KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

REGULATIONS, CURRICULUM & SYLLABI - 2022

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2022 - 2023 and onwards)

MASTER OF TECHNOLOGY DEGREE IN INFORMATION TECHNOLOGY

DEPARTMENT OF INFORMATION TECHNOLOGY

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KONGU ENGINEERING COLLEGE PERUNDURAI ERODE – 638 060
(Autonomous)

INSTITUTE VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

INSTITUTE MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the nation and beyond through research and development
- Continuously improve our services

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION

To be a centre of excellence for development and dissemination of knowledge in Information Technology for the Nation and beyond.

MISSION

Department of Information Technology is committed to:

MS1: To transform the students into innovative, competent and high quality IT professionals to meet the growing global challenges

MS2: To impart value-based IT education to the students and enrich their knowledge

MS3: To endeavour for continuous upgradation of technical expertise of students to cater to the needs of the society

MS4: To achieve an effective interaction with industry for mutual benefits

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Post Graduates of Information Technology will

PEO1: Work on need based research in different domains relevant to Information Technology and carry out research projects of national and social relevance

PEO2: Provide problem solving capability through IT tools and techniques with adequate hands on experience to meet industry/ societal needs

PEO3: Create, apply and disseminate cognitive ideas related to IT field and advance in their profession

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3	PEO4
MS1	3	2	3	2
MS2	2	3	2	3
MS3	2	2	3	2
MS4	1	3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)	
M.Tech(Information Technology) Graduates will be able to:	
PO1:	Carry out research /investigation and development work independently to solve real world problems in the field of information technology
PO2:	Write and present a substantial technical report on their own research findings
PO3:	Apply knowledge of mathematics, science, and computer science/technology to analyze, evaluate, model and integrate technologies for the upcoming issues in the field of Information and Communication Technologies
PO4:	Transfer technology efficiently on engineering needs within engineering community and with society at large, by being able to comprehend and develop presentations and software tools
PO5:	Identify contemporary issues in providing technology solutions for sustainable development considering impact on economic, social, political, and global issues and thereby contribute to the welfare of the society
PO6:	Demonstrate independent learning and erudition by adopting research mission

MAPPING OF PEOs WITH POs

PEOs\POs	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	3		2	3	3	
PEO2			2	2	3	1
PEO3	2	2	3	3		

1 – Slight, 2 – Moderate, 3 – Substantial

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(An Autonomous Institution Affiliated to Anna University)

REGULATIONS 2022

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

MASTER OF ENGINEERING (ME) / MASTER OF TECHNOLOGY (MTech) DEGREE PROGRAMMES

These regulations are applicable to all candidates admitted into ME/MTech Degree programmes from the academic year 2022 – 2023 onwards.

1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

iii. "Programme" means Master of Engineering (ME) / Master of Technology (MTech) Degree programme

iv. "Branch" means specialization or discipline of ME/MTech Degree programme, like Construction Engineering and Management, Information Technology, etc.

v. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Engineering Design Methodology, Machine Learning Techniques, etc.

vi. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

vii. "Grade" means the letter grade assigned to each course based on the marks range specified.

viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

ix. "Principal" means Chairman, Academic Council of the College.

x. "Controller of Examinations" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department" means Head of the Department concerned of the College.

2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

Programme	Branch
	Structural Engineering
	VLSI Design
	Embedded Systems
	Computer Science and Engineering
MTech	Information Technology
	Food Technology

3. ADMISSION REQUIREMENTS

Candidates seeking admission to the first semester of the ME/MTech Degree programme shall be required to have passed an appropriate qualifying Degree Examination of Anna University or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto, subject to amendments as may be made by the Anna University, Chennai from time to time. The candidates shall also be required to satisfy all other conditions of admission prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

4. STRUCTURE OF PROGRAMMES

4.1 Categorisation of Courses

The ME / MTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester and project work, internship,etc that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i. Foundation Courses (FC)

ii. Professional Core (PC) Courses

iii. Professional Elective (PE) Courses

iv. Open Elective (OE) Courses

v. Employability Enhancement Courses (EC) like Innovative Project, Internship cum Project work in Industry or elsewhere, Project Work

4.2 Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits

1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training /Internship Periods	1

The minimum number of credits to complete the ME/MTech programme is 72.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like innovative project, internship cum project work and project work during the programme to gain/exhibit the knowledge/skills.

4.3.1 Innovative Project

A candidate shall earn two credits by successfully completing the project by using his/her innovations in second semester during his/her programme.

4.3.2 Internship cum Project Work

The curriculum enables a candidate to go for full time projects through internship during the third semester and can earn credits through it for his/her academics vide clause 7.6 and clause 7.12. Such candidate shall earn the minimum number of credits as mentioned in the third semester of the curriculum other than internship by either fast track mode or through approved courses in online mode or by self study mode. Such candidate can earn the number of credits for the internship same as that of Project Work in the third semester. Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

4.3.4 Project Work

A candidate shall earn nine credits by successfully completing the project work in fourth semester during the programme inside the campus or in industries.

4.4 One / Two Credit Courses / Online Courses / Self Study Courses

The candidates may optionally undergo One / Two Credit Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 One / Two Credit Courses: One / Two Credit Courses shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through one / two credit courses during the entire duration of the programme.

4.4.2 **Online Courses:** Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.

4.4.3 **Self Study Courses:** The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty. Self study course is limited to one per semester.

4.4.4 The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance (up to second semester).

4.4.5 A candidate can earn a maximum of 15 credits through all one /two credit courses, online courses and self study courses.

4.5 Flexibility to Add or Drop Courses

4.5.1 A candidate has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

4.5.2 From the second to fourth semesters the candidates have the option of registering for additional elective courses or dropping of already registered additional elective courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates. Total number of credits of such courses during the entire programme of study cannot exceed eight.

4.6 Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

4.7 The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

4.8 The medium of instruction, examinations and project report shall be English.

5. DURATION OF THE PROGRAMME

5.1 A candidate is normally expected to complete the ME / MTech Degree programme in 4 consecutive semesters (2 Years), but in any case not more than 8 semesters (4 Years).

5.2 Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

6. COURSE REGISTRATION FOR THE EXAMINATION

6.1 Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

6.2 The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8), earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

6.3 If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The ME/MTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Innovative Project, Internship cum Project work and Project Work. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical (The distribution of marks shall be	50	50
3.	Practical	60	40
4.	Project Work / Internship cum Project Work	50	50
5.	One / Two credit Course	The distribution of marks shall be decided based on the credit weightage assigned	---
6.	All other Courses		

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, innovative project and internships shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 40 marks and the end semester examination shall be for 60 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1 The assessment pattern for awarding continuous assessment marks shall be as follows:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	12.5	---

	Test - II	12.5	
2.	Tutorial / Others (Tutorial/Problem Solving (or) Simulation (or) Simulation & Mini Project (or) Mini Project (or) Case Studies (or) Any other relevant to the course)	10	Type of assessment is to be chosen based on the nature of the course and to be approved by Principal
3.	Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	40	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

7.3.2 A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

7.3.3 The end semester examination for theory courses shall be for duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters of every year.

7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate’s performance during the practical class and the candidate's records shall be maintained.

7.5.1 The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.

7.5.2 The end semester examination shall be conducted for a maximum of 100 marks for duration of 3 hours and reduced to 40 marks. The appointment of examiners and the schedule shall be decided by chairman of Board of Study of the relevant board.

7.6 Project Work

7.6.1 Project work shall becarried out individually. Candidates can opt for full time internship (vide clause 7.7) in lieu of project work in third semester. The project work is mandatory for all the candidates.

7.6.2 The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

7.6.3 The continuous assessment and end semester examination marks for Project Work and the Viva-Voce Examination shall be distributed as below.

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Review I (Max..10 Marks)		Review II (Max.. 20 Marks)		Review III (Max. 20 Marks)		Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Rv. Com	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Ext. Exr.	Guide	Exr.1	Exr.2
5	5	10	10	10	10	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. A candidate must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester. This applies to both Internship cum Project work and Project work.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 Every candidate shall, based on his/her project work, publish a paper in a reputed journal or reputed conference in which full papers are published after usual review. A copy of the full paper accepted and proof for that shall be produced at the time of evaluation.

7.6.7 The project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and guide of the project work.

7.6.8 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.7.

7.6.9 A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

7.7 Internship cum Project Work

Each candidate shall submit a brief report about the internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work as per clause 7.6 excluding 7.6.6.

7.8 One / Two Credit Course

Two assessments shall be conducted during the value added course duration by the offering department concerned.

7.9 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

7.10 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

7.11 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of Registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SC (Successfully Completed). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

8.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

8.1.1 Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

8.1.2 A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

8.1.3 In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

8.1.4 A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

8.1.5 Candidate's progress is satisfactory.

8.1.6 Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

8.2. The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

8.3 The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

9.1 A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

9.2 When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

9.3 A candidate who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

10.1 A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

10.2 The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

10.3 The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

10.4 If a candidate withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

10.5 The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

11.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

11.3 The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

11.4 The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

11.5 If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

12. PASSING REQUIREMENTS

12.1 A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

12.2 A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

12.3 For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

15. AWARD OF LETTER GRADES

For all the passed candidates, the relative grading principle is applied to assign the letter grades.

Marks / Examination Status	Letter Grade	Grade Point
Based on the relative grading	O (Outstanding)	10
	A+ (Excellent)	9
	A (Very Good)	8
	B+ (Good)	7
	B (Average)	6
	C (Satisfactory)	5
Less than 50	U (Reappearance)	0
Successfully Completed	SC	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$\text{GPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in the specific semester}}{\sum(\text{course credits}) \text{ for all courses in the specific semester}}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$\text{CGPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum(\text{course credits}) \text{ for all courses in all the semesters so far}}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the ME / MTech Degree provided the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.

ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate’s programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2020 (vide clause 11.3)

iv. No disciplinary action pending against him / her.

17. CLASSIFICATION OF THE DEGREE AWARDED

17.1 First Class with Distinction:

17.1.1 A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the **First Appearance** within four consecutive semesters excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50

(OR)

17.1.2 A candidate who joins from other institutions on transfer or a candidate who gets readmitted and has to move from one regulation to another regulation and who qualifies for the award of the degree (vide clause 16) and satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the **First Appearance** within four consecutive semesters excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Submission of equivalent course list approved by the respective Board of studies.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 9.00

17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses of all four semesters within six consecutive semesters excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 6.50

17.3 Second Class:

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

17.4 A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the Kongu Engineering College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its ME / MTech programme.

CURRICULUM BREAKDOWN STRUCTURE – R2022						
Summary of Credit Distribution						
Category	**Semester**				**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**		
FC	**7**	**-**	**-**	**-**	**7**	**9.72**
PC	**15**	**12**	**-**	**-**	**27**	**37.5**
PE	**-**	**9**	**9**	**-**	**18**	**25.00**
EC	**-**	**-**	**8**	**12**	**20**	**27.78**
Semester wise Total	**22**	**21**	**17**	**12**	**72**	**100.00**

Category	**Abbreviation**
Lecture hours per week	**L**
Tutorial hours per week	**T**
Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week	**P**
Credits	**C**

CATEGORISATION OF COURSES

FOUNDATION COURSES (FC)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	22AMT13	Advanced Mathematics for Computing	3	1	0	4	I
2.	22GET11	Introduction to Research	2	1	0	3	I
Total Credits to be earned						**7**	

PROFESSIONAL CORE (PC)

S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
1.	22MIT11	Data Structures and Analysis of Algorithms	3	1	0	4	I	N/W &S
2.	22MIT12	Machine Learning Techniques	3	0	0	3	I	CI
3.	22MIT13	Network Design and Technologies	3	0	0	3	I	A&P
4.	22MIT14	Cloud Computing	0	0	2	1	I	A&P
5.	22MIL11	Data Structures and Analysis of algorithms Laboratory	0	0	2	1	I	A&P
6.	22MIL12	Machine Learning Laboratory	3	1	0	4	II	CI
7.	22MIT21	Advanced Database Technology	3	1	0	4	II	CI
8.	22MIT22	Deep Learning Techniques	3	0	0	3	II	CI

9.	22MIT23	Internet of Things	3	1	0	4	II	A&P
10.	22MIL21	Advanced Database Technology Laboratory	0	0	2	1	II	CI
11.	22MIL22	Deep learning Laboratory	0	0	2	1	II	CI
Total Credits to be earned						**27**		

PROFESSIONAL ELECTIVE (PE)

S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
		Elective – I						
1.	22MIE01	Ethical hacking	3	0	0	3	II	N/W &S
2.	22MIE02	Social Network Analysis	3	0	0	3	II	CI
3.	22MIE03	Modern Information Retrieval Techniques	3	0	0	3	II	CI
4.	22MIE04	Randomized Algorithms	3	0	0	3	II	CI
		Elective – II						
5.	22MIE05	Multimedia Compression Techniques	3	0	0	3	II	N/W &S
6.	22MIE06	Software Defined Networking	3	0	0	3	II	N/W &S
7.	22MIE07	Wireless Sensor Networks	3	0	0	3	II	N/W &S
8.	22MIE08	Big Data Analytics	3	0	0	3	II	CI
		Elective – III						
9.	22MIE09	Distributed Systems	3	0	0	3	II	A&P
10.	22MIE10	Advanced Parallel Architecture and Programming	3	0	0	3	II	A&P
11.	22MIE11	Data Mining Techniques	3	0	0	3	II	CI
12.	22MIE12	Mobile and Wireless Security	3	0	0	3	II	N/W &S
		Elective – IV						
13.	22MIE13	User Interface Design	3	0	0	3	III	SD
14.	22MIE14	Multicore Architectures	3	0	0	3	III	A&P
15.	22MIE15	Information Theory and Coding	3	0	0	3	III	N/W &S
16.	22MIE16	Mobile and Pervasive Computing	3	0	0	3	III	N/W &S
		Elective – V						
17.	22MIE17	Web Analytics and Development	3	0	0	3	III	SD
18.	22MIE18	Digital Image Processing and Computer Vision	3	0	0	3	III	A&P
19.	22MIE19	Information Storage Management	3	0	0	3	III	A&P
20.	22MIE20	Nature Inspired Computing	3	0	0	3	III	CI

Elective – VI								
21.	22MIE21	Reinforcement Learning	3	0	0	3	III	CI
22.	22MIE22	Blockchain Technologies	3	0	0	3	III	N/W & S
23.	22MIE23	Quantum Information and Quantum Computing	3	0	0	3	III	A&P
24.	22MIE24	Knowledge Representation and Reasoning	3	0	0	3	III	CI
25.	22GET13	Innovation, Entrepreneurship and Venture Development	3	0	0	3	III	SD
Total Credits to be earned						**18**		

***** Domain/Stream Abbreviations: A&P - Architecture &Programming, SD - Software Development and Engineering, N/W & S - Networks and Security, CI - Computational Intelligence

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
1.	22MIP31	Project Work I	0	0	16	8	III
2.	22MIP41	Project Work II	0	0	24	12	IV
Total Credits to be earned						**20**	

KEC R2020: SCHEDULING OF COURSES – M.Tech. (Information Technology) **Total Credits : 72**

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Credits
I	22AMT13 Advanced Mathematics for Computing (3-1-0-4)	22GET11 Introduction to Research (2-1-0-3)	22MIT11 Data Structures and Analysis of Algorithms (3-0-0-3)	22MIT12 Machine Learning Techniques (3-0-0-3)	20MIT13 Network Design and Technologies (3-1-0-4)	22MIT14 Cloud Computing (3-0-0-3)	22MIL11 Data structures and algorithms Laboratory (0-0-2-1)	22MIL12 Machine Learning Laboratory (0-0-2-1)	22
II	22MIT21 Advanced Database Technologies (3-0-0-3)	22MIT22 Deep Learning Techniques (3-0-0-3)	22MIT23 Internet of Things (3-1-0-4)	Professional Elective – I (3-0-0-3)	Professional Elective – II (3-0-0-3)	Professional Elective – III (3-0-0-3)	22MIL21 Advanced Database technology Laboratory (0-0-2-1)	22MIL22 Deep Learning Laboratory (0-0-2-1)	21
III	Professional Elective IV (3-0-0-3)	Professional Elective V (3-0-0-3)	Professional Elective VI (3-0-0-3)	22MIP31 Project Work I (0-0-16-8)					17
IV	22MIP41 Project Work II (0-0-24-12)								12

MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6
1	22AMT13	Advanced Mathematics for computing	✓		✓			
1	22GET11	Introduction to Research	✓	✓	✓			
1	22MIT11	Data Structures and Analysis of Algorithms	✓	✓	✓	✓		
1	22MIT12	Machine Learning Techniques	✓	✓	✓	✓		
1	22MIT13	Network Design and Technologies	✓	✓	✓	✓		
1	22MIT14	Cloud Computing	✓	✓	✓	✓		
1	22MIL11	Data Structures and Analysis of algorithms Laboratory	✓	✓	✓	✓		
1	22MIL12	Machine Learning Laboratory	✓	✓	✓	✓		
2	22MIT21	Advanced Database Technology	✓	✓	✓	✓		
2	22MIT22	Deep Learning Techniques	✓	✓	✓	✓		
2	22MIC21	Internet of Things	✓	✓	✓	✓		
2	22MIL21	Advanced Database Technology Laboratory	✓	✓	✓	✓		
2	22MIL22	Deep learning Laboratory	✓	✓	✓	✓		
3	22MIP31	Project Work I	✓	✓	✓	✓	✓	✓
4	22MIP41	Project Work II	✓	✓	✓	✓	✓	✓
2	22MIE01	Ethical hacking	✓	✓	✓	✓		
2	22MIE02	Social Network Analysis	✓	✓	✓	✓		
2	22MIE03	Modern Information Retrieval Techniques	✓	✓	✓	✓		

2	22MIE04	Randomized Algorithms	✓	✓	✓	✓		
2	22MIE05	Multimedia Compression Techniques	✓	✓	✓	✓		
2	22MIE06	Software Defined Networking	✓	✓	✓	✓		
2	22MIE07	Wireless Sensor Networks	✓	✓	✓	✓		
2	22MIE08	Big Data Analytics	✓	✓	✓	✓		
2	22MIE09	Distributed Systems	✓	✓	✓	✓		
2	22MIE10	Advanced Parallel Architecture and Programming	✓	✓	✓	✓		
2	22MIE11	Data Mining Techniques	✓	✓	✓	✓		
2	22MIE12	Mobile and Wireless Security	✓	✓	✓	✓		
3	22MIE13	User Interface Design	✓	✓	✓	✓		
3	22MIE14	Multicore Architectures	✓	✓	✓	✓		
3	22MIE15	Information Theory and Coding	✓	✓	✓	✓		
3	22MIE16	Mobile and Pervasive Computing	✓	✓	✓	✓		
3	22MIE17	Web Analytics and Development	✓	✓	✓	✓		
3	22MIE18	Digital Image Processing and Computer Vision	✓	✓	✓	✓		
3	22MIE19	Information Storage Management	✓	✓	✓	✓		
3	22MIE20	Nature Inspired Computing	✓	✓	✓	✓		
3	22MIE21	Reinforcement learning	✓	✓	✓	✓		
3	22MIE22	Blockchain Technologies	✓	✓	✓	✓		
3	22MIE23	Quantum Information and Quantum Computing	✓	✓	✓	✓		
3	22MIE24	Knowledge Representation and Reasoning	✓	✓	✓	✓		
3	22GET13	Innovation, Entrepreneurship and Venture Development	✓	✓	✓	✓		

M.TECH. INFORMATION TECHNOLOGY CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – I									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22AMT13	Advanced Mathematics for Computing	3	1	0	4	40	60	100	FC
22GET11	Introduction to Research	2	1	0	3	40	60	100	FC
22MIT11	Data Structures and Analysis of Algorithms	3	0	0	3	40	60	100	PC
22MST11	Machine Learning Techniques	3	0	0	3	40	60	100	PC
22MIT12	Network Design and Technologies	3	1	0	4	40	60	100	PC
22MIT13	Cloud Computing	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22MIL11	Data Structures and Analysis of Algorithms Laboratory	0	0	2	1	60	40	100	PC
22MSL11	Machine Learning Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					22				

SEMESTER – II									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MIT21	Advanced Database Technology	3	0	0	3	40	60	100	PC
22MIT22	Deep Learning Techniques	3	0	0	3	40	60	100	PC
22MIT23	Internet of Things	3	1	0	4	40	60	100	PC
	Professional Elective - I	3	0	0	3	40	60	100	PE
	Professional Elective – II	3	0	0	3	40	60	100	PE
	Professional Elective - III	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
22MIL21	Advanced Database Technology Laboratory	0	0	2	1	60	40	100	PC
22MIL22	Deep Learning Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					**21**				

M.TECH. INFORMATION TECHNOLOGY CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective – IV	3	0	0	3	40	60	100	PE
	Professional Elective - V	3	0	0	3	40	60	100	PE
	Professional Elective - VI	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
22MIP31	Project Work - I	---	---	16	8	50	50	100	EC
Total Credits to be earned					**17**				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Practical / Employability Enhancement									
22MIP41	Project Work - II	0	0	24	12	50	50	100	EC
Total Credits to be earned					**12**				

Total Credits: 72

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	Course Code	Course Name	L	T	P	C	Domain/ Stream
Semester II							
Elective – I							
1.	22MIE01	Ethical hacking	3	0	0	3	N/W & S
2.	22MIE02	Social Network Analysis	3	0	0	3	CI
3.	22MIE03	Modern Information Retrieval Techniques	3	0	0	3	CI
4.	22MIE04	Randomized Algorithms	3	0	0	3	CI
Elective – II							
5.	22MIE05	Multimedia Compression Techniques	3	0	0	3	N/W &S
6.	22MIE06	Software Defined Networking	3	0	0	3	N/W &S
7.	22MIE07	Wireless Sensor Networks	3	0	0	3	N/W &S
8.	22MIE08	Big Data Analytics	3	0	0	3	CI
Elective – III							
9.	22MIE09	Distributed Systems	3	0	0	3	A&P
10.	22MIE10	Advanced Parallel Architecture and Programming	3	0	0	3	A&P
11.	22MIE11	Data Mining Techniques	3	0	0	3	CI
12.	22MIE12	Mobile and Wireless Security	3	0	0	3	N/W &S
Semester III							
Elective – IV							
13.	22MIE13	User Interface Design	3	0	0	3	SD
14.	22MIE14	Multicore Architectures	3	0	0	3	A&P
15.	22MIE15	Information Theory and Coding	3	0	0	3	N/W &S
16.	22MIE16	Mobile and Pervasive Computing	3	0	0	3	N/W &S
Elective – V							
17.	22MIE17	Web Analytics and Development	3	0	0	3	SD
18	22MIE18	Digital Image Processing and Computer Vision	3	0	0	3	A&P
19.	22MIE19	Information Storage Management	3	0	0	3	A&P
20.	22MIE20	Nature Inspired Computing	3	0	0	3	CI
Elective – VI							
21	22MIE21	Reinforcement Learning	3	0	0	3	CI
22	22MIE22	Blockchain Technologies	3	0	0	3	N/W & S
23	22MIE23	Quantum Information and Quantum Computing	3	0	0	3	A&P
24	22MIE24	Knowledge Representation and Reasoning	3	0	0	3	CI
25	22GET13	Innovation, Entrepreneurship and Venture Development	3	0	0	3	SD

* Domain/Stream Abbreviations: A&P - Architecture &Programming, SD - Software Development and Engineering, N/W & S - Networks and Security, CI - Computational Intelligence

<table>
<tr><th colspan="8">22MIT11 - DATA STRUCTURES AND ANALYSIS OF ALGORITHMS</th></tr>
<tr><th colspan="8">(Common to MTech-Information Technology & ME-Computer Science and Engineering branches)</th></tr>
<tr><td>Programme & Branch</td><td>M.Tech – Information Technology &
M.E - Computer Science and Engineering branches</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>1</td><td>PC</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Preamble</td><td colspan="7">Provides insight into the intrinsic nature of the problem as well as possible solution techniques, independent of programming language/ programming paradigm/computer hardware/ implementation aspect.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction:</td><td>9</td></tr>
<tr><td colspan="8">The Role of Algorithms in Computing- Growth of Functions - Analysis of Recursive and Non-recursive Functions – Lists - Heap Sort – Quick Sort – Sorting in Linear Time.</td></tr>
<tr><td>Unit – II</td><td colspan="6">Advanced Data Structures:</td><td>9</td></tr>
<tr><td colspan="8">Binary Search Trees-Red-Black Trees-Augmenting Data Structures - B- Tress - Binomial Heaps - Fibonacci Heaps.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Algorithm Design Techniques:</td><td>9</td></tr>
<tr><td colspan="8">Overview of Basic Design Techniques: Divide and Conquer (Strassen's Matrix Multiplication) – Dynamic Programming (Rod Cutting) - Greedy Algorithms(Huffman Codes) – Graph:- String Matching: Naive Algorithm - Rabin Karp Algorithm - String matching with finite automata –- Knuth-Morris-Pratt Algorithm - Computational Geometry: Line Segment Properties - Determining segments intersection – Convex Hull – Closest pair of points.</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Graph Algorithms:</td><td>9</td></tr>
<tr><td colspan="8">Elementary Graph Algorithms - Minimum Spanning Trees - Single Source Shortest Paths - All Pairs Shortest Paths - Maximum Flow.</td></tr>
<tr><td>Unit – V</td><td colspan="6">NP and Approximation Algorithm:</td><td>9</td></tr>
<tr><td colspan="8">NP-Completeness: Polynomial Time verification, NP Completeness and Reducibility - NP Completeness Proofs - NP Complete Problems - Approximation Algorithms: Traveling Salesman Problem - Sum of Subset Problem - Vertex Cover Problem.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
</table>

REFERENCES:

1.	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2.	AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012
3.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
4.	Weiss Mark Allen, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Pearson Education, New Delhi, 2007.
5.	Donald E. Knuth, "The Art of Computer Programming", Volumes 1& 3 Pearson Education, 2009. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze algorithms and prove their correctness for searching and sorting	Analyzing (K4)
CO2	determine appropriate data structure as applicable to specified problem definition	Applying (K3)
CO3	design algorithms using different Algorithm Design Techniques and apply them to real world problem	Applying (K3)
CO4	summarize the major graph algorithms and apply on standard problems	Applying (K3)
CO5	outline the significance of NP-completeness and apply Approximation algorithm	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2		
CO2	3	2	2	2		
CO3	3	2	2	2		
CO4	3	2	2	2		
CO5	3	2	2	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	15	70	5			100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	70	5			100

* ±3% may be varied (CAT 1,2, 3 – 50 marks & ESE – 100 marks)

22MST11 - MACHINE LEARNING TECHNIQUES							
(Common to ME-Computer Science and Engineering & MTech-Information Technology branches)							
Programme& Branch	**M.E. – Computer Science and Engineering & MTech-Information Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**1**	**PC**	**3**	**0**	**0**	**3**

Preamble	Provides a concise introduction to the fundamental concepts of machine learning and popular machine learning algorithms	
Unit - I	**Supervised Learning :**	**9**
Definition of Machine Learning - Machine Learning Applications. Supervised Learning: Learning a Class from Examples - VC Dimension - PAC Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm. Dimensionality Reduction: Introduction - Subset Selection – Principal Component Analysis-Feature Embedding - Factor Analysis		
Unit - II	**Tree And Probabilistic Models:**	**9**
Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Different ways to Combine Classifiers – Boosting – Bagging –– Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithm.		
Unit - III	**Multilayer Perceptrons:**	**9**
Introduction - The Perceptron - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - MLP as a Universal Approximator - Backpropagation Algorithm - Training Procedures - Tuning the Network Size - Dimensionality Reduction - Learning Time.		
Unit - IV	**Kernel Machines:**	**9**
Introduction - Optimal Separating Hyperplane - Soft Margin Hyperplane - v-SVM - Kernal Trick - Vectorial Kernels - Defining Kernels - Multiple Kernel Learning - Multiclass Kernel Machines - One class Kernel Machines - Kernel Dimensionality Reduction.		
Unit - V	**Reinforcement Learning:**	**9**
Introduction - Single State Case-Elements of Reinforcement Learning - Model-Based Learning - Temporal Difference Learning - Generalization - Partially Observable States. Design and analysis of Machine Learning Experiments: Introduction - Factors, Response, and Strategy of Experimentation - Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments – Comparing two / more algorithms – Comparison over multiple datasets.		
		Total:45

REFERENCES:

1.	Ethem Alpaydin, “Introduction to Machine Learning”, 3rd Edition, Prentice Hall of India, 2014.
2.	Tom M. Mitchell, "Machine Learning", 1st Edition, McGraw-Hill Education, India, 2013.
3.	Willi Richert, Luis Pedro Coelho, “Building Machine Learning Systems with Python”, 2nd Edition, Packt Publishing Ltd., 2015.
4.	Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the foundations of machine learning and apply suitable dimensionality reduction techniques for an application	Applying (K3)
CO2	make use of supervised methods to solve the given problem	Applying (K3)
CO3	apply neural networks to solve real world problems	Applying (K3)
CO4	solve real world problems using kernel machines	Applying (K3)
CO5	summarize the concepts of reinforcement learning and analyze machine learning algorithms	Analyzing (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2		1
CO2	3	2	2	2		1
CO3	3	2	2	2		1
CO4	3	2	2	2		1
CO5	3	2	2	2		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	50	10			100
ESE	10	30	50	10			100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MIT12 - NETWORK DESIGN AND TECHNOLOGIES							
Programme & Branch	**M.Tech. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Computer Networks**	**1**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course provides insight into Network design, tools for monitoring the network and advanced topics in Networks such as Wireless network protocols, 4G and 5G networks, Software-Defined Networks.

Unit – I	**Network Design Fundamentals:**	**9+3**
Introduction -Cooperative communications -The OSI model -The TCP/IP model -The Internet protocols-Networking hardware-Physical connectivity-Virtual connectivity.		
Unit – II	**Network monitoring and Analysis:**	**9+3**
An effective network monitoring LAN and WAN - Monitoring your network -The dedicated monitoring server – monitoring various network parameters - characteristics of monitoring tools - Types of monitoring tools-Spot check tools-Log analyzers-Trending tools-Real time tools-Benchmarking-Interpret the traffic graph - Monitoring RAM and CPU usage.		
Unit – III	**Wireless Networks:**	**9+3**
IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS.		
Unit – IV	**4G and 5G Networks:**	**9+3**
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10)-4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Introduction to 5G.		
Unit – V	**Software Defined Networks:**	**9+3**
Software Defined Networks: Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – Data centre concepts and constructs : Introduction- The Multitenant Data Center - The Virtualized Multitenant Data Center-Orchestration - Connecting a Tenant to the Internet: VPN - Virtual Machine Migration and Elasticity - SDN Solutions for the Data Center Network – VLANs - Network Topology – Building an SDN Framework :The Juniper SDN Framework.		

Lecture:45, Tutorial:15, Total:60

REFERENCES:

1.	Martin Sauter, “From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband”, 1st Edition, Wiley, 2014.
2.	Thoman D. Nadeau, Ken Gray, “SDN - Software Defined Networks”, 1st Edition, O’Reilly Publishers, 2013.
3.	Flickenger R., Belcher M., Canessa E., Zennaro M., “How To Accelerate Your Internet A Practical Guide to Bandwidth Management and Optimisation using Open Source Software”, 1st Edition, BMO Book Sprint Team, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the components required for designing a network	Applying (K3)
CO2	apply different tools for network monitoring	Applying (K3)
CO3	make use of various wireless network technologies	Applying (K3)
CO4	summarize the features of LTE, 4G and 5G networks	Applying (K3)
CO5	experiment with software defined networks	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	50	25				100
CAT2	20	50	25				100
CAT3	20	50	25				100
ESE	25	50	25				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

<table>
<tr><td colspan="8">22MIT13 - CLOUD COMPUTING</td></tr>
<tr><td>Programme& Branch</td><td>M.Tech. Information Technology</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>1</td><td>PC</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">Provides knowledge about basic concepts of cloud computing, types of cloud services, Technologies and service providers and to understand the distinct basic cloud architecture models and advanced architecture models for complex environments and the security issues and threats in cloud environments</td></tr>
<tr><td>Unit – I</td><td colspan="6">Cloud Computing Basics</td><td>9</td></tr>
<tr><td colspan="8">Introduction to Cloud Computing – Cloud computing reference model- Essential Characteristics -Benefits and challenges of cloud computing- Roles and Boundaries-Cloud Delivery Models - Deployment models -Cloud computing vendors</td></tr>
<tr><td>Unit – II</td><td colspan="6">Cloud Enabling Technology</td><td>9</td></tr>
<tr><td colspan="8">Data Center Technology-Remote operation and management-Facilities- Computing, Storage, Network Hardware- Virtualization Technology-Types of virtualization- OS based virtualization- Hardware based Virtualization- Virtualization Management-Web Technology- Multitenant Technology- Service Technology- Case Study</td></tr>
<tr><td>Unit – III</td><td colspan="6">Fundamental Cloud Architecture</td><td>9</td></tr>
<tr><td colspan="8">Work load Distribution architecture- Resource Pooling Architecture- Dynamic Scalability-Elastic Resource Capacity-Service load balancing-Redundant Storage Architecture- Case Study</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Advanced Cloud Architecture</td><td>9</td></tr>
<tr><td colspan="8">Hypervisor clustering architecture- Cloud Balancing architecture- Resource Reservation- Dynamic failure detection and recovery architecture-Rapid provisioning- Storage workload management architecture-Multipath resource access architecture-Cross Storage device vertical tiering architecture</td></tr>
<tr><td>Unit – V</td><td colspan="6">Security in Cloud</td><td>9</td></tr>
<tr><td colspan="8">Cloud security fundamentals- Basic terms and concepts- Threat agents- Cloud Security Threats-Encryption- Hashing- Digital Signature-Public Key Infrastructure- Identity and Access Management- Single Sign on-Cloud Based Security Groups.</td></tr>
<tr><td colspan="8">Total:45</td></tr>
<tr><td colspan="8">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="7">Thomas Erl, Zaigham Mahmood, Ricardo Puttini, “Cloud Computing: Concepts, Technology and Architecture”, 1st Edition, Prentice Hall, 2013.</td></tr>
<tr><td>2.</td><td colspan="7">Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 1st Edition, McGraw-Hill, 2010.</td></tr>
<tr><td>3.</td><td colspan="7">George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud”, 1st Edition, O'Reilly, 009</td></tr>
<tr><td colspan="8"></td></tr>
</table>

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	articulate the main concepts, key technologies, strengths and limitations of cloud computing	Applying (K3)
CO2	illustrate the architecture, infrastructure and delivery models of cloud computing	Applying (K3)
CO3	make use of the different cloud technologies including virtualization and web based technologies	Applying (K3)
CO4	categorize the appropriate cloud architecture for distinct functional areas.	Applying (K3)
CO5	identify the core issues of cloud computing such as security, threats and privacy.	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	10	60	30				100

* ±3% may be varied (CAT 1 & 2 – 60 marks & ESE – 100 marks)

22MIL11 - DATA STRUCTURES AND ANALYSIS OF ALGORITHMS LABORATORY							
(Common to MTech-Information Technology and ME-Computer Science and Engineering branches)							
Programme& Branch	**MTech-Information Technology & ME - Computer Science and Engineering branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**0**	**0**	**2**	**1**

Preamble	Provides insight into the intrinsic nature of the problem as well as possible solution techniques, independent of programming language/ programming paradigm/computer hardware/ implementation aspect.

LIST OF EXPERIMENTS / EXERCISES:

1.	Implement any two sorting algorithms
2.	Implement Binary Search Trees
3.	Implement Red-Black trees – Insertion and Display
4.	Implement Binomial Heap and Fibonacci heaps algorithms
5.	Implement Strassen‘s matrix multiplication algorithm using Algorithm Design Techniques
6.	Implement Huffman code using Algorithm Design Techniques
7.	Implement String Matching algorithms (any two)
8.	Implement Graph algorithms
9.	Solve NP Problems sum of Subset problem
10.	Implement Travelling sales person problem
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the use of data structure for solving the given problem	Applying (K3) Precision(S3)
CO2	choose and employ appropriate design technique to solve real world problems	Applying (K3) Precision(S3)
CO3	apply operations like searching, insertion, deletion and traversing on various data structures	Applying (K3) Precision(S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2		
CO2	3	1	2	2		
CO3	3	1	2	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

22MSL12 - MACHINE LEARNING LABORATORY							
(Common to ME-Computer Science and Engineering & MTech-Information Technology branches)							
Programme& Branch	**M.E. – Computer Science and Engineering & MTech-Information Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**1**	**PC**	**0**	**0**	**2**	**1**

Preamble	Exposed to apply the various supervised and unsupervised learning algorithms to solve real time problems

LIST OF EXPERIMENTS / EXERCISES:

1.	Implementation of preprocessing techniques
2.	Implementation of linear regression
3.	Implementation of PCA for dimensionality reduction
4.	Implementation of Decision tree
5.	Implementation of k-means clustering
6.	Implementation of k-NN
7.	Implementation of Multilayer perceptron for classification
8.	Implementation of Backpropagation algorithm
9.	Implementation of Gaussian Mixture Model Using the Expectation Maximization
10.	Comparison of linear regression and decision tree algorithm for the given dataset
11.	Comparison of kernel functions of Support Vector Machine for the given dataset
12.	Evaluating machine learning algorithm with balanced and unbalanced datasets
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : MATLAB, Python, R
3.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	implement various supervised algorithms and evaluate the performance	Applying (K3), Precision (S3)
CO2	implement the unsupervised algorithms and evaluate the performance	Applying (K3), Precision (S3)
CO3	implement and compare the performance of different algorithms	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2		1
CO2	3	1	2	2		1
CO3	3	1	2	2		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MIT21 - ADVANCED DATABASE TECHNOLOGY							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Database Management Systems**	**2**	**PC**	**3**	**0**	**0**	**3**

Preamble	The course provides knowledge on advanced databases like parallel and distributed database, object-oriented database, active database, temporal database, spatial database, mobile database, multimedia database, XML database and cloud database to effectively store the data for real time applications.

Unit – I	**Parallel and Distributed Databases:**	**9**
Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures - Parallel Systems - Distributed Systems - Parallel Databases: I/O Parallelism - Inter and Intra Query Parallelism - Inter and Intra operation Parallelism -Design of Parallel Systems - Distributed Database Concepts - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control - Distributed Query Processing - Case Studies.		
Unit – II	**Object Oriented Databases:**	**9**
Object Oriented Databases - Introduction - Weakness of RDBMS - Object Oriented Concepts - Storing Objects in Relational Databases - Next Generation - Database Systems - Object Oriented Data models - OODBMS Perspectives - Persistence - Issues in OODBMS - Object Oriented Database Management System Manifesto - Advantages and Disadvantages of OODBMS - Object Oriented Database Design - OODBMS Standards and Systems - Object Management Group - Object Database Standard ODMG - Object Relational DBMS - Postgres - Comparison of ORDBMS and OODBMS.		
Unit – III	**Intelligent Databases:**	**9**
Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) – Taxonomy – Applications - Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases- TSQL2 - Deductive Databases: Logic of Query Languages - Datalog -Recursive Rules- Syntax and Semantics of Datalog Languages - Implementation of Rules and Recursion - Recursive Queries in SQL - Spatial Databases - Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.		
Unit – IV	**Advanced Data Models:**	**9**
Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution-Mobile Transaction Models-Concurrency Control - Transaction Commit Protocols - Multimedia Databases - Information Retrieval - Data Warehousing - Data Mining - Text Mining.		
Unit – V	**Emerging Technologies:**	**9**
XML Databases: XML Data Model - DTD - XML Schema - XML Querying - Web Databases - Geographic Information Systems - Biological Data Management - Cloud Based Databases: Data Storage Systems on the Cloud - Cloud Storage Architectures - Cloud Data Models - Query Languages - Introduction to Big Data - Storage - Analysis.		
		Total:45

REFERENCES:

1.	Henry F. Korth, Abraham Silberschatz S., Sudharshan, “Database System Concepts”, 7th Edition, McGraw Hill, 2019, (for Unit I)
2.	Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, 6th Edition, Pearson Education, 2015. (for Unit II)
3.	Elmasri R., Navathe S.B., “Fundamentals of Database Systems”, 7th Edition, Pearson Education/Addison Wesley, 2019.(for Unit III and V)
4.	Vijay Kumar, “Mobile Database Systems”, 1st Edition, John Wiley & Sons, 2006. (for Unit IV)
5.	Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill, 2004.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	use the appropriate high performance databases like parallel and distributed database	Applying (K3)
CO2	relate and represent the real world data using object oriented database	Applying (K3)
CO3	construct the semantic database for the meaningful and intelligent data access	Applying (K3)
CO4	demonstrate the advanced data models such as location based and multimedia databases	Applying (K3)
CO5	experiment the data using XML database for better interoperability	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	15	35	50				100
CAT3	15	35	50				100
ESE	15	35	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIT22 - DEEP LEARNING TECHNIQUES

Programme & Branch	M.TECH & Information Technology	Sem	Category	L	T	P	Credit
Prerequisites	**Fundamental concepts of Algorithms and computer programming**	**2**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course will help the students to understand the fundamental concepts in the design of deep neural networks and to implement its various architectures. It also explores different dimensions of deep learning applications.

Unit – I **Foundations of Deep Learning:** **9**

Linear Regression: Linear Regression – LR Implementation from Scratch – Implementation macof LR – Softmax Regression – The image Classification dataset – Implementation of Softmax Regression from Scratch - Concise Implementation of Softmax Regression. **Multilayer Perceptrons:** MLP- Implementation of MLP from Scratch - Concise Implementation of MLP - Model Selection, Underfitting, and Overfitting - Weight Decay – Dropout - Forward & Backward Propagation, and Computational Graphs - Numerical Stability and Initialization.

Unit – II **Convolutional Neural Networks:** **9**

Convolutional Neural Networks: Fully-Connected Layers to Convolutions - Convolutions for Images - Padding and Stride - Multiple Input and Multiple Output Channels – Pooling. **Modern Convolutional Neural Networks:** LeNet – AlexNet – VGG – NiN – GoogleLeNet - Batch Normalization – ResNet – DenseNet

Unit – III **Recurrent Neural Networks:** **9**

Recurrent Neural Networks: Sequence Models - Text Preprocessing - Language Models and the Dataset – RNN – Implementation of RNN from Scratch - Concise Implementation of RNN - Backpropagation Through Time**. Modern Recurrent Neural Networks:** GRU – LSTM – Deep RNN – Bi-RNN - Machine Translation and the Dataset - Encoder-Decoder Architecture - Sequence to Sequence Learning - Beam Search

Unit – IV **Attention Mechanisms and Transformers:** **9**

Attention Cues - Attention Pooling - Attention Scoring Functions - Bahdanau Attention - Multi-Head Attention - Self-Attention and Positional Encoding - The Transformer Architecture - Transformers for Vision - Large-Scale Pretraining with Transformers.

Unit – V **Recommender Systems and Generative Adversarial Networks:** **9**

Recommender Systems : Overview of Recommender Systems - The MovieLens Dataset - Matrix Factorization - AutoRec: Rating Prediction with Autoencoders - Personalized Ranking for Recommender Systems - Neural Collaborative Filtering for Personalized Ranking - Sequence-Aware Recommender Systems - Feature-Rich Recommender Systems - Factorization Machines - Deep Factorization Machines. **Generative Adversarial Networks:** GAN - Deep Convolutional Generative Adversarial Networks

Total:45

REFERENCES:

1.	Aston Zhang, “Dive into Deep Learning”, Link: https://classic.d2l.ai/chapter_preface/index.html
2.	Andrew Glassner, “Deep Learning: A Visual Approach”, https://archive.org/details/deep-learning-a-visual-approach/mode/2up
3.	IndradenBakker, “PythonDeepLearningCookbook”,1st Edition, Packt Publishing, 2017.
4.	Josh Patterson and Adam Gibson,“Deep Learning– A Practitioner‘s Approach”, 1st Edition, O‟Reilly Series, 2017
5.	Ian Goodfellow, Yoshua Bengio and Aaron Courville,“DeepLearning”,1st Edition, MIT Press, 2016.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the concepts of regression and multilayer perceptron to solve simple problems	Applying (K3)
CO2	exemplify the concepts of CNN models and apply it for solving computer vision related problems	Applying (K3)
CO3	apply the concepts of RNN models for solving natural language processing and time series prediction problems	Applying (K3)
CO4	make use of Tensor flow/keras frameworks to build attention based models in deep learning.	Applying (K3)
CO5	utilize deep learning methods for developing recommender systems and Generative Adversarial Networks for solving real world problems	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIT23 - INTERNET OF THINGS							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Microprocessors/ Microcontrollers/ Computer Organization/ Networks**	**2**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course is intended to give students a thorough understanding of IoT and its applications and to design, develop and analyze the various tools for building IoT applications also to develop IoT infrastructure for various real time applications.	
Unit – I	**Introduction to Internet of Things and Design Methodology:**	**9+3**
Definition and Characteristics of IoT - Physical Design of IoT - IoT Protocols - IoT Communication Models - IoT Communication APIs - IoT enabled Technologies - IoT Levels and Templates - M2M - Difference between M2M and IoT - Software defined networks - Network function virtualization - IoT Platform design Methodologies.		
Unit – II	**IoT Architecture and Protocols:**	**9+3**
Four Pillars of IoT - DNA of IoT - Middleware for IoT: Overview - Communication middleware for IoT - LBS and Surveillance Middleware - Protocol Standardization for IoT - Efforts - M2M and WSN Protocols - SCADA and RFID Protocols - Unified Data Standards.		
Unit – III	**Introduction to Python and IoT Physical Devices:**	**9+3**
Language features of Python - Data types - Data structures - Control of flow – Functions – Modules – Packaging - File handling - Data/time operations – Classes - Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib - Introduction to Raspberry PI - Interfaces (serial, SPI, I2C)Programming - Python program with Raspberry PI with focus of interfacing external gadgets - Controlling output - Reading input from pins.		
Unit – IV	**Cloud Storage and Analysis:**	**9+3**
Various Real time applications of IoT - Connecting IoT to cloud - Cloud Storage for IoT - Data Analytics for IoT - Software and Management Tools for IoT		
Unit – V	**Cyber Security and Privacy in Internet of Things :**	**9+3**
Security and Privacy issues and challenges - Mitigating Security and Privacy Challenges - Security Assessment of an IoT Solution - Attacks and Countermeasures: Perception Layer - Network Layer - Transport Layer - Application Layer - IoT security requirements based on CIA Principles - Security in IoT Protocols.		
		Lecture:45; Tutorial : 15; Total: 60

REFERENCES:

1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things - A Hands-on Approach”, 1st Edition, Universities Press, 2015.
2.	Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, 1st Edition, CRC Press, 2012.
3.	https://www.isaca.org/Journal/archives/2015/Volume-4/Pages/security-and-privacy-challenges-of-iot-enabled-solutions.aspx
4.	https://www.researchgate.net/270763270_Survey_of_Security_and_Privacy_Issues

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	depict the physical and logical design of IoT and identify the appropriate IoT level and develop design methodologies for a given application	Applying (K3)
CO2	illustrate the architecture, need for middleware and the role of different standardization protocols	Applying (K3)
CO3	use the basic concepts and packages of Python related to IoT for interfacing with IoT devices	Applying (K3)
CO4	develop simple real time applications, upload the data onto the cloud and perform data analytics	Applying (K3)
CO5	identify the security threats against a given IoT system and suggest simple countermeasures	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40				100
CAT2	15	40	45				100
CAT3	15	40	45				100
ESE	15	40	45				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIL21 - ADVANCED DATABASE TECHNOLOGY LABORATORY								
Programme & Branch	**M.TECH & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Database Management Systems**	**2**	**PC**	**0**	**0**	**2**	**1**

Preamble	To acquire knowledge on advanced databases like parallel and distributed database, object-oriented database, active database, temporal database, spatial database, mobile database, multimedia database, XML database and cloud database to effectively store the data for real time applications.

LIST OF EXPERIMENTS / EXERCISES:

1.	Distributed Database for Bookstore
2.	Deadlock Detection Algorithm for distributed database using wait- for graph
3.	Object Oriented Database – Extended Entity Relationship (EER)
4.	Parallel Database – University Counselling for Engineering colleges
5.	Parallel Database – Implementation of Parallel Join & Parallel Sort
6.	Active Database – Implementation of Triggers & Assertions for Bank Database
7.	Deductive Database – Constructing Knowledge Database for Kinship Domain (Family Relations)
8.	Study and Working of WEKA Tool
9.	Query Processing – Implementation of an Efficient Query Optimizer
10.	Designing XML Schema for Company Database
	Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Front End: Microsoft Visual Studio 6.0, Microsoft .NET Framework SDK v2.0, Java
2.	Back End : ORACLE/SQL SERVER/ MYSQL
3.	WEKA Tool
4.	HTML /JavaScript

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design an effective query processing for parallel and distributed database	Applying (K3), Precision (S3)
CO2	design an online system for various applications	Applying (K3), Precision (S3)
CO3	design an application using advanced data models	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	1		
CO2	3	3	2	1		
CO3	3	3	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MIL22 - DEEP LEARNING LABORATORY

Programme & Branch	M.TECH & Information Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamental concepts of Algorithms and computer programming	2	PC	0	0	2	1

Preamble	This course deals with various algorithms to enable computers to learn data without being explicitly programmed. An insight into various types of deep learning algorithms, strategies for model generation and evaluation.

LIST OF EXPERIMENTS / EXERCISES:

1.	Explore the various deep learning libraries like PyTorch, TensorFlow, MXNet, etc.,
2.	Predict house prices using multi-layer neural network
3.	Test the performance of multi-layer neural network with various activation and loss functions
4.	Develop a simple application for Object detection in Images
5.	Demonstrate a simple application for Image classification using CNN
6.	Create RNN-based Character-Level Language Model
7.	Design a bidirectional RNN with multiple hidden layers
8.	Implement the attention mechanism in the neural network
9.	Implement collaborative filtering based Recommendation system
10.	Develop a simple application using GAN
11.	Implement a simple application for Human Face Detection using CNN
12.	Build a simple application for Named Entity Recognition using LSTM

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Operating System : Windows/ Linux
2.	Software : Anaconda/ Python
3.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	build skills in DL tools/libraries in the field of designing, training and deploying simple neural networks for solving different practical/engineering problems.	Applying (K3), Precision (S3)
CO2	identify and develop various CNN/RNN based models to solve real world problems.	Applying (K3), Precision (S3)
CO3	implement attention mechanism, recommendation system and Generative Adversarial Networks to develop diverse applications.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	1		
CO2	3	3	2	1		
CO3	3	3	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MIP31 - PROJECT WORK I

Programme & Branch	**MTech - Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Knowledge on IT core courses**	**3**	**EC**	**0**	**0**	**16**	**8**

Preamble	It provides practical exposure to the students and an opportunity to apply the computational mathematics concepts and recent technologies to solve the real world problems.

Total:240

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.	Creating (K6), Precision (S3)
CO2	perform literature study in the area of interest.	Evaluating (K5), Precision (S3)
CO3	plan, design, analyze, implement to identify optimal solutions	Evaluating (K5), Precision (S3)
CO4	perform error analysis, synthesize the results and arrive at scientific conclusions.	Evaluating (K5), Precision (S3)
CO5	paraphrase the results in the form of technical report and present their findings.	Creating (K6), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MIP41 - PROJECT WORK II

Programme & Branch	MTech - Information Technology	Sem.	Category	L	T	P	Credit
Prerequisites	**Knowledge on IT core courses**	**4**	**EC**	**0**	**0**	**24**	**12**

Preamble	It provides practical exposure to the students and an opportunity to apply the computational mathematics concepts and recent technologies to solve the real world problems.

Total:360

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.	Creating (K6), Precision (S3)
CO2	perform literature study in the area of interest.	Evaluating (K5), Precision (S3)
CO3	plan, design, analyze, implement to identify optimal solutions	Evaluating (K5), Precision (S3)
CO4	perform error analysis, synthesize the results and arrive at scientific conclusions.	Evaluating (K5), Precision (S3)
CO5	paraphrase the results in the form of technical report and present their findings.	Creating (K6), Precision (S3)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MIE01 - ETHICAL HACKING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides the fundamental knowledge about security permissions in computer, internet and system and how to secure from the various vulnerabilities and provide countermeasures for real world applications.	
Unit – I	**Casing the Establishment:**	**9**
What is foot printing? - Internet Foot printing- Scanning – Determining if the system is alive – Determining which services are running or Listening – Detecting the operating system – Processing and storing scan data - Enumeration - basic banner grabbing- Enumerating Common Network services- Case study- Network Security Monitoring.		
Unit – II	**System Hacking:**	**9**
Introduction – Cracking password – Password cracking websites – Password guessing Algorithms – Password Cracking Tools – Countermeasure – Escalating Privileges- Executing Applications – Key loggers and spywares.		
Unit – III	**Infrastructure and Hardware Hacking:**	**9**
Remote connectivity and VoIP Hacking - Preparing to dial up- War – Dialing - Brute-Force Scripting - PBX hacking - Voice mail hacking - VPN hacking – Hacking Hardware – Physical access –Hacking Devices – Default Configurations – Reverse Engineering Hardware.		
Unit – IV	**Wireless and Firewall Hacking:**	**9**
Wireless Equipment – Discovery and monitoring - Denial of Service Attacks – Common DoS Attack Techniques - DoS Countermeasures - Encryption attacks –Authentication attacks - Firewalls - Firewalls landscape - Firewall Identification - Scanning Through firewalls - Packet Filtering - Application Proxy Vulnerabilities.		
Unit – V	**Application Hacking and Counter measures :**	**9**
Web and Database Hacking – Web Server Hacking - Web application Hacking - Common web application Vulnerabilities – Database Hacking – Mobile Hacking – Hacking android – iOS.		
		Total: 45

REFERENCES:

1.	Stuart McClure, Joel Scambray, Goerge Kurtz, “Hacking Exposed 7 : Network Security Secrets and Solutions”, 7th Edition, Tata McGrawHill Publishers, 2012.
2.	EC- Council Press, “Ethical Hacking and Countermeasures: Threats and Defense Mechanisms”, 1st Edition, Cengage Learning, 2009.
3.	EC- Council Press, “Ethical Hacking and Countermeasures: Attack Phases”, 1st Edition, Cengage Learning, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain the basic vulnerabilities in any computing system	Applying (K3)
CO2	determine the possible security attacks in complex real time systems and their effective countermeasures	Applying (K3)
CO3	identify the security issues in hardware and software	Applying (K3)
CO4	interpret the vulnerabilities in wireless environment and firewall systems	Applying (K3)
CO5	formulate research problems in the computer security applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	20	50	30				100
CAT 2	15	45	40				100
CAT 3	15	45	40				100
ESE	15	45	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE02 - SOCIAL NETWORK ANALYSIS							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provide knowledge on graphs and revelation of their properties with their tools have been termed as Social Network Analysis. Some of the surprising and beautiful discoveries achieved with Social Network Analysis are 6 degrees of separation, the algorithm behind Google search, Link prediction, Viral marketing, etc.,	
Unit – I	**Graph Theory and Social Networks :**	**9**
Graphs: Basic Definitions- Paths and Connectivity- Distance and Breadth First Search-Network Dataset: An overview. Strong and Weak Ties: Triadic Closure- The Strength of Weak Ties- Tie Strength and Network Structure in Large Scale Data- Tie Strength, Social Media, and Passive Engagement- Closure, Structural Holes, and Social Capital- Networks in their Surrounding Contexts: Homophily – Mechanism Underlying Homophily-Selection and Social Influence- Affiliation. Positive and Negative Relationships: Structural Balance- Characterizing the Structure of Balanced Networks – Application of Structural Balance – A Weaker Form of Structural Balance		
Unit – II	**Game Theory and Interaction in Networks:**	**9**
Games: What is Game- Reasoning about Behavior in Game- Best Responses and Dominant Strategies- Nash Equilibrium- Multiple Equilibria- Coordination Games, The Hawk-Dove Game-Mixed Strategies-Examples and Empirical Analysis- Pareto Optimality and Social Optimality. Evolutionary Game Theory: Fitness as a Result of interaction- Evolutionarily Stable Strategies- A General Description of Evolutionarily Stable Strategies- Relationship between Evolutionarily and Nash Equilibria- Evolutionarily Stable Mixed Strategies. Modeling Network Traffic using Game Theory: Traffic at Equilibrium- Braess's Paradox. Matching Markets: Bipartite Graphs and Perfect Matchings- Valuations and Optimal Assignments.		
Unit – III	**Information Networks and the World Wide Web:**	**9**
The Structure of the Web: The World Wide Web- Information Networks, Hypertext, and Associative Memory- The Web as a Directed Graph- The Bow-Tie Structure of the Web. Link Analysis and Web Search: Searching the Web: The problem of Ranking- Link Analysis using Hubs and Authorities- Page Rank- Applying Link Analysis in Modern Web Search.		
Unit – IV	**Network Dynamics - Population Models:**	**9**
Information Cascades: Following the Crowd- A Simple Herding Experiment- Bayes Rule: A model of Decision Making-Making under Uncertainty- Baye's Rule in the Herding Experiment- A Simple, General Cascade Model- Sequential Decision Making and Cascades. Network Effects: The Economy Without Network Effects- The Economy with Network Effects- Stability, Instability and Tipping Points- A Dynamic View of the Market- Industries with Network Goods- Mixing Individual Effects with Population-Level Effects. Power Laws and Rich-Get-Richer Phenomena: Popularity as Network Phenomenon-Power Laws- Rich-Get-Richer Models-The Unpredictability of Rich-Get-Richer Model-The Long Tail-The Effect of Search Tools and Recommendation Systems.		
Unit – V	**Network Dynamics – Structural Models:**	**9**
Cascading Behavior in Networks: Diffusion in Network-Modeling diffusion through a Network- Cascades and Clusters-Diffusion, Thresholds, and the Role of Weak Ties- Extensions of the Basic Cascade Model- Knowledge, Thresholds and Collective Action. The Small-World Phenomenon: Six Degrees of Separation- Structure and Randomness-Decentralized Search- Modeling the process of Decentralized Search- Empirical Analysis and Generalized Models-Core Periphery Structures and Difficulties in Decentralized Search. Epidemics: Diseases and the Networks that transmit them-Branching Processes- The SIR Epidemic Model- The SIS Epidemic Model- Synchronization- Transient Contacts and the Danger of Concurrency.		
		Total:45

REFERENCES:

1.	David Easley, Jon Klienberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World", 1st edition, Cambridge University Press, 2010.
2.	Stanley Wasserman, Katherine Faust, "Social Networks Analysis: Methods and Applications", Cambridge University Press, 2010.
3.	Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings", 1st edition, Oxford University Press, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concepts of graph theory for analysis of social networks distribution	Applying (K3)
CO2	utilize game theory for decision making in the context of social networking	Applying (K3)
CO3	compare and contrast different link analysis and web search techniques	Applying (K3)
CO4	analyze network behavior based on population model	Applying (K3)
CO5	investigate the aggregate behavior of the social networks based on structural model	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	20	50	30				100
CAT 2	20	50	30				100
CAT 3	20	30	50				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE03 - MODERN INFORMATION RETRIEVAL TECHNIQUES

Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**DBMS, Web Technology**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course discusses about the basic concepts of IR, and various modeling techniques with different ways of indexing and searching mechanisms to build a text or multimedia based IR system.	
Unit – I	**Introduction and Classic IR Models:**	**9**
Information Retrieval - The IR Problem - The IR System - Search Interfaces Today - Visualization in Search Interfaces - Modeling – Boolean Model – Term Weighting – TF-IDF Weighting – Vector Model – Set Theoretic Models – Algeraic Models – Latent Semantic Indexing Model – Neural Network Model - Probabilistic Models - Retrieval Evaluation – Retrieval Metrics.		
Unit – II	**Relevance Feedback, Languages and Query Properties:**	**9**
A Framework for feedback methods - Explicit Relevance feedback - Implicit feedback through local analysis - Global analysis - Documents: Metadata - Documents formats - Queries - Query Language – Query Properties.		
Unit – III	**Text Operations, Indexing and Searching:**	**9**
Text Properties - Document Preprocessing - Text Compression – Text Classification – Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms – Decision Tree – K-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation Metrics – Accuracy and Error – Indexing and Searching – Inverted Indexes – Sequential Searching – Multidimensional Indexing.		
Unit – IV	**Web Retrieval and Web Crawling:**	**9**
The Web – Search Engine Architectures – Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – User Interaction –Browsing – Web Crawling – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.		
Unit – V	**Applications:**	**9**
Enterprise Search - Tasks - Architecture – Library Systems – Online Public Access Catalogues – IR System and Document Databases – Digital Libraries – Architecture and Fundamentals.		
		Total:45

REFERENCES:

1.	Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval”, 2nd Edition, Pearson Education Asia, 2011.
2.	Chowdhury G.G., “Introduction to Modern Information Retrieval”, 2nd Edition, Neal-Schuman Publishers, 2003.
3.	Daniel Jurafsky, James H. Martin, “Speech and Language Processing”, 1st Edition, Pearson Education, 2000.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the basic concepts of information retrieval	Applying (K3)
CO2	apply the various modeling techniques	Applying (K3)
CO3	discuss the concepts of feedback, languages and query properties	Applying (K3)
CO4	create an IR application by using text-based indexing and searching mechanisms	Applying (K3)
CO5	design a simple search engine	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	10	50	40				100
CAT 2	20	30	50				100
CAT 3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

<table>
<tr><td colspan="8">22MIE04 – RANDOMIZED ALGORITHMS</td></tr>
<tr><td>Programme & Branch</td><td>M.TECH. & Information Technology</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Design and Analysis of Algorithms, Data Structures and Algorithms</td><td>2</td><td>PE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

Preamble	In this course, the probability tools required to design and analyze a randomized algorithm are studied. The emphasis will be on strengthening the analytical skills of the student so that he can independently design or analyze a randomized algorithm	
Unit – I	**Introduction:**	**9**
Min-Cut Algorithm, Binary Planar Partitions, Game-theoretic techniques: Game Tree Evaluation, The Minimax principle, Randomness and Non-uniformity. Moments and deviations: Occupancy Problems, Markov and Chebyshev Inequalities, Randomized Selection, Two-point Sampling, Stable Marriage Problem and Coupon Collector„s Problem		
Unit – II	**Tail Inequalities:**	**9**
Chernoff Bound, Routing in a parallel Computer, A wiring Problem, Martingales. The probabilistic method: Overview, Maximum Satisfiability, Expanding Graphs, Lovasz Local Lemma and Method of Conditional Probabilities		
Unit – III	**Markov Chains and Random Walks:**	**9**
A 2-SAT Example, Markov Chains, Random Walks on Graphs, Electrical Networks, Cover Times, Graph Connectivity, Expanders and Rapidly Mixing Random Walks. **Algebraic techniques:** Fingerprinting and Freivalds Technique, verifying polynomial identities, perfect matchings in graphs, verifying equality of strings, pattern matching, Interactive proof systems		
Unit – IV	**Data Structures and Graph algorithms:**	**9**
Fundamental Data-structuring problem, Random Treaps, Skip Lists, Hash Tables and Hashing. All-pairs Shortest Paths, Min-cut Problem, Minimum Spanning Trees.		
Unit – V	**Approximate Counting and Parallel and distributed algorithms:**	**9**
Randomized Approximation Schemes, DNF Counting Problem, Volume Estimation. PRAM model and its sorting, Maximal Independent Sets, Perfect Matching, Choice Coordination Problem, Byzantine Agreement		
		Total:45

REFERENCES:

1.	Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, 1st Edition, Cambridge University Press, Reprint 2010
2.	Michael Mitzenmacher and Eli Upfal, “Probability and Computing: Randomized Algorithms and Probabilistic Analysis”, Cambridge University Press, 2005
3.	Grimmett and Stirzaker, “Probability and Random Processes”, Oxford University Press, 2001

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the basic concepts in the design and analysis of randomized algorithms	Applying (K3)
CO2	develop tail inequalities and different probability that are frequently used in algorithmic application	Applying (K3)
CO3	determine the use of Markov chains and Random walks in the different practical applications	Applying (K3)
CO4	discover the applications of data structures and graph algorithms	Applying (K3)
CO5	examine the different appropriate counting schemes and parallel and distributed algorithms for various applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	20	30	50				100
CAT 2	20	30	50				100
CAT 3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE05 - MULTIMEDIA COMPRESSION TECHNIQUES							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Networks	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provide methods for handling and compressing various kinds of data, such as text, images, audio and video data and understand data compression techniques for multimedia and other applications, in particular to the Internet.	
Unit – I	**Introduction:**	**9**
Special features of Multimedia – Graphics and Image Data Representations – Popular File formats – Fundamental Concepts in Video – Digital Audio – Storage requirements for multimedia applications –Need for Compression – Lossy & Lossless compression techniques– Overview of Source Models – Source coding – Scalar and Vector quantization		
Unit – II	**Text Compression:**	**9**
Compression techniques: Shannon- Fano coding –Huffman coding – Adaptive Huffman Coding – Arithmetic coding – Dictionary techniques: LZW algorithm		
Unit – III	**Audio Compression:**	**9**
Audio compression techniques – μ- Law and A-Law companding- Differential Encoding –DPCM- ADPCM – DM – Optimal Predictors and Optimal Quantization –Application to speech coding: G.722 – Application to audio coding : MPEG audio, Speech compression techniques : Formants and CELP Vocoders		
Unit – IV	**Image Compression :**	**9**
Transform Coding: JPEG Standard – Sub band coding algorithms – Design of Filter banks – Implementation using filters- Wavelet based compression: EZW- SPIHT coders – JPEG 2000 standards- JBIG- JBIG2 standards		
Unit – V	**Video Compression:**	**9**
Video compression Based on Motion Compensation – Search for Motion Vectors – H.261 – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4: Object Based Visual Coding –Synthetic Object Coding –Object types-Profiles and Levels – MPEG 7.		
		Total:45

REFERENCES:

1.	Morgan Kauffman, Khalid Sayood, “Introduction to Data Compression”, 2nd Edition, Harcourt India, 2000.
2.	David Salomon, “Data Compression – The Complete Reference”, 2nd Edition, Springer Verlag, New York Inc., 2001.
3.	Mark S. Drew, Ze-Nian Li, “Fundamentals of Multimedia”, 2nd Edition, Prentice Hall India, 2005.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	summarize scalar and vector quantization theory and also to represent the multimedia data in different formats for various applications	Applying (K3)
CO2	make use of different coding techniques and apply various algorithms for text compression	Applying (K3)
CO3	identify the various audio and speech compression techniques for practical applications	Applying (K3)
CO4	take part in image compression techniques and also to implement the compression techniques in MATLAB	Applying (K3)
CO5	compare various video compression algorithms for practical applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	20	40	40				100
CAT 2	10	30	60				100
CAT 3	10	30	60				100
ESE	10	30	60				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE06 - SOFTWARE DEFINED NETWORKING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Operating Systems, Data Structures and Algorithms, Computer Networks	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	Provides insight on basics of software defined networking and how it is changing the way communication networks are managed, maintained, and secured.	
Unit – I	**Introduction to SDN:**	**9**
Traditional switch Architecture, Autonomous and Dynamic Forwarding Table, Why SDN?, The Genesis of SDN, How SDN works, The OpenFlow Specification , OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 and OpenFlow 1.3		
Unit – II	**SDN application in Data Center:**	**9**
SDN in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, SDN in other Environments, SDN Applications, SDN Open Source, Switch Implementation, Controller Implementation, SDN Futures		
Unit – III	**SDN control plane:**	**9**
Distributed Control plane, Centralized Control plane, OpenFlow, SDN Controllers, Network Programmability, Data Center concepts and constructs, The Virtualized Multitenant Data Center, SDN solution for Data Center Network		
Unit – IV	**SDN and NFV:**	**9**
Network Function Virtualization, Virtualization and Data plane I/O, Service Locations and Chaining, Network Topology and Topological Information Abstraction, Building an SDN Framework, IETF SDN Frameworks, Open Daylight Controller/Framework		
Unit – V	**SDN use cases:**	**9**
Use cases for Bandwidth Scheduling, Manipulation and calendaring, Data Center Overlays, Big Data and Network Function Virtualization, Input Traffic Monitoring, Classification, and Triggered Actions.		
		Total:45

REFERENCES:

1.	Paul Goransson, Chuck Black, Morgan Kaufmann, “Software Defined Networks: A Comprehensive Approach”, 1st Edition 2014.
2.	Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, 1st Edition, O’Reilly Media, 2013.
3.	Vivek Tiwari, “SDN and OpenFlow for Beginners”, 1st Edition, Amazon Digital Services Inc., ASIN 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the evolution and motivation of Software Defined Networks	Applying (K3)
CO2	discuss the role of SDN in data center environment	Applying (K3)
CO3	examine the data plane and control plane of SDN	Applying (K3)
CO4	model SDN controllers for various applications	Applying (K3)
CO5	summarize the use cases of SDN	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	30	50	20				100
CAT 2	35	35	30				100
CAT 3	30	30	40				100
ESE	30	30	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE07 - WIRELESS SENSOR NETWORKS							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Wireless Networks**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will cover the most recent research topics in wireless sensor networks, Network architecture, MAC Protocols, Link Layer Protocols, and Topology Control.	
Unit - I	**Wireless Sensor Networks Fundamentals:**	**9**
Introduction to WSNs-Enabling technologies for wireless sensor networks - Node Architecture- Single-node architecture--Hardware components-Sensor node hardware overview-Controller-Memory-Communication device-Sensors and actuators-Power supply of sensor nodes-Energy consumption of sensor nodes-Operation states with different power consumption-Microcontroller energy consumption-Memory-Radio transceivers.		
Unit - II	**Sensor Network Architecture:**	**9**
Sensor network scenarios-Types of sources and sinks-Single-hop versus multi networks-Multiple sinks and sources-Three types of mobility-Optimization goals and figures of merit-Quality of service-Energy efficiency-Scalability-Robustness-Design principles for WSNs-Distributed organization-In-network processing-Adaptive fidelity and accuracy-Data centricity-Component-based protocol stacks and cross-layer optimization ice interfaces of WSNs.		
Unit - III	**MAC protocols:**	**9**
Fundamentals of (wireless) MAC protocols-Requirements and design constraints for wireless MAC protocols-Important classes of MAC protocols-MAC protocols for wireless sensor networks-low duty cycle protocols and wakeup concepts-Sparse topology and energy management (STEM)-S-MAC-The mediation device protocol-Wakeup radio concepts-Contention-based protocols-CSMA protocols-PAMAS-Schedule-based protocols-LEACH-SMACS-Traffic.		
Unit - IV	**Link-layer protocols:**	**9**
Fundamentals: tasks and requirements-Error control-Causes and characteristics of transmission errors-Fundamentals: tasks and requirements -Error control- Framing 167 6.4 Link management ARQ techniques-FEC technique schemes-Combining packet-size optimization and FEC-Treatment of frame headers-Framing: summary-Link management-Link-quality characteristics-Link-quality estimation		
Unit - V	**Topology control:**	**9**
Motivation and basic ideas-Options for topology control-Aspects of topology-control algorithms-Controlling topology in flat networks – Power control-Some complexity results-bounds on critical parameters-Some example constructions and protocols-Hierarchical networks by dominating sets-Motivation and definition-A hardness result-Some ideas from centralized algorithms-Some distributed approximations-Hierarchical networks by clustering		
		Total:45

REFERENCES:

1.	Holger Karl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, 1st Edition, John Wiley & Sons Inc., Hoboken, New Jersey, 2005.
2.	Shelby, Zach, "6LoWPAN : The Wireless Embedded Internet", 1st Edition, John Wiley & Sons Inc., Hoboken, New Jersey, 2009.
3.	“IEEE Standard for Local and metropolitan area networks, Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)”, IEEE Computer Society, pp.1-314,2011, doi: 10.1109/IEEESTD.2011.6012487.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the fundamentals of sensor networks	Applying (K3)
CO2	illustrate sensor network architecture	Applying (K3)
CO3	Outline the function of MAC Protocols	Applying (K3)
CO4	validate the Link layer protocols	Applying (K3)
CO5	Design topology control	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	30	50	20				100
CAT 2	20	40	40				100
CAT 3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE08 - BIG DATA ANALYTICS							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Database Management Systems	**2**	**PE**	**3**	**0**	**0**	**3**
Preamble	Provides basic knowledge about Big data, its framework and storage in databases and prepares the students to perform various analytical operations and visualize the results						
Unit - I	**Big Data:**						**9**
Definition – Wholeness of big data: Understanding – Capturing –Benefits and management – Organizing and analyzing – Challenges – Big data architecture – Big data sources and applications: Big data sources – Machine to machine Communications- Big data Applications.							
Unit - II	**MapReduce Framework:**						**9**
Introducing Hadoop – Starting Hadoop – Components of Hadoop: Working with files in HDFS - Anatomy of a MapReduce program – Reading and writing - Writing basic MapReduce programs: Getting the patent data set- Constructing the basic template of a MapReduce program-Counting things-Adapting for Hadoop's API changes- Streaming in Hadoop- Improving performance with combiners – Hadoop Ecosystem.							
Unit - III	**NoSQL Database Systems:**						**9**
Introduction to NoSQL – CAP theorem - MongoDB : Data types – MongoDB Query Language – Cassandra: Features of Cassandra- Data types – CRUD- Collections Alter Commands – Import and Export- Querying system tables							
Unit - IV	**Mining Data Streams:**						**9**
Stream Data Model - Sampling Data in a Stream–Filtering Streams–Counting Distinct Elements in a Stream–Estimating Moments–Counting Ones in a Window–Decaying Window - Stream processing with SPARK and Kafka.							
Unit - V	**Case Studies:**						**9**
Implement using open source frameworks/tools : Time Series Analysis - Text analysis – Social Network Analysis - Data streams							
							Total:45

REFERENCES:

1.	Anil Maheshwari, "Big Data". 1st Edition, McGraw Hill Education, 2017.
2.	Chuck Lam, "Hadoop in Action", 2nd Edition, Manning Publications, 2011.
3.	Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", 1st Edition, Wiley, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	identify the need for big data analytics	Applying (K3)
CO2	develop simple programs using Hadoop framework	Applying (K3)
CO3	explore NoSQL database system for real world problems	Applying (K3)
CO4	recognize the need for stream processing and discuss SPARK and Kafka architecture	Applying (K3)
CO5	discuss big data use cases and implement using open source frameworks/tools	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	10	20	70				100
CAT 2	10	40	50				100
CAT 3	10	40	50				100
ESE	10	30	60				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

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22MIE09 - DISTRIBUTED SYSTEMS							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Networks	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provide principles of distributed systems, including design and architecture, algorithms, locking, recovery, Replication and handling of failures in distributed environment.

Unit – I	**Introduction and Architectures:**	**9**
Characteristics- Design goals- Types of distributed systems- Architecture styles- Middleware organization- System architecture- Example architecture- the network file system.		
Unit – II	**Process:**	**9**
Threads- Virtualization- Clients- Servers- Code migration. Communications: Foundations- Remote procedure call- Message-oriented communication- multicast communication.		
Unit – III	**Naming and Coordination:**	**9**
Names, identifiers, addresses- flat naming- Structured naming- attribute based naming. Clock synchronization- Logical clocks- Mutual Exclusion- Election algorithms- Location systems.		
Unit – IV	**Consistency and Replication:**	**9**
Introduction -Data-centric consistency models- Client-centric consistency models- Replica management- Consistency Protocols		
Unit – V	**Fault Tolerance:**	**9**
Introduction- Process resilience- Reliable client-server communication- Reliable group communication- Distributed commit- Recovery		
		Total:45

REFERENCES:

1.	Maarten van Steen and Andrew S. Tanenbaum, “Distributed Systems”, 2nd Edition, Pearson Education Inc., 2017.
2.	Brendan Burns, “Designing Distributed Systems”, 1st Edition, O’Reilly Media Inc., 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	gain knowledge about the technologies in distributed environment	Applying (K3)
CO2	develop applications in the area of distributed systems (RMI, RPC)	Applying (K3)
CO3	demonstrate various naming and coordination mechanisms	Applying (K3)
CO4	demonstrate how consistency and replication are handled in distributed environment	Applying (K3)
CO5	explain the concept of fault tolerance	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	20	60	20				100
CAT 2	20	50	30				100
CAT 3	20	50	30				100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE10 - ADVANCED PARALLEL ARCHITECTURE AND PROGRAMMING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Architecture, C Programming	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	Provide principles of GPU computer architecture with programming environments and architectural aspects of modern GPUs, with a special focus on their streaming parallel nature, writing programs on the GPU using high level languages like CUDA.	
Unit – I	**Introduction:**	**9**
Overview of supercomputing - Understanding parallelism with GPUs: Introduction- Concurrency- Types of Parallelism- Some Common Parallel Patterns - CUDA hardware overview : PC Architecture - CPUs and GPUs - Compute Levels - Setting up CUDA: Installing the SDK under Windows - Visual Studio- Linux – Mac- Installing a Debugger- Compilation Model- Error Handling		
Unit – II	**Memory handling with CUDA:**	**9**
Introduction – caches- Types of data storage - shared memory - Sorting using shared memory - Merging lists - A hybrid approach - Shared memory on different GPUs - Constant memory- caching, broadcast, updates at runtime - Global memory - Score boarding - Global memory sorting - Texture Memory- Texture caching- Hardware manipulation of memory fetches- Restrictions using textures		
Unit – III	**CUDA in Practice:**	**9**
Introduction - Serial and Parallel code - Design goals of CPUs and GPUs - Algorithms that work best on the CPU versus the GPU - Processing datasets – Profiling - An example using AES – Multi CPU and Multi GPU solutions: Locality- Multi-CPU Systems and GPU Systems- Algorithms on Multiple GPUs- Single Node Systems- Multiple Node Systems.		
Unit – IV	**Optimizing Application:**	**9**
Parallel/Serial GPU/CPU : Analyzing the problem- Problem decomposition- Grouping the tasks for CPU and GPU - Memory considerations :Memory bandwidth - Memory organization –Transfers: Pinned memory - Zero-copy memory- GPU timing- Thread usage , Calculations and Divergence: Thread memory patterns- Some common compiler optimizations- Understanding the low-level assembly code – Algorithms		
Unit – V	**Designing GPU Based Systems:**	**9**
Introduction - CPU Processor - GPU Device: Large memory support- ECC memory support- Tesla compute cluster driver - Higher double-precision math- Larger memory bus width- PCI E-Bus - Air Cooling - Mass storage: Motherboard-based I/O- Dedicated RAID controllers- HDSL- Mass storage requirements - Power Consideration: Operating Systems- Windows- Linux		
		Total: 45

REFERENCES:

1.	Shane Cook, "CUDA Programming: A Developers guide to parallel computing with GPUs", 1st Edition, Morgan Kaufmann, 2013.
2.	John Cheng, Max Grossman,Ty McKercher, "Professional CUDA C Programming", 1st Edition, John Wiley & Sons Inc., 2014.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe about the parallel programming with GPUs	Applying (K3)
CO2	explain about CUDA memory handling techniques	Applying (K3)
CO3	write programs using CUDA	Applying (K3)
CO4	implement the optimized application using CUDA	Applying (K3)
CO5	explain the GPU based system and its issues and solutions	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	30	40	30				100
CAT 2	10	40	50				100
CAT 3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE11 - DATA MINING TECHNIQUES

Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Database Management Systems	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides students with an overview of the data mining process and techniques for preprocessing. It also make the students to gain knowledge of various data mining techniques and also prepare them for taking research in the area of data mining and its applications.

Unit – I **Introduction:** **9**

Data Mining-Steps in Knowledge Discovery Process- Kinds of Data and Patterns – Technologies used-Targeted applications - Major issues in Data Mining - Data objects and attribute types - Statistical descriptions of data - Data Visualization- Measuring data similarity and dissimilarity.

Unit – II **Data Preprocessing :** **9**

Data Cleaning, Integration, Reduction, Transformation and Discretization, Mining Frequent Patterns - Frequent Itemset Mining Methods.

Unit – III **Classification:** **9**

Decision Tree Induction-Bayesian Classification - Rule based Classification - classification by Back Propagation – Support Vector Machines – Lazy Learners – Model Evaluation and Selection - Techniques to improve Classification Accuracy - k-Nearest Neighbor Classifier.

Unit – IV **Clusters Analysis:** **9**

Partitioning Methods – Hierarchical Methods – Density based Methods - Grid based Methods - Evaluation of Clustering – Outliers and Outlier analysis - Outlier detection Methods - Statistical Approaches.

Unit – V **Applications:** **9**

Mining Complex data types - Statistical Data Mining - Data Mining foundations - Visual and Audio Data Mining – Applications - Ubiquitous and invisible Data Mining - Social impacts of Data Mining.

Total: 45

REFERENCES:

1.	Han Jiawei, Kamber Micheline, “Data Mining: Concepts and Techniques”, 3rd Edition, Morgan Kaufmann Publishers, 2012.
2.	Berson Alex, Smith Stephen J, “Data Warehousing, Data Mining and OLAP”, 1st edition, Tata McGraw Hill, 2013.
3.	Gupta G.K., “Introduction to Data Mining with Case Studies”, 2nd Edition, Prentice Hall India, New Delhi, 2011.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the different data mining techniques and identify different types of data	Applying (K3)
CO2	apply data preprocessing and frequent itemset mining methods for the given problem.	Applying (K3)
CO3	Summarize the characteristics of classification methods and use them for solving a problem	Applying (K3)
CO4	summarize and demonstrate the working of different clustering and outlier methods	Applying (K3)
CO5	Comprehend the role of data mining in various applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	30	50	20				100
CAT 2	35	35	30				100
CAT 3	35	35	30				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE12 - MOBILE AND WIRELESS SECURITY							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Networks	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provide better knowledge on security issues, applications, attacks and security issues in wireless and mobile communications.	
Unit – I	**Introduction to Mobile and Wireless Networks:**	**9**
Cellular Networks, 1G through 3G, IEEE Networks - WLAN IEEE 802.11, WPAN IEEE 802.15, WMAN IEEE 802.16, IEEE 802.20, MIH IEEE 802.21, WRAN IEEE 802.22, Mobile Internet Networks – Macro and Micro mobility – Personal mobility – SIP – Identity based mobility, NEMO and MANETs – Vulnerabilities in wireless communications –security basics – symmetric and asymmetric cryptography, Hash functions – Electronic signatures – MAC – PKI and electronic certificate – IPSec – AAA protocol – Firewalls – Intrusion detection.		
Unit – II	**Wi-Fi Security Architectures:**	**9**
Hot Spot architecture – WIDS – Rogue AP detection – IEEE 802.11 geolocation techniques – Honeypots –Bluetooth Security – Protocol architecture – Radio physical layer – Device addressing – SCO and ACL logical transports – Security mode – Authentication and pairing – Attacks – BlueSmack – WiFi Security-Passive and Active attacks – DOS attacks – Trojan attack – Dictionary Attack.		
Unit – III	**IEEE 802.11 and WiMaX Security:**	**9**
Security in IEEE 802.11 – WEP – WEP2 – IV collisions – RC4 weakness – 802.1x authentication - 802.11i security architecture – policy negotiation – radio security policies – RADIUS – EAP – PKI – WiMAX security – TEK – KEK – IEEE 802.16e – PKMv2-RSA – Security Association – 3 way handshake – role of smart cards in WiMAX.		
Unit – IV	**Security in Adhoc Networks:**	**9**
Attacks to routing protocols – Security mechanisms – Auto-configuration – Key management – Self-managed PKI – Resurrecting Duckling – Group key management – Wireless Sensor Networks – Attacks – Preventive mechanisms – Intrusion tolerance – SNEP - μTELSA – TinySec – key management in WSNs.		
Unit – V	**Security in Mobile Telecommunication Networks:**	**9**
Signaling system 7 (SS7) – GSM security – GRPS security – UMTS infrastructure and security – H.323 – SIP – Megaco – VoIP security flaws and countermeasure – IMS architecture – security flaws – 4G security – Protection of interception – Security issues in Mobile IP – HIP – NetLMM.		
		Total: 45

REFERENCES:

1.	Hakima Chaouchi, Maryline Laurent- Maknavicius, "Wireless and Mobile Network Security: Security basics, Security in On-the-shelf and Emerging Technologies", 2nd Edition, John Wiley & Sons, 2009.
2.	Pallapa Venkataram, Sathish Babu, "Wireless and Mobile Network Security", 1st Edition, Tata McGraw Hill, 2010.
3.	Amitabh Mishra, "Security and Quality of Service in Ad Hoc and Wireless Networks", 1st Edition, Cambridge University Press, 2008.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the physical and logical design of IoT and identify the appropriate IoT level and develop design methodologies for a given application	Applying (K3)
CO2	explain the architecture, need for middleware and the role of different standardization protocols	Applying (K3)
CO3	recall the basic concepts and packages of Python related to IoT for interfacing with IoT devices	Applying (K3)
CO4	develop simple real time applications, upload the data onto the cloud and perform data analytics	Applying (K3)
CO5	identify the security threats against a given IoT system and suggest simple countermeasures	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	10	50	40				100
CAT 2	10	50	40				100
CAT 3	10	50	40				100
ESE	10	50	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

<table>
<tr><td colspan="7">22MIE13 - USER INTERFACE DESIGN</td></tr>
<tr><td>Programme & Branch</td><td>M.TECH. & Information Technology</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>3</td><td>PE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

Preamble	This course provides the basic understanding of how things work in the Web world from the technology point of view as well as to give the basic overview of the different technologies for the development of web-based applications.

Unit – I | **Design and Scripting:** | **9**

Introduction to HTML 5 Tags - Cascading Style Sheet - Responsive Web design: overview – grid – Navbar - Table - Images - Jumbotron – menu – form – layout - Tool tip – panel – popover –tabs – modal

Unit – II | **Introduction to Java Scripting:** | **9**

Control Statements - Function - Objects - Document Object Model and Collections - Event Handling - Form handling and validations- Object-Oriented Techniques in JavaScript - Classes - Constructors and Prototyping (Sub classes and Super classes) - JSON - Introduction to AJAX

Unit – III | **Introduction to NoSQL Database:** | **9**

MongoDB Environment - MongoDB : Introduction to MongoDB - RDBMS and MongoDB - Data Types in MongoDB - CRUD Operations

Unit – IV | **Introduction to Server-side JS Framework:** | **9**

Node JS - Needs of Node JS - Architecture - Blocking vs. Non-Blocking - Event-driven Programming - Event Loop - Installation and setup - Creating web servers with HTTP Request and Response - Node JS Callback Pattern - Event Emitter and Event Handling - GET and POST implementation - Modules - Implementation of CRUD operation using Node JS

Unit – V | **Introduction to Client-side JS Framework:** | **9**

Challenges and Needs - Merits of Model View Controller (MVC) at Client-side over Server-side - Single Page Application (SPA) - Progressive Web Application (PWA) -Introduction to Angular - Setup and Configuration - Use of Components and Modules - Elements of Templates - Work of Change Detection in Components.

Total:45

REFERENCES:

1. Deitel P, Deitel H, Deitel A. “Internet and World Wide Web - How to Program”, 5th Edition, Pearson Education, India, 2012.
2. Fabio Cimo, “Bootstrap Programming Cookbook”, 1st edition, Exelixis Media P.C., 2015.
3. https://www.mongodb.com/
4. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, “ng-book, The Complete Book on Angular 4”, 1st edition, Fullstack.io, 2017.
5. Krasimir Tsonev, “Node.js by Example”, 1st edition, Packt Publishing, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design web pages using html ,CSS and bootstrap framework	Applying (K3)
CO2	develop interactive web pages using Java Script	Applying (K3)
CO3	apply CRUD operation in NoSQL, MongoDB database	Applying (K3)
CO4	demonstrate Web application using server side scripting Node JS	Applying (K3)
CO5	develop Component based web design using Angular JS	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	10	20	70				100
CAT 2	10	30	60				100
CAT 3	10	25	65				100
ESE	10	25	65				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE14 - MULTICORE ARCHITECTURES

Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Architecture and Organization	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will introduce the students to the world of multi-core computer architectures and focuses on delivering an in-depth exposure in memory-subsystems and interconnects and few introductory sessions on advanced superscalar processors.	
Unit – I	**Fundamentals of Quantitative Design and Analysis:**	**9**
Classes of Computers - Trends in Technology, Power, Energy and Cost - Dependability - Measuring, Reporting and Summarizing Performance - Quantitative Principles of Computer Design - Classes of Parallelism - ILP, DLP, TLP and RLP - Multi Threading - SMT and CMP Architectures - Limitations of Single Core Processors - The MultiCore era - Case Studies of Multi Core Architectures.		
Unit – II	**Memory Hierarchy Design:**	**9**
Introduction - Optimizations of Cache Performance - Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines - Design of Memory Hierarchies - Case Studies		
Unit – III	**DLP in Vector, SIMD and GPU Architectures:**	**9**
Architectures - SIMD Instruction Set Extensions for Multimedia - Graphics Processing Units - Detecting and Enhancing Loop Level Parallelism - Case Studies.		
Unit – IV	**TLP and Multiprocessors:**	**9**
Symmetric and Distributed Shared Memory Architectures - Cache Coherence Issues - Performance Issues - Synchronization Issues - Models of Memory Consistency - Inter Connection Networks - Buses, Crossbar and Multi-stage Interconnection Networks.		
Unit – V	**RLP and DLP in Warehouse Scale Architectures:**	**9**
Programming Models and Workloads for Warehouse scale Computers - Architecture for Warehouse scale computing - Domain Specific Architectures: Introduction - Guidelines for DSAs- Example Domain: Deep Neural Network - Google's Tensor Processing Unit - An interface Data Center Accelerator.		
		Total:45

REFERENCES:

1.	John L. Hennessey, David A. Patterson, "Computer Architecture – A Quantitative Approach", 6th Edition, Morgan Kaufmann, Elsevier, 2017.
2.	Kai Hwang, "Advanced Computer Architecture", 1st Edition, Tata McGraw-Hill Education, 2003.
3.	Richard Y. Kain, "Advanced Computer Architecture: A Systems Design Approach", 1st Edition, Prentice Hall, 2011.
4.	David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/ Software Approach", 1st Edition, Morgan Kaufmann, Elsevier, 2013.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	investigate the limitations of ILP and the need for multi core architectures	Applying (K3)
CO2	describe the hierarchical memory system	Applying (K3)
CO3	summarize the salient features of different multi core architectures and how they exploit parallelism	Applying (K3)
CO4	critically analyze the different types of inter connection networks	Applying (K3)
CO5	compare the architectures of GPUs, Warehouse scale computers and Domain specific architecture	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	10	20	70				100
CAT 2	30	50	20				100
CAT 3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE15 - INFORMATION THEORY AND CODING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Communication Networks	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course deals with concept of information and its efficient, error-free and secure delivery of information using binary data streams. It also provides a complete understanding of error-control coding techniques over noisy communication channel.	
Unit – I	**Source Coding:**	**9**
Introduction to Information theory – Uncertainty and Information – Entropy and Average Mutual Information – Information Measure for Continuous Random Variables – Source coding theorem – Huffman Coding – Shannon-Fano-Elias Coding – Arithmetic Coding – Lempel – Ziv Algorithm – Run Length Encoding and the PCX Format – Rate Distortion Function		
Unit – II	**Channel Capacity and Coding:**	**9**
Introduction – Channel Model – Channel Capacity – Channel Coding – Information Capacity Theorem – Error control coding: Introduction to Error Correction Codes – Basic Definitions – Matrix Description of Linear Block Codes – Equivalent Codes – Parity Check Matrix – Decoding of Linear Block Code – Syndrome Decoding – Error Probability after Coding – Perfect Codes – Hamming Codes – Low Density Parity Check (LDPC) Codes – Optimal Linear Codes – Maximum Distance Separable (MDS) Codes		
Unit – III	**Cyclic Codes:**	**9**
Introduction to the Cyclic Codes – Polynomials – Division Algorithm for Polynomials – A Method for Generating Cyclic Codes – Matrix Description of Cyclic Codes – Burst Error Correction – Fire Codes – Golay Codes – Cyclic Redundancy Check (CRC) Codes – Circuit Implementation of Cyclic Codes		
Unit – IV	**Bose-Chaudhuri Hocquenghem (BCH) Codes:**	**9**
Introduction to BCH Code – Primitive Elements – Minimal Polynomials – Generator Polynomials in Terms of Minimal Polynomials – Some Examples of BCH Codes – Decoding of BCH codes – Reed-Solomon Codes – Implementation of Reed –Solomon Encoders and Decoders – Performance of RS Codes Over Real Channels – Nested Codes		
Unit – V	**Convolutional Codes:**	**9**
Introduction to Convolutional Codes – Tree Codes and Trellis Codes – Polynomial Description of Convolution Codes – Distance Notions for Convolutional Codes – The Generating Function – Matrix Description of Convolutional Codes – Viterbi Decoding and Convolutional Codes – Distance Bounds for Convolutional Codes – Turbo Codes		
		Total:45

REFERENCES:

1.	Ranjan Bose, “Information Theory, Coding and Cryptography”, 2nd Edition, Tata McGraw Hill, 2008.
2.	Andrew J. Viterbi, Jim K. Omura, “Principles of Digital Communication and Coding”, 4th Edition, Courier Corporation, 2018.
3.	John G. Proakis, Masoud Salehi, “Digital Communications”, 5th Edition, McGraw Hill, 2008.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	outline the principles behind an efficient, correct and secure transmission of digital data stream	Applying (K3)
CO2	recognize the basics of error-coding techniques	Applying (K3)
CO3	construct the knowledge about the encoding and decoding of digital data streams	Applying (K3)
CO4	examine the performance requirements of various coding techniques	Applying (K3)
CO5	take part in to conduct research in information theory by the professionals	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	20	30	50				100
CAT 2	20	30	50				100
CAT 3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE16 - MOBILE AND PERVASIVE COMPUTING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Network Design and Technologies	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides an understanding of wireless and mobile communication concepts through various layers of mobile networking. It also helps to realize the pervasive and context aware computing architectures, systems and applications.

Unit – I	**Introduction to Wireless Environment:**	**9**
Introduction to wireless communication-Wireless Transmission- Medium Access Control- Wireless MAC protocols – Comparison of 2G, 3G,4G looking ahead 5G systems		
Unit - II	**Mobile Communication:**	**9**
GSM - Bluetooth - Mobile network layer-Mobile transport layer - File system support for mobility support - Mobile execution environments and applications.		
Unit - III	**Pervasive Communication:**	**9**
Pervasive computing principles - Characteristics of pervasive computing environments - Applications and case study - Pervasive Web Application architecture - Pervasive computing and web based applications - Voice enabling pervasive computing- PDA in pervasive computing- User interface issues in pervasive computing.		
Unit - IV	**Context Aware Computing:**	**9**
Structure and Elements of Context-aware Pervasive Systems: Abstract architecture – Infrastructures - Middleware and toolkits, Context-aware mobile services: Context for mobile device users – Location-based services- Ambient service-Enhancing Context-aware mobile services and Context aware artifacts.		
Unit - V	**Context-Aware Pervasive System:**	**9**
Context-aware sensor networks – A framework for Context aware sensors – Context-aware security systems – Constructing Context-aware pervasive system- Future of Content aware systems.		
		Total:45

REFERENCES:

1.	Schiller Jochen, "Mobile Communication", 2nd Edition, PHI/Pearson Education, 2009.
2.	Burkhardt Jochen, Henn Horst, Hepper Stefan, Schaec Thomas, Rindtorff Klaus, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", 1st Edition, Addison Wesley, 2007.
3.	Seng Loke, "Context-Aware Pervasive Systems: Architectures for a New Breed of Applications", 1st Edition, Auerbach Publications, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the operation and performance of wireless protocols	Applying (K3)
CO2	summarize the concepts and principles of various mobile communication technologies	Applying (K3)
CO3	demonstrate the working of protocols that support mobility	Applying (K3)
CO4	illustrate architecture of pervasive computing and identify the applicability of pervasive computing	Applying (K3)
CO5	explain the concepts of context aware computing and pervasive system	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	30	40	30				100
CAT 2	10	40	50				100
CAT 3	10	40	50				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE17 - WEB ANALYTICS AND DEVELOPMENT							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides us to explore the role of web data and analysis tools to perform web analysis to make efficient web search as well as for information retrieval.	
Unit – I	**Web Analytics:**	**9**
Introduction to Social media and network - Social Media: New Technologies of Collaboration - Social Network Analysis Measuring - Mapping - Modeling Collections of Connections - Search Engine Optimization.		
Unit – II	**NodeXL:**	**9**
Getting Started with NodeXL - Layout - Visual Design - Labeling - Calculating and Visualizing Network – Metrics.		
Unit – III	**Social Media Network Analysis:**	**9**
Email - Twitter: Nuts and Bolts - Networks - Acquiring Data - Discovery - Visualizing and Interpreting - Facebook - YouTube - Wiki Networks.		
Unit – IV	**Web Analytics 2.0:**	**9**
Introduction - Optimal Strategy: Steps to Predetermining Your Future Success - Click stream analysis: Introduction-Metrics - Practical Solutions.		
Unit – V	**Competitive Intelligence Analysis:**	**9**
CI Data Sources, Types, and Secrets - Website Traffic Analysis-Search and Keyword Analysis - Audience Identification and Segmentation Analysis - Emerging Analytics: Analyzing Offline Customer Experiences - Measuring the Success of Blogs - Optimal Solutions for Hidden Web Analytics.		
		Total:45

REFERENCES:

1.	Derek Hansen, Ben Shneiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights from a Connected World", 1st Edition, Morgan Kaufmann, 2010,
2.	Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability", 1st Edition, Sybex, 2009.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	gain knowledge about web analytics	Applying (K3)
CO2	elaborate the process of node xl	Applying (K3)
CO3	demonstrate the social media analysis	Applying (K3)
CO4	outline the fundamental concepts of web analytics 2.0	Applying (K3)
CO5	apply the competitive intelligence techniques to perform web analysis	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	30	40	30				100
CAT 2	20	40	40				100
CAT 3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE18 - DIGITAL IMAGE PROCESSING AND COMPUTER VISION							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Digital Signal Processing	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To analyze the images in frequency domain and to perform various operations like enhancement, Restoration, Compression, Registration and Multi resolution analysis.	
Unit – I	**Image Transforms:**	**9**
Orthogonal transforms – FT, DST, DCT, Hartley, Walsh hadamard, Haar, Radon, Slant Wavelet, KL, SVD and their properties.		
Unit – II	**Image Enhancement and Restoration:**	**9**
Image enhancement - Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram processing - histogram equalisation -modification. Spatial operations – smoothing spatial filters, sharpening spatial filters. Transform operations. Color image enhancement. Image Restoration – degradation model, Noise models, Unconstrained and Constrained restoration, Inverse filtering – removal of blur caused by uniform linear motion, Wiener filtering, Restoration by SVD and Homomorphic filtering		
Unit – III	**Image Compression:**	**9**
Image Compression – Need for data compression – Run length encoding – Huffman coding – Arithmetic coding – predictive coding- transform based compression, - vector quantization – block truncation coding, Image Segmentation: Point, Edge and line detection -thresholding-Region based approach Image Representation: boundary based – region based and intensity based description		
Unit – IV	**Registration and Multivalued Image Processing:**	**9**
Registration – geometric transformation – registration by mutual information Mutivalued image processing – colour image processing – colour image enhancement- satellite image processing- radiometric correction – other errors- multi spectral image enhancement- medical image processing – image fusion.		
Unit – V	**Wavelets and Multiresolution Processing:**	**9**
Image Pyramids – Subband coding – The Haar Transform – Multiresolution Expansion – Series Expansion – Scaling Function – Wavelet Function – Wavelet Transform in One Dimension- The Wavelet Series Expansion – The Discrete Wavelet Transform – The Continuous Wavelet Transform – The Fast Wavelet Transform – Wavelet transform in two dimensions– Applications in image denoising and compression.		
		Total:45

REFERENCES:

1.	Gonzalez Rafel C., Woods Richard E., “Digital Image Processing”, 4th Edition, Prentice Hall, New York, 2017.
2.	Chanda B., Dutta Majumder D., “Digital Image Processing and Analysis”, 2nd Edition, PHI Learning, 2011.
3.	Abdeljalil Ouahabi, “Signal and Image Multiresolution Analysis”, 1st edition, John Wiley & Sons, 2012.
4.	Rosenfield Azriel, Kak Avinash C., “Digital Picture Processing”, 2nd Edition, Academic Press Inc., New York, 1982.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	implement the image enhancement and image restoration techniques	Applying (K3)
CO2	model the systems to enhance and restore the image optimally	Applying (K3)
CO3	apply the coding technique to perform compression of images	Applying (K3
CO4	apply the concepts of registration to fuse images of various modalities	Applying (K3)
CO5	analyze the images in one dimension and two dimension simultaneously	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	20	40	40				100
CAT 2	10	40	50				100
CAT 3	10	40	50				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE19 - INFORMATION STORAGE MANAGEMENT							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Networks and Database Management Systems	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course offers essential details about various storage systems, storage networking technologies and business continuity solutions along with management techniques in order to store, manage, and protect digital information in classic, virtualized, and cloud environments
Unit – I	**Storage Systems:** **9**
	Introduction to evolution of storage architecture, key data center elements, virtualization, and cloud computing. Components of storage system environments – Host (or computer), connectivity, storage, and application in both classic and virtual environments. RAID implementations, techniques and levels along with the impact of RAID on application performance. Components of intelligent storage provisioning and intelligent storage implementations.
Unit – II	**Storage Networking Technologies:** **9**
	Fibre channel SAN components, connectivity options, and topologies including access protection mechanism —Zoning, FC protocol stack, addressing operations, SAN-based virtualization and VSAN technology, iSCS and FCIP protocols for storage access over IP network, Converged protocol FCoE and its components Network Attached Storage (NAS) – components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.
Unit – III	**Backup, Archive and Replication:** **9**
	Business continuity terminologies, planning and solutions, clustering and multipathing architecture to avoid single points of failure, Backup and recovery – methods, targets and topologies, Data duplication and backup in virtualized environment, Fixed content and data archive, Local replication in classic virtual environments, Remote replication in classic and virtual environment.
Unit – IV	**Cloud Computing:** **9**
	Business drivers for Cloud computing, Definition of Cloud computing, Characteristics of cloud computing, Steps involved in transitioning from Classic data center to Cloud computing environment services and deployment models, Cloud infrastructure components, Cloud migration considerations.
Unit – V	**Securing and Managing Storage Infrastructure:** **9**
	Security threats, and countermeasures in various domains security solutions for FC-SAN, IP-SAN and NS environments, Security in virtualized and cloud environment, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle management (ILM) and storage tiering, Cloud service management activities
	Total:45

REFERENCES:

1.	EMC Corporation, “Information Storage and Management”, 2nd Edition, Wiley, 2012.
2.	Robert Spalding, “Storage Networks: The Complete Reference”, 2nd Edition, Tata McGraw Hill, Osborne, 2003.
3.	Marc Farley, “Building Storage Networks”, 2nd Edition, Tata McGraw Hill, Osborne, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the various storage systems and RAID implementations	Applying (K3)
CO2	identify various storage networking technologies and its components	Applying (K3)
CO3	apply business continuity solutions – backup and replication, and archive for managing fixed content	Applying (K3)
CO4	describe the fundamentals of cloud storage environment	Applying (K3)
CO5	explain the storage security framework and discuss the storage monitoring and management activities	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	10	50	40				100
CAT 2	10	60	30				100
CAT3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE20 - NATURE INSPIRED COMPUTING								
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Linear algebra and Calculus	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course helps the learners to understand the algorithms that are inspired by naturally occurring phenomena. The focus is on abstracting nature inspired techniques which influence computing.	
Unit – I	**Introduction to Algorithms:**	**9**
Newton's Method – Optimization - Search for Optimality - No-Free-Lunch Theorems - Nature-Inspired Meta heuristics - Brief History of Meta heuristics. Analysis of Algorithms: Introduction - Analysis of Optimization Algorithms - Nature-Inspired Algorithms - Parameter Tuning and Parameter Control.		
Unit – II	**Simulated Annealing:**	**9**
Annealing and Boltzmann Distribution - Parameters - SA Algorithm - Unconstrained Optimization - Basic Convergence Properties - SA Behavior in Practice - Stochastic Tunneling. Genetic Algorithms : Introduction - Genetic Algorithms - Role of Genetic Operators - Choice of Parameters - GA Variants - Schema Theorem - Convergence Analysis.		
Unit – III	**Particle Swarm Optimization:**	**9**
Swarm Intelligence - PSO Algorithm - Accelerated PSO – Implementation - Convergence Analysis - Binary PSO. Cat Swarm Optimization: Natural Process of the Cat Swarm - Optimization Algorithm – Flowchart - Performance of the CSO Algorithm.		
Unit – IV	**TLBO Algorithm:**	**9**
Introduction **-** Mapping a Classroom into the Teaching-Learning-Based optimization – Flowchart. Cuckoo Search: Cuckoo Life Style - Details of COA – flowchart - Cuckoos' Initial Residence Locations - Cuckoos' Egg Laying Approach - Cuckoos Immigration - Capabilities of COA. Bat Algorithms: Echolocation of Bats - Bat Algorithms – Implementation - Binary Bat Algorithms - Variants of the Bat Algorithm - Convergence Analysis.		
Unit - V	**Other Algorithms:**	**9**
Ant Algorithms - Bee-Inspired Algorithms - Harmony Search - Hybrid Algorithms.		
		Total:45

REFERENCES:

1.	Xin-She Yang, "Nature-Inspired Optimization Algorithms", 1st Edition, Elsevier, 2014.
2.	Omid Bozorg- Haddad, "Advanced Optimization by Nature-Inspired Algorithms", Volume 720, 1st Edition, Springer, 2018.
3.	Srikanta Patnaik, Xin-She Yang, Kazumi Nakamatsu, "Nature-Inspired Computing and Optimization Theory and Applications", 1st Edition, Springer Series, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply the basic concepts of optimization techniques	Applying (K3)
CO2	identify the parameter which is to be optimized for an application	Applying (K3)
CO3	analyze and develop mathematical model of different swarm optimization algorithms	Applying (K3)
CO4	select suitable optimization algorithm for a real time application	Applying (K3)
CO5	examine and recommend solutions for optimization based applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	20	50	30				100
CAT 2	10	30	60				100
CAT 3	10	30	60				100
ESE	10	30	60				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE21 - REINFORCEMENT LEARNING							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Machine Learning	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will provide a solid introduction to the field of reinforcement learning and explore the core challenges and approaches, including generalization and exploration with reinforcement learning algorithms.	
Unit – I	**Introduction :**	**9**
Reinforcement Learning – Examples-Elements of Reinforcement Learning – Limitations and Scope – Multi –armed Bandits : A k-armed Bandit Problem - Action-value Methods - The 10-armed Testbed - Incremental Implementation - Tracking a Non-stationary Problem - Optimistic Initial Values - Gradient Bandit Algorithms		
Unit – II	**Finite Markov Decision processes :**	**9**
The Agent – Environment Interface - Goals and Rewards - Returns and Episodes - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Dynamic programming: Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration -Asynchronous Dynamic Programming - Generalized Policy Iteration		
Unit – III	**Monte carlo methods :**	**9**
Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off-policy Prediction via Importance Sampling -Incremental Implementation - Off-policy Monte Carlo Control - Temporal Difference Learning: TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - Sarsa: On-policy TD Control - Q-learning: Off-policy TD Control		
Unit – IV	**n-step Bootstrapping :**	**9**
n-step Sarsa - n-step Off-policy Learning - n-step Tree Backup Algorithm - Planning and Learning with Tabular Methods : Models and Planning – Dyna - Integrated Planning, Acting, and Learning - Prioritized Sweeping - Expected vs. Sample Updates - Trajectory Sampling - Real-time Dynamic Programming - Planning at Decision Time - Heuristic Search - Rollout Algorithms - Monte Carlo Tree Search		
Unit - V	**On-policy Prediction with Approximation :**	**9**
Value-function Approximation - The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods - Feature Construction for Linear Methods -Selecting Step - Size Parameters Manually - On-policy Control with Approximation: Episodic Semi-gradient Control - Semi-gradient n-step Sarsa - Average Reward: A New Problem Setting for Continuing Tasks - Policy Gradient Methods		
		Total:45

REFERENCES:

1.	Sutton, Barto ,"Reinforcement Learning: An Introduction", The MIT Press, 2nd Edition,2018.
2.	Marco Wiering, Martijn van Otterlo ,"Reinforcement Learning: State-of-the-Art (Adaptation, Learning and Optimization)",Volume 12 , Springer, 2012.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning and apply for an application	Applying(K3)
CO2	devise an appropriate solution for the given RL problem	Applying(K3)
CO3	implement common RL algorithms	Applying(K3)
CO4	use performance metrics based on multiple criteria to evaluate RL algorithms	Applying(K3)
CO5	make use of Stochastic –gradient and Semi –gradient methods for On – policy Prediction and Control	Applying(K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	40	30	30				100
CAT 2	30	30	40				100
CAT 3	30	30	40				100
ESE	40	30	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE22 - BLOCKCHAIN TECHNOLOGIES							
Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Cryptography	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain. This course covers both the conceptual as well as application aspects of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains.	
Unit – I	**Introduction to Blockchain:**	**9**
Financial transaction – Ledger – trustless system – Elements of blockchain – types – Byzantine General Problems – benefits – challenges – Components and structure of blockchain: blocks – chain – hashing – digital signatures – example – miners – validators – smart contracts - speed – decentralization Vs distributed systems.		
Unit – II	**Cryptography behind Blockchain:**	**9**
Principles – historical perspectives – classical cryptography- types – symmetric – asymmetric – signatures – hashing. **Bitcoin:** History – Why bitcoin – keys and addresses – transactions – blocks – bitcoin network – wallets.		
Unit - III	**Consensus:**	**9**
Practical Byzantine fault tolerance algorithm – Proof of Work - Proof of Stake - Proof of Authority - Proof of Elapsed time Cryptocurrency Wallets: Introduction to cryptocurrency wallets - Transactions - Types of cryptocurrency wallets – Tenancy - Alternate Blockchains.		
Unit - IV	**Hyperledger and Enterprise Blockchains:**	**9**
History - Hyperledger projects - Hyperledger Burrow - Hyperledger Sawtooth - Hyperledger Fabric - Hyperledger Iroha - Hyperledger Indy - Tools in Hyperledger – Deploy a simple application on IBM cloud.		
Unit – V	**Ethereum:**	**9**
Introducing Ethereum - Components of Ethereum - Ethereum accounts - Ethereum network - Ethereum clients - Ethereum gas - Ethereum virtual machine - Ethereum block – Ether - Basics of Solidity - Ethereum Development.		
		Total:45

REFERENCES:

1.	Brenn Hill, Samanyu Chopra, Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", 1st Edition, Packt Publishing, 2018.
2.	Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2nd Edition, O'Reilly Media, 2017.
3.	Melanie Swan, "Blockchain: Blueprint for a New Economy", 1st Edition, O'Reilly Media, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	illustrate the workings of blockchain	Applying (K3)
CO2	apply various cryptographic algorithms in blockchain	Applying (K3)
CO3	demonstrate different cryptocurrency used in blockchain	Applying (K3)
CO4	deploy a simple application using Hyperledger on IBM cloud	Applying (K3)
CO5	develop and analyze a distributed application using Ethereum and Solidity	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	40	50				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE23 - QUANTUM INFORMATION AND QUANTUM COMPUTING

Programme & Branch	**M.TECH. & Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Linear Algebra, Theory of Computation	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	Provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing

Unit – I	**Qubit and Quantum States:**	**9**
The Qubit- Vector Spaces - Linear Combination of Vectors - Uniqueness of a spanning set - basis & dimensions - inner Products – orthonormality - gram-schmidt orthogonalization - bra-ket formalism - the Cauchy-schwarez and triangle Inequalities.		
Unit - II	**Matrices and Operators:**	**9**
Observables - The Pauli Operators - Outer Products - The Closure Relation - Representation of operators using matrices - outer products & matrix representation - matrix representation of operators in two dimensional spaces - Pauli Matrix - Hermitian unitary and normal operator - Eigen values and Eigen Vectors - Spectral Decomposition - Trace of an operator – important properties of Trace - Expectation Value of Operator - Projection Operator - Positive Operators.		
Unit - III	**Tensor Products:**	**9**
Representing Composite States in Quantum Mechanics - Computing inner products - Tensor products of column vectors - operators and tensor products of Matrices.		
Unit - IV	**Density Operator:**	**9**
Density Operator of Pure and Mix state - Key Properties - Characterizing Mixed State - Practical Trace and Reduce Density Operator - Density Operator and Bloch Vector.		
Unit - V	**Quantum Measurement Theory:**	**9**
Distinguishing Quantum states and Measures - Projective Measurements - Measurement on Composite systems - Generalized Measurements - Positive Operator-Valued Measures.		
		Total:45

REFERENCES:

1.	David McMahon, "Quantum Computing Explained", 1st Edition, John Wiley & Sons Inc., 2008.
2.	Zdzislaw Meglicki, "Quantum Computing Without Magic: Devices", 2nd Edition, The MIT Press, 2008.
3.	Marco Lanzagorta, Jeffrey Uhlmann, "Quantum Computer Science", 1st Edition, Morgan & Claypool Publishers, 2012.
4.	Phillip Kaye, Raymond Laflamme, Michele Mosca , "An Introduction to Quantum Computing", 2nd Edition, Oxford University Press, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explain qubit and quantum states	Applying (K3)
CO2	identify various operation that can be done using operators and matrices	Applying (K3)
CO3	apply Tensor product and density operator to various operation	Applying (K3)
CO4	implement the principles of density operator for solving problems	Applying (K3)
CO5	summarize quantum measurement theory	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	30	50	20				100
CAT 2	35	35	30				100
CAT 3	30	30	40				100
ESE	30	30	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22MIE24 - KNOWLEDGE REPRESENTATION AND REASONING

Programme & Branch	M.TECH. & Information Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Advanced mathematics for computing	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	A comprehensive understanding of Artificial Intelligence and build intelligent behavior to show how this knowledge can be represented symbolically, and how automated reasoning procedures can make Intelligent Systems in the context of Knowledge Engineering.	
Unit – I	**Introduction:**	**9**
Intelligent Agents - Problem Solving - Solving Problems by Searching - Beyond Classical Search - Adversarial Search - Constraint Satisfaction Problems.		
Unit – II	**Knowledge and Reasoning:**	**9**
Logical Agents - First Order Logic - Inference in First Order Logic - Knowledge Representation.		
Unit – III	**Uncertain Knowledge and Reasoning:**	**9**
Quantifying Uncertainty-Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions.		
Unit – IV	**Object Oriented Representation:**	**9**
Object-Oriented Representation - Frame Formalism - Structured Descriptions - Meaning and Entailment - Taxonomies and Classification – Inheritance		
Unit – V	**Actions and Planning:**	**9**
Actions - The Situation Calculus - Frame Problem - Complex Actions - Planning - The STRIPS Representation - Planning as a Reasoning Task - Hierarchical and Conditional Planning		
		Total:45

REFERENCES:

1.	Russell Stuart, Norvig Peter, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education / Prentice Hall of India, New Delhi, 2009.
2.	Ronald Brachman, Hector Levesque, “Knowledge Representation and Reasoning”, 1st Edition, The Morgan Kaufmann Series in Artificial Intelligence, 2004.
3.	Arthur B. Markman, “Knowledge Representation”, 1st Edition, Lawrence Erlbaum Associates, Reprint 2008.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	provide a strong foundation of fundamental concepts in Artificial Intelligence	Applying (K3)
CO2	discover different search strategies for a problem	Applying (K3)
CO3	get familiar with the various applications of AI techniques in Intelligent Systems	Applying (K3)
CO4	analyze different knowledge representation schemes for typical AI problems	Applying (K3)
CO5	evaluate a typical AI problem to be solved using machine learning techniques	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1		
CO2	3	2	1	1		
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	15	30	55				100
CAT 2	15	30	55				100
CAT 3	15	30	55				100
ESE	15	30	55				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

22GET13 - INNOVATION, ENTREPRENEURSHIP AND VENTURE DEVELOPMENT							
(Common to ME/MTech and MCA Programmes)							
Programme & Branch	**All ME/MTech and MCA Programmes**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will direct the students on how to employ their innovations towards a successful entrepreneurial venture development.	
Unit – I	**Innovation and Entrepreneurship:**	**9**
Creativity and Innovation – Types of innovation – challenges in innovation- steps in innovation management- Meaning and concept of entrepreneurship - Role of Entrepreneurship in Economic Development - Factors affecting Entrepreneurship – Entrepreneurship vs Intrapreneurship.		
Unit – II	**Design Thinking and Product Design:**	**9**
Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping. Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction.		
Unit – III	**Business Model Canvas (BMC) and Business Plan Preparation:**	**9**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies. Objectives of a Business Plan - Business Planning Process and Preparation.		
Unit – IV	**IPR and Commercialization:**	**9**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing.		
Unit – V	**Venture Planning and Means of Finance:**	**9**
Startup Stages - Forms of Business Ownership - Sources of Finance – Idea Grant – Seed Fund – Angel & Venture Fund – Institutional Support to Entrepreneurs – Bank and Institutional Finance to Entrepreneurs.		
		Total:45

REFERENCES:

1.	Gordon E. & Natarajan K., "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.
2.	Sangeeta Sharma, "Entrepreneurship Development", 1st Edition, PHI Learning Pvt. Ltd., New Delhi, 2017.
3.	Charantimath Poornima M., "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
4.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, "Entrepreneurship", 10th Edition, McGraw Hill, Noida, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the relationship between innovation and entrepreneurship	Understanding (K2)
CO2	understand and employ design thinking process during product design and development	Analyzing (K4)
CO3	develop suitable business models as per the requirement of the customers	Analyzing (K4)
CO4	practice the procedures for protection of their ideas IPR	Applying (K3)
CO5	understand and plan for suitable type of venture and modes of finances	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				3	2	1	3	2		1	1	
CO2	1	2			3	2	1						1	
CO3	3	1	3			1							1	
CO4	1	2				3							1	
CO5	1	2				3							1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)