Study & Evaluation Scheme

of

Master of Technology
Computer Science & Engineering

[Applicable w.e.f. Academic Session - 2020-21 till revised]

[As per CBCS guidelines given by UGC]

TEERTHANKER MAHAVEER UNIVERSITY
N.H.-24, Delhi Road, Moradabad, Uttar Pradesh-244001
Website: www.tmu.ac.in

TEERTHANKER MAHAVEER UNIVERSITY
(Established under Govt. of U.P. Act No. 30, 2008)
Delhi Road, Bagarpur, Moradabad (U.P.)

Study & Evaluation Scheme	
SUMMARY	
Institute Name	*College of Computing Sciences and Information Technology (CCSIT)*
Programme	*M.Tech (Computer Science and Engineering)*
Duration	*Two Years Regular(Four Semesters)*
Medium	*English*
Minimum Required Attendance	*75%*
Credits	
Maximum Credits	*78*
Minimum Credits Required for Degree	*74*

Assessment:					
Evaluation			**Internal**	**External**	**Total**
Theory			40	60	100
Practical/ Dissertations/ Project Reports/ Viva-Voce			50	50	100
Class Test-1	**Class Test-2**	**Class Test-3**	**Assignment(s)**	**Attendance& Participation**	**Total**
Best two out of three					
10	10	10	10	10	40
Duration of Examination			**External**	**Internal**	
			3 Hours	1.5 Hours	

To qualify the course a student is required to secure a minimum of 45% marks in aggregate including the semester end examination and teachers continuous evaluation.(i.e. both internal and external).A candidate who secures less than 45% of marks in a course shall be deemed to have failed in that course. The student should have at least 45% marks in aggregate to clear the semester.

 # Provision for delivery of 25% content through online mode.

 # Policy regarding promoting the students from semester to semester & year to year. No specific condition to earn the credit for promoting the students from one semester to next semester.

 # Maximum Duration: Maximum no of years required to complete the program: N+2

Question Paper Structure	
1	*The question paper shall consist of six questions. Out of which first question shall be of short answer type (not exceeding 50 words) and will be compulsory. Question no. 2 to 6 (from Unit-I to*

	V) shall have explanatory answers (approximately 350 to 400 words) along with having an internal choice within each unit.
2	*Question No. 1 shall contain 8 parts from all units of the syllabus with at least one question from each unit and students shall have to answer any five, each part will carry 2 marks.*
3	*The remaining five questions shall have internal choice within each unit; each question will carry 10 marks.*
IMPORTANT NOTES:	
1	*The purpose of examination should be to assess the Course Outcomes (CO) that will ultimately lead to of attainment of Programme Specific Outcomes (PSOs). A question paper must assess the following aspects of learning: Remember, Understand, Apply, Analyze, Evaluate & Create (reference to Bloom's Taxonomy).*
2	*Case Study is essential in every question paper (wherever it is being taught as a part of pedagogy) for evaluating higher-order learning. Not all the courses might have case teaching method used as pedagogy.*
3	*There shall be continuous evaluation of the student and there will be a provision of fortnight progress report.*

Program Structure-M.Tech

A. Introduction:

High-quality M.Tech education is essential for the digital age. The main aim of this program is to produce quality professionals and research fellows who can work in every sector of the world by implementing the technology of computer systems and software. The programme introduces the various domains of computer science consists of Artificial Intelligence, Advanced database management system, advanced data Structure and algorithms, cloud computing, semantic web, Big Data Analytics. Employability, innovation, theory to practice connectedness is the central focus of M.Tech curriculum.

The institute emphasis on the following courses ***balanced with core and elective courses****:* The curriculum of M.Tech program emphasizes an intensive, flexible engineering education with 36 credits of Professional core courses, 12 credits of professional electives, 12 credits of Laboratory courses, 2 credits of seminar and 16 credits of dissertation. Total 78 credits are allotted for the M.Tech degree.

The programme structure and credits for M.Tech are finalized based on the stakeholders' requirements and general structure of the programme. Minimum number of classroom contact teaching credits for the M.Tech program will be 60 credits; 02 credits for Seminar and 16 credits for Dissertation. However,the minimum number of the credits for award of M.Tech degree will be 74 credits. Out of 60 credits of classroom contact teaching, 36 credits are to be allotted for professional core courses(PCC), 12 credits are allotted to professional elective courses (PEC) and12 credits are allotted to Lab Courses (LC)

Course handouts for students will be provided in every course. Course handout is a thorough teaching plan of a faculty taking up a course. It is a blueprint which will guide the students about the pedagogical tools being used at different stages of the syllabus coverage and more specifically the topic-wise complete plan of discourse, that is, how the faculty members treat each and every topic from the syllabus and what they want the student to do, as an extra effort, for creating an effective learning. It may be a case study, a role-play, a classroom exercise, an assignment- home or field, or anything else which is relevant and which can enhance their learning about that particular concept or topic. Due to limited availability of time, most relevant topics will have this kind of method in course handout.

M.Tech CSE : Two-Years (4-Semester) CBCS Programme			
Basic Structure: Distribution of Courses			
S.No.	**Type of Course**	**Credits**	**Total Credits**
1	**Professional Core Course (PCC)**	**9 Courses of 4 Credit Hrs. each (Total Credit Hrs. 9X4)**	**36**
2	**Professional Elective Course (PEC)**	**3 Courses of 4 Credit Hrs. each (Total Credit Hrs. 3X4)**	**12**
3	**Laboratory Course(LC)**	**6 Courses of 2 Credit Hrs. each (Total Credit Hrs. 6X2)**	**12**
4	**Seminar**	**1 Course of 2 Credit Hrs. each (Total Credit Hrs. 1X2)**	**2**
5	**Dissertation**	**1 Course of 4 Credit Hrs. each (Total Credit Hrs. 1X4)** **1 Course of 12 Credit Hrs. each (Total Credit Hrs. 1X12)**	**16**
Total Credits			**78**

Contact hours include work related to Lecture, Tutorial and Practical (LTP), where our institution will have flexibility to decide course wise requirements.

B. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve his target number of credits as specified by the UGC and adopted by our University.

The following is the course module designed for the M.Tech program:

Professional Core Course (PCC): Professional Core courses of M.Tech program will provide a holistic approach to master education, giving students an overview of the field, a basis to build and specialize upon. These core courses are the strong foundation to establish engineering knowledge and provide broad multi-disciplined knowledge can be studied further in depth during the elective phase.

The core courses will provide more practical-based knowledge, case-based lessons and collaborative learning models. It will train the students to analyze, decide, and lead-rather than merely know-while creating a common student experience that can foster deep understanding, develop decision-making ability and contribute to the business and community at large.

A wide range of core courses provides groundwork in the basic engineering disciplines: The integrated foundation is important for students because it will not only allow them to build upon existing skills, but they can also explore career options in a range of industries, and expand their understanding of various research fields.

Professional Elective Course (PEC): Professional Elective is an interdisciplinary additional subject that is compulsory in the first, second and third semester of a program. The score of Professional Elective is counted in your overall aggregate marks under Choice Based Credit System (CBCS). Each Professional Elective paper will be of 4 Credits and students will have the choice of taking PEC's. We offer three PEC's of 4 credits in semester I, II and III. Each student has to take Professional Electives from department other than the parent department.

Laboratory Courses (LC): A laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills by development of small application/project. We offer Laboratory courses in semester I, II and III during the M.Tech program. There will be total 14 credits.

C. Programme Specific Outcomes (PSOs)

The learning and abilities or skills that a student would have developed by the end of two-years.

M.Tech(Computer Science and Engineering):

PSO – 1	Understanding and Analyzing the real time problems and to develop solutions by applying appropriate mathematical logic and algorithms.
PSO – 2	Applying knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.
PSO – 3	Applying skills acquired for retrieving, analyzing and managing large data leading to effective decision making and application development using suitable engineering tools.

D. Pedagogy & Unique practices adopted: "Pedagogy is the method and practice of teaching, especially for teaching an academic subject or theoretical concept". In addition to conventional time-tested lecture method, the institute will emphasize on **experiential learning.:**

***1. Case Based Learning*:**Case based learning enhances student skills at delineating the critical decision dilemmas faced by organizations, helps in applying concepts, principles and analytical skills to solve the delineated problems and develops effective templates for business problem solving. Case method of teaching is used as a critical learning tool for effective learning and we encourage it to the fullest.

2. Role Play&Simulation:Role-play and simulation are forms of experiential learning. Learners take on different roles, assuming a profile of a character or personality, and interact and participate in diverse and complex learning settings. Role-play and simulation function as learning tools for teams and groups or individuals as they "play" online or face-to-face. They alter the power ratios in teaching and learning relationships between students and educators, as students learn through their explorations and the viewpoints of the character or personality they are articulating in the environment. This student-centered space can enable learner-oriented assessment, where the design of the task is created for active student learning. Therefore, role-play& simulation exercises such as virtual share trading, marketing simulation etc. are being promoted for the practical-based experiential learning of our students.

3. Video Based Learning (VBL)&Learning through Movies (LTM):These days technology has taken a front seat and classrooms are well equipped with equipment and gadgets. Video-based learning has become an indispensable part of learning. Similarly, students can learn various concepts through movies. In fact, many teachers give examples from movies during their discourses. Making students learn few important theoretical concepts through VBL & LTM is a good idea and method. The learning becomes really interesting and easy as videos add life to concepts and make the learning engaging and effective. Therefore, our institute is promoting VBL & LTM,wherever possible.

***4. Field/Live Projects*:**The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other their regular classes.

5. Industrial Visits: Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

6. MOOCS: Students may earn credits by passing MOOCs as decided by the college from time to time. (A) Degree level programmes may be awarded Honors degree provided they earn pre-requisite credits specified by UGC/ Concerned Council. (B) Few theoretical courses (Max 20%) may be identified by the respective Colleges for On-Line Learning (either Coursera or NPTL). The students may obtain the certificate of passing such courses from the concerned platform or the colleges may arrange to conduct exams for such identified courses and (C) A student may earn few extra credits (shall be considered as audit Courses) by independent Learning through any of the MOOCs Platform,

7. Special Guest Lectures (SGL)): Some topics/concepts need extra attention and efforts as they either may be high in difficulty level or requires experts from specific industry/domain to make things/concepts clear for a better understanding from the perspective of the industry. Hence, to cater to the present needs of industry,we organize such lectures, as part of lecture-series and invite prominent personalities from academia and industry from time to time to deliver their vital inputs and provide greaterinsights.

8. Student Development Programs (SDP): Harnessing and developing the right talent for the right industry an overall development of a student is required. Apart from the curriculum teaching various student development programs (training programs) relating to soft skills, interview skills, SAP, Advanced excel training etc. that may be required as per the need of the student and industry trends, are conducted across the whole program. Participation in such programs is solicited through volunteering and consensus.

9. Industry Focused programes:Establishing collaborations with various industry partners to deliver the programme on sharing basis. The specific courses/contents are to be delivered by industry experts to provide practice based insight to the students.

10. Special Assistance Programme for Slow &Fast Learners: After the first class test (CT-1), we identify the slow learners and the fast learners on the basis of their performance in the class and test. We counsel the slow learners to assess the knowledge gap and provide them special assistance in terms of tutorial programmes in learning the subjects or topics. We motivate the fast learners to go through the various journals and references available in library and online. We encourage the slow learners and the fast learners both to read the research papers and after reading them, they write the research papers with the help of their supervisors to be presented in conferences. We organise at least one international conference in each semester.

11. Orientation Program: We organize Orientation Programme of 15 days for the students to make them well aware of the rules and regulations of college and university including anti ragging policies. We cover the elementary topics of Mathematics, English, Soft Skills, Science and Reasoning during orientation programme.

12. **Mentoring Scheme**: Every Student shall be provided with a faculty Mentor to help him /her in their personal & Academic Issues. The mentor maintains a register of al all his/her mentees with complete personal & parents 'details. It is essential to have at least to meet once in a month. The mentor enters the discussions held, advice given and efforts & improvements made by the mentee. This register of the mentor must be counter signed by the HOD once a month and by the Principal once in a semester

13. **Career &Personal Counseling:** We have Training and Placement Cell for Career & Personal Counseling of the students.

14. **Competitive Exam Preparation:** Institute provides the foundation for the preparation of competitive exams. For this, special classes are conducted by the faculty members.

15. **Extra-curricular Activities**: We organize various extracurricular activities to help students develop confidence & face audience with care. It brings out their leadership qualities along with planning & organizing skills. Students undertake various cultural, sports and other competitive activities within and outside then campus. This helps them build their wholesome personality.

16**. Participation in Workshops, Seminars & writing & Presenting Papers:** The purpose of Workshops, Seminars, and conference are important for the overall development of the students. Here the students go through the discussion of a research area/ academic subject with the expert(s). College conducts at least one Workshop and at least one Seminar. In addition, College also conducts on national and one international conference every year. Students actively participated in Workshops, Seminars & writing & Presenting Papers.

17. Formation of Student Clubs , Membership &Organising& Participating events:: We find the interest of student and based upon that they are asked to join an existing club or found a new club. We have various clubs and various events take place among these clubs. The clubs organize events and participation depends on the nature of event.

18. Capability Enhancement & Development Schemes: A student may have a wide spectrum of capabilities hidden inside. We explore the capability of student with the help of various events throughout the year and find the students with the caliber in a specific field or skill. We then shape the students by mentoring and providing resources and guide which is required to make him an Ace of their field or skill.

19. Library Visit & Utilization of E-Learning Resources: libraries have supported education efforts by providing teaching resources, information and referral services. A more active approach has been taken by libraries offering educational classes or one-to-one tutoring programs. Libraries have outreach programs designed to meet the needs of specific groups of people with limited educational skills.

M.Tech. (CSE) Curriculum

M.Tech. (CSE)-Semester I

S.N	Category	Course Code	Course	Periods			Credit	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PCC-1	MCS107	Data Warehousing and Mining	3	1	0	4	40	60	100
2	PCC-2	MCS 111	Advanced Database System	3	1	0	4	40	60	100
3	PCC-3	MCS 112	Advanced Data Structure and Algorithms.	3	1	0	4	40	60	100
4	PEC-1		Professional Elective Course I: Elective-1 / Elective-2 / Elective-3	3	1	0	4	40	60	100
5	LC-1	MCS 153	Data Warehousing and Mining Lab	0	0	4	2	50	50	100
6	LC-2	MCS 154	Advanced Database System Lab	0	0	4	2	50	50	100
7	LC-3	MCS 155	Advanced Data Structure and Algorithms Lab	0	0	4	2	50	50	100
Total				12	4	12	22	310	390	700

M.Tech. (CSE)-Semester II

S.N	Category	Course Code	Course		Periods L	Periods T	Periods P	Credit	Evaluation Scheme Internal	Evaluation Scheme External	Evaluation Scheme Total
1	PCC-4	MCS 202	Advanced Computer Network		3	1	0	4	40	60	100
2	PCC-5	MCS 204	Big Data Analytics and Business Intelligence		3	1	0	4	40	60	100
3	PCC-6	MCS 205	Semantic Web and Social Networks		3	1	0	4	40	60	100
4	PEC-2		Professional Elective Course II:	Elective-1	3	1	0	4	40	60	100
				Elective-2							
				Elective-3							
				Elective-4							
				Elective-5							
5	LC-4	MCS 252	Advanced Computer Network Lab		0	0	4	2	50	50	100
6	LC-5	MCS 253	Big Data Lab		0	0	4	2	50	50	100
7	Seminar	MCS 291	Seminar		0	0	0	2	50	50	100
Total					12	4	8	22	310	390	700

M.Tech. (CSE)-Semester III

S.N	Category	Course Code	Course		Periods L	T	P	Credit	Evaluation Scheme Internal	External	Total
1	PCC-7	MCS 303	Network Security and Cryptography		3	1	0	4	40	60	100
2	PCC-8	MCS 304	Artificial Intelligence and Machine Learning		3	1	0	4	40	60	100
3	PCC-9	MCS 339	Cloud Computing		3	1	0	4	40	60	100
4	PEC-3		Professional Elective Course III:	Elective-1	3	1	0	4	40	60	100
				Elective-2							
				Elective-3							
5	LC-6	MCS 353	Artificial Intelligence And Machine Learning Lab		0	0	4	2	50	50	100
6	Dissertation	MCS 392	Dissertation I		0	0	0	4	50	50	100
			Total		12	4	4	22	260	340	600

M.Tech. (CSE)-Semester IV

S. N	Category	Course Code	Course	Periods L	T	P	Credit	Evaluation Scheme Internal	External	Total
1	Dissertation	MCS 491	Dissertation II	0	0	0	12	50	50	100
			Total	0	0	0	12	50	50	100

ELECTIVE COURSES OFFERED

Professional Elective Courses (PEC)

S.No	Code	Course	L	T	P	Credit
Semester I (Any One)						
1	MCS102	Advanced Computer Architecture	3	1	0	4
2	MCS104	Advanced Software Engineering	3	1	0	4
3	MCS106	Advanced Real Time Operating System	3	1	0	4
Semester II (Any One)						
4	MCS 231	Pattern Recognition and Image Processing	3	1	0	4
5	MCS 232	Neural Networks	3	1	0	4
6	MCS 235	Genetic Algorithms	3	1	0	4
7	MCS 238	Natural Language Processing	3	1	0	4
8	MCS 240	Software Testing	3	1	0	4
Semester III (Any One)						
9	MCS 337	Distributed and Parallel Computing	3	1	0	4
10	MCS 344	Computational Technique using Matlab	3	1	0	4
11	MCS 345	Digital Image Processing	3	1	0	4

Course Code: **MCS 107**	**Professional Core Course-1** **M.Tech- Semester I** **DATA WAREHOUSING AND MINING**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding and applying the concepts of various data warehousing and data mining models.	
CO2	Understanding and applying the concepts of classification and clustering algorithms.	
C03	Understanding and applying the concepts of Data Cube Technology.	
CO4	Understanding and applying the concepts of Association Rules in Large Databases	
CO5	Applying the concepts of Mining the World Wide Web.	
CO6	Applying the concepts of Mining Time-Series and Sequence Data.	
Course Content:		
Unit-1:	**Introduction:** Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Warehouse and OLAP Technology for Data Mining Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining **Data Preprocessing:** Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation, Online Data Storage.	**8 Hours**
Unit-2:	**Data Mining Primitives, Languages, and System Architectures:** Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on Data Mining Query Language Architectures of Data Mining Systems. **Concepts Description: Characterization and Comparison:** Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases.	**8 Hours**

Unit-3:	**Mining Association Rules in Large Databases:** Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining. **Classification and Prediction:** Issues Regarding Classification and Prediction, Classification By decision tree induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, other Classification	**8 Hours** Other other
Unit-4:	**Cluster Analysis Introduction :**Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis.	8 **Hours**
Unit-5:	**Mining Complex Types of Data:** Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web	**8 Hours**
Text Book:	1. Data Warehousing Fundamentals –Paulraj Ponnaiah Wiley Student EDITION Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE Harcourt India.	
Reference Books:	1. Data Warehousing in the Real World – Sam Anahory & Dennis Murray Pearson Edn. Asia. 2. The Data Warehouse Life cycle Tool kit – Ralph Kimball Wiley Student EDITION. 3. Data Mining Introductory and advanced topics –Margaret H Dunham, PEARSON EDUCATION ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://lecturenotes.in/notes/22356-note-for-data-mining-and-data-warehousing-dmdw-by-akash-sharma?reading=true&continue=12 2. https://lecturenotes.in/notes/38-notes-for-data-mining-and-data-warehousing-dmdw-by-verified-writer-	

Course Code: MCS 111	**Professional Core Course-2** **M.Tech- Semester I** **ADVANCED DATABASE SYSTEM**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of DBMS architectures.	
CO2	Understanding and applying the concepts of Normalization techniques.	
C03	Understanding and applying the concepts of DB2, MySQL,SQLJ, JDBC and related Java capabilities in Oracle.	
CO4	Understanding and applying the concepts of Distributed Databases.	
CO5	Understanding and applying the concepts of Database Administration tools	
CO6	Understanding and applying the concepts of Transaction Processing & Locking techniques.	
Course Content:		
Unit-1:	**Elementary Database Concepts**: Hierarchical, Relational, Network and OO Database Architectures and their comparison. Data Modeling. Relational model – Concept, Algebra and Constraints. Use of SQL as a relational database language in data definition & query formulation.	**8 Hours**
Unit-2:	**Comparison of DBMS:** MySQL, DB2, MS SQL Server, Oracle 8i/9i/10g - their strengths & weaknesses. Summary of Normalization techniques used with RDBMS – relative comparison and applications. Concept and use of Indexes.	**8 Hours**
Unit-3:	**Database Backup**: Recovery and management using Oracle RMAN.DBMS performance tuning, goals, principles & benchmarks, DBMS Storage management. Oracle Enterprise Manager: Console functions, Database Administration tools – DBA Studio.	**8 Hours**
Unit-4:	**Oracle Enterprise Security Manager:** User authentication & privilege management. Integrity Management – Locking techniques; implementation using Latches. Database Replication Management – Multiple master technique; types of propagation & replication; conflict resolution. Programmatic interfaces to Oracle RDBMS; Case Study of SQLJ, JDBC and related Java capabilities in Oracle.	**8 Hours**
Unit-5:	**Distributed Databases:** Introduction to distributed databases, Distributed DBMS architectures, storing data in a distributed DBMS, distributed catalog management, distributed query processing Updating distributed data, distributed transactions, distributed concurrency control, Distributed recovery.	**8 Hours**
Text Book:	1. Data base System Concepts, Silberschatz, Korth, McGraw hill, IV edition.	
Reference Books:	1. Introduction to Database Systems, C.J.Date Pearson Education 2. Data base Management System, ElmasriNavate Pearson Education 3. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw-Hill 3 Edition ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.oracle.com/technetwork/articles/oem/s316928-1-175928.pdf 2. https://www.oracle.com/technetwork/database/availability/rman-perf-tuning-bp-452204.pdf	

Course Code: MCS 112	Professional Core Course-3 M.Tech- Semester I ADVANCED DATA STRUCTURE AND ALGORITHMS	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of advanced data structures.	
CO2	Understanding and applying the concepts of designing an algorithm.	
CO3	Understanding and applying the concepts of advanced tree and graph algorithms.	
CO4	Understanding and applying the concepts of shortest path algorithms.	
CO5	Understanding and applying the concepts of minimum spanning tree algorithms.	
CO6	Understanding and applying the concepts of Approximation algorithms and Randomized Algorithm.	
Course Content		
Unit-1:	**Introduction to Basic Data Structures**: Importance and need of good data structures and algorithms, Arrays, Linked lists, Stacks, Queues, Priority queues, Heaps; Strategies for choosing the appropriate data structures. Advanced Data Structures: AVL Trees, Red-Black Trees, Splay Trees, B-trees, Fibonacci heaps, Data Structures for Disjoint Sets, Augmented Data Structures. Algorithms Complexity and Analysis: Probabilistic Analysis, Amortized Analysis, Competitive Analysis.	**8 Hours**
Unit-2:	**Graphs & Algorithms:** Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism,Graph Coloring, Covering and Partitioning,, Depth- and breadth-first traversals, Minimum Spanning Tree: Prim's and Kruskal's algorithms, Shortest-path Algorithms: Dijkstra's and Floyd's algorithm, Topological sort, Max flow: Ford-Fulkerson algorithm, max flow – min cut. String Matching Algorithms: Suffix arrays, Suffix trees, tries, Rabin-Karp, KnuthMorris-Pratt, Boyer-Moore algorithm.	**8 Hours**
Unit-3:	**Approximation algorithms:** Need of approximation algorithms: Introduction to P, NP, NP-Hard and NP-Complete; Deterministic, non-Deterministic Polynomial time algorithms; Knapsack, TSP, Set Cover, Open Problems.	**8 Hours**
Unit-4:	**Randomized Algorithm**: Introduction to probability and randomized algorithms. Examples of 8 randomized algorithms. Basic inequalities, Random variables. max-cut and derandomization. Permutation routing in a hypercube. 8 Basic Chernoff bound. Markov chains and random walks (2-SAT example, random walk on a path example).	**8 Hours**
Unit-5:	**Parallel Algorithms:**Flynn"s Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication – Data Distribution on EREW, Mesh and Butterfly	**8 Hours**
Text Book:	1. Computer Algorithms/C++, E. Horowitz, S. Sahani and S. Rajasekharan, Galgotia Publishers pvt. Limited.	

Reference Books:	1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education. 2. Introduction to the Design and Analysis of Algorithms, A.Levitin, Pearson Education. 3. Introduction to Algorithms, 2nd Edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, PHI pvt.Ltd./ Pearson Education. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.geeksforgeeks.org/red-black-tree-set-1-introduction-2/ 2. https://www.youtube.com/watch?v=EmxWC18iuSc 3. https://www.geeksforgeeks.org/np-completeness-set-1/	

Course Code: MCS 102	Professional Elective Course-1 M.Tech- Semester I ADVANCED COMPUTER ARCHITECTURE	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Instruction set principles, ILP Techniques.	
CO2	Understanding the concepts of VLIW approach.	
CO3	Understanding and applying the concepts of symmetric shared and distributed shared memory architecture.	
CO4	Understanding and applying the concepts of RAID- errors and failures.	
CO5	Applying and analyzing the performance of different ILP techniques.	
Course Content		
Unit-1:	**Fundamentals of Computer Design**- Technology trends- cost-measuring and reporting performance quantitative principles of computer design. Instruction set principles and examples- classifying instruction set-memory addressing-type and size of operands- addressing modes for signal processing-operations in the instruction set- instructions for control flow- encoding an instruction set.-the role of compiler	**8 Hours**
Unit-2:	**Instruction Level Parallelism (ILP)** - Over coming data hazards-reducing branch costs – high performance instruction delivery-hardware based speculation-limitation of ILP	**8 Hours**
Unit-3:	**ILP Software Approach**- compiler techniques, static branch protection-VLIW approach-,H.W support for more ILP at compile time,H.W verses S.W solutions, Memory hierarchy design, cache performance, reducing cache misses penalty and Miss rate, virtual memory-protection and examples of VM.	**8 Hours**
Unit-4:	**Multiprocessors and Thread Level Parallelism**- symmetric shared memory architectures, distributed shared memory, Synchronization, multi threading. Storage systems-Types, Buses, RAID- errors and failures, bench marking a storage device, designing, I/O system.	**8 Hours**
Unit-5:	**Inter Connection Networks and Clusters**- interconnection network media, practical issues in interconnecting networks, examples, clusters, designing a cluster.	**8 Hours**
Text Book:	1. Computer Architecture A quantitative approach 3 edition John L. Hennessy & David A. Patterson Morgan Kufmann (An Imprint of Elsevier)	
Reference Books:	1. "Computer Architecture and parallel Processing" Kai Hwang and A. Briggs International Edition McGraw-Hill. 2. Advanced Computer Architectures, DezsoSima, Terence Fountain, Peter Kacsuk, Pearson. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://eecs.ceas.uc.edu/~wilseypa/classes/eecs7095/lectureNotes/ilp/ilp.pdf 2. http://www.csit-sun.pub.ro/courses/cn2/Carte_H&P/H%20and%20P/chapter_6.pdf 3. http://www.vidyarthiplus.in/2012/05/advanced-computer-architecture-adcunit_11.html	

Course Code: MCS 104	Professional Elective Course-1 M.Tech- Semester I ADVANCED SOFTWARE ENGINEERING	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of advanced process models.	
CO2	Understanding, applying and analyzing the concepts of Context Models, Behavioral models, Data models.	
CO3	Understanding, applying and analyzing the concepts of Object-Oriented Design and User inter face design.	
CO4	Understanding, applying and analyzing the role of design patterns in software development.	
CO5	Understanding, applying and analyzing testing techniques on developed software.	
C06	Understanding, applying and analyzing modern engineering tools for software Development.	
Course Content		
Unit-1:	**Introduction to Software Engineering:** The evolving role of software, Changing Nature of Software, Software myths. **A Generic view of process:** Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models. **Process models:** The waterfall model, Incremental process models, Evolutionary process models, The Unified process. Overview of agile process and aspect oriented programming.	**8 Hours**
Unit-2:	**Software Requirements:** Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. **Requirements engineering process:** Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. **System models:** Context Models, Behavioral models, Data models, Object models, structured methods.	**8 Hours**
Unit-3:	**Design process and Design quality**: Design concepts, the design model. **Creating an architectural design:** software architecture, Data design, Architectural styles and patterns, Architectural Design. **Object-Oriented Design:** Objects and object classes, An Object-Oriented design process, Design evolution.	**8 Hours**
Unit-4:	**Performing User interface design:**Golden rules, User inter face analysis and design, interface analysis, interface design steps, Design evaluation. **Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Software Quality Assurance: Software Configuration Management, Overview of Software Quality Control and Quality Assurance, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model (CMM) and Comparison between ISO & SEI CMM.	**8 Hours**
Unit-5:	Technical Metrics for Software: A Framework for Technical Software	**8 Hours**

	Metrics, Metrics for the Analysis Model, Metrics for Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance. CASE (Computer Aided Software Engineering): CASE and its Scope, CASE support in Software Life Cycle, Documentation Support, Architecture of CASE Environment .	
Text Book:	1. Software Engineering, A practitioner's Approach-Roger S. Pressman, 6th editions. McGraw Hill International Edition.	
Reference Books:	1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers 2. Software Engineering, an Engineering approach- James F. Peters, WitoldPedrycz, John Wiley. 3. Systems Analysis and Design- Shelly Cashman Rosenblatt, Thomson Publications. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.youtube.com/watch?v=TtC_OFjknWI 2. https://www.tutorialspoint.com/software_engineering/case_tools_overview.htm 3. https://www.geeksforgeeks.org/computer-aided-software-engineering-case/	

Course Code: **MCS 106**	**Professional Elective Course-1** **M.Tech- Semester I** **ADVANCED REAL TIME OPERATING SYSTEM**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the Structure of real time system	
CO2	Understanding the concepts of embedded software architectures and Scheduling algorithms	
CO3	Understanding the concepts of Interrupt basic system design using an RT	
CO4	Understanding and Analyzing the Real time v/s general purpose	
CO5	Understanding and Analyzing Disk scheduling algorithms.	
C06	Understanding and analyzing Fault Tolerance Techniques.	
Course Content		
Unit-1:	Introduction to Real time systems: Issues in real time computing, Structure of real time system, Need for RTOS, Task classes. Performance measures for real time system: Properties, traditional performance measures, performability, cost functions and hard deadlines, and Estimating program run times. Introduction LINUX/ UNIX OS.	**8 Hours**
Unit-2:	Embedded software and Task Scheduling: Examples of embedded system, their characteristics and their typical hardware components, embedded software architectures, Scheduling algorithms: round robin, round robin with interrupts, function queue scheduling real time operating system selection, CPU scheduling algorithms: Rate monotonic, EDF, MLF. Priority Scheduling, Priority Ceiling and Priority inheritance Real time operating system: Tasks and task states, shared data and reentrancy semaphores and shared data, use of semaphores protecting shared data.	**8 Hours**
Unit-3:	Features of Real Time Operating System: Messages, queues, mailboxes, pipes, timer function, events memory management, Interrupt basic system design using an RT (OS design principles, interrupt routines, task structures and priority.) Current research in RTOS. Case Studies: Vx Works and Micro OS-II.	**8 Hours**
Unit-4:	Real Time Databases: Real time v/s general purpose, databases, main memory databases, transaction priorities, transaction aborts, concurrency control issues: pessimistic concurrency control and optimistic concurrency control, Disk scheduling algorithms	**8 Hours**
Unit-5:	Fault Tolerance Techniques: Causes of failure, Fault Types, Fault detection, Fault and error Containment, Redundancy: hardware redundancy, software redundancy, Time redundancy, information redundancy, Data diversity, Integrated failure handling.	**8 Hours**
Text Book:	1. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, McGraw Hill, 1997.	
Reference Books:	1. Computers as Components Principles of Embedded Computing System Design by 2. Real Times Systems Theory and Practice by Rajib Mall (Pearson	

	Education) 3. Real-Time Systems, Krisha & Shin, McGraw Hill 4. Embedded/Real time systems programming, Dr. KV K K Prasad, (Dreamtech) ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.geeksforgeeks.org/real-time-systems/ 2. https://www.csie.ntu.edu.tw/~ktw/rts/rtdbms.pdf 3. http://worldcolleges.info/engineering_notes/Real-Time-Vs-General-Purpose-Databases	

Course Code: **MCS 153**	**Laboratory Course-1** **M.Tech- Semester I** **Data Warehousing and Mining Lab**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of WEKA Tool.	
CO2	Applying various Data Mining techniques available in WEKA.	
CO3	Analyzing Data Preprocessing tasks and performing association rule mining on data sets.	
CO4	Analyzing classification algorithms on data set.	
CO5	Analyzing clustering algorithms on data sets.	
	The following operation has to be performed:	
	1. Build Data Warehouse and Explore WEKA 2. Data Mining Query Languages 3. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets 4. Demonstrate performing classification on data set. 5. Classification by decision tree induction 6. Classification by Bayesian Classification 7. Classification by Back propagation 8. Demonstrate performing clustering on data sets 9. Demonstrate performing Regression on data sets 10. Demonstration of clustering rule process on dataset iris.arff using simple k-means 11. Demonstrate performing Partitioning Methods 12. Demonstrate performing Density-Based Method 13. Demonstrate performing Grid-Based Methods	

Course Code: **MCS 154**	**Laboratory Course-2** **M.Tech- Semester I** **ADVANCED DATABASE SYSTEM LAB**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Applying and Analyzing mySQL statements to perform different operations.	
CO2	Applying and Analyzing various Normalization techniques.	
CO3	Applying and Analyzing various queries related to Transaction Processing.	
CO4	Applying recovery techniques for database recovery	
CO5	Applying various Locking Protocols and Techniques to control the concurrency for Database Management System.	
CO6	Creating an index.	
	The following operation has to be performed:	
	1. Granting Roles and Privileges. 2. Implementation of various constraints. 3. performance tuning 4. Creation of Index. 5. Storage Management 6. Recovery 7. Hands on Testing with Database Administration tools- DBA studio 8. Locking techniques 9. Database Replication Management 10. Distributed catalog management 11. Distributed query processing 12. Updating distributed data 13. Distributed transactions 14. Distributed concurrency control 15. Distributed recovery.	

Course Code: **MCS 155**	**Laboratory Course-3** **M.Tech- Semester I** **Advanced Data Structure and Algorithms Lab**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Applying and Analyzing Algorithms for solving problems like sorting, searching, insertion and deletion of data.	
CO2	Applying and Analyzing BFS and DFS for a given graph.	
CO3	Applying and Analyzing Shortest-path Algorithms	
CO4	Applying and Analyzing Minimum Spanning Tree algorithms	
CO5	Applying and Analyzing B-Tree, AVL Tree Operations.	
	Write a C/C++ program to perform the following operations:	
	1 Write a program to implement the following using an array a) Stack ADT b) Queue ADT 2 Write a program to implement the following using a singly linked list a. Stack ADT b. Queue ADT. 3 Write aProgram to implement the DEQUE (double ended queue) ADTusing arrays. 4 Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree. 5 Write a program that use recursive functions to traverse the given Binary tree in a) Preorder b) In order and c) Post order 6 Write a program that use non –recursive functions to traverse the given binary tree in a) Preorder b) In order and c) Post order 7 Write C programs for the implementation of BFS and DFS for a given graph. 8 Write C programs for implementing the following sorting methods: a) Merge Sort b) Heap Sort. 9 Write a program to perform the following operations. a) Insertion into a B-tree b) Deletion from a B-tree 10 Write a program to perform the following operations. a) Insertion into an AVL-tree b) Deletion from an AVL-tree 11 Write a Program to implement all the functions of Dictionary (ADT)using hashing.	

Course Code: MCS 202	**Professional Core Course-4** **M.Tech- Semester II** **ADVANCED COMPUTER NETWORK**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding and analyzing the concepts of network models.	
CO2	Understanding and analyzing the concepts of LAN and WAN standards.	
CO3	Understanding and Analyzing the concepts of IPV4, IPV6, Routing Protocols.	
CO4	Understanding and analyzing the concepts of Transmission Control Protocol, User Datagram Protocol.	
CO5	Understanding and analyzing the concepts of DNS, SNMP, RMON.	
Course Content		
Unit-1:	**Introduction** Introduction to Network models-ISO-OSI, SNA, Apple talk and TCP/IP models. Review of Physical layer and Data link layers, Review of LAN (IEEE 802.3, 802.5, 802.11b/a/g, FDDI) and WAN (Frame Relay, ATM, ISDN) standards.	**8 Hours**
Unit- 2	**Network layer** ARP, RARP, Internet architecture and addressing, internetworking, IPv4, overview of IPv6, ICMP, Routing Protocols- RIP, OSPF, BGP, IP over ATM.	**8 Hours**
Unit-3:	**Transport layer** Design issues, Connection management, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Finite state machine model.	**8 Hours**
Unit-4:	**Application layer:** WWW, DNS, e-mail, SNMP, RMON	**8 Hours**
Unit-5:	**Network Security**: Cryptography, Firewalls, Secure Socket Layer (SSL) and Virtual PrivateNetworks (VPN). **Case study:** Study of various network simulators, Network performance analysis using NS2.	**8 Hours**
Text Book:	**1.** Tananbaum A. S., "Computer Networks", 3rd Ed., PHI, 1999.	
Reference Books:	1. Black U, "Computer Networks-Protocols, Standards and Interfaces", PHI, 1996. 2. Stallings W., "Data and Computer Communications", 6th Ed., PHI, 2002. 3. Stallings W., "SNMP, SNMPv2, SNMPv3, RMON 1 & 2", 3rd Ed., Addison Wesley, 1999. 4. Laurra Chappell (Ed), "Introduction to Cisco Router Configuration", Techmedia, 1999. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. http://www.crectirupati.com/sites/default/files/lecture_notes/Computer%20Networks.pdf 2. https://www.geeksforgeeks.org/simple-network-management-protocol-snmp/	

Course Code: MCS 204	**Professional Core Course-5 M.Tech- Semester II BIG DATA ANALYTICS AND BUSINESS INTELLIGENCE**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Data Visualization, Correlation, and Regression.	
CO2	Understanding and Applying the concepts of Big Data Architecture and Big data warehouses.	
CO3	Analyzing the concepts of BI Framework, BI Project Life Cycle.	
CO4	Analyzing the concepts of Business Intelligence and Business Analytics.	
CO5	Understanding, Applying and Analyzing the concepts of Hadoop Ecosystem, HDFS, Map-Reduce.	
Course Content		
Unit-1:	**Introduction to Data Analytics:** Data and Relations, Data Visualization, Correlation, Regression, Forecasting, Classification, Clustering.	**8 Hours**
Unit-2:	**Big Data Technology Landscape:**Fundamentals of Big Data Types, Big data Technology Components, Big Data Architecture, Big Data Warehouses, Functional vs. Procedural Programming Models for Big Data.	**8 Hours**
Unit-3:	**Introduction to Business Intelligence:** Business View of IT Applications, Digital Data, OLTP vs. OLAP, BI Concepts, BI Roles and Responsibilities, BI Framework and components, BI Project Life Cycle, Business Intelligence vs. Business Analytics.	**8 Hours**
Unit-4:	**Big Data Analytics:** Big Data Analytics, Framework for Big Data Analysis, Approaches for Analysis of Big Data, ETL in Big Data, Introduction to Hadoop Ecosystem, HDFS, Map-Reduce Programming, Understanding Text Analytics and Big Data, Predictive analysis on Big Data, Role of Data analyst.	**8 Hours**
Unit-5:	**Business implementation of Big Data:**Big Data Implementation, Big Data workflow, Operational Databases, Graph Databases in a Big Data Environment, Real-Time Data Streams and Complex Event Processing, Applying Big Data in a business scenario, Security and Governance for Big Data, Big Data on Cloud, Best practices in Big Data implementation, Latest trends in Big Data, Latest trends in Big Data, Big Data Computation, More on Big Data Storage, Big Data Computational Limitations.	**8 Hours**
Text Book:	**1.** M., Dhiraj A., Big Data, Big Analytics: Emerging Business	
Reference Books:	1. White T., Hadoop: The Definitive Guide, O' Reilly Media (2012), 3rd Ed. 2. Intelligence and Analytic Trends for Today's Businesses, Wiley CIO Series (2013), 1sted. ***Latest editions of all the suggested books are recommended.**	

Additional Electronic Reference material	1. https://www.geeksforgeeks.org/hadoop-ecosystem/ 2. https://techvidvan.com/tutorials/hadoop-ecosystem-tutorial/	

Course Code: MCS 205	**Professional Core Course-6** **M.Tech- Semester II** **SEMANTIC WEB AND SOCIAL NETWORKS**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of AI and their role in the semantic web	
CO2	Understanding and analyzing the concepts of Ontology's languages.	
CO3	Understanding and analyzing the concepts of Ontology Engineering, Ontology Methods.	
CO4	Understanding and Analyzing the concepts of Semantic Web and Semantic Search Technology	
CO5	Applying and analyzing the concepts of social networks analysis.	
Course Content		
Unit-1:	**Web Intelligence** Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.	**8 Hours**
Unit-2:	**Knowledge Representation for the Semantic Web** Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.	**8 Hours**
Unit-3:	**Ontology Engineering** Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.	**8 Hours**
Unit-4:	**Semantic Web Applications, Services and Technology** Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.	**8 Hours**
Unit-5:	**Social Network Analysis and semantic web** What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.	**8 Hours**
Text Book:	1. Berners Lee, Godel and Turing , "*Thinking on the Web*", Wiley , 2008.	
Reference Books:	1. J.Davies, R.Studer, P.Warren, *Semantic Web Technologies, Trends and Research in Ontology Based Systems*,John Wiley & Sons,2006. 2. Liyang Lu Chapman ,*Semantic Web and Semantic Web Services* ,Hall/CRC Publishers,2007. 3. HeinerStucken Schmidt, Frank Van Harmelen, *Information Sharing on the semantic Web*, Springer Publications,2006. ***Latest editions of all the suggested books are recommended.**	

Additional Electronic Reference material	1. https://www.slideshare.net/marinasantini1/lecture-ontologies-and-the-semantic-web 2. http://courses.daiict.ac.in/pluginfile.php/8224/mod_resource/content/0/IT556_SOC/lecture_notes/The_Semantic_Web_and_its_Applications.pdf	

Course Code: **MCS 231**	**Professional Elective Course-2** **M.Tech- Semester II** **PATTERN RECOGNITION AND IMAGE PROCESSING**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding and applying the concepts of Machine perception, pattern recognition and Bayesian Decision Theory.	
CO2	Understanding, applying and analyzing Un-supervised learning Algorithms.	
CO3	Understanding, applying and analyzing the concepts of Pattern recognition using discrete hidden Markov models.	
CO4	Understanding and analyzing the concepts of sampling and quantization.	
CO5	Understanding and analyzing the Image Segmentation and Edge Detection.	
Course Content		
Unit-1:	**Introduction**: Machine perception, pattern recognition example, pattern Recognitionsystems, the design cycle, learning and adaptation. **Bayesian Decision Theory**: Introduction, continuous features – two categoriesclassifications, minimum error-rate classification-zero–one loss function, classifier s, discriminate functions, and decision surfaces.	**8 Hours**
Unit-2:	**Normal Density**:Univariate and multivariate density, discriminant functions for the normaldensity-different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context. **Maximum likelihood and Bayesian parameter estimation**: Introduction, maximumlikelihood estimation, Bayesian estimation, Bayesian parameter estimation–Gaussian case	**8 Hours**
Unit-3:	**Un-supervised learning and clustering**: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering – similarity measures, criteria function for clustering. **Pattern recognition using discrete hidden Markov models:**Discrete-time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMMs.	**8 Hours**
Unit-4:	**Continuous hidden Markov models:** Continuous observation densities, multiple mixtures per state, speech recognition applications. **Digital image fundamentals:**Introduction, an image model, sampling and quantization, basic relationships between pixels, image geometry.	**8 Hours**
Unit-5:	**Image enhancement:** Back ground, enhancement by point processing histogram processing, spatial filtering, introduction to image transforms, image enhancement in frequency domain. **Image Segmentation and Edge Detection:** Region Operations, Crack Edge Detection, Edge Following, Gradient operators, Compass and Laplace operators. Threshold detection methods, optimal thresholding, multispectral thresholding, thresholding in hierarchical data structures; edge based image segmentation- edge image thresholding, edge relaxation, border tracing, border detection.	**8 Hours**

Text Book:	1. Pattern Recognition and Image Analysis – Earl Gose, Richard John baugh, PHI,2000	
Reference Books:	2. A.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India. 3. Digital Image Processing – M.Anji Reddy, BS Publications. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. http://www.multiresolutions.com/strule/jon/www-jgcampbell-com/ip/pr.pdf	

Course Code: MCS 232	**Professional Elective Course-2** **M.Tech- Semester II** **NEURAL NETWORKS**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of neural network, Knowledge Representation and Artificial Intelligence	
CO2	Understanding the concepts of SOM algorithm.	
CO3	Understanding, Applying and analyzing the concept of Single Layer and Multi Layer Perceptrons.	
CO4	Understanding, Applying and analyzing the concepts of back propagation and differentiation.	
CO5	Applying the appropriate learning technique to pattern classification.	
Course Content		
Unit-1:	**INTRODUCTION** What is a neural network, Human Brain, Models of a Neuron, Neuralnetworks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks. **LEARNING PROCESS** – Error Correction learning, Memory based learning, Hebbianlearning, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process.	**8 Hours**
Unit-2:	**SINGLE LAYER PERCEPTRONS** Adaptive filtering problem, UnconstrainedOrganization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perceptron –convergence theorem, Relation between perceptron and Bayes classifier for a Gaussian Environment **MULTILAYER PERCEPTRON** – Back propagation algorithm XOR problem, Heuristics,Output representation and decision rule, Computer experiment, feature detection.	**8 Hours**
Unit-3:	**BACK PROPAGATION** back propagation and differentiation, Hessian matrix,Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.	**8 Hours**
Unit-4:	**SELF ORGANIZATION MAPS Two** basic feature mapping models, Self-organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization, Adaptive patter classification.	**8 Hours**
Unit-5:	**NEURO DYNAMICS** Dynamical systems, stability of equilibrium states, attractors,neurodynamical models, manipulation of attractors as a recurrent network paradigm **HOPFIELD MODELS** – Hopfield models, computer experiment.	**8 Hours**
Text Book:	1. Neural networks A comprehensive foundations, Simon Hhaykin,	

	Pear son Education edition 2004.	
Reference Books:	1. Artificial neural networks - B.Vegnanarayana Prentice Hall of India P Ltd 2005 2. Neural networks in Computer intelligence, Li Min Fu TMH 2003 3. Neural networks James A Freeman David M S kapurapearson education 2004 ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. http://www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/1-Intro.pdf 2. https://www.cs.princeton.edu/~rlivni/cos511/lectures/lect16.pdf	

Course Code: MCS 235	Professional Elective Course-2 M.Tech- Semester II GENETIC ALGORITHMS	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Genetic Algorithms	
CO2	Understanding the concept of Two-Armed and k-armed problem	
CO3	Understanding the concepts of crossover & mutation	
CO4	Understanding and applying the concepts of advanced operators such as Dominance, duplicity, & abeyance	
CO5	Analyzing the techniques in genetic search.	
Course Content		
Unit-1:	**Introduction** A brief history of evolutionary computation, Elements of Genetic Algorithms, A simple genetic algorithm, Applications of genetic algorithms **Genetic Algorithms in Scientific models** Evolving computer programs, data analysis & prediction, evolving neural networks, modeling interaction between learning & evolution, modeling sexual selection, measuring evolutionary activity.	**8 Hours**
Unit-2:	**Theoretical Foundation of genetic algorithm** Schemas & Two-Armed and k-armed problem, royal roads, exact mathematical models of simple genetic algorithms, Statistical- Mechanics Approaches.	**8 Hours**
Unit-3:	**Computer Implementation of Genetic Algorithm** Data structures, Reproduction, crossover & mutation, mapping objective functions to fitness form, fitness scaling, coding, a multiparameter, mapped, fixed point coding, discretization and constraints.	**8 Hours**
Unit-4:	**Some applications of genetic algorithms** The risk of genetic algorithms, De Jong & function optimization, Improvement in basic techniques, current application of genetic algorithms .	**8 Hours**
Unit-5:	**Advanced operators & techniques in genetic search** Dominance, duplicity, & abeyance, inversion & other reordering operators, other micro operators, Niche & speciation, multi objective optimization, knowledge based techniques, genetic algorithms & parallel processors.	**8 Hours**
Text Book:	**1.** David E. Goldberg, "Genetic algorithms in search, optimization & Machine Learning" Pearson Education, 2006.	
Reference Books:	1. Melanie Mitchell, "An introduction to genetic algorithms", Prentice Hall India, 2002. 2. Michael D. Vose, "The simple genetic algorithm foundations and theory, Prentice Hall India, 1999. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. http://www.cs.cmu.edu/~02317/slides/lec_8.pdf	

Course Code: **MCS 238**	**Professional Elective Course-2** **M.Tech- Semester II** **NATURAL LANGUAGE PROCESSING**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Natural Language Processing.	
CO2	Understanding the concepts of Semantic Roles	
CO3	Understanding and applying the concept of Finite State Machine Based Morphology and Automatic Morphology Learning	
CO4	Understanding, applying and analyzing the concept of Rule-Based Machine Translation and Knowledge Based MT System	
CO5	Understanding and analyzing the techniques in Speech Recognition.	
Course Content		
Unit-1:	**Introduction:** Origin of Natural Language Processing (NLP), Challenges of NLP, NLP Applications, Processing Indian Languages.	**8 Hours**
Unit-2:	**Words and Word Forms:** Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields, Scope Ambiguity and Attachment Ambiguity resolution.	**8 Hours**
Unit-3:	**Machine Translation:** Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation, UNL Based Machine Translation, and Translation involving Indian Languages.	**8 Hours**
Unit-4:	**Meaning:** Lexical Knowledge Networks, WorldNet Theory; Indian Language Word Nets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors.	**8 Hours**
Unit-5:	**Speech Recognition:** Signal processing and analysis method, Articulation and acoustics, Phonology and phonetic transcription, Word Boundary Detection; Argmax based computations; HMM and Speech Recognition. Other Applications: Sentiment Analysis; Text Entailment; Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR.	**8 Hours**
Text Book:	1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).	
Reference Books:	1. Jensen K., Heidorn G.E., Richardson S.D., Natural Language Processing: The PLNLP Approach, Springer (2013). 4. Roach P., Phonetics, Oxford University Press (2012). ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.cl.cam.ac.uk/teaching/2002/NatLangProc/nlp1-4.pdf	

Course Code: MCS 240	Professional Elective Course-2 M.Tech- Semester II Software Testing	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Testing Process and Graph Theory.	
CO2	Understanding the role of Test Planning and Policy development.	
CO3	Understanding, Applying and Analyzing the concepts of Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.	
CO4	Understanding and Analyzing test cases from use cases.	
CO5	Understanding, applying and analyzing the concepts of Software Testing Tools.	
CO6	Understanding, Applying and Analyzing Object oriented Testing.	
Course Content		
Unit-1:	**Introduction:** Testing Process, Terminologies: Error, Fault, Failure, Test Cases, Testing Process, Limitations of Testing, Graph Theory: Graph, Matrix representation, Paths and Independent paths, Generation of graph from program, Identification of independent paths. Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.	**8 Hours**
Unit-2:	**Structural Testing:** Control flow testing, Path testing, Data Flow Testing, Slice based testing, Mutation Testing Software Verification: Verification methods, SRS verification, SDD verification, Source code reviews, User documentation verification, and Software project audit.	**8 Hours**
Unit-3:	**Creating Test Cases from Requirements and use cases:** Use case diagram and use cases, Generation of Test cases from use cases, Guidelines for generating validity checks, Strategies for data validating, Database testing, Regression Testing: What is Regression Testing?, Regression test cases selection, Reducing the number of test cases, Risk analysis, Code coverage prioritization technique Software Testing Activities: Levels of Testing, Debugging, Software Testing Tools, and Software test Plan.	**8 Hours**
Unit-4:	**Object oriented Testing:** What is Object orientation?, What is Object Oriented testing?, Path Testing, State Based Testing, Class Testing, Testing Web Applications: What is Web testing?, Functional Testing, User interface Testing, Usability Testing, Configuration and Compatibility Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing	**8 Hours**
Unit-5:	**Basic concepts of Test Management** :Testing, debugging goals, policies – Test planning – Test plan components – Test plan attachments – Locating test items – Reporting test results – The role of three groups in test planning and policy development – Process and the engineering disciplines – Introducing the test specialist – Skills needed by a test specialist – Building a testing	**8 Hours**

	group.	
Text Book:	1. Yogesh Singh, "Software Testing", Cambridge University Press, New York, 2012	
Reference Books:	1. Marc Roper, "Software Testing", McGraw-Hill Book Co., London, 1994. 2. Watts Humphrey, "Managing the Software Process", Addison Wesley Pub. Co. Inc., Massachusetts, 1989. 3. Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990. 12. Louise Tamres, "Software Testing", Pearson Education Asia, 2002 4. K.K. Aggarwal&Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, 2005 ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.guru99.com/what-everybody-ought-to-know-about-test-planing.html 2. https://www.tutorialspoint.com/software_testing_dictionary/regression_testing.htm	

Course Code: **MCS 252**	**Laboratory Course-4** **M.Tech- Semester II** **ADVANCED COMPUTER NETWORK LAB**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Applying and analyzing the concepts of various network simulators.	
CO2	Applying and Analyzing various networking protocols.	
CO3	Applying and Analyzing Socket Programming.	
CO4	Applying and Analyzing Routing Protocols.	
CO5	Applying and Analyzing Application Layer protocol.	
Network Programming		
1	Socket Programming a. TCP Sockets b. UDP Sockets c. Applications using Sockets	
2	Simulation of Sliding Window Protocol	
3	Simulation of Routing Protocols	
4	Analyzing Routing layer protocol properties	
5	Analyzing Transport Layer Protocol	
6	Analyzing Application Layer protocol	
7	Implementation of algorithms such as RSA, Diffie Hellman.	

Course Code: MCS 253	**Laboratory Course-5** **M.Tech- Semester II** **BIG DATA LAB**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Applying and analyzing Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics.	
CO2	Applying and analyzing clustering algorithms.	
CO3	Applying and analyzing algorithms for large Datasets using Map Reduce techniques.	
CO4	Applying and analyzing Page Rank Computation.	
CO5	Creating NoSQL query with API.	
LIST OF EXPERIMENTS:		
	1. Introduction, use and assessment of most recent advancements in Big Data technology along with their usage and implementation with relevant tools and technologies. 2. Map Reduce application for word counting on Hadoop cluster. 3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API. 4. K-means clustering using map reduce. 5. Page Rank Computation. 6. Data retrieval from AQL. 7. Data Retrieval from JQL 8. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics	

Course Code: **MCS 291**	**Seminar** **M.Tech- Semester II** **SEMINAR**	**L-0** **T-0** **P-0** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the factual knowledge of current areas of research.	
CO2	Applying gained knowledge in thinking, problem solving, or decisions making process.	
CO3	Analyzing problems after doing research literature survey	
CO4	Analyzing the applicability of modern software tools and technology.	
CO5	Creating Seminar Report.	
Selection of Topic:		
	All students pursuing M.Tech shall submit the proposed topic of the seminar in the first week of the semester to the course coordinator. Care should be taken that the topic selected does not directly relate to the subject of the courses being pursued or thesis work, if any. The course coordinator shall then forward the list to the concerned department coordinators who will vet the list and add some more topics in consultation with the faculty of the department .The topics will then be allocated to the students along with the name of the faculty guide.	
Preparation of the Seminar		
1	The student shall meet the guide for the necessary guidance for the seminar work.	
2	During the next two to four weeks the student should read the primary literature germane to the seminar topic. Reading selection should continuously be informed to the guide.	
3	After necessary collection of data and literature survey, the students must prepare a report. The report shall be arrange in the sequence consisting of the following: - a. Top Sheet of transparent plastic. b. Top cover. c. Preliminary pages. (i) Title page (ii) Certification page. (iii) Acknowledgment. (iv) Abstract. (v) Table of Content. (vi) List of Figures and Tables. (vii) Nomenclature. d. Chapters (Main Material). e. Appendices, If any. f. Bibliography/ References.	

	g. Evaluation Form. h. Back Cover (Blank sheet). i. Back Sheet of Plastic (May be opaque or transparent).	
4	Top Cover-The sampled top cover shall be as Under:	

Title of the seminar

Submitted in Partial fulfillment of the requirement for the degree of

MASTER OF TECHNOLOGY
In
COMPUTER SCIENCE & ENGINEERING
by
Name of Student in capital Letters
(Roll No.)
Under the guidance of
GUIDE NAME
Designation, CCSIT,
TMU, Moradabad.

COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY
TEERTHANKER MAHAVEER UNIVERSITY
N.H. 24, BAGARPUR,
MORADABAD-244001

MONTH AND YEAR

5	Title Page: The Sampled title page shall be as under:

Title of the seminar

Submitted in Partial fulfillment of the requirement for the degree of

MASTER OF TECHNOLOGY
In
COMPUTER SCIENCE & ENGINEERING
by
Name of Student in capital Letters
(Roll No.)

Under the guidance of
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Designation, CCSIT,
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COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY
TEERTHANKER MAHAVEER UNIVERSITY
N.H. 24, BAGARPUR,
MORADABAD-244001

MONTH AND YEAR

6	Certification page:- This shall be as under

College of Computing Sciences and Information Technology
Teerthanker Mahaveer University
Moradabad-244001

The seminar Report and Title "Topic of the Seminar."
Submitted by Mr. /Ms. (Name of the student) (Roll No.) may be accepted for being evaluated

Date ***Signature***
Place ***(Name of guide)***

For Guide*If you Choose not to sign the acceptance certificate above, please indicate reasonsfor the same from amongst those given below:*

i) The amount of time and effort put in by the student is not sufficient;
ii) The amount of work put in by the student is not adequate;
iii) The report does not represent the actual work that was done / expected to be done;
iv) Any other objection (Please elaborate)

7	Acknowledgement:- This shall be as under

I am highly thankful to the almighty who gave me the strength and health for completing my seminar.It gives me pleasure to express my thanks and gratitude to my seminar guide **Guide Name** who gave me the opportunity to do this seminar. His/Her guidance and support helped me to complete my seminar.

I would like to thanks Principal Sir **……,** HOD**…….** and my course coordinator **……..** for their motivation and encouragement.

I am also thankful to everyone who has helped me in making this report. I am really thankful to them. Their encouragement really helped me to frame this seminar in a better manner. I also, whole heartedly, thank my parents and friends for their support and helpfulness.

Place: Moradabad Name of the Student

8	**Abstract-** A portion of the seminar evaluation will be based on the abstract. The abstract will be evaluated according to the adherence to related technical field and according to the format described below.
The seminar abstract is an important record of the coverage of your topic and provides a valuable source of leading references for students. Accordingly, the abstract must serve as an introduction to your seminar topic. The abstract will be limited to 500 words, excluding figures and tables (if any). The abstract will include references to the research articles upon which the seminar is based as well as research articles that have served as key background material.	

Course Code: MCS 303	Professional Core Course-7 M.Tech- Semester III NETWORK SECURITY AND CRYPTOGRAPHY	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding, Applying and analyzing various protocols for network security to protect against the threats in the networks.	
CO2	Understanding, Applying and analyzing different encryption and decryption techniques.	
CO3	Applying the knowledge of cryptographic checksums and Analyzing the performance of different message digest algorithms for verifying the integrity of varying message sizes.	
CO4	Applying different digital signature algorithms to achieve authentication and create secure applications	
CO5	Analyzing different attacks on networks.	
CO6	Analyzing the performance of firewalls and security protocols like SSL.	
Course Content		
Unit-1:	**Introduction:** Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques. **Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations. Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, R C 5, C AST -128, R C 2, and Characteristics of Advanced Symmetric block ciphers.	**8 Hours**
Unit-2:	**Conventional Encryption:** Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation. Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.	**8 Hours**
Unit-3:	**Number theory:** Prime and Relatively prime numbers, Modular arithmetic, Fermat's andEuler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms. **Message authentication and Hash functions**: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.	**8 Hours**
Unit-4:	**Hash and Mac Algorithms:** MD File, Message digests Algorithm, Secure Hash Algorithm, RIPEMD-160, and HMAC. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. **Authentication Applications:**Kerberos, X.509 directory Authentication service, Electronic Mail Security: Pretty Good Privacy, S/MIME.	**8 Hours**

Unit-5:	**IP Security:**Over view, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management, Web Security: Web Security requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction. **Intruders, Viruses and Worms:**Intruders, Viruses and Related threats, Fire Walls: Fire wall Design Principles, Trusted systems.	**8 Hours**
Text Book:	1. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson Education.	
Reference Books:	1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press) 2. Network Security - Private Communication in a Public World by Char lie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI. 3. Principles of Information Security, Whitman, Thomson. 4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH ***Latest editions of all the suggested books are recommended**	
Additional Electronic Reference material	1. https://engineering.purdue.edu/kak/compsec/NewLectures/Lecture3.pdf 2. https://www.vssut.ac.in/lecture_notes/lecture1428550736.pdf	

Course Code: MCS 304	**Professional Core Course-8 M.Tech- Semester III ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of state space and its searching strategies.	
CO2	Understanding the concepts of knowledge representation and predicate logic.	
CO3	Understanding the concepts of Supervised and Unsupervised learning	
CO4	Applying the concepts of Unsupervised learning, Neural Network.	
CO5	Applying the k-Means Algorithm.	
Course Content		
Unit-1:	AI Fundamentals: Defining Artificial Intelligence, Defining AI techniques, State Space Search and Heuristic Search Techniques, Defining problems as State Space search, Production systems and characteristics, Hill Climbing, Breadth first and depth first search, Best first search	**8 Hours**
Unit-2:	Knowledge Representation Issues, Representations and Mappings, Approaches to knowledge representation. Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Forward vs backward reasoning , Symbolic Logic under Uncertainty, Non-monotonic Reasoning, Logics for non-monotonic reasoning	**8 Hours**
Unit-3:	Introduction : Idea of Machines learning from data, Classification of problem – Regression and Classification, Supervised and Unsupervised learning, Linear Regression, Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Multivariable model representation, Multivariable cost function, Gradient Decent in practice, Normal Equation and non-invertibility	**8 Hours**
Unit-4:	Logistic Regression Classification: Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs. All), Problem of Overfitting, Regularization, Neural Networks, Non-linear Hypothesis, Biological Neurons, Model representation, Intuition for Neural Networks, Multiclass classification, Cost Function, Back Propagation Algorithm, Back Propagation Intuition, Weights initialization, Neural Network Training.	**8 Hours**
Unit-5:	Unsupervised learning unsupervised learning introduction, k-Means Algorithm, Optimization objective, Random Initialization, Choosing number of clusters. Recommender Systems Problem Formulation, Content based recommendations, Collaborative Filtering, Vectorization, Implementation details.	**8 Hours**
Text Book:	1. Artificial Intelligence, 2nd Edition, Rich and Knight	
Reference Books:	1. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig 2. Machine Learning, Tom M. Mitchell	

	***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf 2. https://www.ritchieng.com/one-variable-linear-regression/ 3. http://cs229.stanford.edu/notes/cs229-notes1.pdf	

Course Code: MCS 339	**Professional Core Course-9 M.Tech- Semester III CLOUD COMPUTING**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Cloud Computing and its applications.	
CO2	Understanding and analyzing the Concepts of Cloud Infrastructure Model including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.	
CO3	Understanding and applying the importance of virtualization along with their technologies and Analyzing the comparative advantages and disadvantages of Virtualization technology.	
CO5	Understanding and analyzing the concepts of Cloud Computing Architecture.	
CO6	Understanding, Applying and Analyzing the concepts of Map-Reduce for Simplified data processing on Large clusters	
Course Content		
Unit-1:	**Introduction and Evolution of Computing Paradigms:** Overview of Existing Hosting Platforms, Cluster Computing, Grid Computing, Utility Computing, Autonomic Computing, mesh, Introduction to Cloud Computing, Cloud Computing history and evolution, practical applications of cloud computing for various industries, economics and benefits of cloud computing.	**8 Hours**
Unit-2:	**Cloud Issues and Challenges:**Cloud computing issues and challenges like Security, Elasticity, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Cost Management, Big Data. Data Center: Classic Data Center Virtualized Data Center (Compute, Storage, Networking and Application), and Business Continuity in VDC	**8 Hours**
Unit-3:	**Cloud Computing Architecture:** Cloud Architecture model, Types of Clouds: Public Private & Hybrid Clouds, Cloud based services: Iaas, PaaS and SaaS. Classification of Cloud Implementations: Amazon Web Services, The Elastic Compute Cloud (EC2), The Simple Storage Service (S3), The Simple Queuing Services (SQS), Google AppEngine - PaaS, Windows Azure, Aneka, A Comparison of Cloud Computing Platforms	**8 Hours**
Unit-4:	**Virtualization:**Virtualization, Advantages and disadvantages of Virtualization, Types of Virtualization: Resource Virtualization i.e. Server, Storage and Network virtualization, Migration of processes, VMware vCloud – IaaS	**8 Hours**
Unit-5:	**Cloud based Data Storage:**Introduction to Map Reduce for Simplified data processing on Large clusters, Design of data applications based on Map Reduce in Apache Hadoop, Task Partitioning, Data partitioning, Data Synchronization, Distributed File system, Data Replication , Shared access to weakly consistent to data stores, introduction to Python.	**8 Hours**
Text Book:	1. David, E.Y. Sarna, *Implementing and Developing Cloud Computing Applications*, CRC Press.	
Reference Books:	1. Mather, T., Cloud Security and Privacy: An Enterprise Perspective On Risks And Compliance,	

	O'Relly. 2. Kumar Saurabh, "Cloud Computing: Insights into New-Era Infrastructure", Wiley India, 2011. 3. John Rhoton, "Cloud Computing Explained: Implementation Handbook for Enterprises", Recursive Press, 2013. **Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.iare.ac.in/sites/default/files/lecture_notes/CC%20LECTURE%20NOTES.pdf 2. https://k21academy.com/microsoft-azure/az-900/cloud-deployment-models-public-private-hybrid-cloud/	

Course Code: MCS 337	**Professional Elective Course-3** **M.Tech- Semester III** **DISTRIBUTED AND PARALLEL COMPUTING**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of Architectural models for distributed and mobile computing systems	
CO2	Understanding and analyzing the concepts of Middleware, client/server model, common layer application protocols such as RPC, RMI, streams	
CO3	Understanding and analyzing the Model for Simulations.	
CO4	Understanding and analyzing the concepts of Grid Computing and its applications.	
CO5	Understanding and analyzing the concepts of Processor organization such as Static and dynamic interconnections.	
Course Content		
Unit-1:	**Fundamentals of Distributed Computing:** Architectural models for distributed and mobile computing systems. Basic concepts in distributed computing such as clocks, message ordering, consistent global states, and consensus. **Basic Algorithms in Message:** Passing Systems, Leader Election in Rings, and Mutual Exclusion in Shared Memory, Fault-Tolerant Consensus, Causality and Time. Message Passing: PVM and MPI.	**8 Hours**
Unit-2:	**Distributed Operating Systems:** OS and network operating systems, Distributed File systems. Middleware, client/server model for computing, common layer application protocols (RPC, RMI, streams), distributed processes, network naming, distributed synchronization and distributed object-based systems.	**8 Hours**
Unit-3:	**Simulation:**A Formal Model for Simulations, Broadcast and Multicast, Distributed Shared Memory, Fault-Tolerant Simulations of Read/Write Objects Simulating Synchrony, Improving the Fault Tolerance of Algorithms, Fault-Tolerant Clock Synchronization.	**8 Hours**
Unit-4:	**Distributed Environments:** Current systems and developments (DCE, CORBA, JAVA).Randomization, Wait-Free Simulations of Arbitrary Objects, Problems Solvable in asynchronous Systems, Solving Consensus in Eventually Stable Systems, High Performance Computing-HPF, Distributed and mobile multimedia systems. Adaptability in Mobile Computing. Grid Computing and applications. Fault tolerant Computing Systems.	**8 Hours**
Unit-5:	**Parallel Processing:**Basic Concepts: Introduction to parallel processing, Parallel Processors: Taxonomy and topology - shared memory multiprocessors, distributed memory networks. Processor organization - Static and dynamic interconnections. Embeddings and simulations.	**8 Hours**
Text Book:	1. Tannenbaum, A, Van Steen. Distributed Systems, Principles and Paradigm, Prentice Hall India, 2002	
Reference Books:	1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to parallel computing", 2nd Edition, Pearson Education, 2007	

	2. Cameron Hughes, Tracey Hughes, "Parallel and distributed programming using C++", Pearson Education, 2005 3. Tanenbaum, A, "Modern Operating Systems", 2nd Edition, Prentice Hall India, 2001. 4. Singhal and Shivaratri, "Advanced Concepts in Operating Systems", McGraw Hill, 1994 **Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. http://www-sop.inria.fr/oasis/Denis/ProgRpt/COURS/IntroductionToParallelProgramming.pdf 2. https://cseweb.ucsd.edu/classes/sp16/cse291-e/applications/ln/lecture3.html	

Course Code: **MCS 344**	**Professional Elective Course-3** **M.Tech- Semester III** **COMPUTATIONAL TECHNIQUE USING MATLAB**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the concepts of MATLAB.	
CO2	Understanding, applying and analyzing Linear Equations, Inverse Matrix, Decomposition,Iterative Methods to Solve Equations .	
CO3	Understanding, applying and analyzing Nonlinear Equations such as Bisection Method, Regula Falsi Method.	
CO4	Understanding, applying and analyzing Differential Equations such as Euler's Method, Runge–Kutta Method	
CO5	Understanding, applying and analyzing Eigenvalues and Eigenvectors, Power Method, Jacobi Method	
CO6	Understanding, applying and analyzing Partial Differential Equations such as Elliptic, Hyperbolic, and Parabolic PDE	
Course Content		
Unit-1:	MATLAB Usage and Computational Errors: Introduction to MATLAB, Types of Computer Errors, IEEE 64-bit Floating-Point Number Representation, Vectors in MATLAB, Efficient programming techniques. System of Linear Equations: Solution for a System of Linear Equations, Solving a System of Linear Equations, Inverse Matrix, Decomposition (Factorization), Iterative Methods to Solve Equations	**8 Hours**
Unit-2:	Interpolation and Curve Fitting: Interpolation by Lagrange, Newton, and Chebyshev Polynomial, Hermite Interpolating Polynomial, Cubic Spline interpolation, Straight Line, Polynomial Curve, and Exponential Curve Fit, Fourier transform Nonlinear Equations: Bisection Method, Regula Falsi Method, Newton Raphson Method, Secant Method, and Newton Method for a System of Nonlinear Equations	**8 Hours**
Unit-3:	Numerical Differentiation/Integration: Difference Approximation for First Derivative, Approximation Error of First Derivative, Numerical Integration and Quadrature, Trapezoidal Method and Simpson Method, Romberg Integration, Adaptive and Gauss Quadrature. Ordinary Differential Equations: Euler's Method, Runge–Kutta Method, PredMEor–Corrector Method, Vector Differential Equations, Boundary Value Problem (BVP)	**8 Hours**
Unit-4:	Optimization: Unconstrained Optimization, Constrained Optimization, MATLAB Built-In Routines for Optimization, Matrices and Eigenvalues: Eigenvalues and Eigenvectors, Power Method, Jacobi Method	**8 Hours**
Unit-5:	Partial Differential Equations: Elliptic, Hyperbolic, and Parabolic PDE, Finite Element Method (FEM) for solving PDE.	**8 Hours**
Text Book:	1. "Applied Numerical methods using MATLAB", By W. Y. Yang, Wiley Publications, 2005	

Reference Books:	1. “Numerical Methods using MATLAB”, John H. Mathews, Prentice Hall 2. "Introduction to MATLAB® for Engineers”, W.J Palm, McGraw-Hill ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf 2. http://web4.cs.ucl.ac.uk/teaching/3085/archive/2010/matlab_tutorial/matlab_booklet.pdf	

Course Code: MCS 345	Professional Elective Course-3 M.Tech- Semester III DIGITAL IMAGE PROCESSING	L-3 T-1 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the fundamental concepts of a digital image processing system.	
CO2	Understanding and Analyzing images in the frequency domain using various transforms, image enhancement and restoration techniques.	
CO3	Understanding, applying and analyzing a suitable technique in frequency domain to perform image enhancement, perform basic processing on color images.	
CO4	Understanding, applying and analyzing the concepts of image segmentation.	
CO5	Understanding, applying and Analyzing the image compression techniques in spatial and frequency domains.	
Course Content		
Unit-1:	Introduction and fundamental to digital image processing: What is digital image processing, Origin of digital image processing, Examples that use digital image processing, Fundamental steps in digital image processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels. Image enhancement in spatial domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial filters.	**8 Hours**
Unit-2:	Image enhancement in frequency domain: Introduction to Fourier transform, sampling, discrete Fourier transform, extension to functions of two variables, Basics of filtering in frequency domain, Smoothing and sharpening frequency domain filters. Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise, inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations.	**8 Hours**
Unit-3:	Color Image Processing: Color fundamentals, Color models, Basics of full color image processing, Color transformations, Smoothing and sharpening. Image Compression: Fundamentals, Spatial and temporal redundancy, measuring image information, Image compression methods, Loss less compression, Lossy compression, Digital image watermarking.	**8 Hours**
Unit-4:	Image Segmentation: Fundamentals, Point, line and edge detection, Edge linking and boundary detection, Thresholding, Region based segmentation. Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors	**8 Hours**
Unit-5:	Pattern and Pattern classes-Recognition based on matching techniques and neural networks. Software and Tools to be learnt: MATLAB tool box on image processing, SCILAB.	**8 Hours**
Text Book:	1. Rafael C. Gonzalez and Richard E. Woods,—Digital Image Processing‖, Pearson Education,Ed, 2001.	

Reference Books:	1. Chanda and D. Dutta Majumdar, ―Digital Image Processing and Analysis‖, PHI, 2003. 2. Milan Sonka, Vaclav Hlavac, Roger Boyle, ―Image Processing, Analysis, and Machine Vision‖, Brookes/Cole, PWS Publishing Company, Thomson Learning, 2nd edition,1999. 3. Anil K. Jain, ―Fundamentals of Digital Image Processing‖, Pearson Education, PHI, 2001. ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference material	1. https://www.cet.edu.in/noticefiles/272_Digital-Image-Processing.pdf 2. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/BEC007%20%20-Digital%20image%20processing.pdf	

Course Code: MCS 353	Laboratory Course-6 M.Tech- Semester III ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	L-0 T-0 P-4 C-2
Course Outcomes:	On completion of the course, the students will be :	
CO1	Applying and Analyzing various Classification Techniques.	
CO2	Applying and Analyzing various Clustering Techniques.	
CO3	Applying and Analyzing different machine learning techniques for real world problems.	
CO4	Applying and Analyzing various Regression Techniques.	
CO5	Implementing clustering of patterns	
LIST OF EXPERIMENTS		
	A. Hello World 1. Data Types: Create and print a numeric. 2. Data Structures: Create and print a vector. 3. Data Frames: Create a data frame. 4. Print a data frame: Index the data frame by row 1 and column 2. B. Classification 1. Explore the Data 2. Set the working directory 3. Load Iris data 4. Inspect the data 5. Create a color palette 6. Create a scatter plot matrix colored by species C. Regression 1. Explore the Data 2. Load Iris data 3. Create scatter plot matrix 4. Load corrgram package 5. Create correlogram D. Clustering 1. Explore the Data 2. Load Iris data 3. Load color brewer library 4. Create a color palette 5. Create a scatterplot matrix colored by species	

Course Code: MCS 392	Dissertation M.Tech- Semester III DISSERTATION I	L-0 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding an independent learning in the identified area of computer science and engineering.	
CO2	Understanding the process of research and the ethical issues related to it.	
CO3	Applying the process of research.	
CO4	Applying knowledge about emerging trends and the scope for research and development by publishing the review or survey paper in the identified area.	
CO5	Applying ideas into the form of a research synopsis/proposal.	
Selection of Topic:		
1	The student will submit a synopsis at the beginning of the semester for the approval of thesis topic to the Departmental Research Committee (DRC) (DRC shall be nominated by the Director), in a specified format. The format shall be as per the following guidelines-	

		Template for Synopsis:	
Topic:			
(1)	Introduction		1 Page
(2)	Theory/Problem Statement		1-2 Pages
	(a)	Background/Literature Review	
	(b)	Hypothesis formulation	
(3)	Expected Contribution of the study		1-2 Pages
(4)	Research Methodology		1-2 Pages
(5)	References		1-2 Pages

2	Synopsis must be submitted within four weeks of the commencement of semester.	
3	On acceptance of the synopsis/topic, a guide will be allotted to the student. The guide may be from within the faculty or from outside. In either of the cases the student is required to submit an acceptance certificate from the proposed guide. In case the propose guide is from outside his/her bio-data duly verified by the head of the organization where he/she is working must be submitted by the student. In this case it is the responsibility of the student to ensure that the guide is present in the college on the day of synopsis presentation and final presentation. It is to be noted that a person cannot act as guide for more than five projects/thesis simultaneously. This condition is inclusive of non TMU students. This aspect will also be included in the certificate provided by the guide.	
	Dissertation work:	
4	On confirmation of the topic and allocation of the guide, the student shall immediately start the thesis work.	

5	He/she shall submit the progress of the work done by him/her in the form of a monthly report till the completion of the work and the submission of the thesis.	
6	In phase-1 the student shall be evaluated based on the following- (a) Synopsis (25%) (b) Frequency of interaction with the guide. (Progress report) (25%) (c) Final Presentation of the work done during the semester. (50%)	
7	Serial 6-(a & c) shall be assessed by DRC and 6-(b) by the guide. The student is required to submit three hard copies of the proposed presentation duly countersigned by the guide to the departmental head. Student should generally restrict him/her self to the presentation slide submitted by him/her.	

Course Code: **MCS 491**	**Dissertation** **M.Tech- Semester IV** **DISSERTATION II**	**L-0** **T-0** **P-0** **C-12**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1	Understanding the objectives of the dissertation by grasping and analyzing through an extensive literature review in the significant area of study.	
CO2	Applying the methodology and execute the study through conduct of analytical/experimental work to achieve the objectives.	
CO3	Analyzing and review the existing literature on a research question.	
CO4	Analyzing and Evaluating the dissertation work as per appropriate standards of documentation and presentation.	
CO5	Designing solutions to the problem and publish research papers.	
Dissertation work		
1	As brought out for MCS 392, the student shall meet the guide frequently for the necessary guidance for the Thesis work.	
2	During the next six to eight weeks as well as the semester break, student should read the literature germane to the thesis topic. The progress of the Research / thesis work should continuously be informed to the guide.	
3	In the end after necessary collection of data, literature survey and research work, the students must prepare a thesis report (Final Report). The report shall be arranged in the sequence consisting of the following:- (a) Top Sheet of transparent plastic. (b) Top cover. (c) Preliminary pages. (i) Title page (ii) Declaration Page (iii) Certification page. (iv) Acknowledgment. (v) Abstract. (vi) Table of Content. (vii) List of Figures/Photographs and Tables. (viii) Nomenclature. (d) Chapters (Main Material). (e) Appendices, if any. (f) Bibliography/ References. (g) Back Cover (Blank sheet). (h) Back Sheet of Plastic (May be opaque or transparent). (Note: Sample of above is given in succeeding paragraphs.)	

4	Top Cover-**The sampled top cover shall be as Under**	

M.Tech. Thesis

Title

Submitted in Partial fulfillment of the requirement for the degree of

MASTER OF TECHNOLOGY
In
COMPUTER SCIENCE & ENGINEERING
by
Name of Student in capital Letters

(Roll No.)

Under the Guidance of

Name of the Guide with designation in capital letters

(TMU LOGO)

COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY
TEERTHANKER MAHAVEER UNIVERSITY
N.H. 24, BAGARPUR, MORADABAD-244001

MONTH AND YEAR

5	**Title Page:- The Title Page cover shall be as under:**	

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N.H. 24, BAGARPUR, MORADABAD-244001

MONTH AND YEAR

COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY
TEERTHANKER MAHAVEER UNIVERSITY
DELHI ROAD, MORADABAD

Declaration

The work presented in dissertation entitled **" Topic** " submitted to the Department of College of Computing Sciences and Information Technology(CCSIT), Teerthanker Mahaveer University, Moradabad, for the award of the degree of Master of Technology in Computer Science and Engineering, during the session …., is my original work. I have neither plagiarized nor submitted the same work for the award of any degree.

Date **Signature**
Place **Student Name**
Enrollment No

COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY
TEERTHANKER MAHAVEER UNIVERSITY
DELHI ROAD, MORADABAD

CERTIFICATE

I have certify that the work which is being presented in the thesis entitled " **Thesis Title** " in partial fulfillment of the requirements for the award of the Degree of Master of Technology and submitted in the Department of College of Computing Sciences and Information Technology(CCSIT), Teerthanker Mahaveer University, Moradabad. It is an authentic record of my own work under the supervision of **Guide Name**. The matter presented in this thesis has not been submitted by me for the award of any other degree of this or any other institute.

(Student Name)

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

Date **Signature** **Signature**
Place **(Name of Supervisor, Designation)** **(Name of Supervisor, Designation)**

The M.Tech CSE Viva –Voce Examination of **Student Name** has been held on .....

Signature of Supervisor **Signature of Supervisor**
(Name of Supervisor, Designation) **(Name of Supervisor, Designation)**

Dr. Ashendra Kr. Saxena **Dr. Rakesh Kumar Dwivedi** **External Examiner**
HOD, CCSIT **(Prof. & Principal, CCSIT)**

Abstract- A portion of the dissertation evaluation will be based on the abstract. The abstract will be evaluated according to the adherence to related technical field and according to the format described below.

The dissertation abstract is an important record of the coverage of your topic and provides a valuable source of leading references for students. Accordingly, the abstract must serve as an introduction to your dissertation topic. The abstract will be limited to 500 words, excluding figures and tables (if any). The abstract will include references to the research articles upon which the dissertation is based as well as research articles that have served as key background material.

Table of Content:- This shall be as under

SAMPLE SHEET FOR TABLE OF CONTENTS

TABLE OF CONTENTS

General points for the thesis

1. The report should be typed on A4 sheet. The Paper should be of 70-90 GSM.
2. Each page should have minimum margins as under

    a. Left 1.5 inches
    b. Right 0.5 Inches
    c. Top 1 Inch
    d. Bottom 1 Inch (Excluding Footer, If any)

3. The printing should be only on one side of the paper
4. The font for normal text should Times New Roman, 12 size for text and 14 size for heading and should be typed in double space. The references may be printed in Italics or in different fonts.
5. The Total Report should not exceed 50 pages including top cover and blank pages.
6. A CD of the report should be pasted/attached on the bottom page of the report.
7. Three copies completed in all respect as given above are to be submitted to the guide. One copy will be kept in departmental/University Library, One will be returned to the student and third copy will be kept for the guide.
8. The power point presentation should not exceed 30 minutes which include 10 minutes for discussion/Viva.