. https://in.udacity.com/course/high-performance-computing--ud281
2. https://www.edx.org/course/high-performance-computing-reproducible-harvardx-ph525-6x-1

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**CLOUD COMPUTING**						

COURSE OBJECTIVES:

- To gain knowledge about virtualization and Virtual Machines
- To familiarize Cloud Computing and its services

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO1: Interpret various types of Virtualization [K2].
CO2: Outline the Cloud Application Architectures and Infrastructure Models [K2].
CO3: Analyze the Data center to cloud [K2].
CO4: Analyze various services of Cloud Computing [K2].
CO5: Analyze the Security and Disaster Management in Cloud [K2].

SYLLABUS:

UNIT–I

Introduction to virtualization and virtual machine: types of virtualization: Server virtualization, Application/ desktop virtualization, client virtualization, storage virtualization, Network virtualization service / application infrastructure virtualization, virtual machines & virtualization middleware, Software as a Service (SaaS), SOA , On-Demand Computing.

UNIT–II

Cloud computing: Introduction, What it is and What it isn't, from Collaborations to Cloud, Cloud application architectures, Value of cloud computing, Cloud Infrastructure models, Scaling a Cloud Infrastructure, Capacity Planning, Cloud Scale.

UNIT–III

Data Center to Cloud: Move into the Cloud, Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications

UNIT-IV

Security: Disaster Recovery, Web Application Design, Machine Image Design, Privacy Design, Database Management, Data Security, Network Security, Host Security, Compromise Response.

UNIT–V

Defining Clouds for the Enterprise: Storage-as-a-Service, Database-as-a-Service, Information-as-a-Service, Process-as-a-Service, Application-as-a-Service, Platform-as-a-Service, Integration-as-a-Service, Security-as-a-Service, Management/Governance-as-a-Service, Testing-as-a-Service Infrastructure-as-a-Service

UNIT–VI

Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management, Types of Clouds, Cloud centres in detail.

TEXT BOOKS:

1. Cloud Computing – Web Based Applications That Change the way you Work and Collaborate Online – Michael Miller, Pearson Education.
2. Cloud Application Architectures, 1st Edition by George Reese O'Reilly Media.

REFERENCE BOOKS:

1. Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide David S. Linthicum Addison-Wesley Professional.
2. Distributed & Cloud Computing From Parallel Processing to the Internet of Things by Kai Hwang. Geoffrey C. Fox. Jack J. Dongarra

ONLINE REFERENCES:

1. http://nptel.ac.in/courses/106106129/21
2. https://freevideolectures.com/course/3649/cloud-computing
3. https://www.youtube.com/watch?v=Eg4AAGCE7X4&list=PL2UlrhJ_JwyA5IlOCdEWlNArFke4jgtlg

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**DEEP LEARNING**						

COURSE OBJECTIVE:

- This course covers the basics of machine learning, neural networks and deep learning. Model for deep learning technique and the various optimization and generalization mechanisms are included. Major topics in deep learning and dimensionality reduction techniques are covered. The objective of this course is:
- To present the mathematical, statistical and computational challenges of building neural networks.
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO 1: Compare and Contrast concepts of deep learning[K2].
CO 2: Make use of various deep learning models[K3].
CO 3: Interpret Statistical reasoning and filler structures[K2].
CO 4: Analyze optimization and generalization in deep learning[K4].
CO 5: Analyze the deep learning applications[K4].

SYLLABUS:

UNIT-I

INTRODUCTION :Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT-II

DEEP NETWORKS History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT-III

DIMENTIONALITY REDUCTION Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT-IV

OPTIMIZATION AND GENERALIZATION Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks-

UNIT-V
RECURRENT NEURAL NETWORK

Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT VI

CASE STUDY AND APPLICATIONS Imagenet- Detection-Audio WaveNet- Natural Language Processing Word2Vec - Joint DetectionBioInformatics- Face Recognition- Scene Understanding-Gathering Image Captions

TEXT BOOKS:

1. Cosma Rohilla Shalizi, " Advanced Data Analysis from an Elementary Point of View", 2015.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**DATA MINING AND DATA WAREHOUSING**						

COURSE OBJECTIVES:

Identify the scope and necessity of Data Mining & Warehousing for the society.
Describe the design of Data Warehousing so that it can be able to solve the root problems.
Categorize and carefully differentiate between situations for applying different data mining techniques: mining frequent pattern, association, correlation, classification, prediction, and Cluster analysis.
Evaluate the performance of different data mining algorithms.

COURSE OUTCOMES:

After completion of this course, the students will be able to:
CO 1: Interpret the data mining terminology and types of data to be mined [K2].
CO 2: Outline the need and importance of preprocessing techniques [K2].
CO 3: Interpret data warehousing concepts and operations [K2].
CO 4: Compare and contrast different dominant Data Mining Algorithms [K2].

SYLLABUS

UNIT-I

Introduction to data mining: -What Is Data Mining, -Motivating Challenges, -The Origins of Data Mining, -Data Mining Tasks, -Types of Data: Attributes and Measurement, Types of Data Sets, -Data Quality: Measurement and Data Collection Issues, Issues Related to Applications.

UNIT-II

Data:- Data Preprocessing: Aggregation, Sampling, Dimensionality Reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization, Variable Transformation, -Measures of similarity and dissimilarity: Basics, Similarity and Dissimilarity between Simple Attributes, Dissimilarities between Data Objects, Similarities between Data Objects, Examples of Proximity Measures.
Exploring data: -The Iris Data set, -Summary Statistics: Frequencies and the Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, Multivariate Summary Statistics, Other Ways to Summarize the Data.

UNIT-III

Data Warehouse and OLAP Technology for Data Mining: -What is a Data Warehouse, -
A Multidimensional Data Model: From tables to data cubes, Stars, snowflake, and fact constellations(schemas for multidimensional databases), Examples for defining star, snowflake, and fact constellation schemas, Measures(their categorization and computation), Introducing concept hierarchies, OLAP operations in the multidimensional data model, A starnet query model for querying multidimensional databases, -**Data Warehouse Architecture**: Steps for the design and construction of data warehouses, A three-tier data warehouse architecture, OLAP server architectures: ROLAP vs. MOLAP vs. HOLAP, SQL extensions to support OLAP operations, -**Data Warehouse implementation**: Efficient computation of data cubes, Indexing OLAP data, Efficient processing of OLAP queries, Metadata repository, Data warehouse back-end tools and utilities, -Further development

of data cube technology: Discovery-driven exploration of data cubes, Complex aggregation at multiple granularities (Multifeature cubes), -**From data warehousing to data mining**: Data warehouse usage, From on-line analytical processing to on-line analytical mining.

UNIT-IV

Classification: Basic Concepts, Decision Trees, and Model Evaluation: -Preliminaries, - General Approach to Solving a Classification Problem, Decision Tree Induction: How a Decision Tree Works, How to Build a Decision Tree, Methods for Expressing Attribute Test Conditions, Measures for Selecting the Best Split, Algorithm for Decision Tree Induction, -**Model Overfitting**: Overfitting Due to Presence of Noise, Overfitting Due to Lack of Representative Samples, -Evaluating the Performance of a Classifier: Holdout Method, Random Subsampling, Cross-Validation, Bootstrap.

UNIT-V

Association Analysis: Basic Concepts and Algorithms: -Problem Definition, -Frequent Itemset Generation: The Apriori principle, Frequent Itemset Generation in the Apriori Algorithm, Candidate Generation and Pruning, Support Counting, -Rule Generation: Confidence-Based Pruning, -Compact Representation of Frequent Itemsets: Maximal Frequent Itemsets, Closed Frequent Itemsets, -FP-Growth algorithms: FP-Tree Representation, Frequent Itemset Generation in FP-Growth Algorithm.

UNIT-VI

Cluster Analysis: Basic Concepts and Algorithms: -Overview: What is Cluster Analysis? Different Types of Clustering, Different Types of Clusters, -K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, K-means and Different Types of Clusters, Strengths and Weaknesses, -Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm, Specific Techniques, -DBSCAN: Traditional Density (center based approach), The DBSCAN algorithm, Strengths and Weaknesses.

TEXT BOOKS:

1. Michael Steinbach, Vipin kumar “Introduction to Data Mining”: Pang-Ning tan, , Addision- Wesley.
2. Data Mining, Concepts and Techniques, 2/e, Jiawei Han, Micheline Kamber, Elsevier, 2006.

REFERENCE BOOKS:

1. Margaret H Dunham “Data Mining: Introductory and Advanced Topics”, Pearson, 2008.
2. Introduction to Data Mining with Case Studies: GK Gupta; Prentice Hall.
3. Fundamentals of data warehouses, 2/e , Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer.
4. Data Mining Theory and Practice, Soman, Diwakar, Ajay, PHI, 2006.

I M.TECH II SEMESTER PROFESSIONAL ELECTIVE – II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
SUBJECT CODE:	**FUNCTIONAL PROGRAMMING**						

COURSE OBJECTIVE:

- Able to understand various features and their implementation of functional programming.

COURSE OUTCOMES:

After completion of this course, the students would be able to:
CO1. Compare and contrast features of functional programming and procedural programming[K2]
CO2.analyze various properties of functional programming [K4]
CO3. Solve problems related to type and inferencing[K2]
CO4. Interpret programs in Haskel[K2]

SYLLABUS

UNIT-I

Introduction to functional programming features: Expressions and function definitions. Recursive formulation of programming problems.Types-monomorphic, universally polymorphic and conditional polymorphic (type variables ranging over type classes). Naive type inferencing.Lazy evaluation, its significance and consequences.Referential transparency and its significance.Abstractions supported by functional languages - Higher order functions, data abstraction through algebraic data types. Pattern matching.The Haskell program development environment.
Programming with Lists, Trees and Graphs: Generic functions over these data structures and their properties. List comprehensions. Examples of applications coded using these data structures.

UNIT-II

Reasoning about functional programs: Proving properties of functional programs through structural induction and rewrites.

UNIT-III

Lambda Calculus: Historical background. Relevance to functional programming. Syntax and reductions. Church Rosser theorem. Expressibility-Church numerals, booleans, algebraic datatypes. Computational completeness.

UNIT-IV

Type inferencing: The typed lambda calculus. Type rules, type checking and type inferencing. Type rules of the Hindley-Milner type system. Introducing polymorphism through the let construct. The Hindley-Milner type inferencing algorithm.

UNIT-V

Type classes and their implementation: Translation of conditional polymorphic functions to universally polymorphic functions through type dictionaries. The Haskell organization of numeric types into classes. Ambiguous types and their resolution.
Monads and IO:IO and referential transparency. Values and computations. Modelling side-effects through monads. Examples of monads. IO as a form of state monad. IO in Haskell

UNIT-VI

Implementation of lazy languages through graph reduction: Different translation (interpretation and compilation) models used for implementing functional programming languages. Translation of a subset of Haskell into(enriched) lambda terms. Graph representation of lambda terms. Emulating different evaluation orders through graph reduction. Incorporating laziness through sharing.

REFERENCE BOOKS

1. R.Bird. Introduction to Functional Programming using Haskell. Prentice Hall Europe, 1998.
2. Bryan O'Sullivan, Don Stewart, and John Goerzen. Real World Haskell. O'Reilly Media, November 2008.
3. S.Peyton Jones. The Implementation of Functional Programming languages, Prentice Hall, New York, 1987.
4. Henk Barendregt. Lambda Calculus with Types, From Handbook of Logic in Computer Science, Eds. S. Abramsky, D. Gabbay, T.S.L. Maibaum, Oxford University Press.
5. H.P. Barendregt. The lambda calculus, its syntax and semantics, Elsevier Science Publishers B.V. Amsterdam, 1984.

I M.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	6	40	60	100	3
SUBJECT CODE:	**DATA SCIENCE LAB**						

COURSE OUTCOMES:

After the completion of this course the student should be able to

CO1: Develop programs using python

CO2: Develop programs using NumPy

CO3: Develop programs using Pandas

LIST OF EXPERIMENTS

1. The student has to experiment the given below programs:
   a) To convert list of tuples into list of strings in python
   b) To remove duplicate lists in tuples using comprehensions.
   c) Write a python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary.
2. Experiments in NumPy
   a) create a 2X3 array using NumPy
   b) createa 2X3 array in an array of 8 with random numbers
   c) Create a list and convert into array using NumPy command
   d) Find out shape and type of an array
3. a) Operations between Arrays and Scalars
   b) Crete a 3d array, copy array to another array(old_array) using copy command, restore old_array
   c) Boolean Indexing:
      create an array with names 'Bob', 'Joe', 'Will', 'Bob', 'Will', 'Joe', 'Joe'
      create a Boolean array by comparing names with ‘Bob’
      create a random array of size (7,3), assume that each row belongs one person and display the rows corresponding to ‘Bob’
      (Hint: use Boolean indexing)
   d) Fancy Indexing
      Create an array like: array
      ([[0., 0., 0., 0.],
      [1., 1., 1., 1.],
      [2., 2., 2., 2.],
      [3., 3., 3., 3.],

[4., 4., 4., 4.],
[5., 5., 5., 5.],
[6., 6., 6., 6.],
[7., 7., 7., 7.]])

Display rows as given below using fancy +veindexing array

([[4., 4., 4., 4.],
[3., 3., 3., 3.],
[0., 0., 0., 0.],
[6., 6., 6., 6.]])

Display rows as given below using fancy -ve indexing array

([[5., 5., 5., 5.],
[3., 3., 3., 3.],
[1., 1., 1., 1.]])

e) do an experiment Expressing Conditional Logic as Array Operations?

f) Generate 5X4 Matrix and do some Mathematical and Statistical operations on that data.

g) Do an experiment on sort, unique and setlogic

h) LINEAR ALGEBRA MATRIX MULTIPLICATION Transpose inverse Experiments using pandas

4. Series using pandas
   a) Load the car data into frame without headers using pandas
   b) display top 5 rows
   c) display last 10 rows
   d) save the file into various formats (csv,excel, pdf,JSON, sql)
   e) display data types of each column
5. Perform different operations in dataframe using pandas
   a)dropping b)concatenating values
6. Filtering data from csv file using pandas By using single condition filtering
7. Draw a barplot graph in pandas using group by filter condition and also plot graph with series and dataframe.

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