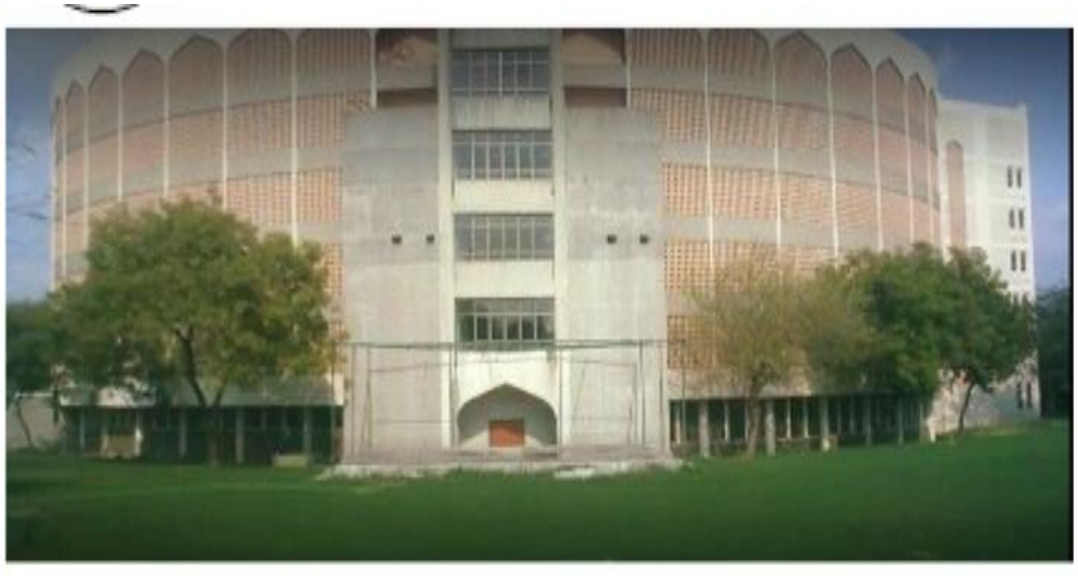
Jamia Hamdard

Deemed to be University

Accredited in 'A' Grade by NAAC

Declared to be designated as Institute of Eminence (IoE) by MHRD, GOI



PROGRAMME NAME: M.TECH. (COMPUTER SCIENCE & ENGINEERING)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL ENGINEERING SCIENCE AND TECHNOLOGY

JAMIA HAMDARD **(**Deemed to be University)

Accredited in 'A' Grade by NAAC

Declared to be designated as Institute of Eminence (IoE) by MHRD, GOI

New Delhi 110 062

www.jamiahamdard.edu

PROGRAMME NAME: MASTER OF TECHNOLOGY
COMPUTER SCIENCE & ENGINEERING

PROGRAME CODE: 550

ACADEMIC SESSION OF INTRODUCTION OF THE PROGRAMME: (2022-23)

SCHOOL NAME: SCHOOL ENGINEERING SCIENCE AND TECHNOLOGY

DEPARTMENT NAME: COMPUTER SCIENCE & ENGINEERING

APPROVAL DATE OF THE BOARD OF STUDIES (BOS) MEETING FOR THE PRESENT SYLLABUS
26 JUNE 2022

APPROVAL DATE NUMBER OF ACADEMIC COUNCIL OF MEETING FOR THE PRESENT SYLLABUS

ADMISSION & EXAMINATION BYE-LAWS

FOR

MASTER OF TECHNOLOGY

(COMPUTER SCIENCE & ENGINEERING)

M. TECH. (CSE)

Program Code: 550

-

CHOICE BASED CREDIT SYSTEM (CBCS)
(W.E.F. 2022-23)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
School of Engineering Sciences & Technology
JAMIA HAMDARD
(DEEMED TO BE UNIVERSITY)
Hamdard Nagar, New Delhi-110 062
Ph. 011 26059688, Extn.-5858

CONTENTS

- **Approval date of the BOS meeting for the present syllabus:**

Approval date and number for the Academic Council meeting for the present syllabus

Name of Programme	Programme Code	Date of Revision
M.Tech CSE	550	02.11.2018

SCHOOL OF EGINEERING SCIENCES AND TECHNOLOGY

Vision Statement (School Level): To become the best institution in the national and international map in terms of quality of teaching and research, technical knowledge and academics in the field Computer Science & Engineering, Electronics & Communication Engineering, Bioinformatics with sincere honesty adding values in the core aspect of students' life.

Mission Statements (3 to 4) (School Level):

MS1: To offer state-of-the-art undergraduate, postgraduate and doctoral programs in Computer Science & Engineering, Electronics and Communication Engineering & Engineering and Bioinformatics.

MS 2: To provide one of the best working environments to motivate faculty and students to work towards vision of the Department.

MS 3: To develop association with industry, other Universities/Institute/Research Laboratories and work in collaboration with them.

MS 4: To use our expertise in all the relevant disciplines for helping society in solving its real life problem.

MS 5: To develop entrepreneurship skills in the students so that they can become problem solver and innovative developer and contribute to the society by providing employment to others.

PROGRAM EDUCATIONAL OBJECTIVES

Upon the completion of Academic Programme (M.Tech. CSE), students will be able –

PEO 1: To prepare professionals who will have successful career in industries, academia, research and entrepreneurial endeavours.

PEO 2: To prepare graduates who will demonstrate analytical, research, design and implementation skills offering techno-commercially feasible and socially acceptable solutions to real life problems.

PEO 3: To prepare graduates who will thrive to pursue life-long learning and contribute to society as an ethical and responsible citizen.

Mapping Program Educational Objectives (PEOs)
with Mission Statements (MS)

	MS-1	MS-2	MS-3	MS-4	MS-5
PEO-1	3	2	2	2	2
PEO-2	2	3	2	3	3
PEO-3	3	2	2	2	3

'3' for 'high-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping.

PROGRAM OUTCOMES

At the end of the program a student is expected to have:

PO1: An understanding of the theoretical foundations and the limits of computing.

PO2: An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.

PO3: An ability to design, develop and evaluate new computer-based systems for novel applications which meet the desired needs of industry and society.

PO4: Understanding and ability to use advanced computing techniques and tools.

PO5: An ability to undertake original research at the cutting edge of computer science & its related areas.

PO6: An ability to function effectively individually or as a part of a team to accomplish a stated goal.

PO7: An understanding of professional and ethical responsibility.

PO8: An ability to communicate effectively with a wide range of audience.

PO9: An ability to learn independently and engage in lifelong learning.

PO10: An understanding of the impact of IT related solutions in an economic, social and environment context.

PO11: Develop robust, reliable, scalable techniques and tools for knowledge-based systems.

PO12: Communicate effectively, write and present technical reports on complex engineering activities by interacting with the engineering fraternity and with society at large.

PROGRAMME SPECIFIC OUTCOMES:

PSO 1: Students should be able to develop and implement the solution of real life computing problems using contemporary technologies.

PSO 2: Students should be able to apply ethical principles and commit to professional and social responsibilities.

Mapping of Program Outcomes (POs) and Program Specific Outcomes (PSOs) with Program Educational Objectives (PEOs)

	PEO-1	**PEO-2**	**PEO-3**
PO-1	3	3	2
PO-2	3	3	1
PO-3	3	2	2
PO-4	2	3	2
PO-5	3	2	2
PO-6	2	3	3
PO-7	2	3	3
PO-8	2	3	2
PO-9	1	2	3
PO-10	2	2	1
PO-11	3	2	3
PO-12	1	2	3
PSO-1	3	2	3
PSO-2	2	3	2

‘3’ for ‘high-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping.

ADMISSION & EXAMINATION RULES
for

MASTER OF TECHNOLOGY
(Computer Science & Engineering)

M.Tech. CSE Programme has been offered by the Department of Computer Science & Engineering.

1. PROGRAM OBJECTIVE

To prepare highly skilled professionals with a strong conceptual, theoretical & practical proficiency and research ability in the field of Computer Science & Engineering and related emerging areas; such as Data Science, Big Data Analytics, Information Security, and Cyber Forensics.

2. THE PROGRAM

Highlights of the program are described in the following table:

a.	*Name of the Program*	M. Tech. (CSE)
b.	*Nature*	Regular and Full Time
c.	*Duration*	Two Years (4 Semesters)
d.	*Total number of credits*	68
e.	*Medium of Instruction and Examinations*	English
f.	*Eligibility Criteria*	Passed B.Tech./BE or equivalent degree in Computer Science/Computer Science & Engineering/Computer Engineering/ Information Technology/Software Engineering/ ICT with at least 55% marks (or equivalent CGPA) in aggregate **(OR)** MCA or M.Sc in IT/Computer Science/Information Science & Technology/Electronics/Software Engineering or equivalent degree with at least 55 % marks (or equivalent CGPA) in aggregate . **(OR)** B.Tech. / B.E. or equivalent degree in Electronics & Communication / Electronics Engineering / Electrical Engineering with at least 55% marks (or equivalent CGPA) in aggregate.
g.	*Selection procedure*	As per the merit of the qualifying examination
h.	*Total Seats*	30 in each program; inclusive of seats reserved for NRI / sponsored candidates; additional seats are available for Foreign Nationals.
i.	*Period of Completion*	Not more than 04 years (8 Semesters)
j.	*Commencement of the Program*	July of the every academic session

3. PROGRAM STRUCTURE

Semester-wise program structures, guidelines for teaching, practical and associated assessments of **M. Tech. CSE** programme are described in the following tables:

Program Summary

Course Type	Abbreviation	Credits
Program Core	PC	12
Program Elective	PE	15
Open Elective (OE)	OE	3
Research Methodology & IPR	RMIPR	2
Audit Course	AC	0
Laboratory	LAB	8
Mini Project with Seminar	MPS	2
Dissertation	DISS	26
Total Credits		**68**

Semester – I

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTCSE 101	Mathematical Foundations of Computer Science	PC	25	75	100	3-0-0	3
MTCSE 102	Advanced Data Structures	PC	25	75	100	3-0-0	3
	Program Elective – I	PE	25	75	100	3-0-0	3
	Program Elective – II	PE	25	75	100	3-0-0	3
MTCSE 103	Research Methodology & IPR	RMIPR	25	75	100	2-0-0	2
	Audit Course – I	AC	25	75	100	2-0-0	0
MTCSE 104	Lab– I (Advanced Data Structures)	LAB	25	75	100	0-0-4	2
MTCSE 105	Lab – II (Based on Elective II)	LAB	25	75	100	0-0-4	2
Total					**800**	**16-0-8**	**18**

L-T-P stands for number of contact hours as Lecture-Tutorial-Practical in a week.

Semester – II

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTCSE 201	Advanced Algorithms	PC	25	75	100	3-0-0	3
MTCSE 202	Soft Computing	PC	25	75	100	3-0-0	3
	Program Elective – III	PE	25	75	100	3-0-0	3
	Program Elective – IV	PE	25	75	100	3-0-0	3
	Audit Course – II	AC	25	75	100	2-0-0	0
MTCSE 203	Lab – III (Based on Advanced Algorithms and Soft Computing)	LAB	25	75	100	0-0-4	2
MTCSE 204	Lab – IV (Based on Elective III)	LAB	25	75	100	0-0-4	2
MTCSE 205	Mini Project with Seminar[@ #]	MPS	25	75	100	2-0-0	2
Total					**800**	**16-0-8**	**18**

*****Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.

Semester – III *

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
	Program Elective – V	PE	25	75	100	3-0-0	3
	Open Elective	OE	25	75	100	3-0-0	3
MTCSE 301	Dissertation – I//Industrial Project @ #	DISS	200	100	300	0-0-20	10
Total					**500**	**6-0-20**	**16**

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

***The list of online courses to be cleared through MOOCs shall be floated in the respective semester after approval from the Board of Studies.**

Semester – IV

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTCSE 401	Dissertation – II@ # $	DISS	300	200	500	0-0-32	16

Grand Total of Credits = 68

@ *Dissertation/Mini Project shall be based on latest research topics.*

*Students are required to get approval of their title of Dissertation/Mini Project by Dissertation Assessment & Evaluation committee constituted by HOD. Supervisor of respective students must be member of the above committee. Students are required to give at least three presentations/seminars for progress monitoring & assessment purpose to their respective supervisors. Viva-voce will be held only after the submission of completion report duly signed by the supervisor of the respective student. A plagiarism report duly signed by the students are mandatory to submit in compliance with UGC (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations, 2017 (or any such regulations notified from time to time) by competent authority.*

$ *Students are required to publish at least one article related to their work of Dissertation in SCI/SCIE/Scopus indexed or UGC approved International Refereed Journal/International Conference. Acceptance of paper is a must for viva voce to be held, but the degree will be awarded only on proof of publication verified by the supervisor. In any case consent of the Supervisor is mandatory for publication. Before submitting the paper, student **MUST** take the consent of their respective supervisor.*

PROGRAM ELECTIVES (PE)

Course Code	Course Title	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Program Elective – I						
MTCSE PE111	Machine Learning	25	75	100	3-0-0	3
MTCSE PE112	Wireless Sensor Networks	25	75	100	3-0-0	3
MTCSE PE113	Introduction to Intelligent Systems	25	75	100	3-0-0	3
Program Elective – II						
MTCSE PE121	Data Science	25	75	100	3-0-0	3
MTCSE PE122	Distributed Systems	25	75	100	3-0-0	3
MTCSE PE123	Advanced Wireless & Mobile Networks	25	75	100	3-0-0	3
Program Elective – III						
MTCSE PE231	Data Preparation & Analysis	25	75	100	3-0-0	3
MTCSE PE232	Secure Software Design & Enterprise Computing	25	75	100	3-0-0	3
MTCSE PE233	Computer Vision	30	70	100	3-0-0	3
Program Elective – IV						
MTCSE PE241	Pattern Recognition	25	75	100	3-0-0	3
MTCSE PE242	Graphics Processing Unit Computing	25	75	100	3-0-0	3
MTCSE PE243	MOOCs1	25	75	100	3-0-0	3
Program Elective – V						
MTCSE PE351	Compilers for High Performance Computing	25	75	100	3-0-0	3
MTCSE PE352	Optimization Techniques	25	75	100	3-0-0	3
MTCSE PE353	MOOCs2	25	75	100	3-0-0	3

*** The list of online courses to be cleared through MOOCs shall be floated in the respective semester after approval from the Board of Studies with a provision for in house examination.**

OPEN ELECTIVES (OE)

Paper Code	Title of the Paper	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Open Elective						
MTCSE OE311	Business Analytics	25	75	100	3-0-0	3
MTCSE OE312	Block chain Design And Their Use Cases	25	75	100	3-0-0	3
MTCSE OE313	Operation Research	25	75	100	3-0-0	3
MTCSE OE314	Cost Management of Engineering Projects	25	75	100	3-0-0	3
MTCSE OE315	IoT Fundamentals and Architecture	25	75	100	3-0-0	3
MTCSE OE316	Numerical Methods	25	75	100	3-0-0	3

AUDIT COURSE (AC)

Paper Code	Title of the Paper	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Audit Course – I						
MTCSE AC111	English for Research Paper Writing	25	75	100	2-0-0	0
MTCSE AC112	Disaster Management	25	75	100	2-0-0	0
MTCSE AC113	Pedagogy Studies	25	75	100	2-0-0	0
Audit Course – II						
MTCSE AC221	Constitution of India	25	75	100	2-0-0	0
MTCSE AC222	Value Education	25	75	100	2-0-0	0
MTCSE AC223	Personality Development through Life Enlightenment Skills	25	75	100	2-0-0	0

4. MODE OF CURRICULUM DELIVERY

Mode of curriculum delivery includes classroom teaching, assignments, test, lab work, presentations, participation in relevant events and regularity.

5. ATTENDANCE

a. All students are supposed to attend every lecture and practical classes. However, the attendance requirement for appearing in the examination shall be a minimum of 75% of the classes held.

b. Each one-period teaching shall account for one attendance unit.

c. The concerned teacher will take a roll call in every scheduled class, maintains and consolidate the attendance record, which would be submitted to the Head of the Department at the conclusion of the semester.

d. Attendance on account of participation (with prior permission from the Head of the Department) in the co-curricular/extra-curricular activities can be granted by the Dean on

receipt of certificates or recommendations of the respective activity issued by the Head of the Department.

e. Attendance records displayed on the Notice Board from time to time, in respect of short attendance, shall be deemed to be a proper notification and no individual notice shall be sent to the students/local guardian.

f. In case a student is found to be continuously absent from the classes without information for a period of 30 days, the concerned teacher shall report it to the Head of the Department.

g. Head of the Department may recommend for striking off the name of a student from rolls, after ensuring '**one month continuous absence**', from all the concerned teachers.

h. A student, whose name has been struck off on account of long absence may apply to the Dean for readmission within 15 days of the notice of striking off the name. The readmission shall be effected on payments of prescribed readmission fees.

i. A student with less than 75% attendance in a subject shall not be allowed to appear in that subject in the semester examination. The Head of the Department shall recommend all such cases to the Dean of the School.

j. The Dean, on the recommendation of the Head of the Department, may consider the relaxation of attendance up to 10% on account of sickness and /or any other valid reason. No application for relaxation of attendance (duly certified by a Registered Medical Practitioner/Public hospital or a competent authority) will be entertained after 15 days from the recovery from illness etc.

6. INTERNAL ASSESSMENT

a. Internal assessment, to be made by concerned teachers, will be based on unit tests, quizzes, presentation, programming test, demonstrations and assignments.

b. There will be three (3) Internal Assessment (Unit Tests) with a total of 20 marks ,and the best two (2) performances out of the three Unit tests of Internal Assessment will be counted. Other modes of assessment shall account for remaining 5 marks.

c. Dates for unit tests will be announced at the beginning of the semester, by the examination coordinator.

d. The teacher concerned shall maintain a regular record of the marks obtained by students in minor tests and display the same in due course.

e. The concerned teachers shall submit the compiled internal assessment marks to the Head of the Department, on the conclusion of teaching of the current semester.

f. The Head shall display a copy of the compiled sheet, of internal assessment marks of all the papers, before forwarding it to the Controller of Examination, i.e. at the conclusion of the semester.

g. A promoted candidate, who has to reappear in the examination of a paper, will retain internal assessment marks.

h. In the case of re-admission, the candidates shall have to go through the internal assessment process afresh and shall retain nothing of the previous year.

7. SEMESTER EXAMINATIONS

Prescriptions for conducting semester examinations of theory and lab papers, those shall be conducted after the conclusion of each of the semesters, are presented in the following table:

S.N.	Classification	Theory	Lab
1.	Mode	Written Only	Written, Demo, Programming and viva- voce etc.
2.	Duration	03 Hours	04 Hours
3.	Total Marks	75 (Seventy Five Only)	75 (Seventy Five Only)

8. DISSERTATION

a. Each student of the final semester will have to go for a Research based Dissertation work either in the industry or in the Department under the guidance of one or two faculty members.
b. Dissertation shall be based on latest research topics.
c. Students are required to get approval of their title of Dissertation by Dissertation Assessment & Evaluation committee constituted by HOD. Supervisor of respective students must be member of the above committee. Students are required to give at least three presentations for progress monitoring & assessment purpose to their respective supervisors. Viva-voce will be held only after the submission of completion report duly signed by the supervisor of the respective student. A plagiarism report duly signed by the students are mandatory to submit in compliance with UGC (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations, 2017 (or any such regulations notified time to time) by competent authority.
d. *Students are required to publish at least one article related to their work of Dissertation in UGC approved International Refereed Journal/International Conference. Before submitting the paper Student **MUST** take the consent of their respective supervisor.*
e. A supervisor will be allocated to every student for dissertation work as decided by the Dissertation Committee of the Department.
f. All the students, who are pursuing the Dissertation work, shall be continuously in touch with the internal supervisor.
g. ***There shall be three presentations by the students for evaluation of the progress*** and the internal supervisors will conduct it. However, an internal supervisor may ask the student to submit a confidential progress-report from the external supervisor *(if any).*
h. All the candidates shall submit ***Three (03***) hard copies of the project reports that are duly approved and signed by internal as well as external *(if applicable)* supervisors.
i. An external examiner, appointed for the purpose, shall evaluate the project report.
j. The Head of the Department shall fix a date and time for viva-voce examinations, on receipt of the evaluation-report of the project reports from the external examiner.
k. Head of the Department shall forward the compiled total marks (awarded in internal assessment, project Report and Viva-voce Examination), in the project-semester of each of the candidate, to the Controller of Examination.

9. EXAMINATION

a. The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/ tutorials, quizzes/ viva voce and attendance. The end semester examination shall be comprised of written papers, practical and viva voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.
b. The marks obtained in a subject shall consist of marks allotted in end semester theory paper, practical examination and sessional work.
c. The minimum pass marks in each subject including sessional marks (Theory, Practical or Project etc.) shall be 40%.

10. PROMOTION SCHEME

a. A student will be required to clear minimum **40% of his/her papers** (including Labs; excluding non-credit papers) in a semester/annual examination to be eligible **for promotion to the next semester/year**. A student may appear in the supplementary examination after each semester/annual examination and can have a choice to appear in the backlog papers in the supplementary examination or in the subsequent regular semester/annual examination with a prescribed fee. A students detained due to shortage of attendance will repeat his/her paper in the subsequent semester concerned (even/odd).

b. A **detained** Student is not allowed to re-appear in the internal assessment (Unit test). His/her old internal assessment marks will remain same.

A student who cleared all the papers of a semester/annual examination of a programme/course will be eligible for improvement examination as per university rule.

After having passed all the FOUR semesters, the students shall be eligible for the award of M. Tech. Computer Science & Engineering degree of JAMIA HAMDARD.

11. THE GRADING SYSTEM

As per University Rule

12. CALCULATION OF SGPA AND CGPA OF A STUDENT IN A SEMESTER

As per University Rule
After having passed all the FOUR semesters successfully, the students shall be eligible for the award of ***Master of Technology (Computer Science & Engineering) M.Tech. (CSE)*** degree of JAMIA HAMDARD based on their enrollment in the respective program.

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES

The result of successful candidates, who fulfill the criteria for the award of ***Master of Technology (Computer Science & Engineering) M. Tech. (CSE)*** shall be classified at the end of last semester, on the basis of his/her final CGPA (to be calculated as per university rule).

SEMESTER-I

Syllabus

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE 101
Title of the Course: Mathematical Foundations of Computer Science
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Discrete Mathematics

Total Teaching Hours: 44 hours

COURSE OUTCOMES (COs)

After completing this Course, the students should be able to:
CO-1: Understand the basic notions of discrete and continuous probability distribution, and solve the problems. (Cognitive Level: Understand)
CO-2: Describe the random samples and the sampling distributions, and analyze different types of samples. (Cognitive Level: Analyze)
CO-3: Discuss Statistical inference and multivariate statistical models, and categorize & classify the data. (Cognitive Level: Creating)
CO-4: Define and explain the basic concepts of graph theory and solve problems in almost every conceivable discipline using graph models. (Cognitive Level: Understand)
CO-5: Express & use the vector spaces and related topics. (Cognitive Level: Remember)
CO-6: Enumerate objects and solve counting problems and analyze algorithms. (Cognitive Level: Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2			1				1	1	
CO2	3	3	3	1	2		1		2		1		1	1
CO3	2	3	2	1	2					1	1		1	
CO4	3	2	3	2	2	1							1	1
CO5	3	3	2	1	-								1	
CO6	3	3	2	2	2								1	

-

Detailed Syllabus:

Unit 1: Probability Functions and Distributions ***8 Hours***
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

Unit 2: Random Sample Distribution ***8 Hours***
Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood.

Unit 3: Statistical Models ***6 Hours***

Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** the problem of over-fitting model assessment.

Unit 4: Graph Theory ***8 Hours***

Graph Theory: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Unit 5: Vector Spaces: ***8 Hours***

Vector spaces; subspaces; Linearly independent and dependent vectors; Bases and dimension; coordinate vectors-Illustrative examples. Linear transformations; Representation of transformations by matrices; linear functional; Non singular Linear transformations; inverse of a linear transformation- Problems.

Unit-IV: Number-Theoretic Algorithms ***6 Hours***

Division Algorithm, GCD, Primes, Euclidean Algorithm, Congruences, Properties of Congruences, Solutions of Linear Congruences.

Reference Books:

1. Kenneth H. Rosen, "Discrete mathematics and its applications", McGraw-Hill, (7th Edition), (Smartbook available).
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th ed., Wiley.
3. Gupta S.C and Kapoor V .K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons 11th edition.
4. John Vince, Foundation Mathematics for Computer Science, Springer.
5. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
6. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
7. David M. Burton, "Elementary Number Theory", McGraw-Hill, 7th Edition (2012).
8. David C.Lay, Steven R.Lay and J.J.McDonald: Linear Algebra and its Applications, 5 th Edition, Pearson Education Ltd., 2015.

Teaching-Learning Strategies in brief

1. Build positive environment in the classroom.
2. Provide concrete basic and advanced knowledge of the subject.
3. Solve problems based on the basic & advanced concepts of the subject.
4. Encourage to the students to ask more & more questions.
5. Motivate to the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. By taking two sessional examinations.
2. By giving assignments.
3. By conducting class tests.
4. By taking semester examination.
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE 102
Title of the Course: Advanced Data Structures
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Total Teaching Hours: 42 hours

Course Prerequisite: UG level course in Data Structures

Course Outcomes:

The course will help students
CO1: The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem. (Cognitive Level: Analyze)
CO2: Students should be able to understand the necessary mathematical abstraction to solve problems. (Cognitive Level: Understand)
CO3: To familiarize students with advanced paradigms and data structure used to solve algorithmic problems. (Cognitive Level: Create)
CO4: Student should be able to come up with analysis of efficiency and proofs of correctness. (Cognitive Level: Analyze)
CO5: To make students future ready for Applying Data Structure concepts in upcoming technologies. (Cognitive Level: Analyze)

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

Unit wise Syllabus

Unit – I: Dictionaries & Hashing ***8 Hours***

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit – II: Skip Lists ***7 Hours***

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit – III: Trees ***6 Hours***

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit – IV: Text Processing ***8 Hours***

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit – V: Computational Geometry ***7 Hours***

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit – VI: Recent Trends in Hashing, Trees & Computational Geometry

6 Hours

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

Text/ Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

2. M T Goodrich Roberto Tamassia, Algorithm Design, John Willey, 2002.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering

Course Code: MTCSE 103

Title of the Course: Research Methodology & IPR

L-T-P: 2-0-0 Credit:2

Total Teaching hours: 40

Course Outcomes:

The course will help students
CO1: Understand some basic concepts of research and its methodologies (Cognitive Level: Understand)
CO2: Identify appropriate research topics. (Cognitive Level: Remember)
CO3: Select and define appropriate research problem and parameters. (Cognitive Level: Create)
CO4: Prepare a project proposal (to undertake a project). (Cognitive Level: Create)
CO5: Organize and conduct research (advanced project) in a more appropriate manner. (Cognitive Level: Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Research Problem, Scope & Objectives ***8 Hours***

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit – II: Effective Literature Studies ***6 Houes***

Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit – III: Effective Technical Writing ***6 Hours***

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit – IV: Nature of Intellectual Property ***8 Hours***

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International

Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

Unit – V: Patent Rights ***6 Hours***

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit – VI: New Developments in IPR ***6 Hours***

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/ Reference book:

Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.
- Asimov , "Introduction to Design", Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE 104

Title of the Course: Advanced Data Structure Lab
L-T-P: 0-0-4 Credit:2

Course Outcomes:

CO1: Able to design and implement the basic as well as advanced data structures.
CO2: Searching and sorting are ore emphasised using advanced data structure.
CO3: Able to implement Text Data Processing Techniques using BOYER Algorithms.
CO4: To learn efficient use of Hash Tables.
CO5: Able to implement Text Data Processing Techniques using LCS Algorithms.

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOME

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO1	PSO2
CO 1	1	2	3	1	3	2	1	2	2	3	2	1
CO 2	3	2	2	2	2	2	1	3	3	2	1	3
CO 3	2	2	1	3	1	3	2	1	2	2	3	2
CO 4	-	2	2	3	3	3	3	1	2	3	2	3
CO 5	-	-	2	1	4	2	1	1	2	3	1	2

List of Program

1. Implementation of Traversal, Insertion, Deletion, Searching, Sorting in Linked list.
2. Implementation of stacks (PUSH, POP,SEARCH and SORT)
3. Implementation of Queues (Enque, Deque, Search and Sort)
4. Implementation of binary search Tree.
5. Implementation of Height Balanced Tree and calculation of balance factor.
6. Implementation of Red- Black Trees.
7. Implementation of Splay Tree.
8. Updating, deletion and creation of a hash table.
9. Implement Boyer-Moore Algorithm for Text Processing.
10. Implement LCS Algorithm for Text Processing.

Teaching-Learning Strategies in brief

1. Build openness and positive environment in the Lab.
2. Provide concrete basic and advanced knowledge of the subject.
3. Create collaborative environment among students.
4. Encourage students to ask questions and clarify doubts.
5. Motivate the students to develop critical & strategic thinking.

Assessment methods and weightages in brief

1. Giving assignments and Quizzes based on the subject.
2. Conducting viva.
3. Mid Term assessment and semester examination.
4. Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.

Course Name: Machine Learning Lab (Lab Based on Elective-I)
Course Code: MTCSE 105

L-T-P: 0-0-4 **Credits: 2**
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

CO-1: Understand modern notions in predictive data analysis
CO-2: Select data, model selection, model complexity and identify the trends
CO-3: Understand a range of machine learning algorithms along with their strengths and weaknesses
CO-4: Build predictive models from data and analyze their performance

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	1	2
CO2	3	3	3	1	2	2	-	-	-	2	2	1
CO3	2	3	2	1	2	-	3	2	-	-	3	-
CO4	3	2	3	2	2	-	-	3	-	-	-	3

-

List of Programs

1. Write a python program to compute
   - Central Tendency Measures: Mean, Median, Mode
   - Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression.
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn.
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

Teaching-Learning Strategies in brief

1. Build openness and positive environment in the Lab.
2. Provide concrete basic and advanced knowledge of the subject.
3. Create collaborative environment among students.
4. Encourage students to ask questions and clarify doubts.
5. Motivate the students to develop critical & strategic thinking.

Assessment methods and weightages in brief

1. Giving assignments and Quizzes based on the subject.
2. Conducting viva.
3. Mid Term assessment and semester examination.
4. Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.

SEMESTER-II

Course Code: MTCSE 201

Title of the Course: Advanced Algorithms
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Total Teaching hours: 48

Course Prerequisite: Algorithm Design & Analysis

Course Outcomes:

CO-1: Analyze the complexity and performance of different algorithms in different contexts. (Cognitive Level :Analyze)
CO-2: Determine the appropriate data structure for solving a particular set of problems. (Cognitive Level: Understand)
CO-3: Create and identify the computational issues and apply suitable algorithms to solve it effectively. (Cognitive Level: Create)
CO-4: Design and implement optimized algorithmic solutions in real world problems involving large data sets and artificial intelligence. (Cognitive Level: Understand)
CO-5: Design efficient and effective algorithmic solutions for different real world problems. (Cognitive Level: Remember)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Sorting ***8 Hours***

Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit – II: Matroids ***8 Hours***

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit – III: Flow-Networks ***8 Hours***

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit – IV: Shortest Path in Graphs ***8 Hours***

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit – V: Linear Programming ***8 Hours***

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Unit – VI: Recent Trends in problem solving ***8 Hours***

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text/ Reference book:

- "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
- "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
- "Algorithm Design" by Kleinberg and Tardos.
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE 202
Title of the Course: Soft Computing
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Basic knowledge of mathematics

Course Outcomes:
After completing this Course, the students should be able to
CO-1: Identify and describe soft computing techniques and their roles in building intelligent machines. (Cognitive Level :Understand)
CO 2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. (Cognitive Level :Apply)
CO-3: Analyze the effectiveness of using Neural Networks for solving real life problems. (Cognitive Level :Analyze)
CO 4: Explain the application of genetic algorithms to combinatorial optimization problems. (Cognitive Level :Understand)
CO 5: Evaluate and compare solutions by various soft computing approaches for a given problem. (Cognitive Level :Evaluate)
CO-6: Design deep learning based models for solving various machine learning problems. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	1	1	1	1	1	1	1	2	3	1
CO2	2	3	3	3	2	1	1	1	1	1	1	3	3	1
CO3	3	2	2	2	3	1	1	1	1	2	2	2	2	1
CO4	2	3	2	3	3	2	1	2	2	1	1	1	3	1
CO5	2	2	3	2	2	1	1	1	1	1	2	1	3	1
CO6	3	3	2	2	3	1	1	2	2	2	2	1	3	1

Detailed Syllabus:

Unit 1: Introduction to Soft Computing **6 Hours**

Evolution of Computing, Soft Computing Constituents, From Conventional AI to Computational Intelligence, Tools for Soft Computing, Machine Learning Basics

Unit 2: Fuzzy logic **8 Hours**

Fuzzy logic vs. Crisp logic Concept of Fuzzy System, Fuzzy sets, Membership Functions, Fuzzy Terminologies, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems

Unit 3: Neural Networks **8 Hours**

Neural Network Architectures, Perceptron Model, Feed forward Networks, Adaptive Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures

Unit 4: Genetic Algorithms **8 Hours**

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition

Unit 5: Matlab/Python Lib **6 Hours**

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Unit 6: Recent Trends in Deep Learning **6 Hours**

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Reference Books:

1. Padhy N. P., Simon S. P. Soft Computing: With MATLAB Programming, Oxford University Press, 2015.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall,1995.
3. Neural Networks: Algorithms, Applications and Programming Techniques, James A Freeman, David M. Skapura.
4. Genetic Algorithms in Search, Optimization, and Machine Learning, David E. Goldberg

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE 203
Title of the Course: Lab III Lab Based on Core (Advanced Algorithms/Soft Computing)
L-T-P: 0-0-2 **Credits**: 1
(L=Lecture hours, T=Tutorial hours, P=Practical hours)

COURSE OUTCOMES (CO)

CO1: Able to understand concept of different approaches of algorithms
CO2: Able to design clean and optimized codes.
CO3: Able to design and code algorithms based on brute force, greedy and divide and conquer and dynamic programming approaches (Cognitive level: create).
CO4: Able to identify syntax and semantics and logical issues in codes (Cognitive level: understand).
CO5: Able to understand the code complexity and create and design low complexity codes (Cognitive level: create).

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PS O1	PS O2
CO1	1	1	-	-	-	-	1	1	2	1	1	1
CO2	-	1	3	-	1	-	2	1	-	1	2	2
CO3	1	1	3	1	-	1	-	2	1	2	3	2
CO4	-	1	-	-	1	-	1	-	-	-	1	1
CO5	1	-	3	-	-	1	1	1	1	2	1	2

List of experiments

1. Write a program to implement merge sort and binary search algorithms.
2. Write a program to implement LCS approach
3. Write a program to implement Dijkstra Algorithm
4. Write a program to 8 Queen Problem and activity selection problem.
5. Write a program to implement magic square of order 3X3
6. Write a program in python to implement all logic gates.
7. Write a program in python to Implement Perceptron Learning Algorithm.
8. Write a program to implement SVM classification by using the concept of Fuzzy concepts.
9. Write a program to implement a Fuzzy Controller for Washing Machines.
10. Write a program in python to implement Hebb's and Delta rules.

Teaching-Learning Strategies in brief

1. Build openness and positive environment in the Lab.
2. Provide concrete basic and advanced knowledge of the subject.
3. Create collaborative environment among students.
4. Encourage students to ask questions and clarify doubts.
5. Motivate the students to develop critical & strategic thinking.

Assessment methods and weightages in brief

1. Giving assignments and Quizzes based on the subject.
2. Conducting viva.
3. Mid Term assessment and semester examination.
4. Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.

Name of The Course: M. Tech. (CSE)
Course Code: MTCSE 204
Title of the Course: Data Preparation & Analysis LAB
L-T-P: 0-0-2
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 2
Course Outcomes:

CO-1: To identify the data parsing and transformations. and understand the difference between data and information with formats. (Cognitive Level: analyse)

CO2: To explain and apply the basic concept of data cleaning for valuable information with a minimum consistency checking (Cognitive level: apply)

CO-3: To understand statistical exploratory analysis with hypothesis generation. (Cognitive Level: Evaluate)

CO-4: To design visualizations for exploratory analysis and understand the concept of correlations and connections for geo-located data. (Cognitive level: Create)

CO-5: To learn data transformations and segmentation to solve statistical problems. Able to extract the data for performing the Analysis. (Cognitive level: Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

List of Experiments

1. There are four medicines MedA, MedB, MedC, and MedD. They have two attributes, weight index, and ph. Group these medicines into two groups on the basis of these attributes using k means clustering algorithm.

	Weight	ph
MedA	1	1
Med2	2	1
Med3	4	3
Med4	5	4

2. Calculate mean, median, and mode of following dataset using excel as the tool.
   3,7,1,9,2,6,11,4,5,23,18
   How do you identify the outliers?

3. For the following data which denotes weight of raisins in (kgs), use excel to calculate correlation co-efficient, and standard deviation. Display it.
   20,16,32,31,45,67,56,60
4. Write a program that implements the association rule mining technique.
5. Design a program that works on a given dataset and performs any of the normalization technique
6. Implement any of the missing data techniques.
7. For a given data, (can be fetched yourself from any real dataset), use any two visualization methods for viewing the data. Use any visualization tool or method.
8. Implement any noisy data handling technique.
9. Fetchany datset from UCI machine learning repository and apply any pre-processing technique on same.
10. Convert numerical data to categorical for a given dataset.

Teaching-Learning Strategies in brief

1. Build openness and positive environment in the Lab.
2. Provide concrete basic and advanced knowledge of the subject.
3. Create collaborative environment among students.
4. Encourage students to ask questions and clarify doubts.
5. Motivate the students to develop critical & strategic thinking.

Assessment methods and weightages in brief

1. Giving assignments and Quizzes based on the subject.
2. Conducting viva.
3. Mid Term assessment and semester examination.
4. Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.

Program Electives

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE111
Title of the Course: Machine Learning
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Total Teaching Hours: 48 hours

Course Outcomes:
CO-1: To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IoT nodes. (Cognitive Level :Understand)
CO-2: To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances. (Cognitive Level :Understand)
CO-3: Explore supervised and unsupervised learning paradigms of machine learning. (Cognitive Level :Remember)
CO-4: To explore Deep learning technique and various feature extraction strategies. (Cognitive Level :Create)
CO-5: Design experiments to evaluate and compare different machine learning techniques on real-world problems. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Supervised Learning ***8 hours***
Supervised Learning (Regression/Classification) - Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes - Linear models: Linear Regression, Logistic Regression, Generalized Linear Models; Support Vector Machines, Nonlinearity and Kernel Methods; Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Unit – II: Clustering ***6 hours***
Clustering: K-means/Kernel K-means; Dimensionality Reduction: PCA and kernel PCA; Matrix Factorization and Matrix Completion; Generative Models

Unit – III: Evaluating Machine Learning ***8 hours***
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

Unit – IV: Sparse Modeling & Estimation ***6 hours***

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Unit – V: Scalable Machine Learning ***8 hours***

Scalable Machine Learning (Online and Distributed Learning A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

Unit – VI: Recent Trends in various learning technique ***6 hours***

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Text/ Reference Books:

- Tom M. Michell, Machine Learning, McGraw Hills
- AurÈlien GÈron, Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, Orielly Publications
- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE112
Title of the Course: Wireless Sensor Networks
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Wireless Communication

Total Teaching Hours: 48 hours

Course Outcomes:
CO-1: Architect sensor networks for various application setups. (Cognitive Level :Understand)
CO-2: Devise appropriate data dissemination protocols and model links cost. (Cognitive Level :Analyze)
CO-3: Understanding of the fundamental concepts of wireless sensor networks and has a basic knowledge of the various protocols at various layers. (Cognitive Level: Understand)
CO-4: Evaluate the performance of sensor networks and identify bottlenecks. (Cognitive Level: Evaluate)

CO-5: To familiar with WSN standard and its applications. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Introduction to Wireless Sensor Networks
Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture Hardware Platforms: Motes, Hardware parameters.

Unit – II: Introduction to ns-3
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit – III: Medium Access Control Protocol design
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled Introduction to Markov Chain: Discrete time Markov Chain definition,

properties, classification and analysis MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain).

Unit – IV: Security

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

Unit – V: Routing protocols

Routing protocols: Introduction, MANET protocols Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain), Advanced topics in wireless sensor networks.

Unit – VI: Advanced Topics

ADVANCED TOPICS: Recent development in WSN standards, software applications.

Text/ Reference Books:

- W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010
- KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007
- Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE113
Title of the Course: Introduction to Intelligent Systems
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Prerequisite: Data Structures and Data Management or Data Structures

Total Teaching Hours: 48 hours

Course Outcomes:
CO-1: The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems. (Cognitive Level :Understand)
CO-2: Problems for which solutions are difficult to express using the traditional algorithmic approach. (Cognitive Level :Remember)
CO-3: It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behavior. (Cognitive Level :Create)
CO-4: Dealing with uncertainty learning from experience and following problem solving strategies found in nature. (Cognitive Level :Understand)

CO-5: Knowledge representation and use of inference. (Cognitive Level :Applying)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

-

Unit wise Syllabus

Unit – I: Biological foundations to intelligent systems I ***6 Hours***
Biological foundations to intelligent systems I: Artificial neural networks, Back propagation Networks, Radial basis function networks, and recurrent networks.

Unit – II: Biological foundations to intelligent systems II ***6 Hours***
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit – III: Search Methods Basic concepts of graph and tree search ***8 Hours***
Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

Unit – IV: Knowledge representation ***8 Hours***

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Unit – V: Reasoning under uncertainty ***8 Hours***

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Unit – VI: Recent Trends ***6 Hours***

Recent trends in Fuzzy logic, Knowledge Representation.

Text/ Reference Books:

- Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
- Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE121
Title of the Course: Data Science
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Total Teaching Hours: 48 hours

Course Outcomes:
CO-1: Provide you with the knowledge and expertise to become a proficient data scientist. (Cognitive Level :Create)
CO-2: To understand how data is collected from multiple sources and stored. (Cognitive Level :Understand)
CO-3: Demonstrate an understanding of statistics and machine learning concepts that are vital for data science. (Cognitive Level :Understand)
CO-4: Critically evaluate data visualizations based on their design and use for communicating stories from data. (Cognitive Level :Evaluate)
CO-5: Produce Python code to statistically analyze a dataset. (Cognitive Level :Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Introduction to core concepts and technologies **6 Hours**
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit – II: Data collection and management ***6 Hours***
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

Unit – III: Data analysis ***8 Hours***
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit – IV: Data Visualisation ***8 Hours***
Data visualisation: Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit – V: Applications of Data Science ***6 Hours***
Applications of Data Science,Technologies for visualisation, (Python)

Unit – VI: Recent trends ***6 Hours***

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Text/ Reference Books:

- Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media
- Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media
- Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
- Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE122

Title of the Course: Distributed Systems

L-T-P: 3-0-0

(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Prerequisite: Database Management Systems

Total Teaching Hours: 48 hours

Course Outcomes:

CO-1: To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems. (Cognitive Level :Understand)

CO-2: To provide hardware and software issues in modern distributed systems. (Cognitive Level :Analyze)

CO-3: To get knowledge in distributed architecture, naming, synchronization, consistency. (Cognitive Level :Understand)

CO-4: Replication, fault tolerance, security, and distributed file systems. (Cognitive Level :Remember)

CO-5: To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed. (Cognitive Level :Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Introduction to Distributed Database Management System Architecture ***8 Hours***

INTRODUCTION: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts

DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Unit – II: Distributed Database Design ***8 Hours***

DISTRIBUTED DATABASE DESIGN: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation

SEMANTICS DATA CONTROL: View management; Data security; Semantic Integrity Control

QUERY PROCESSING ISSUES: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Unit – III: Distributed Query Optimization ***8 Hours***

DISTRIBUTED QUERY OPTIMIZATION: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

TRANSACTION MANAGEMENT: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

CONCURRENCY CONTROL: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Unit – IV: Reliability ***6 Hours***

RELIABILITY: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Unit – V: Parallel Database Systems ***6 Hours***

PARALLEL DATABASE SYSTEMS: Parallel architectures; parallel query processing and optimization; load balancing

Unit – VI: Advanced Topics ***6 Hours***

ADVANCED TOPICS: Mobile Databases, Distributed Object Management, Multi-databases.

Text/ Reference Books:

- Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
- Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE123
Title of the Course: Advanced Wireless & Mobile Networks
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Prerequisite: Computer Networks

Total Teaching Hours: 48 hours

Course Outcomes:
CO-1: The students should get familiar with the wireless/mobile market and the future needs and challenges. (Cognitive Level :Understand)
CO-2: To get familiar with key concepts of wireless networks, standards, technologies and their basic operations. (Cognitive Level :Create)
CO-3: To learn how to design and analyse various medium access. (Cognitive Level :Analyze)
CO-4: To learn how to evaluate MAC and network protocols using network simulation software tools. (Cognitive Level :Evaluate)

CO-5: The students should get familiar with the wireless/mobile market and the future needs and challenges. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Introduction to WLAN ***8 Hours***

INTRODUCTION: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.
WIRELESS LOCAL AREA NETWORKS: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues

Unit – II: Wireless Cellular Networks ***6 Hours***

WIRELESS CELLULAR NETWORKS: 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

Unit – III: WiMAX ***8 Hours***

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview
WIRELESS SENSOR NETWORKS: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

Unit – IV: Wireless PANs ***6 Hours***

WIRELESS PANs: Bluetooth AND Zigbee, Introduction to Wireless Sensors.

Unit – V: Security in Wireless Networks ***6 Hours***

SECURITY: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

Unit – VI: Advanced Topics ***6 Hours***

ADVANCED TOPICS: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks

Text/ Reference Books:

- Schiller J., Mobile Communications, Addison Wesley 2000
- Stallings W., Wireless Communications and Networks, Pearson Education 2005
- Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
- Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
- Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE231
Title of the Course: Data Preparation & Analysis
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Outcomes:
CO-1: To Gain knowledge to identify the data parsing and transformations. and understand the difference between data and information with formats. (Cognitive Level :Understand)
CO-2: To explain the basic concept of data cleaning for valuable information with a minimum consistency checking. (Cognitive Level :Remember)
CO-3: To understand statistical exploratory analysis with hypothesis generation. (Cognitive Level :Understand)
CO-4: To design visualizations for exploratory analysis and understand the concept of correlations and connections for geo located data. (Cognitive Level :Evaluate)

CO-5: To learn data transformations and segmentation to solve statistical problems. Able to extract the data for performing the Analysis. (Cognitive Level :Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	3	1	2	3	2	1	2	3	2	2	2	2
CO2	2	3	2	2	2	2	2	3	2	3	2	2	2	1
CO3	2	2	2	2	3	3	1	2	3	2	2	2	3	1
CO4	3	3	2	2	2	2	2	3	2	2	3	2	2	1
CO5	2	2	2	2	2	2	2	2	2	2	2	3	2	1

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Unit wise Syllabus

Unit – I: Defining Data Analysis Problems ***6 Hours***
Knowing the client, Understanding the questions
Unit – II: Data Gathering and Preparation ***8 Hours***
Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues.
Unit – III: Data Cleaning ***6 Hours***
Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.
Unit – IV: Exploratory Analysis ***8 Hours***
Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation.
Unit – V: Visualization ***6 Hours***
Visualization: Designing visualizations, Time series, Geolocated data, Correlations and

connections, Hierarchies and networks, interactivity.

Unit – VI: Ethics in Profession ***6 Hours***

Cases in computing, statistics and Communication

Text/ Reference Books:

- Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE232
Title of the Course: Secure Software Design & Enterprise Computing
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Computer Programming, Software Engineering

Course Outcomes:
CO-1: To fix software flaws and bugs in various software. (Cognitive Level :Understand)
CO-2: To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic. (Cognitive Level :Understand)
CO-3: Techniques for successfully implementing and supporting network services on an enterprise scale. (Cognitive Level :Apply)
CO-4: Techniques for successfully implementing and supporting network services Heterogeneous systems environment. (Cognitive Level :Apply)

CO-5: Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws. (Cognitive Level :Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Secure Software Design ***6 Hours***
Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit – II: Enterprise Application Development ***8 Hours***
Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Unit – III: Enterprise Systems Administration ***8 Hours***

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit – IV: Troubleshooting ***6 Hours***

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Unit –V: SQL Injection ***6 Hours***

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Unit – VI: Case Study ***6 Hours***

Case study of DNS server, DHCP configuration and SQL injection attack.

Text/ Reference Books:

- Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
- Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Teaching-Learning Strategies in brief

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2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE PE233
Title of the Course: Computer Vision
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Linear algebra, vector calculus, Data structures and Programming.

Course Outcomes:
CO-1: Be familiar with both the theoretical and practical aspects of computing with images. (Cognitive Level :Understand)
CO-2: Have described the foundation of image formation, measurement, and analysis. (Cognitive Level :Analyze)
CO-3: Understand the geometric relationships between 2D images and the 3D world. (Cognitive Level :Understand)
CO-4: Grasp the principles of state-of-the-art deep neural networks. (Cognitive Level :Create)
CO-5: Design experiments to evaluate and compare different machine learning techniques on real-world problems. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Overview of Image Analysis ***8 Hours***
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

Unit – II: Edge Detection ***6 Hours***
Edge detection, Edge detection performance, Hough transform, corner detection

Unit – III: Segmentation ***6 Hours***
Segmentation, Morphological filtering, Fourier transform

Unit – IV: Feature Extraction ***6 Hours***
Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing

Unit –V: Pattern Analysis ***10 Hours***

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Unit – VI: Recent Trends ***6 Hours***

Recent trends inActivity Recognition, computational photography, Biometrics.

Text/ Reference Books:

- Computer Vision: Algorithms and Applications by Richard Szeliski.
- Deep Learning, by Goodfellow, Bengio, and Courville.
- Dictionary of Computer Vision and Image Processing, by Fisher et al.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE PE241
Title of the Course: Pattern Recognition
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Course Prerequisite: Data Mining

COURSE OUTCOMES

After completing this Course (or unit of a course) the students should be able to:
CO1: Basic concepts of pattern recognition. (Cognitive Level :Analyze)
CO2: fundamental problems in pattern recognition system, design concepts and methodologies. (Cognitive Level :Understand)
CO3: Compare and describe different types of cognitive models. (Cognitive Level :Understand)
CO4: Assess the applicability of mobile ecosystem. (Cognitive Level :Analyze)
CO5: Interpret the various aspects of Web Interface Designing. (Cognitive Level :Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1				3			1	2				1		
CO 2	1	2	3	1		1					1	1	2	1
CO 3		2					1		1		1			
CO 4		1	2		1	1				2	2		1	
CO 5		2	2								1		1	

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Unit wise Syllabus

Unit – I: Pattern recognition fundamentals: ***8 hours***
Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.

Unit – II: Bayesian decision theory ***8 hours***
Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features, Missing and noisy features, Bayesian networks (Graphical models) and inferencing.

Unit – III: Maximum-likelihood and Bayesian parameter estimation: ***8 hours***

Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Fisher discriminant analysis, PCA Expectation Maximization method: Missing features

Unit – IV: Sequential Models and Linear discriminant functions ***8 hours***

State Space, Hidden Markov models, Dynamic Bayesian, Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbour method

Gradient descent procedures, Perceptron criterion function, Minimum-squared-error procedures, Ho-Kashyap procedures, Support vector machines

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Unit –V: Unsupervised learning and clustering: ***8 hours***

Unsupervised maximum-likelihood estimates, Unsupervised Bayesian learning, Criterion functions for clustering, Algorithms for clustering: Kmeans, Hierarchical and other methods, Cluster validation, Low-dimensional representation and multidimensional scaling (MDS).

Text/ Reference Books:

- Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addision –Wesley.
- Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006.
- A probabilistic theory of pattern recognition, Luc Devroye, László Györfi, Gábor Lugosi, Springer, 1996.
- Pattern classification, Richard O. Duda, Peter E. Hart and David G. Stork, Wiley, 2001.
- Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE242
Title of the Course: Graphics Processing Unit Computing
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Prerequisite: Basics of Data Structure, Computer Architecture, Computer Graphics

Course Outcomes:
CO-1: To learn parallel programming with Graphics Processing Units (GPUs). (Cognitive Level :Understand)
CO-2: To convey a deep understanding of GPU architecture and APIs. (Cognitive Level :Understand)
CO-3: Understanding the traditional use of GPUs for general purpose computations. (Cognitive Level :Understand)
CO-4: To learn debugging and profiling parallel programs. (Cognitive Level :Apply)
CO-5: To learn the concepts in parallel programming. (Cognitive Level :Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Introduction ***8 Hours***
History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

Unit – II: Memory ***6 Hours***
Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Unit – III: Synchronization ***8 Hours***

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit – IV: Support ***8 Hours***

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit –V: Case Studies ***6 Hours***

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Unit – VI: Advanced Topics ***6 Hours***

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

Text/ Reference Books:

- Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
- CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE352
Title of the Course: Compilers for High Performance Computing
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Prerequisite: Data Structure, Compiler Design, Theory of Computation

Course Outcomes:

CO-1: The objective of this course is to introduce structure of compilers and high performance compiler design for students. (Cognitive Level :Understand)

CO-2: Concepts of cache coherence and parallel loops in compilers are included. (Cognitive Level :Understand)

CO-3: Concepts of data dependence, conditional and parallel loops. (Cognitive Level :Create)

CO-4: Implementation of array region analysis and pointer analysis. (Cognitive Level :Analyze)

CO-5: Description of message passing machines, SIMD and MIMD types. (Cognitive Level :Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: High Performance System ***6 Hours***

High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.

Unit – II: Data Dependence ***8 Hours***

Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use- Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.

Unit – III: Array Region Analysis ***8 Hours***

Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis. Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Unit – IV: Concurrency Analysis ***8 Hours***

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

Unit –V: Message Passing Machines ***6 Hours***

Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Unit – VI: Recent Trends ***6 Hours***

Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

Text/ Reference Books:

- Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Course Code: MTCSE PE353
Title of the Course: Optimization Techniques
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3

Course Prerequisite: Linear Algebra and Numerical Methods

Total Teaching Hours: 48 hours

Course Outcomes:
After completing this Course (or unit of a course) the students should be able to:
CO1: Formulate the design problems. (Cognitive Level :Remember)
CO2: Appraise the general structure of optimization algorithms. (Cognitive Level :Analyze)
CO3: Compare and describe various Mathematical Programming techniques. (Cognitive Level :Apply)
CO4: Assess the usefulness of Genetic Optimization approaches. (Cognitive Level :Evaluate)
CO5: Evaluate the real-life problems and formulate them mathematically as standard programming problems. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Optimization ***6 Hours***
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

Unit – II: Structure of Optimization Algorithms ***6 Hours***
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit – III: Mathematical Programming ***8 Hours***
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

Unit – IV: Genetic Optimization ***8 Hours***
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

Unit –V: Real Life Problem ***8 Hours***
Real life Problems and their mathematical formulation as standard programming problems.

Unit – VI: Recent Trends ***6 Hours***

Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

Text/ Reference Books:

- Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
- Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
- An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
- Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
- John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 9780-8493-1914-3.
- H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
- Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank;
- Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer
- Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
- Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

OPEN ELECTIVES

Name of the Academic Program: M.Tech Computer Science & Engineering
Course Code: MTCSE OE311
Title of the Course: Business Analytics
L-T-P: 3-0-0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Credits: 3
Course Prerequisite: Optimization, Data Mining
Course Outcomes:
After completing this Course (or unit of a course) the students should be able to:
CO1: Appraise the scope and process of Business Analytics. (Cognitive Level :Understand)
CO2: Interpret Trendlines and Regression. (Cognitive Level :Understand)
CO3: Compare linear and non-linear optimization. (Cognitive Level :Evaluate)
CO4: Assess the different forecasting models. (Cognitive Level :Analyze)
CO5: Formulate decision problems and decision strategies. (Cognitive Level :Analyze)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Business Analytics ***8 Hours***

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit – II: Trendiness & Regression Analysis ***8 Hours***

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytic Technology.

Unit – III: Business Analytics ***8 Hours***

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive

analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit – IV: Forecasting Techniques ***8 Hours***

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit – V: Decision Analysis ***6 Hours***

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit – VI: Recent Trends ***6 Hours***

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Text/ Reference Books:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE OE312
Title of the Course: Block Chain Design and Their Use Cases
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Course Prerequisite: Data Structure, Compiler Design, Theory of Computation

COURSE OUTCOMES:

CO-1: To impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies. (Cognitive Level :Understand)
CO-2: Capable to identifying problems on which blockchains could be applied. (Cognitive Level :Apply)
CO-3: Introduce the concept and the basics of blockchain technologies. (Cognitive Level :Understand)
CO-4: Enable awareness on the different generations of blockchains. (Cognitive Level :Analyze)
CO-5: Provide knowledge on various applications of blockchain technologies. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unitwise Syllabus

Unit – I: Introduction ***8 hours***
Blockchain history, basics, architectures, Types of blockchain, Base technologies – Dockers, Hash function, Digital Signature - ECDSA, Zero Knowledge Proof.

Unit – II: Bitcoins ***8 hours***
Fundamentals, aspects of bitcoins, properties of bitcoins, bitcoin transactions, bitcoin

Unit – III: P2P networks ***8 hours***
Block generation at bitcoins, consensus algorithms- Proof of Work, Proof of Stake, Proof of Burn.

Unit – IV: Blockchain hyperledger ***8 hours***

Fabric architecture, implementation, networking, fabric transactions, demonstration, smart contracts.

Unit – V: Applications ***8 hours***

Blockchain applications, e-governance, smart cities, smart industries, anomaly detections, use cases, trends on Blockchains, serverless blocks, scalability issues, blockchain on clouds.

Text/ Reference Books:

- Baxv Kevin Werbach, The Blockchain and the new architecture of Trust, MIT Press, 2018
- Joseph J. Bambara and Paul R. Allen, Blockchain – A practical guide to developing business, law, and technology solutions, McGraw Hill, 2018.
- Joseph J. Bambara and Paul R. Allen, Blockchain, IoT, and AI: Using the power of three to develop business, technical, and legal solutions, Barnes & Noble publishers, 2018.
- Melanie Swan, Blockchain – Blueprint for a new economy, OReilly publishers, 2018. Page 19 of 23
- Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Blockchain for Business, Pearson publishers, 2019.
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE OE313
Title of the Course: Operation Research
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)
Course Prerequisite: Data Structure, Compiler Design, Theory of Computation

Course Outcomes
At the end of the course, the student should be able to
CO-1: Students should able to apply the dynamic programming. (Cognitive Level :Apply)
CO-2: Problems of discreet and continuous variables. (Cognitive Level :Understand)
CO-3: Students should able to apply the concept of non-linear programming. (Cognitive Level :Apply)
CO-4: Students should able to carry out sensitivity analysis. (Cognitive Level :Analyze)
CO-5: Student should able to model the real world problem and simulate it. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Optimization Techniques ***6 Hours***
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit – II: Formulation of LPP ***6 Hours***
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit – III: Nonlinear Programming Problem ***8 Hours***
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit – IV: Scheduling & Sequencing ***8 Hours***
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit – V: Competitive Models ***8 Hours***
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Unit – VI: Transportation Problem ***6 Hours***

Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution, Moving Towards Optimality.

Text/ Reference Books:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE OE314
Title of the Course: Cost Management of Engineering Projects
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes
CO-1: Identify and use the tools and techniques of project management. (Cognitive Level :Remember)
CO-2: Effectively use project reporting tools and techniques. (Cognitive Level :Analyze)
CO-3: Understand the importance of risk, cost, schedule and resource control and management of a project. (Cognitive Level :Understand)
CO-4: Understand the need for effective project management skills, training and the specific training needs of project managers. (Cognitive Level :Understand)
CO-5: Demonstrate an understanding of the role of Project Management vs. Functional Management. Write clear goal and objective statements and establish measurable criteria for project success. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit-I ***8 Hours***
Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-II ***8 Hours***
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents.

Unit-III ***8 Hours***

Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit-IV ***8 Hours***

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Unit-V ***8 Hours***

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-VI ***6 Hours***

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text/ Reference Books:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE OE315
Title of the Course: IoT Fundamentals and Architecture
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcome:

CO1: Identify the IoT networking components with respect to OSI layer. (Cognitive Level :Understand)
CO2: Build schematic for IoT solutions. (Cognitive Level :Create)
CO3: Design and develop IoT based sensor systems. (Cognitive Level :Analyze)
CO4: Select IoT protocols and software. (Cognitive Level :Create)
CO5: Evaluate the wireless technologies for IoT. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Detailed Syllabus

Unit 1: Evolution of IoT **8 hours**
Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting,IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer.

Unit 2: Introduction to IoT components **8 hours**
Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardwares, Examples of IoT infrastructure

Unit 3: IoT protocols and softwares **8 hours**
MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols,

Unit 4: IoT point to point communication technologies **6 hours**
IoT Communication Pattern, IoT protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE, SIG, NFC, LORA, Lifi, Widi)

Unit 5: Introduction to Cloud computation and Big data analytics **6 hours**
Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop.

Unit 6: IoT security, IoT application and its Variants **10 hours**
Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security

Case studies: IoT for smart cities, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0, IoT standards.

Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
5. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1 st Edition, VPT, 2014.
6. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Teaching-Learning Strategies in brief

1. Build positive environment in the classroom.
2. Provide concrete basic and advanced knowledge of the subject.
3. Solve problems based on the basic & advanced concepts of the subject.
4. Encourage to the students to ask more & more questions.
5. Motivate to the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. By taking two sessional examinations.
2. By giving assignments.
3. By conducting class tests.
4. By taking semester examination.
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE OE316
Title of the Course: Numerical Methods
L-T-P: 3-0-0 Credit:3
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:
CO1: Solve first and second order ordinary differential equation arising in flow problems using single step numerical methods. (Cognitive Level :Analyze)
CO2: Determine the externals of functional and solve the simple problems of the Calculus of variations. (Cognitive Level :Understand)
CO3: Solve the mathematical formulation of linear programming problem. (Cognitive Level :Analyze)
CO4: Solve the applications of transport problems and theory of games. (Cognitive Level :Analyze)
CO5: Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Detailed Syllabus:

UNIT I: (10 Hours)
Errors in Numerical Methods
Approximate numbers and Significant figures; Rouding-off numbers; Errors: Absolute, Relative and Percentage; Error in Arithmetical operations; A General Error Formula; Errors in Numerical Computations; Inverse Problems.
Solution of equations in one variable
Bisection method; Iteration method; Regula-Falsi method; Convergence of Regula-Falsi method; Secant method; Newton-Raphson method; Generalised Method for multiple roots; Rate of Convergence of Newton‘s square root formula; Newton‘s Inverse formula; Graffe‘s Root-Squaring method; Ramanujan‘s method; Rate of Convergence and. Computer Programmes for the above methods;

UNIT II: (8 Hours)
Numerical solution of system of equations
Gauss elimination method; Gauss-Jordan method; Jacobi‘s iteration method; Gauss Sidel method; Error analysis; Computer programs based for the above methods.
Operators and Difference Equations

Forward difference operator, Backward difference operator, Shift operator, Average operator, Central difference operator and their relations; Factorial Notation; Synthetic division; Missing Term Technique; Basic ideas of Difference Equations.

UNIT III: (10 Hours)

Interpolation

Newton‘s forward interpolation formula; Newton‘s backward interpolation formula; Stirling‘s Formula; Bessel formula; Lagrange‘s interpolation formula; Divided differences; Newton‘s divided difference formula; Numerical differentiation and applications; Central Difference Interpolation Formulae; Gauss‘ Forward central Difference Formula; Gauss‘ Backward central Difference Formula; Computer Programs for the above formulas.

UNIT IV: (8 Hours)

Numerical integration

A general quadrature formula for equidistant nodes; Trapezoidal rule; Simpson‘s one-third rule, Simpson‘s three-eight rule; Wedddle‘s rule; Inherent errors in numerical integrations; Newton-Cotes quadrature formula; Euler-Maclaurin formula; Gaussian quadrature formula; Flow charts, Algorithms and Computer Programs to implement the above techniques.

UNIT V: (8 Hours)

Numerical Methods of Solution of O.D.E, Picard‘s Method of Successive Approximations; Picard‘s Method for Simultaneous First Order Differential Equations; Euler‘s Method;; Modified Euler‘s Method; Runge-Kutta method; Flow-charts, algorithms and computer programs for the above methods.

Reference Books:

1. B.S. Grewal, “Higher Engineering Mathematics” Khanna Publishers, 43rd Edition, 2013.
2. S. D. Sharma, “Operations Research”, Kedar Nath and Ram Nath Publishers, Seventh Revised Edition 2014.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley-India publishers, 10th edition, 2014.
4. Ramana B. V., “Higher Engineering Mathematics”, Tata Mc Graw-Hill, 2006.
5. Bali N. P. & Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 8th Edition

Teaching-Learning Strategies in brief

1. Build positive environment in the classroom.
2. Provide concrete basic and advanced knowledge of the subject.
3. Solve problems based on the basic & advanced concepts of the subject.
4. Encourage to the students to ask more & more questions.
5. Motivate to the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. By taking two sessional examinations.
2. By giving assignments.
3. By conducting class tests.
4. By taking semester examination.
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

AUDIT COURSE

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC111
Title of the Course: English for Research Paper Writing
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:

After completing this Course (or unit of a course) the students should be able to:
CO1: Appraise the different aspects of Planning and Preparation involved in writing research papers. (Cognitive Level :Understand)
CO2: Interpret and highlight the key findings. (Cognitive Level :Remember)
CO3: Compare and describe various sections of a research paper. (Cognitive Level :Understand)
CO4: Assess the skills needed to write various sections of a research paper. (Cognitive Level :Create)
CO5: Evaluate the usefulness of different types of phrases in the context of research paper writing. (Cognitive Level :Evaluate)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

Unit wise Syllabus

Unit – I: Planning and Preparation ***8 hours***

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit – II: Plagiarism ***6 hours***

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit – III: Review Study ***8 hours***

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit – IV: Writing Skill ***6 hours***

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit – V: Writing Skill-II ***6 hours***

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit – VI: Quality Assurance ***6 hours***

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Text/ Reference Books:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
- Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC112
Title of the Course: Disaster Management
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:

Students will be able to:
CO-1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. (Cognitive Level :Understand)
CO-2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. (Cognitive Level :Evaluate)
CO-3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. (Cognitive Level :Understand)
CO-4: Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries. (Cognitive Level :Understand)
CO-5: Critically understand the strengths and weaknesses of disaster management in their home country or the countries they work in. (Cognitive Level :Apply)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Introduction ***6 hours***

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit – II: Repercussions of Disasters and Hazards ***8 hours***

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit – III: Disaster Prone Areas In India ***8 hours***

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post Disaster Diseases And Epidemics

Unit – IV: Disaster Preparedness And Management ***6 hours***

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit – V: Risk Assessment ***6 hours***

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit – VI: Disaster Mitigation ***6 hours***

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Text/ Reference Books:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
- Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC113
Title of the Course: Pedagogy Studies
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:

CO-1: The course imparts knowledge of pedagogical practices being used by teachers in formal and informal classrooms. (Cognitive Level :Understand)
CO-2: Evidence on the effectiveness of pedagogical practices. (Cognitive Level :Remember)
CO-3: Identify critical evidence gaps to guide the development. (Cognitive Level :Understand)
CO-4: Appraise the different aspects of Planning and Preparation involved in writing research papers. (Cognitive Level :Create)
CO-5: Interpret and highlight the key findings. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Introduction and Methodology ***8 hours***

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions**.** Overview of methodology and Searching.

Unit – II: Thematic Overview ***8 hours***

Thematic overview: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.Curriculum, Teacher education.

Unit – III: Pedagogical Practices ***8 hours***

Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

Unit – IV: Professional Development ***8 hours***

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Unit – V: Future Directions ***8 hours***

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text/ Reference Books:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basi maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.
- Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Teaching-Learning Strategies in brief (4 to 5 sentences)

1. Learning through discussion among the peer group
2. Learning through Case Studies
3. Open ended questions by teacher
4. Open ended questions from students
5. Preparation of question bank by students at various cognitive level

Assessment methods and weightages in brief (4 to 5 sentences)

1. time-constrained examinations;
2. closed-book and open-book tests;
3. individual project reports(case-study reports)
4. viva voce interviews
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC221
Title of the Course: Constitution of India
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:

After completing this Course, the students should be able to ……

CO1. To give overview of Development of constitution of India. (Cognitive Level :Understand)

CO2. To Explain Schedule and sources of constitution of India. (Cognitive Level :Understand)

CO3. To discuss Citizenship Act, 1955. (Cognitive Level :Understand)

CO4. To highlight the Fundamental Rights. (Cognitive Level :Understand)

CO5. To make aware of Amendment of constitution. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: History of Making of the Indian Constitution ***6 hours***

History, Drafting Committee, (Composition & Working)

Unit – II: Philosophy of the Indian Constitution ***6 hours***

Preamble, Salient Features

Unit – III: Contours of Constitutional Rights & Duties ***8 hours***

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Unit – IV: Organs of Governance ***8 hours***

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Unit – V: Local Administration ***8 hours***

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit – VI: Election Commission ***6 hours***

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text/ Reference Books:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC222
Title of the Course: Value Education
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes: The course will be able to
CO-1: Help student understand value of education and self- development. (Cognitive Level :Understand)
CO-2: Imbibe good values in students. (Cognitive Level :Understand)
CO-3: Help students know about the importance of character. (Cognitive Level :Understand)
CO-4: To give students a deeper understanding about the purpose of life. (Cognitive Level :Understand)
CO-5: To teach and inculcate the essential qualities to become a good leader. (Cognitive Level :Understand)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit – I: Value & Self Development ***6 hours***

Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles.
Value judgements

Unit – II: Cultivation of Values ***8 hours***

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit – III: Personality & Behaviour Development ***8 hours***

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs

suffering, love for truth. Aware of self- estructive habits. Association and Cooperation, Doing best for saving nature

Unit – IV: Character & Competence ***6 hours***

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.
All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Unit – V: Value Education towards National and Global Development ***6 hours***

Constitutional Values: Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity, Social Values: Pity and Probity, Self-Control, Universal Brotherhood. Professional Values: Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith.

Unit – VI: Religious, Moral Values, and Aesthetic Values: ***6 hours***

Tolerance, Wisdom, character. Love and Appreciation of literature, fine arts and respect for the same.

Text/ Reference Books:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**

Name of the Academic Program: M.Tech. Computer Science & Engineering
Course Code: MTCSE AC223
Title of the Course: Personality Development through Life Enlightenment Skills
L-T-P: 2-0-0 Credit: 0
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Course Outcomes:

CO-1: To learn to achieve the highest goal happily. (Cognitive Level :Understand)
CO-2: To become a person with stable mind, pleasing personality and determination. (Cognitive Level :Understand)
CO-3: To awaken wisdom in students. (Cognitive Level :Remember)
CO-4: The course aims to cause a basic awareness about the significance of soft skills in professional and inter-personal communications. (Cognitive Level :Understand)
CO-5: It helps understand personality traits and formation and vital contribution in the world of business. (Cognitive Level :Remember)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

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

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Unit wise Syllabus

Unit-I: Introduction to Personality Development ***6 hours***

The concept of personality - Dimensions of personality – Theories of Freud & Erickson- Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis.

Unit-II: Attitude ***8 hours***

Motivation Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation.

Unit-III: Stages of development ***6 hours***

Freudian stages of development, Erik Erickson's stages of development. Maslow's hierarchy of needs.

Unit – IV: Neetisatakam ***8 hours***

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses-29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses-71,73,75,78 (do's)

Unit – V: Approach to day to day work and duties ***6 hours***

Approach to day to day work and duties, Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Unit – VI: Statements of basic knowledge ***6 hours***

Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Text/ Reference Books:

- Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi
- "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
- Department), Kolkata
- Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi.

Teaching-Learning Strategies in brief

1. Provide visuals, illustrations, explanations etc.
2. Provide basic and advanced knowledge about the subject.
3. Encourage the students to ask more & more questions.
4. Motivate the students to develop critical & strategic thinking

Assessment methods and weightages in brief

1. Sessional examination (2 Nos.)
2. Assignments.
3. Class tests
4. Semester examination
5. **Internal assessment (25 Marks) & Semester Examination (75 Marks) &Total Marks-100.**