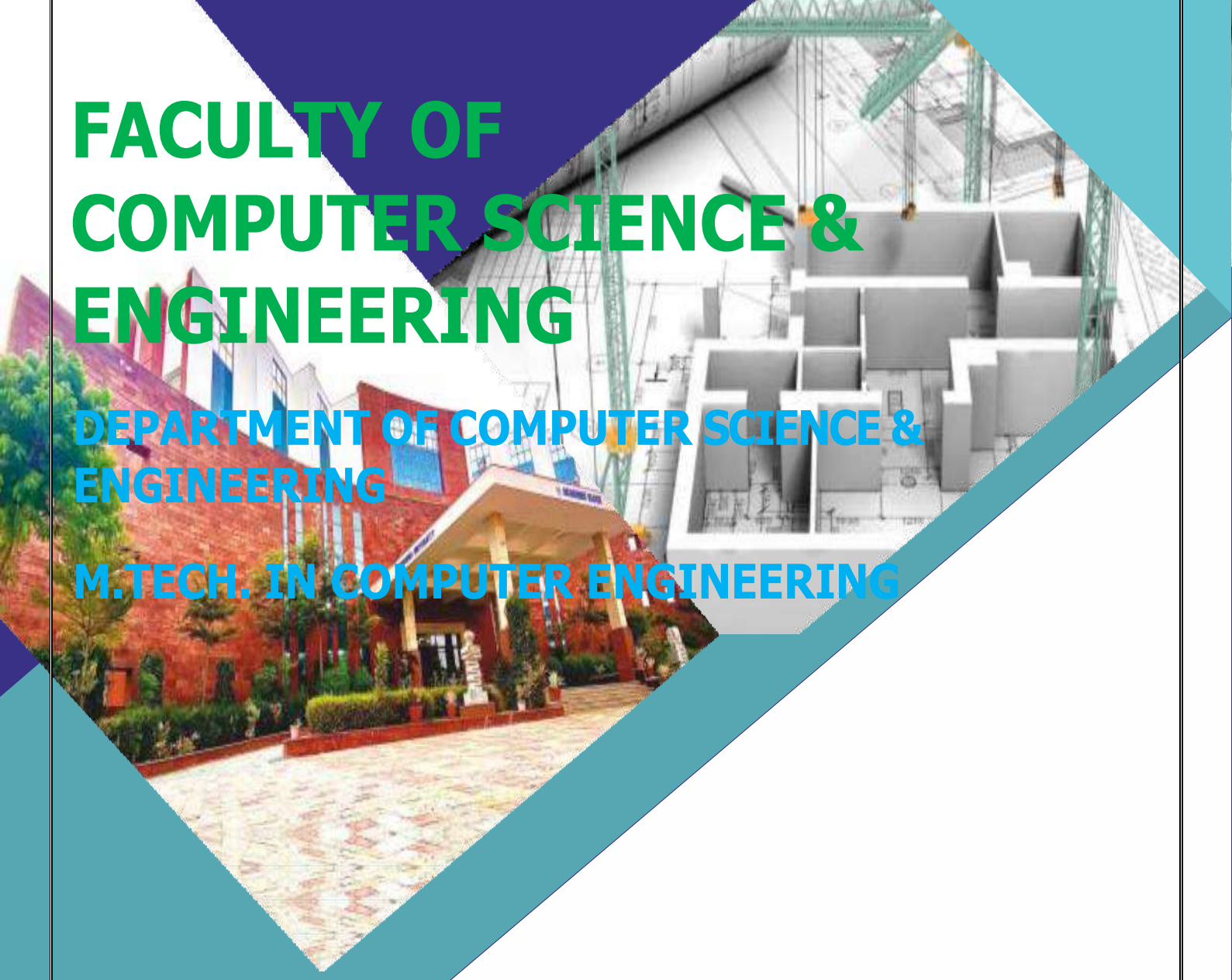
Your Dreams Our Goal

POORNIMA UNIVERSITY

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)



FACULTY OF COMPUTER SCIENCE & ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

M.TECH. IN COMPUTER ENGINEERING

SCHEME & SYLLABUS BOOKLET

BATCH 2023-2025

SCHEME & SYLLABUS

BATCH: 2023-25

INDEX

Disclaimer: The scheme, syllabus and other materials published in this booklet may be changed or modified as per the requirement after approval of competent authority. The decision taken by the management of Poornima University will be final and abiding to all.

Student Details

Name of Student:

Name of Program:

Semester:

VISION

To create knowledge based society with scientific temper, team spirit and dignity of labor to face global competitive challenges.

Mission

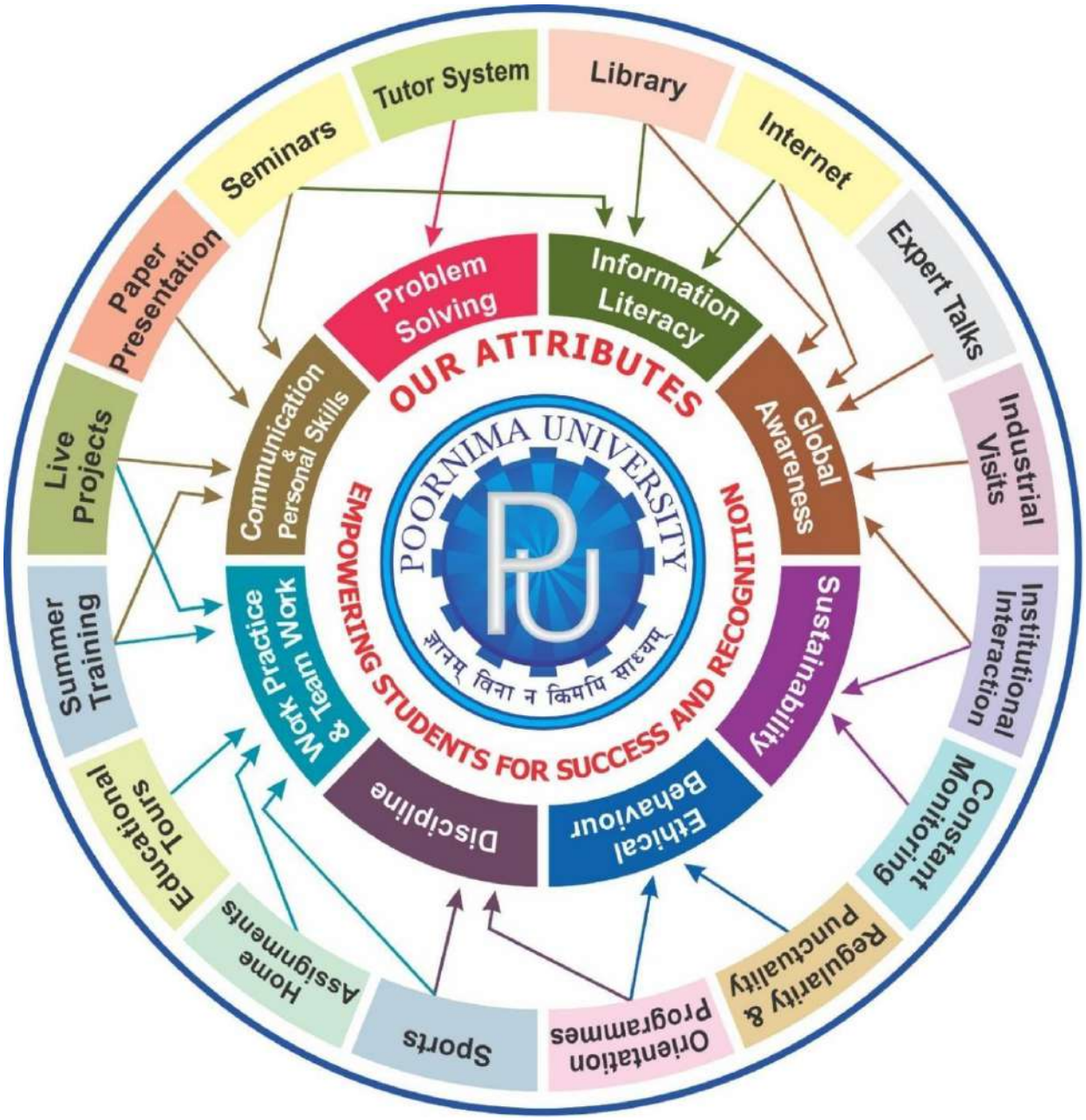
To evolve and develop skill based systems for effective delivery of knowledge so as to equip young professionals with dedication and commitment to excellence in all spheres of life.

Quality Policy

To provide Quality Education through Faculty development, updating of facilities and continual improvement meeting University norms and keeping stake holders satisfied

Knowledge Wheel

At Poornima, the academic atmosphere is a rare blend of modern technical aswell as soft skills and traditional systems of learning processes.



About Program and Program Outcomes (PO):

Title of the Programme: Master of Technology (M. Tech.)

Nature of the Programme: M. Tech. is a two year full-time programme.

Program Outcomes (PO) :

Engineering Graduates will be able to:

A. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

B. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

C. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

D. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

E. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

F. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

G. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

H. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

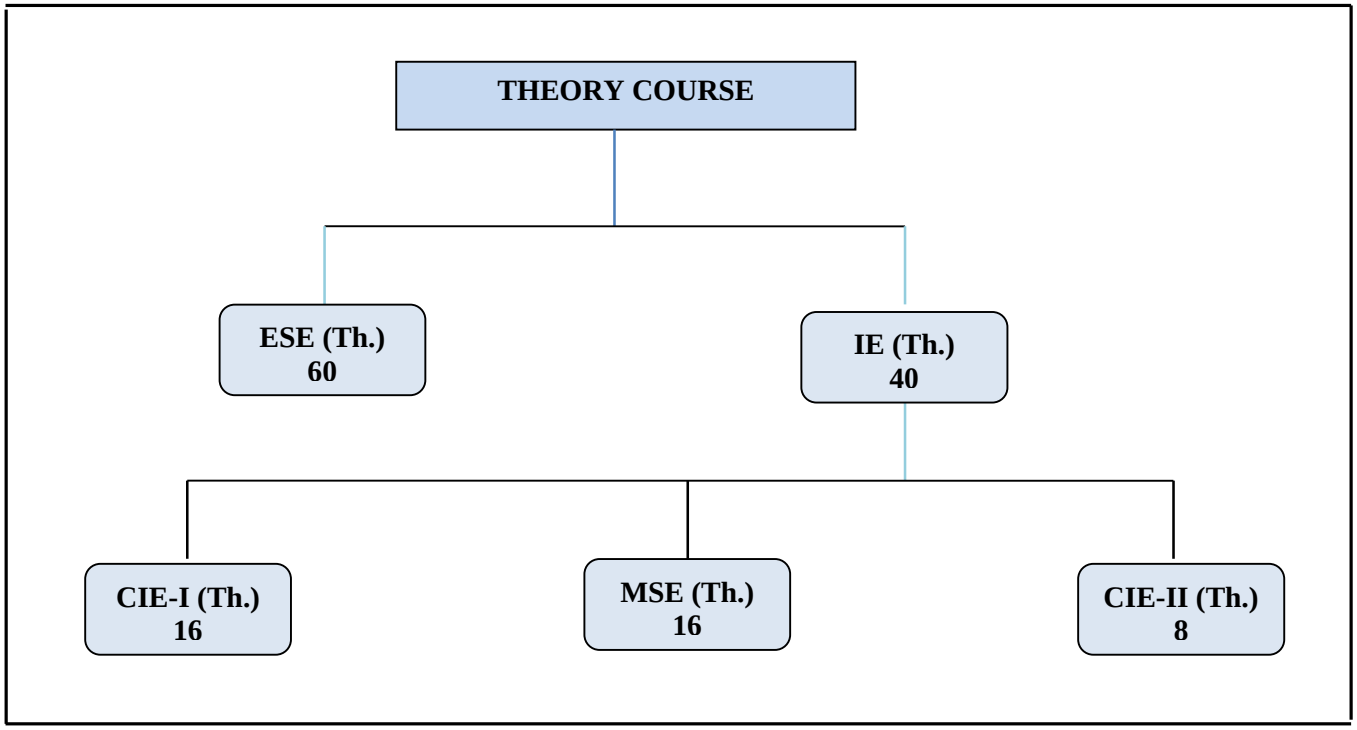
J. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

K. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

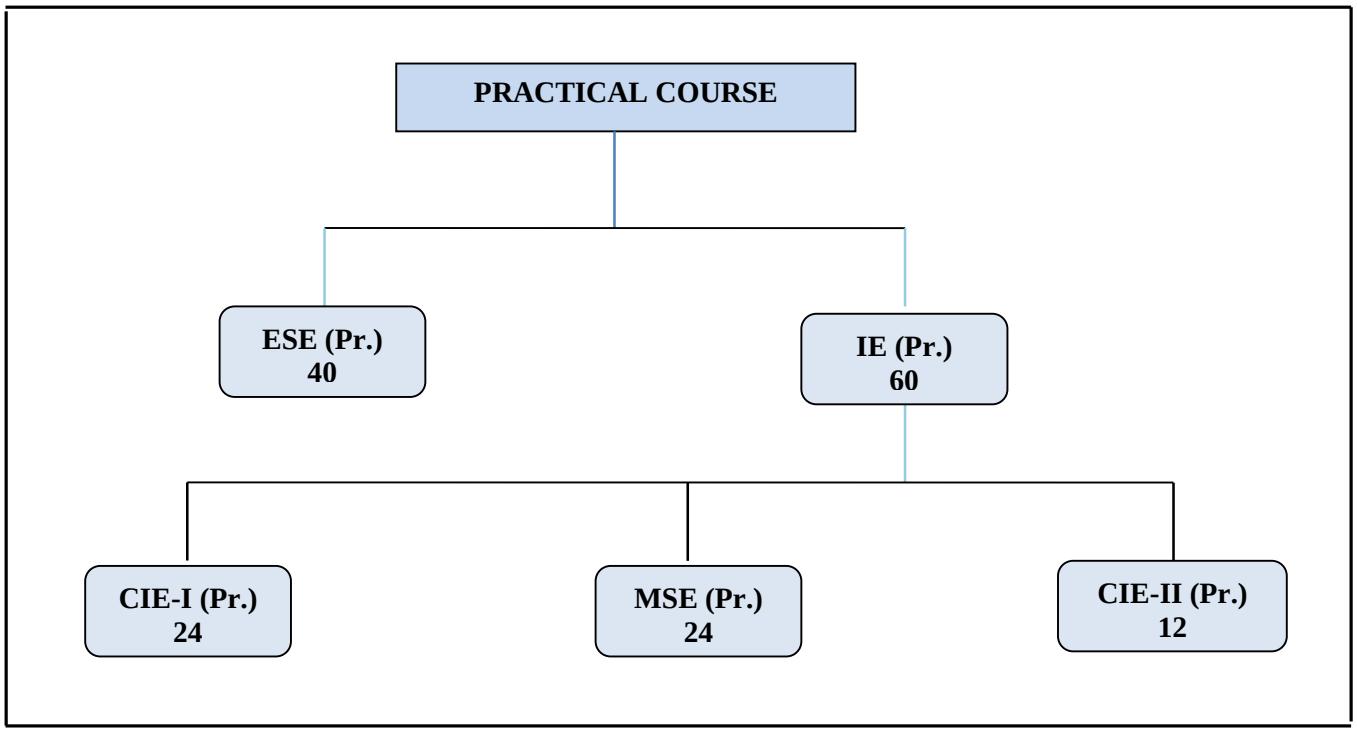
L. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Examination System :

A. Marks Distribution of Theory Course:



B. Marks Distribution of Practical Course :



Th.: Theory, Pr.: Practical, **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **CIE:** Continuous Internal Evaluation.

CO Wise Marks Distribution:

Exam Entity	Theory Subject		Practical/ Studio Subject	
	Maximum Marks	CO to be Covered	CO to be Covered	Maximum Marks
CIE-I	16 (8 + 8)	1 & 2	1 & 2	24 (12 + 12)
MSE	16 (8 + 8)	3 & 4	3 & 4	24 (12 + 12)
CIE-II (Activity/ Assignment)	8 (8)	5	5	12 (12)
ESE	60	-	-	40
TOTAL	100	-	-	100

Minimum Passing Percentage in All Exams:

S No.	Program Name	Minimum Passing Percentage in		
		IE Component	ESE Component	Total Component
1	Course Work for PhD Registration	-	-	50%
2	B. Arch.	-	45%	50%
3	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH	-	40%	40%
4	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH	-	35%	35%

SGPA Calculation

$$SGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$SGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course in the semester

CGPA Calculation

$$CGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$CGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course of all the semesters up to which CGPA is computed

Grading Table:

Applicable for B.Arch. & Ph.D. Courses

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Fail	F	0	x <50
Absent	Ab	0	Absent

Applicable for All Courses except B.Arch. & Ph.D.

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Average	C	5	40≤ x <50
Pass	P	4	35≤ x <40
Fail	F	0	x <35
Absent	Ab	0	Absent

CGPA to percentage conversion rule:

Equivalent % of Marks in the Program = *CGPA* *10

Award of Class

CGPA	Percentage	Equivalent Division
7.50 ≤ CGPA	75% or more	First Division with Distinction
6.00 ≤ CGPA < 7.50	60% ≤ x <75%	First Division
5.00 ≤ CGPA < 6.00	50% ≤ x <60%	Second Division
4.00 ≤ CGPA < 5.00	40% ≤ x < 50%	Pass Class

Guidelines for Massive Open Online Courses (MOOCs)

(Session 2023-24)

Poornima University, in its never ending endeavor to equip students with best-of-class learning and knowledge, has undertaken to include MOOC courses as part of its credit scheme from session 2023-24 onwards. The objective behind this is to enable students to study courses designed by the best teachers in the country and to scale their knowledge base with the rest of learners from the nation. The MOOCs which are included under this scheme is can be chosen from SWAYAM and NPTEL.

1. Introduction of MOOCs: SWAYAM and NPTEL

About SWAYAM:

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through a platform that facilitates hosting of all the courses, taught in classrooms to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated centers on specified dates. Eligibility for the certificate will be announced on the course page and learners will get certificates only if this criteria is matched.

The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology.

In order to ensure that best quality content is produced and delivered, nine National Coordinators have been appointed. They are:

1. AICTE (All India Council for Technical Education) for self-paced and international courses
2. NPTEL (National Programme on Technology Enhanced Learning) for Engineering
3. UGC (University Grants Commission) for non-technical post-graduation education
4. CEC (Consortium for Educational Communication) for under-graduate education
5. NCERT (National Council of Educational Research and Training) for school education
6. NIOS (National Institute of Open Schooling) for school education
7. IGNOU (Indira Gandhi National Open University) for out-of-school students
8. IIMB (Indian Institute of Management, Bangalore) for management studies
9. NITTTR (National Institute of Technical Teachers Training and Research) for Teacher Training programme

Two types of courses are offered on SWAYAM platform: Credit Courses and Non- Credit Courses. Credit courses are offered for each semester in January and July every year. The list is available on SWAYAM official website: https://onlinecourses.swayam2.ac.in/

About NPTEL:

NPTEL (National Programme on Technology Enhanced Learning), is a joint venture of the IITs and IISc, funded by the Ministry of Education (MoE) Government of India, and was launched in 2003. Initially started as a project to take quality education to all corners of the country, NPTEL now offers close to 600+ courses for certification every semester in about 22 disciplines.

Some highlights:

- Largest online repository in the world of courses in engineering, basic sciences and selected humanities and management subjects
- YouTube channel for NPTEL – most subscribed educational channel, 1.3 billion views and 40+ lakhs subscribers

- More than 56000 hours of video content, transcribed and subtitled
- Most accessed library of peer-reviewed educational content in the world
- Translation of more than 12000 hrs of English transcripts in regional Indian languages

NPTEL Online Certification:

The objective of enabling students obtain certificates for courses is to make students employable in the industry or pursue a suitable higher education programme. Through an online portal, 4, 8, or 12-week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered. Enrolment to and learning from these courses is free. Following these online courses, an in-person, proctored certification exam is conducted and a certificate is provided through the participating institutions and industry, as applicable.
Some statistics regarding the open online courses since March 2014 till Dec 2021
Completed courses: 3496;
Enrollments across courses: 1.58 CRORE +
Number of exam registrations: 15.1 LAKH +
All the statistics pertaining to completed courses are available at https://beta.nptel.ac.in/courses. All courses are completely free to enroll and learn from. The certification exam is optional and comes at a fee of Rs 1000/course exam.

2. MOOCs at Poornima University:

MOOCs envelops best in class teaching - learning processes along with meeting the requirements of various courses in terms of quality of teaching and evaluation system. To promote the MOOCs among students of Poornima University, it is decided to consider the credits earned through MOOCs.

(a) Options for MOOCs at Poornima University

(For this document, only those MOOCs will be considered which are available on SWAYAM & NPTEL platforms)

- Credit and Non-credit SWAYAM MOOCs can be opted by anyone, anytime, anywhere and in any language. However, prior-permission of the University Authorities is mandatory if the credits are to be transferred to regular degree.
- In case of credit courses, there are two ways to opt these courses for the purpose of credit transfer to PU system as given below:

OPTION–I: As Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards):

Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards) are available at University level in offline mode for which relevant booklets are already published. **These courses carries 02 credits.** These category/type of courses (similar/different) are also available as MOOC courses. The respective Deans / HODs shall provide both the options to all the students to either select offline courses or MOOCs as per details given below:

- Deans / HODs shall prepare a list of upto 05 appropriate MOOC courses of 02/03 credits each, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students so that they can select any one course from the list, the credits **(only 02)** of which will be counted against Open Elective/ Multidisciplinary courses pertaining to that particular semester.
- If the students are not willing to opt for MOOC Open Elective/ Multidisciplinary course, they can proceed with the current offline practice of opting for Multidisciplinary courses.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.

OR

OPTION–II: As Major / Minor Courses:

- Deans / HODs shall identify a course of **03 credits** for each semester, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students citing that the particular course will be conducted through MOOCs only and is compulsory for all respective students. The credits of this course will be counted against Major/Minor courses pertaining to that particular semester.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.
- This is to be noted that if Deans / HODs decide to conduct any major/minor course in any semester through MOOCs, no offline course will be conducted against that.

(b) Important points related to MOOCs at Poornima University

- Only one MOOC shall be allowed in a particular semester for the purpose of credit transfer in the beginning.
- No attendance will be taken for MOOC courses.
- Last period of T/T/S shall be taken for MOOC courses which shall be in self-study mode.
- The method of assessments of MOOC such as assignments and examination are completely associated with that particular MOOC and no exam will be conducted by the department as well as by the Examination Cell.
- The respective Dean / HOD must submit the detail of course i.e., code, name and credit of MOOC opted against that particular course in particular semester attached with highlighting in the related examination scheme of syllabus of that semester signed by BOS Convener / HoD and Dean of Faculty to the office of Pro-President before commencement of the classes.
- SWAYAM will award a certificate to all the students passing the examination along with the credit earned. The center of examination for SWAYAM MOOCs will be finalized by SWAYAM. All the responsibility related to registration for MOOCs, timely submission of assignments, examinations etc. will be borne by the students only.
- The list of registered students in MOOC along with name of course will be submitted to the Examination Cell by the Deans / HoDs before commencement of the classes.
- Any student who would not be able to register/present/clear/pass the MOOC in the stipulated time, it is the choice of the student that he or she may register in next semester (odd or even) with MOOC again or appear as a back exam candidate of the University as per PU norms.
- There will be no provision of re-evaluation of MOOC.
- The scorecard and related certificate of MOOC along with a consolidated list of students with marks of assignment and final exam will be submitted to the examination cell by the concerned Dean / HOD for further process. It is also recommended that alteration/changes/scaling in marks obtained by the students in any MOOC will not be considered.
- The exam registration fee of MOOC up to Max. INR 1000/- will be reimbursed to the student only after successful completion of the course in first attempt and submission of the fee receipt, score-card and certificate of the MOOC to the concerned department within stipulated time after declaration of the results.

NOTE: This is to be noted that the procedure for getting approval from BOS, Faculty Board, Academic Council and BoM is to be followed as per regular process.

Attached Items:

Open Elective Booklet	Annexure-1
Soft Skills Booklet	Annexure-2
Value Added Course Booklet	Annexure-3

Required credits for Honors:

S.No	Program Duration	Required credits for Honors
1.	2- Year	10- Credits
2.	3- Year	15- Credits
3.	4-Year	20- Credits

S. No	NPTEL/ SWAYAM Course duration (in weeks)	Equivalent Credits
1	4	2
2	8	3
3	12	4

Attached Items:

Open Elective Booklet	Annexure-1
Soft Skills Booklet	Annexure-2
Value Added Course Booklet	Annexure-3

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Computer Science & Engineering Duration: 2 Years Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-I								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MCECCE1101	Advanced Topics in Algorithms	3	1	-	-	40	60	100	4
MCECCE1102	Advanced Data Structure	3	1	-	-	40	60	100	4
A.2	**Practical**								
MCECCE1201	R Programming Lab-I	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MCEECE1111	Linear Algebra and Optimization	3	1	-	-	40	60	100	4
MCEECE1112	Parallel and Distributed Computing			-	-	40	60	100	
MCEECE1113	Distributed Operating Systems			-	-	40	60	100	
MCEECE1121	R Language	3	1	-	-	40	60	100	4
MCEECE1122	Stochastic Models			-	-	40	60	100	
MCEECE1123	Data Mining & Data Warehousing			-	-	40	60	100	
MCEECE1124	Embedded Systems			-	-	40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
		-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
MULCHM1201	Soft Skills - I	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE1201	Skill Enhancement Technical Course			2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MCECCE1401	Seminar-I	-	-	4		60	40	100	2
Total		12	4	10					**21**
Total Teaching Hours		**26**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Computer Science & Engineering Duration: 2 Years**								**Total Credits: 80**
	Teaching Scheme for Batch 2023-25								
	Semester-II								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MCECCE2101	Digital Image Processing	3	1	-		40	60	100	4
MCECCE2102	Soft Computing	3	1	-		40	60	100	4
A.2	**Practical**								
MCECCE2201	Digital Image Processing Lab	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MCEECE2111	Data Science with Big Data Analytics	3	1			40	60	100	4
MCEECE2112	Genetic Algorithm					40	60	100	
MCEECE2113	Data Visualization with R					40	60	100	
MCEECE2122	Grid Computing	3	0			40	60	100	3
MCEECE2123	High Level System Design & Modeling					40	60	100	
MCEECE2121	Cloud Computing					40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
MULEBX2109	Engineering Economics	3	-	-	-	40	60	100	3
D		**Ability Enhancement Courses (AEC)**							
MULCHM2201	Soft Skills – II	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE2201	Skill Enhancement Technical Course-II			2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MCECCE2401	Seminar-II	-	-	2		60	40	100	1
Total		15	3	8					**22**
Total Teaching Hours		**26**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Structural Engineering** **Duration: 2 Years** **Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-III								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MCECCE3101	Cloud Web Services	3	1	-		40	60	100	4
MCECEE3102	Research Methodology	3	1	-		40	60	100	4
A.2	**Practical**								
MCECCE3201	Cloud Web Services Lab	-	-	2		60	40	100	1
MCECCE3401	Review/Research Paper	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives/*Open Elective***							
B.1	**Theory**								
MULEEE3107	E-Commerce and Knowledge Management	3	1	-		40	60	100	3
MULECV3108	Water and Environmental Pollution			-		40	60	100	
MULEME3109	IPR & Patents			-		40	60	100	
MULEEE3110	Robotics			-		40	60	100	
MULEEE3111	Digital India Implementation			-		40	60	100	
MULECV3112	Smart City Design			-		40	60	100	
MULEEE3113	Renewable Energy			-		40	60	100	
B.2	**Practical**								
C		**Multidisciplinary Courses**							
MSTEMC3121	MOOC Course - I	3	-	-	-	-	-	-	3
D		**Ability Enhancement Courses (AEC)**							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
G		**Summer Internship / Research Project / Dissertation**							
MCECCE3301	Dissertation Part - I	-	-	12		60	40	100	6
Total		12	3	16					**22**
Total Teaching Hours		**31**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Computer Science & Engineering Duration: 2 Years Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-IV								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
A.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
B.		**Minor Stream Courses/ Department Electives/*Core Elective***							
B.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
B.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
-	-	-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
-	-	-							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MSTCCV4401	Dissertation Part - II	-	-	30		250	250	500	15
Total		0	0	30					**15**
Total Teaching Hours		**30**							

Syllabus – First Semester

Code: MCECCE1101 Advanced Topics in Algorithms 4 Credits [LTP: 4-0-0]

COURSE OUTCOME

After successful completion of this course the student would be able

- To analyze to various algorithms according to the space and time complexity.
- To understand basic parallel algorithms and their working.
- To understand basic geometric algorithms and their working
- To understand graph algorithm and their application in solving networking problems.
- To understanding approximation algorithms and their applications.

A. OUTLINE OF THE COURSE

Unit No.	Title of The Unit	Time required for the Unit (Hours)
1.	**Complexity and Advanced data structures**	07
2.	**Parallel algorithms**	08
3.	**Geometric algorithms**	08
4.	**Graph algorithms**	07
5.	**Approximation algorithms**	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Complexity and Advanced data structures**
	• Introduction of Unit • Complexity and Asymptotic Notations • Operations on Binary Search Tree • Weight Balanced Trees (Huffman Trees), • Statics and Interval Tree Applications • Conclusion of Unit
2.	**Parallel algorithms**
	• Introduction of Unit • Basic techniques for sorting, • Searching and Merging, • List ranking in PRAMs and Interconnection networks • Conclusion of Unit
3.	**Geometric algorithms**
	• Introduction of Unit • Point location, • Convex hulls • Voronoi diagrams, • Arrangements • Conclusion of Unit
4.	**Graph algorithms**
	• Introduction of Unit • Isomorphism Components, Algorithms for Connectness, • Finding all Spanning Trees in a Weighted Graph,Cut-sets.

	• Cut-Vertices Planer and Dual graphs,Spanning Trees • Strongly Connected Components and Aritculation Point. • Single source shortest path and all pair shortest path algorithms. • Min-Cut Max- Flow theorem of Network Flows. • Ford-Fulkerson Max Flow Algorithms. • Conclusion of Unit
5.	**Approximation algorithms**
	• Introduction of Unit • Use of Linear programming • Primal dual • Local search heuristic • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Introduction to Algorithms	Cormen	Fourth Edition	Prentice Hall of India
2.	The Design and Analysis of Computer Algorithms	Aho A.V.,Hopcrptt J.E. and Ullman J.D.	Fourth Edition	Pearson Education.
Reference Book				
1.	Data Structure and Algorithms, Horowitz and Sahni			
2.	Baase-Computer Algorithms,pearson Education			
3.	Fundamentals of Data Structures Galgotia Book Source			

Code: MCECCE1102	Advanced Data Structure	4 Credits [LTP: 4-0-0]

COURSE OVERVIEW AND OBJECTIVES:

This course introduces to students with a number of highly efficient algorithms and data structures for fundamental computational problems across a variety of areas. Course provides an understanding for implementation and complexity analysis of fundamental algorithms such as parallel and distributed algorithms, max flow, discrete Fourier transform.

COURSE OUTCOME

The student would be able

CO01102.1 To create various kind of multi-way search tree, AVL tree, Splay tree.

CO01102.2 To understand basic probability theory with random variables.

CO01102.3 To analyze convex hull problems and gift-wrapping algorithms.

C001102.4 To design Ford-Fulkerson Algorithm to obtain the solution of Graph based problems.

CO01102.5 Understanding of Parallel and Distributed algorithms.

A. OUTLINE OF COURSE

1.	Advanced Data Structures	12
2.	Randomized Algorithms	7
3.	Geometric Algorithms	8
4.	Graph And Approximation Algorithms	8
5.	Parallel And Distributed Algorithms	7

B. DETAILED SYLLABUS

Unit	Contents
1.	**ADVANCED DATA STRUCTURES** Binary Search Tree, AVL Trees, Multi-Way Search Tree, (2-4) Trees, Red-Black Trees, Splay Trees, persistence Trees.
2.	**RANDOMIZED ALGORITHMS** Basic Probability Theory, Independent Events, Random variables and Expectation, Hat Check Problem, Job Hiring Problem using Indicator Random Variable, Birthday Paradox, Las Vegas and Monte Carlo Algorithms.
3.	**GEOMETRIC ALGORITHMS** One Dimensional Range Searching, Quad trees, K-D Trees, Convex Hulls and Gift-Wrapping Algorithm, Graham Scan Algorithm.
4.	**GRAPH AND APPROXIMATION ALGORITHMS** Matching and Flows, Residual Capacity and Augmenting Paths, Ford-Fulkerson Algorithm, Edmonds-Karp Algorithm, Bipartite Matching. Approximation algorithms: Introduction to Approximation Algorithm, Vertex Cover Algorithm, Clustering, TSP Problem, Local Search Heuristics.
5.	**PARALLEL AND DISTRIBUTED ALGORITHMS** Introduction, PRAM Model, ER, CR, EW and CW Models, Parallel Search Algorithm, ER Broadcast Algorithm, Semi group Algorithms and Accelerated Cascading, Recursive Doubling, Parallel Prefix, Sorting Network, Bitonic Sort, Merging and Shearsort.

C. RECOMMENDED STUDY MATERIAL

1.	Randomized Algorithms, Cambridge University Press	Motwani and Raghavan
2.	Computational Geometry, Springer Verlag	Preparata and Shamos

3.	Data Structures and Algorithms: 1, Searching and Sorting, Springer Verlag	Mehlhorn
4.	Combinatorial Optimization, Princeton University Press	Papadimitrou and Steiglitz

Important Web Links:

1- https://www.udemy.com/course/introduction-to-data-structures
2- https://www.coursera.org/learn/advanced-data-structures
3- https://www.geeksforgeeks.org/data-structures-and-algorithms-online-courses-free-and-paid/
4- https://www.onlinetraining.in/course/c-data-structures/
5- courses.csail.mit.edu/6.851/spring12/lectures

Code: MCECCE1201 **R PROGRAMMING LAB** **4 Credits [LTP: 4-0-0]**

A. List of Programs

Part A

1. Install and configure R, set working directory.
2. Install Packages and calling installed packages
3. R studio environment and functionalities of R studio
4. Implement basic R operations (data input, missing values, importing data into R using different formats : xlsx, CSV, Text files)
5. Use R as a calculator
6. Explore various functionalities of dataframes.
7. Create data set using data frames, list and tables.
8. Create the contingency table for the given raw data.
9. Create the interactive user input code line in r using readline ( ) function.
10. Create the contingency table for the given vector format data.
11. Convert the contingency table to original format of the given data.
12. Analyse and give interpretation of summary statistics for the given data.
13. Calculate mean, median and mode for the grouped data and compare the results for the given data.
14. Analyse the given data for non-parametric tests and give the interpretations.
15. Use R for test the given data

order to compare the effectiveness of two sources of nitrogen, namely ammonium chloride (NH4Cl) and urea, on grain yield of Coarse cereal, an experiment was conducted. The results on the grain yield of Coarse Cereal (kg/plot) under the two treatments are given below.

H4Cl : 13.4, 10.9, 11.2, 11.8, 14.0, 15.3, 14.2, 12.6, 17.0, 16.2, 16.5, 15.7.

rea : 12.0, 11.7, 10.7, 11.2, 14.8, 14.4, 13.9, 13.7, 16.9, 16.0, 15.6, 16.0.

ssess which source of nitrogen is better for Coarse Cereal.

Part B

16. Before an increasing in exercise duty on tea, 800 persons out of a sample of 1000 persons were found to be tea drinkers. After an increasing in duty, 800 people were tea drinkers in a sample of 1200 people. Using SE of a proportion, state whether there is a significant decrease in consumption of tea after the increase in the exercise duty.
17. Use R for test the given data

    A health status survey in a few villages revealed that the normal serum protein value of children in that locality is 7.0 g/100ml. A group of 16 children who received high protein food for a period of six months had serum protein values shown below. Can we consider that the mean serum protein level of those who were fed on high protein diet is different from that of the general population?

S.No. (Child No.)	1	2	3	4	5	6	7	8
Protein level (g%)	7.10	7.70	8.20	7.56	7.05	7.08	7.21	7.25

S.No. (Child No.)	9	10	11	12	13	14	15	16
Protein level (g%)	7.36	6.59	6.85	7.90	7.27	6.56	7.93	8.56

18. Students were selected to training. Their performance was noted by giving a test and the marks recorded out of 50. They were given effective 6 months training and again they were given a test and marks were recorded out of 50.

Students	1	2	3	4	5	6	7	s	9	10	
before training	25	20	35	15	42	28	26	44	35	48	
after training	26	20	34	13	43	40	29	41	36	46	

by applying the t-test can it be concluded that the students have benefited by the training?

19. 100 individuals of a particular race were tested with an intelligence test and classified into two classes. Another group of 120 individuals belong to another race were administered the same intelligence test and classified into the same two classes. The following are the observed frequencies of the two races:

race	intelligence	
	intelligent	non-intelligent total
race i	42	58 100
race ii	55	65 120
total	97	123 220

test whether the intelligence is anything to do with the race.

20. Obtain the correlation coefficient between the heights of father(x) and of the son (y) from the following data

x	65	66	67	68	69	70	71	72
y	67	68	65	68	72	72	69	71

and also test its significance. Using r functions.

21. Consider the inbuilt data set cars.
22. Find correlation between possible variables and pairwise correlation
23. Find regression line between appropriate variables
24. Display the summary statistics and comment on the results

Code: MCEECE1111	Linear Algebra and Optimization	4 Credit [4-0-0]

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

D. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Vector Space	12
2.	Linear Transformation	7
3.	Eigen Space	8
4.	Optimization	8
5.	Analysis of Newton's Method	7

E. DETAILED SYLLABUS

Unit	Contents
1.	Vector Spaces: Vector Spaces, Subspaces- Definition and Examples, Linear independence of vectors, Bases and dimension, Linear Span, Field-Definition, Vector space in Rn: System of linear equations, row space, Column space and null space. Four fundamental spaces, relation between rank and nullity, consistency theorem, basis from a spanning set and independent set.
2.	Linear transformations: General linear transformation, Matrix of transformation, Kernel and range, properties, Isomorphism, change of basis, invariant subspace, Linear functional. Inner Product: Real and complex inner product spaces, properties of inner product, length and distance, Cauchy-Schwarz inequality, Orthogonality, Orthogonal complement, Orthonormal bases, Gram Schmidt orthogonalisation
3.	EigenSpace: Properties of Eigen values and Eigen vectors , Eigen values, Eigen vectors, minimal polynomial, Diagonalization, Orthogonal diagonalization, Jordan canonical form Matrix Factorization: LU decomposition, QR Decomposition and singular value decomposition
4.	Optimization: Conditions for local minimization-One dimensional Search methods:Golden search method, Fibonacci method, Newton's Method, Secant Method, Remarks on Line Search Gradient-based methods-introduction, the method of steepest descent, analysis of Gradient Methods, Convergence, Convergence Rate.
5.	Analysis of Newton's Method, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares. Conjugate direction method, Conjugate Direction Algorithm, Conjugate Gradient Algorithm for Non-Quadratic Quasi Newton method.

F. RECOMMENDED STUDY MATERIAL

S. No	Title of the Book	Author
1.	Linear Algebra and It's Applications, 4th edition, Cengage Learning, 2006.	Gilbert Strang
2.	Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares, Cambridge University Press, 2018	Stephen Boyd, Lieven Vandenberghe
3.	Linear Algebra with applications, 4th edition, McGraw-Hill, 2002	W. Keith Nicholson

4.	Topics in Linear Algebra, Wiley Eastern, 1975.	I.N Herstein
5.	Linear Algebra : A Geometric Approach, Prentice-Hall of India, 2000.	S.Kumaresan
6.	Schaum's outline of linear algebra, 3rd Ed., Mc Graw Hill Edn., 2017	Seymour Lipschutz, Marc Lipson

Code: MCEECE1112 **Parallel & Distributed Computing** **4 Credits [LTP: 4-0-0]**

COURSE OUTCOME

The student would be able

CO01104.1.1 To provide hardware and software issues in modern distributed systems.

CO01104.1.2 Analyze the Communication system provided in the Distributed System.

CO01104.1.3 To distinguish between the concepts of distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security.

CO01104.1.4 Understand client server communication & group communication.

CO01104.1.5 Study a case study of distributed file system (SUN, CODA).

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction To Distributed Operating Systems	10
2.	Communication In Distributed Systems	08
3.	Synchronization In Distributed Systems	06
4.	Processes And Processors In Distributed Systems	09
5.	Distributed File Systems	09

B. DETAILED SYLLABUS

Unit	Contents
1.	**INTRODUCTION TO PARALLEL AND DISTRIBUTED SYSTEMS** Goals, hardware concepts, software concepts, client server model.
2.	**COMMUNICATION & PROCESSES** Communication, layered protocols, remote procedure call, objective invocation, message & stream-oriented communication, processes, threads, clients, servers; naming entities, mobile and unreferenced entities
3.	**CLOCK SYNCHRONIZATION** Algorithms, transaction; consistency and replication, data-centric & client-centric models, protocols.
4.	**FAULT TOLERANCE & SECURITY** Process resilience, reliable client-server & group Communication, commit, recovery, security, channels, access, security control.
5.	**DISTRIBUTED OBJECT-BASED SYSTEMS** explanation and comparison, distributed file systems (SUN, CODA) and comparison; distributed document-based system and coordination-based systems, multimedia systems, Parallel Programming Languages and Algorithms.

S.No	Title of the Book	Author
1.	Distributed Systems Principals and Paradigms, Pearson Edu	Andrew S. Tanenbaum, marten van steen
2.	Distributed Systems Concepts and Design" Pearson Edu.	George Coulouris, Jean Dollimore, Tim Kindber
3.	An Introduction to Distributed & Parallel Computing, PHI.	Joel M. Crichlow
4.	Introduction to parallel Processing, PHI	M. Sasikumar, Dinesh Shikhare P Ravi Prakash
5.	Distributed Operating System, TMH	Andrew S. Tanenbaum

Important Web Links:

1. https://www.geeksforgeeks.org/difference-between-network-os-and-distributed-os/ 2. https://nptel.ac.in/courses/106/106/106106107/
3. https://www.nptel.ac.in/courses/106/106/106106168/
4. https://www.ics.uci.edu/~cs230/lectures/DistributedOSintro.pdf 5. https://link.springer.com/chapter/10.1007/3-540-52609-9_73

Code: MCEECE1113	Distributed Operating System	4 Credits [LTP: 4-0-0]

COURSE OUTCOME

The student would be able

CO01104.1.1 Demonstrate knowledge of the process synchronization.

CO01104.1.2 Analyze the architecture of distributed systems and issues in distributed operating systems.

CO01104.1.3 To distinguish between the concepts of distributed architecture, naming, synchronization,consistency and replication, fault tolerance, security.

CO01104.1.4 Analyze and identify the limitations of distributed systems.

CO01104.1.5 Design a protocol to ensure failure recovery and fault tolerance in distributed operating system.

C. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of Process Synchronization	10
2.	Distributed Operating Systems	08
3.	Theoretical Foundations	06
4.	Processes And Processors In Distributed Systems	09
5.	Failure Recovery & Fault Tolerance	09

D. DETAILED SYLLABUS

Unit	Contents
1.	**Fundamentals of Process Synchronization** Overview – Synchronization Mechanisms – The Critical-Section Problem, Peterson's Solution,Semaphores, Classic Problems of Synchronization, Process Scheduling algorithms. .
2.	**Distributed Operating Systems** Architectures of Distributed Systems, issues in distributed operating systems, communication networks, communication primitives
3.	**Theoretical Foundations** Inherent limitations of a distributed system, lamp ports logical clocks, vector clocks, causal ordering of messages, global state
4.	**Distributed Deadlock Detection** Deadlock handling strategies in distributed systems, issues in deadlock detection and resolution, centralized deadlock detection algorithms, path-pushing algorithm, Edge-chasing algorithm.
5.	**Failure Recovery & Fault Tolerance** Classification of failures, backward and forward error recovery approaches, Fault Tolerance issues, commit protocols

S.No	Title of the Book	Author
1.	Distributed Systems Principals and Paradigms, Pearson Edu	Andrew S. Tanenbaum, marten van steen
2.	Distributed Systems Concepts and Design" Pearson Edu.	George Coulouris, Jean Dollimore, Tim Kindber
3.	An Introduction to Distributed & Parallel Computing, PHI.	Joel M. Crichlow

4.	Introduction to parallel Processing, PHI	M. Sasikumar, Dinesh Shikhare P Ravi Prakash
5.	Distributed Operating System, TMH	Andrew S. Tanenbaum

Important Web Links:

1. https://www.geeksforgeeks.org/difference-between-network-os-and-distributed-os/ 2. https://nptel.ac.in/courses/106/106/106106107/
3. https://www.nptel.ac.in/courses/106/106/106106168/
4. https://www.ics.uci.edu/~cs230/lectures/DistributedOSintro.pdf 5. https://link.springer.com/chapter/10.1007/3-540-52609-9_73

Code: MCEECE 1121	**R Language**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

The student would be able

1. Analyse data and find relative patterns to predict outcomes
2. Analyse continuous data in varying scenarios
3. Perform Confirmatory Data analysis
4. Able to solve Machine learning and Data science problem
5. Able to develop projects to solve real time problems

Demonstrate expert knowledge in outcome predictions

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to R	10
2.	Data with R	08
3.	Data Analysis with R	06
4.	Machine Learning with R	09
5.	Documentation	09

B. DETAILED SYLLABUS

Unit	Contents
1.	Introduction to R: R Installation Guide and Installing R Packages; Basic data types and data structures in R;Reading, writing, manipulating and visualizing data in R
2.	Reading and getting data into R, Vectors and assignment, Logical and Index vectors, Generating regular sequences, Missing values, Ordered and Unordered Factors, The function tapply() and ragged arrays, Ordered factors, Readingdata from files.
3.	**Exploring and cleaning data for analysis**, Data organization, Arrays and Matrices, Basics of Arrays in R, Matrixoperations, Advanced Matrix operations, Additional Matrix facilities, Lists and Data frames.
4.	**Mapping models to Machine Learning**, Evaluating and Validating models, Probability distributions in R, **Statisticalmodels in R**, Building linear models, Generalized linear models, Nonlinear least squares and maximum likelihood models.
5.	**Documentation**, Graphical analysis, plot() function, Displayingmultivariate data, Using graphics parameters,Matrix plots, Exporting graphs, ggplot package.

C. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author
1.	Mastering Machine Learning with R, Packt Publishing	Cory Lesmeister
2.	Machine Learning with R, Springer	Abhijit Ghatak
3.	Machine Learning, MIT Press	Kevin Murphy
4.	Practical Data Science with R, Manning Publications. 2014	Nina Zumel, John Mount
5.	Practical DataScience Cookbook, Packt PublishingLimited, 2014	Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta

Code: MCEECE 1122	**Stochastic Models**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

The student would be able

1.Analyse data and find relative patterns to predict outcomes
2. Analyse continuous data in varying scenarios
3. Perform Confirmatory Data analysis
4.Able to solve Machine learning and Data science problem
5. Able to develop projects to solve real time problems

C. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**Markov Chains**	10
2.	**Stochastic Models**	08
3.	**Time Series Models**	06
4.	**Statistical Packages**	09
5.	**R programming**	09

D. DETAILED SYLLABUS

Unit	Contents
1.	Introduction to stochastic processes; classification of stochastic process according to state-space and time-domain. Finite and countable state Markov chains; time-homogeneity; Chapman-Kolmogorov equations; marginal distribution and finite – dimensional distribution; classification of states of a Markov chain – recurrent, positive recurrent, null - recurrent and transient states. Period of a state.
2.	Discrete state-space, continuous time Markov Processes – Kolmogorov difference - differential equations. Poisson process and its properties. Birth and Death Process, application in queuing. Pure Birth and pure Death processes. Weiner process as limit of random walk. First passage time of the process.
3.	Stationary stochastic processes. The autocovariance and Auto correlation functions and their estimation. Standard errors of autocorrelation estimates. Bartlett's approximation (without proof). The periodogram, the power spectrum and spectral density functions. Link between the sample spectrum and autocorrelation function.
4.	**SPSS Package** 1. Charts and Diagrams 2. Basic Statistics 3. Design of Experiments 4. Multivariate Analysis 5. Time Series Analysis 6. Parametric tests 7. Non–Parametric tests 8. Regression Analysis 9. Statistical Quality Control 10. Operations Research (TORA Package)
5.	1. Introduction to the R language: • Objects - types of objects, classes, creating and accessing objects • Arithmetic and matrix operations • Introduction to functions 2. More details on working with R • Reading and writing data • R libraries

	• Functions and R programming – the if statement – looping: for, repeat, while – writing functions – function arguments and options 3. Graphics • Basic plotting • Manipulating the plotting window • Advanced plotting using lattice library • Saving plots 4. Standard statistical models in R • Model formulae and model options • Output and extraction from fitted models • Models considered: – Linear regression: lm() – Logistic regression: glm() – Poisson regression: glm() – Survival analysis: Surv(), coxph() – Linear mixed models: lme() 5. Advanced R – Data management (importing, subsetting, merging, new variables, missing data etc.) – Multivariate analysis, Cluster analysis, dimension reduction methods (PCA).

C. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author
1.	Mastering Machine Learning with R, Packt Publishing	Cory Lesmeister
2.	Machine Learning with R, Springer	Abhijit Ghatak
3.	Machine Learning, MIT Press	Kevin Murphy
4.	Practical Data Science with R, Manning Publications. 2014	Nina Zumel, John Mount
5.	Practical DataScience Cookbook, Packt PublishingLimited, 2014	Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta

Code: MCEECE 1123	**Data Mining & Data Warehousing**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

The student would be able

1.Analyse data and find relative patterns to predict outcomes
2. Analyse continuous data in varying scenarios
3. Perform Confirmatory Data analysis
4.Able to solve Machine learning and Data science problem
6. Able to develop projects to solve real time problems

E. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**DATA WAREHOUSING**	10
2.	**DATA MINING**	08
3.	**CLASSIFICATION AND PREDICTION**	06
4.	**CLUSTER ANALYSIS**	09
5.	**MINING OBJECT**	09

F. DETAILED SYLLABUS

Unit	Contents
1.	Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.
2.	Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.
3.	Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.
4.	Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.
5.	Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

C. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author
1.	Mastering Machine Learning with R, Packt Publishing	Cory Lesmeister
2.	Machine Learning with R, Springer	Abhijit Ghatak
3.	Machine Learning, MIT Press	Kevin Murphy
4.	Practical Data Science with R, Manning Publications. 2014	Nina Zumel, John Mount
5.	Practical DataScience Cookbook, Packt PublishingLimited, 2014	Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta

1. https://www.geeksforgeeks.org/difference-between-network-os-and-distributed-os/ 2. https://nptel.ac.in/courses/106/106/106106107/
3. https://www.nptel.ac.in/courses/106/106/106106168/
4. https://www.ics.uci.edu/~cs230/lectures/DistributedOSintro.pdf 5. https://link.springer.com/chapter/10.1007/3-540-52609-9_73

Code: MCEECE 1124	**Embedded System**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

The objective of this course is to introduce the importance & concept of basic functions and structure of embedded systems in order to achieve applications goal. This subject also deals with development software of embedded system. At the end of course work student is expected to present various concepts of Embedded Systems and the methodology to implement these concepts.

COURSE OUTCOME
The student will be able to:

CO02103.3.1 Understand about the basic terminologies of Embedded System.
CO02103.3.2 Differentiate between various types of Processor and Architecture.
CO02103.3.3 Analyze various types of buses and its configurations.
CO02103.3.4 Analyze various design patterns of Embedded System using data flow and control flow graphs.
CO02103.3.5 Study about Embedded System Accelerators.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Embedded Computing Requirements	07
2	Embedded Processors	10
3	Embedded Computing Platform	09
4	Embedded Software Analysis and Design	10
5	Embedded System Accelerators	06

B. DETAILED SYLLABUS

Unit	Contents
1.	**Embedded Computing Requirements**: Characteristics and applications of embedded systems; Components of Embedded Systems; challenges in Embedded System Design and design process; Formalism for system design.
2.	**Embedded Processors**: RISC vs. CISC architectures; ARM processor – processor architecture and memory organization, instruction set, data operations and flow control; SHARC processor – memory organization, data operations and flow control, parallelism within instructions; Input and output devices, supervisor mode, exception and traps; Memory system, pipelining and superscalar execution.
3.	**Embedded Computing Platform**: CPU Bus – Bus protocols, DMA, system bus configurations, ARM bus; Timers and counters, A/D and D/A converters, Keyboards, LEDs, displays and touchscreens; Design examples.
4.	**Embedded Software Analysis and Design:** Software design pattern for Embedded Systems; Model programs – data flow graphs and control/data flow graphs; Assembly and linking; Compilation techniques; Analysis and optimization of execution time, energy, power and program size.
5.	**Embedded System Accelerators**: Processor accelerators, accelerated system design

C. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Computer as Components	Wayne Wolf published by Elsevier Inc
2.	An Introduction to Geographical Information System	Andrew S. Loss published by Elsevier Inc
3.	Embedded System Design	Steve Heath published by Elsevier Inc
4.	Embedded System design: A unified hardware/software Introduction	by Frank Vahid & Tony Givagi published b John Wiley & Sons Inc

Important Web Links:

1. https://nptel.ac.in/courses/108/102/108102045
2. https://swayam.gov.in/nd1_noc20_cs15/preview
3. https://www.youtube.com/playlist?list=PLrjkTql3jnm-lZMoUb1xMCp0HgxvJ7ocx
4. http://www.nptelvideos.in/2012/11/embedded-systems.html
5. https://www.youtube.com/watch?v=TP1_F3IVjBc

Code: MULCHM1201	**Soft Skills-I**	**1 Credit [LTP: 2-0-0]**

COURSE OUTCOME

The student would be able to:

CO01206.1 Effectively communicate through verbal/oral communication and improve the listening skills

CO01206.2 To develop and nurture the soft skills of the students through individual and group activities.

CO01206.3 To expose students to right attitudinal and behavioral aspects and to build the same through activities

CO01206.4 To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.

CO01206.5 To encourage the all round development of students by focusing on soft skills.

A. DETAILED SYLLABUS

Unit	Unit Details
1	Personality Enhancement Self-Awareness, Self Esteem & Confidence , Attitude Branding Yourself: Assertiveness and Confidence, The Corporate Fit-Dressing and Grooming, Corporate Dressing – Dress for Success, Etiquette: Social etiquette, business etiquette – civic sense – social norms
2	Effective Management Skills Time & Stress Management: Act in time on commitment Planning & Prioritizing, Emotional Intelligence: Managing Emotions
3	Art of Communication Interview Skills: Fluency & Expression, Group Discussions: Structured & Unstructured, Presentations: Voice, Body Language, Content and Visual Aids, Audience Management
4	Interpersonal Skills The Team Concept& Elements of Teamwork, Stages of Team Formation, & an Effective Team, Essential Building Blocks of Effective Teams Leadership Skills: style andtraits
5	Written & Oral Communication Writing Skills: Picture perception & Story Making, Storytelling, Extempore & Paper Presentations.

Code: MULCSE1201	**Skill Enhancement Technical Course**	**1 Credit [LTP: 2-0-0]**

COURSE OUTCOME

The student would be able to:

CO01206.1 Learn the syntax and semantics of Python Programming Language

CO01206.2 Write Python functions to facilitate code reuse and manipulate strings.

CO01206.3 Illustrate the process of structuring the data using lists, tuples and dictionaries

CO01206.4 Demonstrate the use of built-in functions to navigate the file system

CO01206.5 Appraise the need for working on web scraping.

A. DETAILED SYLLABUS

Unit	Unit Details
1	Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program.
2	Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit().
3	Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling.
4	Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods.
5	Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things.

Code: MCECCE1401	**SEMINAR-I**	**1 Credits [LTP: 2-0-0]**

A. DETAILED SYLLABUS

Unit	Contents
	Students will be grouped in two to three, will have to decide final thesis area, download research papers from IEEE, ACM, Elsevier, Springer etc. Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of Their approach, the drawbacks of the papers. Generalize results from a research paper to related research problems. Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject. Practice sessions on how to read, analyze and summarize research papers. Students in group will have to deliver seminar, prepare a report and a review paper based on analysis.

Syllabus – Second Semester

Code: MCECCE 2101	**Digital Image Processing**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:
This course provides knowledge of image fundamentals and mathematical transforms which are necessary for image processing.
Course aims to study image enhancement techniques, image restoration procedures, image compression procedures.

COURSE OUTCOME
The student would be able
CO02101.1 Review the fundamental concepts of a digital image processing system.
CO02101.2 Evaluate the techniques for image enhancement and image restoration
CO02101.3 Discuss various image restoration techniques using colour fundamentals.
C002101.4 Categorize various compression techniques and Interpret Image compression standards
CO02101.5 Interpret image segmentation and representation techniques.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit(Hours)
1	Introduction	07
2	Image Enhancements	10
3	Image Restoration	09
4	Image Compression	10
5	Image Segmentation	06

B. DETAILED SYLLABUS

Unit	Contents
1.	**Introduction:** Fundamental Steps in Digital Image Processing Components of an Image ProcessingSystem Digital Image Fundamentals: Elements of Visual Perception Light and the lectromagneticSpectrum Image Sensing and Acquisition Image Sampling and Quantization Some BasicRelationships between Pixels Image Enhancement in the spatial domain: Background SomeBasic Intensity Transformation Functions HistogramProcessing Histogram EqualizationHistogram Matching (Specification) Enhancement using arithmetic/logic operations Basics ofSpatial filtering Smoothing Spatial Filters Sharpening Spatial Filters
2.	**Image Enhancements** Image Enhancements in the Frequency Domain:Introduction to the Fourier Transform and theFrequency Domain Smoothing Frequency Domain Filters Ideal Lowpass Filters ButterworthLowpass Filters GaussianLowpass Filters Sharpening Frequency Domain Filters: IdealHighpass Filters Butterworth Highpass Filters Gaussian Highpass Filters Implementation:Properties of 2-D FT Convolution and Correlation theorems TheFast Fourier Transform (FFT)
3.	**Image Restoration:** A Model of the Image Degradation/Restoration Process Noise Models, Restoration in the Presence of NoiseMean Filters Order-Statistics Filters Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering Color Image Processing, Color Fundamentals,Color Models, Basics of Full-Color Image Processing, ColorTransformations: FormulationColor Complements Color Slicing Tone and Color Corrections Histogram Processing Smoothingand Sharpening: Color Image Sming Color Image Sharpening
4.	**Image Compression:** Image Segmentation Based on Color,Segmentation in HSI Color Space Segmentation in RGBVector Space Image Compression, Fundamentals, Image Compression Model, Error-FreeCompression, Variable-Length Coding, LZW Coding Lossy Compression: Lossy PredictiveCoding Morphological Image Processing: Preliminaries Erosion and Dilation Opening andClosing The Hit-or-Miss Transformation Some Basic

	Morphological Algorithms
5.	**Image Segmentation** Image Segmentation, Detection of Discontinuities, Edge Linking and Boundary DetectionThresholding: Foundation Basic Global Thresholding Basic Adaptive Thresholding Optimal Global and Adaptive ThresholdingRegion-Based Segmentation, Representation andDescription, Representation Boundary Descriptors, Regional Descriptors

C. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Fundamentals of Digital Image Processing	A.K.Jain, PHI
2.	Digital Image Processing	W.K.Pralt, McGraw Hill
3.	Digital Image Processing	Michael Morrison

Important Web Links:

1- www.nptelvideos.in/2012/12/digital-image-processing.html
2- https://www.cet.edu.in/noticefiles/272_Digital-Image-Processing.pdf
3- https://www.electronicsforu.com/videos-slideshows/digital-image-processing
4- https://www.geeksforgeeks.org/digital-image-processing-basics
5- https://nptel.ac.in/courses/117105135

Code: MCECCE2102	Soft Computing	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

1. Learn soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Define the fuzzy systems.
4. Understand the genetic algorithm concepts and their applications.
5. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution

A. OUTLINE OF THE COURSE

Unit No.	Title of The Unit	Time required for the Unit (Hours)
1.	Introduction to Soft Computing	**6**
2.	Fuzzy Logic	**7**
3.	Artificial Neural Networks	**7**
4.	Nature Inspired Algorithms	**6**
5.	Multi-Objective Optimization	**6**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	Introduction to Soft Computing
	• Introduction of Unit • Concept of Computing Systems • Soft Computing Versus Hard Computing • Characteristics of Soft Computing, • Applications of Soft Computing Techniques • Conclusion of Unit
2.	Fuzzy Logic
	• Introduction of Unit • Fuzzy Sets and Membership Functions, • Operations on Fuzzy Sets, • Fuzzy Relations, Rules, Propositions, • Implications and Inferences, • Defuzzification Techniques - Fuzzy Logic Controller Design, • Applications of Fuzzy Logic • Conclusion of Unit
3.	Artificial Neural Networks
	• Introduction of Unit • Biological Neurons and its Working, • Simulation of Biological Neurons to Problem Solving, • Different ANNs Architectures, • Training Techniques for ANNs, • Applications of ANNs to Solve Real Life Problems • Conclusion of Unit
4.	Nature Inspired Algorithms

	• Introduction of Unit • Genetic Algorithms, Concept of "Genetics" and "Evolution" • Application to Probabilistic Search Techniques, • Basic GA Framework and Different GA Architectures, GA Operators- Encoding, Crossover, Selection, Mutation, etc., • Solving Single-Objective Optimization Problems Using GAs, Particle Swarm Optimization-Implementation, Operators, • Ant Bee Colony Optimization Implementation, Operators, Case Studies. • Conclusion of Unit
5.	Multi-Objective Optimization
	• Introduction of Unit • Problem Solving Concept of Multi-Objective Optimization Problems (MOOPs) and Issues of Solving Them. • Multi-Objective Evolutionary Algorithm (MOEA), • Non-Pareto Approaches to Solve MOOPs, • Pareto-Based Approaches to Solve MOOPs, • Applications with MOEAs. • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

S. No	Textbooks:	Author	Edition	Publication
1.	Principles of soft computing	Sivanandam.S. N, Deepa.S.N	Second Edition	Wiley India Pvt Limited, 2011
2.	"Neuro fuzzy and soft computing	Juh Shing Roger Jang, Cheun Tsai Sun, Eiji Mizutani	Fourth Edition	Prentice Hall, 1997
Reference Book				
1.	Aliev,R.A, Aliev,R.R, "Soft Computing and its Application", World Scientific Publishing Co. Pvt. Ltd., 2001			
2.	Mehrotra.K, Mohan.C.K, Ranka.S, "Elements of Artificial Neural Networks", The MIT Press, 1997			
3.	Juh Shing Roger Jang,Cheun Tsai Sun,Eiji Mizutani, "Neuro fuzzy and soft computing", Prentice Hall, 1997.			
4.	Ronald R.Yager, Lofti Zadeh, "An Introduction to fuzzy logic applications in intelligent Systems", Kluwer Academic, 1992.			
5.	Cordón.O, Herrera.F, Hoffman.F, Magdalena.L "Genetic Fuzzy systems", World Scientific Publishing Co. Pvt. Ltd., 2001.			

Code: MCECCE2201	**Digital Image Processing Lab**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

This course provides knowledge of image fundamentals and mathematical transforms which are necessary for image processing.

Course aims to study image enhancement techniques, image restoration procedures, image compression procedures.

COURSE OUTCOME

The student would be able

CO02101.1 Review the fundamental concepts of a digital image processing system.

CO02101.2 Evaluate the techniques for image enhancement and image restoration

CO02101.3 Discuss various image restoration techniques using colour fundamentals.

C002101.4 Categorize various compression techniques and Interpret Image compression standards

CO02101.5 Interpret image segmentation and representation techniques.

D. OUTLINE OF THE COURSE

Exp No.	**Title of the unit**	**Time required for the Unit(Hours)**
1	Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale)	07
2	Implementation of Relationships between Pixels	10
3	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization	09
4	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image	10
5	Implementation of image sharpening filters and Edge Detection using Gradient Filters	06
6	Image Compression by DCT,DPCM, HUFFMAN coding	
7	Implementation of image restoring techniques	

E. RECOMMENDED STUDY MATERIAL:

S.No	**Title of the Book**	**Author**
1.	Fundamentals of Digital Image Processing	A.K.Jain, PHI
2.	Digital Image Processing	W.K.Pralt, McGraw Hill
3.	Digital Image Processing	Michael Morrison

Important Web Links:

6- www.nptelvideos.in/2012/12/digital-image-processing.html
7- https://www.cet.edu.in/noticefiles/272_Digital-Image-Processing.pdf
8- https://www.electronicsforu.com/videos-slideshows/digital-image-processing
9- https://www.geeksforgeeks.org/digital-image-processing-basics
10- https://nptel.ac.in/courses/117105135

Code: MCEECE 2111	Data Science with Big Data Analytics	4 Credits [LTP: 4-0-0]

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

The student would be able

1. Understands various phases of the data analytics life cycle.
2. Apply statistical methods to data for inferences.
3. Analyze data using Classification, Graphical and computational methods.
4. Understand Big Data technologies and NOSQL.
5. Analyze various types of data using Data Analytics Techniques

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Data analytics life cycle	10
2.	Overview of supervised learning	08
3.	Time series analysis	06
4.	Introduction to big data	09
5.	NoSql Data Management	09

B. DETAILED SYLLABUS

Unit	Contents
1.	**Data Analytics Life Cycle:** Data Analytics Life cycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalise, Exploratory Data Analysis, Statistical Methods for Evaluation, ANOVA.
2.	**Overview of Supervised Learning:** Variable Types and Terminology, Two Simple Approaches to Prediction: Least Squares and Nearest Neighbors, Model Selection and Bias–Variance Tradeoff. **Association Analysis:** Association rules, Apriori algorithm, FP-Growth Technique
3.	**Time Series Analysis:** Overview of Time Series Analysis, ARIMA Model; **Text Analysis:** Text Analysis Steps, Stop Word Removal, Tokenization, Stemming and Lemmatization, Representing Text: Term-Document Matrix, Term Frequency
4.	**Introduction to Big Data:** Defining big data, 4 V's of big data, Big data types, Analytics, Examples of big data, Big data and Data Risk, Big data technologies, benefits of big data, Crowd sourcing analytics; **Hadoop Distributed File Systems:** Architecture of Apache Hadoop HDFS and other File Systems, HDFS File Blocks, HDFS File Commands
5.	**NoSQL Data Management:** Types of NOSQL data bases, Benefits of NO SQL, **Map Reduce:** Introduction, Map reduce example, Job Tracker, Map Operations. **Data Stream Mining:** The stream data model, streaming applications, continuous query processing and optimization, Distributed query processing.

C. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author
1.	Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data", Wiley Publishers, 2012.	EMC Education Services
2.	The elements of statistical learning: Data Mining, Inference, and Prediction", Vol. 2. No. 1. New York: Springer, 2009	Hastie, Trevor, et al.,
3.	Big Data & Hadoop", Khanna Publishing House, 2017.	V.K. Jain

Code: MCEECE 2112	**Genetic Algorithm**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

This course will give an introduction to the **Genetic Algorithms**. This course will cover the most fundamental concepts in the area of **Artificial Intelligence** techniques. The main focus will be on the applications and techniques of Genetic Algorithm as the most well-regarded **optimization algorithm** in history. The Genetic Algorithm is a search method that can be easily applied to different applications including **Machine Learning, Data Science, Neural Networks, and Deep Learning.**

COURSE OUTCOME

The student would be able

CO01103.4.1 Understand the mathematical theorems implemented in Genetic Algorithms.

CO01103.4.2 Understand the data structure, mutation concepts used in Genetic Algorithm.

CO01103.4.3 Analyze the applications of genetic algorithm in various fields.

CO01103.4.4 Understand the various macro operator to implement in knowledge based techniques.

CO01103.4.5 Analyze the applications of genetic algorithm in the fields of industry.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Mathematical Foundations	10
2.	Computer Implementation Of Genetic Algorithms	09
3.	Applications Of Genetic Algorithms	07
4.	Advanced Operators And Techniques In Genetic Algorithm Search	10
5.	Industrial Application Of Genetic Algorithms	06

B. DETAILED SYLLABUS

Unit	Contents
1.	**MATHEMATICAL FOUNDATIONS** Definition Robustness of traditional optimization and search techniques Goals of optimization A Simple Genetic Algorithm Similarity Templates, Fundamental theorem Schema Processing Problem solving-2 armed and K armed bandit problem Building block hypothesis Minimal deceptive problem Similarity templates as hyper planes.
2.	**COMPUTER Implementation of Genetic Algorithms:** Data structure, reproduction, crossover and mutation Mapping objective functions to fitness form Fitness scaling, discretization and constraints.
3.	**APPLICATIONS OF GENETIC ALGORITHMS** DeJong and Function optimization structural optimization via genetic algorithm Medical image registration with genetic algorithms Iterated prisoner's dilemma problem.
4.	**ADVANCED OPERATORS AND TECHNIQUES IN GENETIC ALGORITHM SEARCH** Dominance, Diploidy and abeyance Inversion and other re-ordering operators Macro operators, niche and special speciation Multi objective optimization Knowledge based techniques Genetic Algorithms and Parallel processors Genetic Based machine learning Classifier systems.
5.	**INDUSTRIAL APPLICATION OF GENETIC ALGORITHMS** Data mining using genetic Algorithms, Search in data mining Genetic algorithms for game playing e.g. TIC TAC TOE

C. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author

1.	Genetic Algorithms in search, optimization machine leaning	David Goldberg 6th edition
2.	Industrial applications of Genetic Algorithms	Charles L Karr and L.Michael Freeman, CRC Press
3.	Handbook of Genetic Algorithms	Davis, Lawrence

Important Web Links:

1- https://www.udemy.com/course/geneticalgorithm/
2- https://www.pluralsight.com/courses/genetic-algorithms-genetic-programming
3- https://www.cs.rit.edu/~jmg/courses/ga/20091/intro.html
4- https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html
5- https://www.udemy.com/course/genetic-algorithms-in-python-and-matlab/

Code: MCEECE 2113	Data Visualization with R	4 Credits [LTP: 4-0-0]

COURSE OVERVIEW AND OBJECTIVES:

COURSE OUTCOME

The student would be able

1. Understand the necessity of visualisation in data management.
2. Apply visual analytics principles to appropriately preprocess data for visualisation.
3. Use R functions to generate plots for given data.
4. Perform validation of visualisations based on type and purpose of data.
5. Create dashboards and drill-down methods for data visualisation

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction	10
2.	Visual Analytics	08
3.	Presenting	06
4.	Dashboard development	09
5.	Hypothesis Testing	09

D. DETAILED SYLLABUS

Unit	Contents
1.	**Introduction to visualization** - the visualization pipeline, The Value ofVisualization, Data - Why Do Data Semantics and Types Matter, Data Types, Dataset Types, Attribute Types, Semantics **Plotting in R** - plot() function, Displaying multivariate data, Using graphics parameters, Matrix plots, Exporting graphs.
2.	**Visual Analytics** - Optimal visualization types, Binning values,Calculated fields, Table calculations, Level of Detail calculations. **Validation** - Four Levels of Design, Angles of Attack, Threats and Validation Approaches, Validation Examples, Defining Marks and Channels, Using Marks and Channels, Channel Effectiveness, Relativevs. Absolute Judgments.
3.	**Presenting results to stakeholders**, ggplot library in R - layers, geoms, stats, positioning, annotations, scales, axes and legends, facetting, autoplot and fortify
4.	**Dashboard development** - Dashboard design principles, Dashboard interactivity, Connected "drill-down" dashboards. Visualization case studies - Textual data, Temporal data.
5.	**Hypothesis Testing** Testing the general linear hypothesis, Test for Significance of Regression Tests on Individual Regression Coefficients and Subsets of Coefficients, CI Estimation of the Mean Response, Confidence Intervals on Regression Coefficients, T-test, F test

E. RECOMMENDED STUDY MATERIAL

S.No	Title of the Book	Author
1	Visualization Analysis and Design (VAD), CRC press	Tamara Munzner,
2	Practical Data Science with R, Manning Publications. 2014	Nina Zumel, John Mount "

Code: MCEECE 2122	**Grid Computing**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES.

COURSE OUTCOME
The student will be able to:

1. Learn the foundations of Grid Computing
2. Understand basic of CORBA
3. Learn different measurement techniques
4. Implement principles of grid computing for solving real world problems

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Soft Computing	07
2	History	8
3	Grid Computing	09
4	CORBA	8
5	Computing Model	06

B. DETAILED SYLLABUS

Unit	Contents
1.	Soft Computing Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.
2.	Cluster computing models, Grid models, Mobile grid models, Applications. Parset: System independent parallel programming on distributed systems: Motivation and introduction, Semantics of the parset construct, Expressing parallelism through parsets, Implementing parsets on a loosely coupled distributed system. Anonymous remote computing model: Introduction, Issues in parallel computing on interconnected workstations, Existing distributed programming approaches, The arc model of computation, The two tired arc language constructs, Implementation
3.	Introduction and motivation, A model for integrating task parallelism into data parallel programming platforms, Integration of the model into ARC, Design and implementation applications, performance analysis, guidelines for composing user programs, related work Anonymous remote computing and communication model: Introduction, Location in dependent inter task communication with DP, DP model of iterative grid computations, Design and implementation of distributed pipes, Case study, and Performance analysis.
4.	Parallel programming model on CORBA Introduction, Existing works, notion of concurrency, system support implementation performance, sitability of CORBA: introspection.
5.	Grid computing model: Introduction, a parallel computing model over grids, Design and implementation of the model, Performance studies, Related work.

C. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Grid Computing a Research Monograph" by Tata McGraw hill publications, 2005	D. Janakiram,
2.	Grid Computing: A Practical Guide to technology and Applications" by River media – 2003	Ahmar Abbas, Charles

Code: MCEECE 2123 **High Level System Design & Modeling** **4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

This course covers the architecture that would be used for developing a software product. HLD uses possibly nontechnical to mildly technical terms that should be understandable to the administrators of the system. In contrast, low-level design further exposes the logical detailed design of each of these elements for programmers.

COURSE OUTCOME
The student will be able to:

CO02104.3.1 Discuss about various types of flow-graph and charts to design high level design.
CO02104.3.2 Understand about various type of Controller architecture, parallel processors, Embedded systems
CO02104.3.3 Build an understanding for VHDL, Verilog and other language specific features.
CO02104.3.4 Understand the application specific implementation of High Level Systems.
CO02104.3.5 Understand to differentiate between various type of Partitioning issues of structural and functional.

C. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction	07
2	Architectural Taxonomy	10
3	Specification Requirements Languages	09
4	A Specification example of Telephone answering machine	10
5	System Partitioning	06

D. DETAILED SYLLABUS

Unit	Contents
1.	**Introduction** Introduction to Design Representation of Digital Systems, levels of abstraction, design Methodologies, System level methodologies, System specification and design. Model Taxonomy: State-Oriented models -finite-state machine, Petri net, Hierarchical concurrent finite state machine; Activity-oriented models - Dataflow graph, flow charts; Heterogeneous model control/data flowgraph, Object oriented model, Program-state machine;
2.	**Architectural Taxonomy** : Application specific architectures -Controller Architecture, Data path architecture, Finite-state machine with data path; Processors -Complex instruction set Computer, Reduced instruction set Computer; Vector machine -Very long instruction word Computer; Parallel processors. Embedded Systems
3.	**Specification Requirements Languages** : Characteristics of Conceptual models Concurrency, State Transitions, Hierarchy, Programming Constructors, Behavioral Completion, Communication, Synchronization, Exception handling, Timing; Comparative features of Specification languages -VHDL, Verilog, HardwareC, State-charts, Esterel; Embedded system specification in spec-charts.
4.	**A Specification example of Telephone answering machine** : Specification capture with speccharts, Sample test bench, Advantage of executable specifications; Strengths of the PSM model -Hierarchy, State transitions, Programming Constructors, Concurrency, Exception handling, Completion.
5.	**System Partitioning:** Structural versus functional Partitioning. Partitioning issues -Specification extraction level, Granularity, System Component allocation, Metrics and Estimations, Objective functions and closeness functions, Partitioning Algorithm, Output. Basic Partitioning algorithms -Random mapping, Hierarchical clustering, Multistage Clustering, Group Migration, Radio cut and Simulated Annealing

C. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
3.	Specification and Design of Embedded Systems	Daniel D. Gajski, PTR Prentice Hall EnglewoodNew Jersey
4.	High Level System Modeling : Specification and Design Methodologies	Ronald Waxman, Kluwer Academic Publishers
Important Web Links		
1- https://www.youtube.com/watch?v=gTuWkoOq1k0 2- https://swayam.gov.in/nc_details/NPTEL 3- https://www.fhwa.dot.gov/cadiv/segb/files/i15/i15hld.htm 4- https://www.coursera.org/lecture/software-design-development-life-cycle/the-role-of-architecture-in-design-n72Qe 5- https://coderanch.com/t/99762/engineering/Diffrence-High-Level-Desgin-Level		

Code: MCEECE 2121	**Cloud Computing**	**4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

This course is the delivery of computing services over the Internet. Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at remote locations. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate anduser applications

COURSE OUTCOME

The student will be able to:

CO02104.1.1: To have a deep understanding of the concepts of virtualization along with VMWare Server, citrix Xen Server.
CO02104.1.2: To discuss about the architecture of cloud computing with IaaS, Paas, SaaS
CO02104.1.3: To understand about how application can be deploy on Azure.
CO02104.1.4: To understand the concepts of security in cloud computing with cloud security reference model, internal security breaches and identity management.
CO02104.1.5: To learn about the applications of cloud computing..

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction of Virtualization	07
2	Cloud Computing Architecture	10
3	Windows Azure Platform Architecture	09
4	Analyzing the Windows Azure Operating System	10
5	Cloud Applications and advanced topics in Cloud Computing	06

C. DETAILED SYLLABUS

Unit	Contents
1.	**Introduction of Virtualization** Traditional Server Concept, advantages and disadvantages of traditional server concept, Virtual server concept, Cloud Computing and Virtualization, Pros and Cons of Virtualization
2.	**Cloud Computing Architecture** Introduction, Cloud Reference Model, Architecture, Infrastructure as a service, Platform as a service, Software as a service, Files [storage] as a Service, Communication as a Service, Monitoring as a Service, Everything as a Service, Cloud Computing Ontologies, Cloud Computing Concerns
3.	An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud, CryptDb: Onion Encryption layers-DET, RND, OPE,JOIN,SEARCH, HOM, and Homomorphic Encryption, FPE. Trust, Reputation and Security Management.
4.	**Virtual Machines and Virtualization of Clusters and Data Centers:** Levels of Virtualization, Virtualization Structures//Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization Data-Center Automation. Case studies: Xen Virtual machine monitors- Xen API. VMware - VMware products-Vmware Features. Microsoft Virtual Server - Features of Microsoft Virtual Server.
5.	**Cloud Applications and advanced topics in Cloud Computing** Scientific Applications: ECG analysis, Protein structure Prediction, Satellite Image Processing (Geoscience), Media Applications, Drop Box and iCloud, Social Networking

	Energy Efficient and Green Cloud Computing Architecture, Market Oriented Cloud Computing (MOCC), Reference model for MOCC, Market Oriented Architecture for Datacenters

D. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Cloud Computing with the Windows Azure Platform	Roger Jennings, Wiley
2.	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, McGraw Hill
3.	Cloud Computing	Michael Miller, Pearson Education

Important Web Links:

1- http://www.tutorialspoint.com/cloud_computing/
2- http://www.thecloudtutorial.com/
3- https://www.youtube.com/playlist?list=PLV8vIYTIdSnaKSiSGvJf2QquSN4lEzGob
4- https://www.nptel.ac.in/courses/106/105/106105223/
5- https://swayam.gov.in/nd1_noc20_cs65
6- https://swayam.gov.in/nd1_noc19_cs64

Code: MULEBX2109 **Engineering Economics** **4 Credits [LTP: 4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

This course is the delivery of computing services over the Internet. Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at remote locations. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate anduser applications

COURSE OUTCOME

The student will be able to:

CO02104.1.1: To have a deep understanding of the concepts of virtualization along with VMWare Server, citrix Xen Server.
CO02104.1.2: To discuss about the architecture of cloud computing with IaaS, Paas, SaaS
CO02104.1.3: To understand about how application can be deploy on Azure.
CO02104.1.4: To understand the concepts of security in cloud computing with cloud security reference model, internal security breaches and identity management.
CO02104.1.5: To learn about the applications of cloud computing..

E. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Time value of money	07
2	Use and situations for equivalent annual worth comparison	10
3	Depreciation	09
4	Fixed and variable cost	10
5	Valuation	06

F. DETAILED SYLLABUS

Unit	Contents
1.	Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infite lives, comparison of deferred investments, Future worth comparison, pay back period comparison
2.	Use and situations for equivalent annual worth comparison, Comparison of assets of equal and unequal life. Rate of return, Internal rate of return, comparison of IIR with other methods, IRR misconceptions. Analysis of public Projects: Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost –effectiveness analysis.
3.	Depreciation, Computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models. Sensitivity analysis: single and multiple parameter sensitivity
4.	Fixed and variable cost, Product and Process Costing, Standard Costing, Cost estimation, Relevant Cost for decision making, Cost estimation, Cost control and Cost reduction techniques
5.	Definitions of value, price and cost, depreciation, sinking fund, different type of values and their significance, factor affecting value, rent and standard rent, Lease hold and free hold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and Years purchase, valuation tables, Easement, types of easements, significance of easement in valuation, Methods of valuation of buildings and land, Estimation of values of different types of buildings and lands.

	Energy Efficient and Green Cloud Computing Architecture, Market Oriented Cloud Computing (MOCC), Reference model for MOCC, Market Oriented Architecture for Datacenters

G. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Horn green, C.T., Cost Accounting	Prentice Hall of India

Important Web Links:

4- http://www.tutorialspoint.com/cloud_computing/
5- http://www.thecloudtutorial.com/
6- https://www.youtube.com/playlist?list=PLV8vIYTIdSnaKSiSGvJf2QquSN4lEzGob
4- https://www.nptel.ac.in/courses/106/105/106105223/
7- https://swayam.gov.in/nd1_noc20_cs65
8- https://swayam.gov.in/nd1_noc19_cs64

Code: MULCHM2201	**Soft Skills-II**	**1 Credit [LTP: 2-0-0]**

COURSE OUTCOME

The student would be able to:

CO01206.1 Effectively communicate through verbal/oral communication and improve the listening skills

CO01206.2 To develop and nurture the soft skills of the students through individual and group activities.

CO01206.3 To expose students to right attitudinal and behavioral aspects and to build the same through activities

CO01206.4 To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.

CO01206.5 To encourage the all round development of students by focusing on soft skills.

B. DETAILED SYLLABUS

Unit	Unit Details
1	Personality Enhancement Self-Awareness, Self Esteem & Confidence , Attitude Branding Yourself: Assertiveness and Confidence, The Corporate Fit-Dressing and Grooming, Corporate Dressing – Dress for Success, Etiquette: Social etiquette, business etiquette – civic sense – social norms
2	Effective Management Skills Time & Stress Management: Act in time on commitment Planning & Prioritizing, Emotional Intelligence: Managing Emotions
3	Art of Communication Interview Skills: Fluency & Expression, Group Discussions: Structured & Unstructured, Presentations: Voice, Body Language, Content and Visual Aids, Audience Management
4	Interpersonal Skills The Team Concept& Elements of Teamwork, Stages of Team Formation, & an Effective Team, Essential Building Blocks of Effective Teams Leadership Skills: style andtraits
5	Written & Oral Communication Writing Skills: Picture perception & Story Making, Storytelling, Extempore & Paper Presentations.

Code: MULCSE2201	**Skill Enhancement Technical Course II**	**1 Credit [LTP: 2-0-0]**

COURSE OUTCOME

The student would be able to:

CO01206.1 Effectively communicate through verbal/oral communication and improve the listening skills

CO01206.2 To develop and nurture the soft skills of the students through individual and group activities.

CO01206.3 To expose students to right attitudinal and behavioral aspects and to build the same through activities

CO01206.4 To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.

CO01206.5 To encourage the all round development of students by focusing on soft skills.

B. DETAILED SYLLABUS

Unit	Unit Details
1	Manipulating Strings - Working with Strings, Useful String Methods.
2	Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re .DOTALL, and re .VERBOSE
3	Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function.
4	Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module.
5	Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML.

Code: MCECCE 2401	**SEMINAR-II**	**1 Credit [LTP: 2-0-0]**

A. DETAILED SYLLABUS

Unit	Contents
	Students grouped in two to three during Semester I, will now continue to download further the research papers in the area, analyze, allocate individually, the set of papers, **Literature survey** Overview – What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography Methods of data collection – Observation, survey, contact methods, experimental, determining sample design Searching for publications – Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web Online tools – Google, Cite Seer, ACM Digital Library, IEEE, The on-line Computer Science bibliography, Survey papers, Finding material not on the web, Searching patents **Publishing a paper** How to write scientific paper Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper: Abstract writing, chapter writing, discussion, conclusion, references, bibliography, and In-class discussion of technical writing examples, Poster papers, review papers, how to organize thesis Project report, How to write a research proposal? How research is funded? Research ethics – Legal issues, copyright, and plagiarism General advice about writing technical papers in English Tips for writing correct English Practice sessions on above will be conducted. Students will have to deliver seminar, prepare a report and a review paper based on analysis individually.

Syllabus – Semester 3

MCECCE3101	Cloud Web Services	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

Upon successful completion of this subject students should be able to:

1. To explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2. To apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost by Load balancing approach.
3. To discuss system virtualization and outline its role in enabling the cloud computing system model.
4. To illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
5. To analyze various cloud programming models and apply them to solve problems on the cloud.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Cloud Technologies	**08**
2.	Introduction to AWS	**08**
3.	AWS identity services, security and compliance	**08**
4.	AWS computing and marketplace	**07**
5.	Other AWS services and management services	**07**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Cloud Technologies**
	• Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud. • Virtualization and Cloud Platforms Exploring virtualization, Load balancing, Hypervisors, Machine imaging, Cloud marketplace overview, Comparison of Cloud providers.
2.	**Introduction to AWS**
	• AWS history, AWS Infrastructure, AWS services, AWS ecosystem. • Programming, management console and storage on AWS Basic Understanding APIs - AWS programming interfaces, Web services, AWS URL naming, Matching interfaces and services, Elastic block store - Simple storage service, Glacier - Content delivery platforms
3.	**AWS identity services, security and compliance**
	• Users, groups, and roles - Understanding credentials, Security policies, IAM abilities and limitations, AWS physical security - AWS compliance initiatives, Understanding public/private keys, Other AWS security capabilities
4.	**AWS computing and marketplace**
	• Elastic cloud compute - Introduction to servers, Imaging computers, Auto scaling, Elastic load balancing, Cataloging the marketplace, AMIs, Selling on the marketplace. • AWS networking and databases Virtual private clouds, Cloud models, Private DNS servers (Route 53), Relational database service – DynamoDB, ElastiCache, Redshift.
5.	**Other AWS services and management services**
	• Analytics services, Application services, Cloud security, CloudWatch, CloudFormation, CloudTrail, OpsWorks. • AWS billing and Dealing with disaster Managing costs, Utilization and tracking, Bottom line impact, Geographic and other concerns, Failure plans, Examining logs.

C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing Bible	Barrie Sosinsky	Latest	John Wiley & Sons
2.	Amazon Web Services For Dummies	Bernard Golden	Latest	_
3.	Cloud Computing: Principles and Paradigms	Rajkumar Buyya	Latest	John Wiley & Sons,

Code: MCECEE3102 Research Methodology 4 Credits [LTP: 4-0-0]

A. COURSE OVERVIEW AND OBJECTIVES

To familiarize students with basic of research and the research process. To enable the students in conducting research work and formulating research synopsis and report. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling

COURSE OUTCOME

The student will be able to:

CO02102.1 To be able to distinguish a purpose statement, a research question or hypothesis, and a research objective.

CO02102.2 To be able to define the meaning of a variable, and to be able to identify independent, dependent, and mediating variables

CO02102.3 To be able to distinguish between categorical and continuous measures

CO02102.4 To be able to design a good quantitative purpose statement and good quantitative research questions and hypotheses

CO02102.5 To understand the link between quantitative research questions and data collection and how research questions are operationalized in educational practice.

A. DETAILED SYLLABUS

Unit	Contents
1.	**Overview of Research Methodology**
	Introduction, Mathematical tools for analysis, Research problems in management, Types of research, Research Process
2.	**Data Collection & Presentation**
	Introduction, Primary data, Secondary data, Data Presentation
3.	**Review of Basic Statistical Measures**
	Introduction, Measures of Central Tendencies, Measures of Variation, Measures of Skewness
4.	**Design and Analysis of Experiments**
	Introduction, Analysis of Variance, Completely Randomized design, Randomized complete block design, Latin square design, Duncan's multiple Range Test, Functional design, second factorial experiment, Expected Mean Square.
5.	**Basic Multivariate Analysis**
	Introduction, Correlation analysis, Forecasting, Linear regression & Time series
6.	**Algorithmic Research**
	Introduction, Algorithmic Research Problems, Types, Types of Solution Procedures, Steps of development, Steps of Algorithmic Research, Design of Experiments, Meta Heuristics for Combinational Problems.
7.	**Simulation**
	Introduction, Need for simulation, Types, Simulation Languages, case study.
8.	**Report Writing and Presentation**
	Introduction, Types of report, Guidelines for review draft, Report format, Typing Instructions, Oral Presentations

B. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Research Methodology	R. Panneerselvam, PHI
2.	Research Methodology: Methods and Trends	Dr. C. R. Kothari
3.	Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar

MCECCE3201	Cloud Web Services Lab	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

Upon successful completion of this subject students should be able to:

6. To explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
7. To apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost by Load balancing approach.
8. To discuss system virtualization and outline its role in enabling the cloud computing system model.
9. To illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
10. To analyze various cloud programming models and apply them to solve problems on the cloud.

D. OUTLINE OF THE COURSE

Experiement No.	Title of the unit	Time required for the Unit (Hours)
1.	Understand deployment models, service models, advantages of cloud computing	**08**
2.	Explore Storage as a Service for remote file access using web interface	**08**
3.	Understand security of web server and data directory	**08**
4.	Understand on demand application delivery and Virtual desktop infrastructure. Technology	**07**
5.	Create cloud applications such as messenger, photo editing website, your own social media etc	**07**

RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Cloud Computing Bible	Barrie Sosinsky	Latest	John Wiley & Sons
2.	Amazon Web Services For Dummies	Bernard Golden	Latest	–
3.	Cloud Computing: Principles and Paradigms	Rajkumar Buyya	Latest	John Wiley & Sons,

Code: MCECEE3401 **Review/Research Paper** **4 Credits [LTP: 4-0-0]**

A. COURSE OVERVIEW AND OBJECTIVES

To familiarize students with basic of research and the research process. To enable the students in conducting research work and formulating research synopsis and report. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling

COURSE OUTCOME

The student will be able to:

CO02102.1 To be able to distinguish a purpose statement, a research question or hypothesis, and a research objective.

CO02102.2 To be able to define the meaning of a variable, and to be able to identify independent, dependent, and mediating variables

CO02102.3 To be able to distinguish between categorical and continuous measures

CO02102.4 To be able to design a good quantitative purpose statement and good quantitative research questions and hypotheses

CO02102.5 To understand the link between quantitative research questions and data collection and how research questions are operationalized in educational practice.

C. DETAILED SYLLABUS

Unit	Contents
1.	**Foundations of Research**
	Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process
2.	**Problem Identification & Formulation**
	Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance
3.	**Research Design**
	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4.	**Qualitative and Quantitative**
	Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5.	**Data Analysis**
	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
6.	**Interpretation of Data and Paper Writing**
	Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
7.	**Use of Encyclopedias, Research Guides, Handbook**
	Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline
8.	**Use of tools / techniques for Research**
	Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

D. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Research Methodology	R. Panneerselvam, PHI

2.	Research Methodology: Methods and Trends	Dr. C. R. Kothari
3.	Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar

Code: MULEEE3107 **E- Commerce & Knowledge Management** **4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

This course provides an introduction to information systems for business and management. It is designed to familiarize students with organizational and managerial foundations of systems, the technical foundation for understanding information systems.

COURSE OUTCOME

The student would be able to

CO03115.1 Understand the basic concepts and technologies used in the field of management information systems.

CO03115.2To impart the knowledge of the different types of management information systems.

CO03115.3 To Understand the processes of developing and implementing information systems.

CO03115.4 To aware of the ethical, social, and security issues of information systems.

CO03115.5 To familiarize students with organizational and managerial foundations of systems.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction To Electronic Commerce	9
2.	Building Own Website	8
3.	Internet And Extranet	9
4.	Electronic Data Interchange	9
5.	Planning For Electronic Commerce	9

B. DETAILED SYLLABUS

Unit	Unit Details
1	**INTRODUCTION TO ELECTRONIC COMMERCE** Introduction of Unit, what is E-Commerce (Introduction and Definition), Main activities E- Commerce, Goals of E-Commerce, Technical Components of E-commerce, Functions of E- commerce, Advantages and Disadvantages of E-commerce, Scope of E-commerce, Electronic commerce Applications, Electronic commerce and Electronic Business, Conclusion of Unit.
2	**BUILDING OWN WEBSITE** Introduction of Unit, Reasons for building own website, Benefits of website, Bandwidth requirements, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Banner Exchange, Shopping Bots, Conclusion of Unit

3	**INTERNET AND EXTRANET** Introduction of Unit, Definition of Internet, Advantages and Disadvantages of the Internet, Component of an Intranet Information technology structure, Development of a Intranet, Extranet and Intranet Difference, Role of Intranet in B2B Application, Conclusion of Unit.
4	**ELECTRONIC DATA INTERCHANGE** Introduction of Unit, Concepts of EDI and Limitation, Application of EDI, Disadvantages of EDI, EDI model, Conclusion of Unit.
5	**PLANNING FOR ELECTRONIC COMMERCE** Introduction of Unit, planning electronic commerce initiatives, linking objectives to business strategies, measuring cost objectives, comparing benefits to costs, strategies for developing electronic commerce web sites, Conclusion of Unit.

C. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author
1.	E-Commerce	Greenstein & Feinman, Tata McGrew Hill
2.	Frontiers of Electronic Commerce	Kalakota Winston ,Pearson Education

Important Web Links:

1. https://www.kmslh.com/3-reasons-why-ecommerce-must-have-knowledge-management/
2. https://link.springer.com/chapter/10.1007/978-3-642-23993-9_31
3. https://ieeexplore.ieee.org/document/5279962
4. https://www.sciencedirect.com/science/article/pii/S0268401207001120
5. https://www.slideshare.net/monoaziz/knowledge-management-1852596

Code: MULECV3108	**Water and Environmental Pollution**	**4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES

The aim of this course is to teach students about current environmental problems. From an environmental perspective, the student will learn how to develop an activity using various strategies to control, reduce and monitor all environmental problems that might arise as a result.

COURSE OUTCOME

The student would be able to

CO03114.1 To be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.

CO03114.2 To be able to analyse an industrial activity and identify the environmental problems.

CO03114.3 TO be able to plan strategies to control, reduce and monitor pollution.

CO03114.4 To be able to select the most appropriate technique to purify and/or control the emission of pollutants.

CO03114.5 To be able to apply the basis of an Environmental Management System (EMS) to an industrial activity.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Water And Water Analysis	9
2.	Wastewater And Their Treatment	8
3.	Global Atmospheric Change	9
4.	Air Pollution & Meteorology	9
5.	Solid Waste Management	9

B. DETAILED SYLLABUS

1	**WATER AND WATER ANALYSIS** Water resources, Sources of water, characteristics of water, water pollutants, oxygen demanding wastes, surface water quality, ground water quality. Municipal water supply: Requisites of drinking water, Steps involved in treatment of water
2	**WASTEWATER AND THEIR TREATMENT** Wastewater Characteristics: Quality parameters: BOD, COD, TOC, Solids, DO, Nitrogen, Phosphorus, Standards of disposal into natural watercourses and on land, Indian standards. wastewater treatment systems, disposal scope
3	**GLOBAL ATMOSPHERIC CHANGE** The atmosphere of earth, greenhouse effect, radiative forcing of climate change, global warming potential, carbon cycle, carbon emissions from fossil fuels, regional impacts of temperature change, global initiatives.

4	**AIR POLLUTION & METEOROLOGY** Atmospheric motion, Lapse rate, atmospheric stability, inversion, atmospheric dispersion, maximum mixing depth, Air quality standards, plume rise, emission controls. Air pollution control methods in industries. **NOISE POLLUTION:** Effect of noise on people, rating systems, community noise sources and criteria, traffic noise prediction, noise control
5	**SOLID WASTE MANAGEMENT** Integrated solid waste management, hazardous waste management, biomedical waste treatment technologies and disposal options, e-waste management, waste minimization for sustainability, waste management – Indian scenario.

C. RECOMMENDED STUDYMATERIAL:

S.No	Title of the Book	Author
1.	Environmental Engineering	Howard S Peavy, Donald RRowe, George Tchobanoglous
2.	Engineering: Treatment, and Reuse, 4th edition, Tata McGraw Hill, 2007.	Metcalf and Eddy Inc
3.	Manual for Water Treatment.	Ministry of Urban development, Govt of India
4.	Manual for Sewage Treatment	Ministry of Urban development, Govt of India
5.	Air Pollution	M N Rao
6.	Air Pollution Control Engineering	De Nevers
7	Solid Wastes: Engineering principles and Management issues	Tchobanoglous G.

Important Web Links:

1. https://www.google.co.in/search?biw=1366&bih=608&ei=Y4HLXvytHffYz7sPn9eB4AY&q=water+and+enviroment+polluation+nptel&oq=water+and+enviroment+polluation+nptel&gs_lcp=CgZwc3ktYWIQAzIKCCEQFhAKEB0QHjIKCCEQFhAKEB0QHjIKCCEQFhAKEB0QHjoECAAQRzoGCAAQFhAeOgcIIRAKEKABUIsYWP4mYMItaABwAXgAgAG8AogBuw2SAQcwLjEuNS4xmAEAoAEBqgEHZ3dzLXdpeg&sclient=psy-ab&ved=0ahUKEwi868D4y87pAhV37HMBHZ9rAGwQ4dUDCAw&uact=5\
2. https://www.nrdc.org/stories/water-pollution-everything-you-need-know
3. https://www.environmentalpollutioncenters.org/water/
4. https://www.explainthatstuff.com/waterpollution.html
5. https://wwf.panda.org/knowledge_hub/teacher_resources/webfieldtrips/water_pollution/

Code: MULEME3109	**IR& Patents**	**4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work. Further teacher will have to demonstrate with productsand ask the student to identify the different types of IPR's

COURSE OUTCOME:

CO03116.1 To introduce fundamental aspects of Intellectual property Rights to students who aregoing to play a major role in development and management of innovative projects in industries. CO03116.2 To disseminate knowledge on patents, patent regime in India and abroad and registration aspects

CO03116.3 To acquire knowledge on copyrights and its related rights and registration aspects

CO03116.4 To understand knowledge on trademarks and registration• aspects

CO03116.5 To disseminate knowledge on Design, Geographical Indication (GI), Plant Varietyand Layout Design Protection and their registration aspects

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction To Ipr	9
2.	Types Of Ipr And Wipo	8
3.	Legal And Commercial Aspects Of Ipr	9
4.	Introductions To Patents	9
5.	Patent Procedures	9

B. DETAILED SYLLABUS

Unit	Unit details
1	**INTRODUCTION TO IPR** General Regime of Intellectual Property Rights, Concept of Property vis-à-vis Intellectual Property, Concept of Property and Theories of Property - An Overview. Theories of Intellectual Property Rights, Intellectual Property as an Instrument of Development, Need for Protecting. Intellectual Property- Policy Consideration- National Perspectives and International demands.
2	**TYPES OF IPR AND WIPO** Types of Intellectual Property- Origin and Development- An Overview, Intellectual Property Rights as Human Right, Role of International Institutions, World Intellectual Property Organization (WIPO), Function of WIPO, Membership of WIPO, Agreement between the WIPO and the WTO.

3	**LEGAL AND COMMERCIAL ASPECTS OF IPR** Dispute Settlement- New Treaties, Commercialization of Intellectual Property Rights by Licensing, Determining Financial Value of Intellectual Property Rights, Negotiating Payments Terms in Intellectual Property Transaction, Intellectual Property Rights in the Cyber World.
4	**INTRODUCTIONS TO PATENTS** Introduction to Patent Law, Paris Convention, Patent Cooperation Treaty, WTO- TRIPS, Harmonization of CBD and TRIPs, Indian Patent Law, The Patents Act, 1970, Amendments to the Patents Act, Patentable Subject Matter, Patentability Criteria.
5	**PATENT PROCEDURES** Procedure for Filing Patent Applications, Patent Granting Procedure, Revocation, Patent Infringement and Remedies, Relevant Provisions of the Biological Diversity Act, 2002, Access and Benefit SharingIssues.

C. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author
1.	Intellectual Property Rights in India	VK Ahuja (Lexis Nexis butter worths Publications)

Important Web Link:

1. https://www.cencenelec.eu/ipr/Pages/default.aspx
2. http://www.ipindia.nic.in/
3. https://en.wikipedia.org/wiki/Intellectual_property
4. https://en.wikipedia.org/wiki/Intellectual_propert
5. https://www.itu.int/en/ITU-T/ipr/Pages/default.aspx

Code: MULEEE3110	**Robotics**	**4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

To understand the basic concepts associated with the design and Functioning and applications of Robots To study about the drives and sensors used in Robots To learn about analyzing robot kinematics and robot programming.

COURSE OUTCOME:

The student would be able to**:**

CO03117.1 To be able to introduce basics of robotics.

CO03117.2 To understand robot kinematics and robot programming

CO03117.3 To understand the application of Robots

CO03117.4 To learn about force and torque sensing

CO03117.5 To acquire knowledge of robotics programming.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Fundamentals	9
2.	Robot Kinematics	9
3.	Robot Dynamic Analysis And Forces	8
4.	Actuators And Sensors	9
5.	Robot Programming, Systems And Applications	9

B. DETAILED SYLLABUS

Unit	Unit details
1	**FUNDAMENTALS** Historical information, robot components, Robot characteristics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, Position Analysis forward and inverse kinematics of robots, Including frame representations.
2	**ROBOT KINEMATICS** Transformations, position and orientation analysis and the Denavit-Hartenberg representation of robot kinematics, The manipulators, The wrist motion and grippers. Differential motions, Inverse Manipulator Kinematics: Differential motions and velocity analysis of robots and frames.
3	**ROBOT DYNAMIC ANALYSIS AND FORCES** Analysis of robot dynamics and forces, Lagrangian mechanics is used as the primary method of analysis and development. Trajectory Planning: Methods of path and trajectory planning, Both in joint-space and in Cartesian-space.

4	**ACTUATORS AND SENSORS** Actuators, including hydraulic devices, Electric motors such as DC servomotorsand stepper motors, Pneumatic devices, as well as many other novel actuators, It also covers microprocessor control of these actuators, Mechatronics, Tactile sensors, Proximity and range sensors, Force and torque sensors, Uses of sensors in robotics.
5	**ROBOT PROGRAMMING, SYSTEMS AND APPLICATIONS** Robot languages, Method of robots programming, Lead through programming methods, A robot programs as a path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and limitation of lead through methods and robotic applications. Basic principles of fuzzy logic and its applications in microprocessor control and robotics.

C. RECOMMENDED STUDYMATERIAL:

S.No	Title of the Book	Author
1.	Robotics Control Sensing, Vision and Intelligence	McGraw Hill Gonzalez, R. C., Fu, K. S. and Lee, C.S.G.
2.	Robotics for Engineers	McGraw Hill Koren,Y
3.	Introduction to Robotics, Analysis, Systems, Applications,	Dorling Kingsley, Dorling Kingsley Niku, S.B
4.	Programming robot controllers	McGraw Hill Predko, M

Important Web Links:

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101099/
3. https://nptel.ac.in/courses/112/101/112101098/
4. https://swayam.gov.in/nd1_noc20_me03
5. https://www.youtube.com/watch?v=DaWMvEY3Qgc

Code: MULEEE3111 **Digital India Implementation** **4 Credit [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES:

The Digital India programme aims to provide broadband highways, universal access to mobile connectivity, public internet access programme, e-governance: Reforming government through technology, eKranti - Electronic delivery of services, Information for all, Electronics manufacturing: Target net zero imports, IT for jobs and early harvest programmes.

COURSE OUTCOME:

At the end of the course students will be able to:

1. Understand concepts and objectives digital India and digital infrastructure.
2. Understand the pillars of the digital India.
3. Understand the concept of new digital services and platforms for implementations purpose.
4. Understand the various digital facilities to empower citizen.
5. Apply the digital India initiative for training objective.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Digital India Initiative	8
2.	Focus Area	8
3.	Implementation	9
4.	Facilities To Digitally Empower Citizen	7
5.	Training	8

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Digital India Initiative** Concept, aims and objectives, opportunities, inclusive growth in areas of electronic services, products, manufacturing and job opportunities, centered on three keyareas – Digital Infrastructure as a Utility to Every Citizen, Governance & Services on Demand and Digital Empowerment of Citizens.
2	**Focus Area** The Government of India specifically targets nine 'Pillars of the Digital India' as follows: Broadband Highway, Universal Access to Mobile connectivity, Public Internet Access Programme, E-Governance, reforming Government through Technology, E- Kranti, electronic delivery of services, Information for All, Electronics Manufacturing, IT for Jobs
3	**Implementation** New digital services, MyGov.in is a platform to share inputs and ideas on matters of policy and governance, UMANG (Unified Mobile Application for New-age Governance) ,AADHAR,Digi-Locker,Bharat Bill Payment System, PAN, EPFO services, PMKVY services, Indian railway tickets bookings, birth certificates, e-District, e-Panchayat, e-Sign framework, Swachh Bharat Mission(SBM)

	Mobile app, e-Hospital application, Digital attendance.
4	**Facilities To Digitally Empower Citizen** Digital locker facility, eliminating the use of physical documents and enables the sharing of verified electronic documents across government agencies, three key stakeholders of citizen, issuer and requester. BPO and job growth, government is planning to create 28,000 seats of bpos in various states and set up at least one common service centre in each of the gram panchayats in the state. Easy access to a common services center (CSC), Shareable private space on a public cloud, Safe and secure cyberspace, Universally accessible digital resources, Collaborative digital platforms for intergovernmental operations. E- Samparkvernacular email service: connect rural India with the digital India, the government of India impelled email services provider giants including Gmail, office and rediff to provide the email address in regional languages, anIndian-based company, data Xgen technologies pvt.ltd, has launched world"s first free linguistic email address under the name „Data mail" which allows creating email ids in 8 Indian languages, English; and 3 foreign languages – Arabic, Russian and Chinese. Overthe period of time the email service in 22 languages will be offered by Data Xgen technologies.
5	**Training** PradhanMantriGramin, Digital SakshartaAbhiyan, PMG Disha, Ongoing awareness campaign, reception within country and the outside world, criticism and impact.

C. RECOMMENDED STUDY MATERIAL:

S.No	Tittle of Book	Author
1.	Digital India: Understanding Information,Communication and Social Change	PradipNinan Thomas
2.	Book on Digital India (Special Edition) by National e-governance mission, Government of India	
Important Web Links:		
1. https://economictimes.indiatimes.com/tech/internet/digital-india-15-salient-things-to-know-about-pm-narendra-modis-project/articleshow/47893380.cms 2. https://en.wikipedia.org/wiki/Digital_India 3. https://www.researchgate.net/publication/303643369_Digital_India_Objectives_Initiatives_and_Inherent_Challenges 4. https://digitalindia.gov.in/content/programme-pillars 5. https://www.civilserviceindia.com/subject/Essay/digital-india-or-green-india-discuss3.html		

Code: MULECV3112	**SMART CITY DESIGN**	**4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES: The objective of the Smart Cities **Mission** is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean andsustainable environment and **application** of 'Smart' Solutions.

COURSE OUTCOME:

At the end of the course students will be able to:

CO03112.1 Understand the concept of smart city and smart energy business concepts.

CO03112.2 Apply governance of smart city by various techniques like Augmented Reality for City Planning.

CO03112.3 Understand the concept and characteristics of Smart City Intelligent Buildings and Urban Spaces.

CO03112.4 Understand the environmental and economic impacts on buildings by Multi-objective optimization.

CO03112.5 Apply the energy management and Smart City Distributed Energy.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Smart City Introduction And Concept	7
2.	Smart City Governance	8
3.	Smart City Intelligent Buildings And Urban Spaces	7
4.	Multi Objective Optimization- Smart City	7
5.	Smart City Distributed Energy	8

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Smart City Introduction And Concept** Smart City: local but networked, distributed but integrated Smart City, City monitoringandoperationsystemsVisionofanopensmartcityinteroperability environment Road maps for research and innovation policy Smart energybusiness concepts for Energy Hub districts Identifying development trends in smart city technologies – VTT Trend generator Public procurement of innovation for smart city solutions.
2	**Smart City Governance** Real-time decision support systems for city management, Boosting collaborative planning with visualisation technology, Virtual Model Facilitating Citizen Interaction, Mobile Augmented Reality for City Planning, Co-creating future smart cities - Visual and participative urban planning services Citizen-driven co- design for a smarter city Social media for citizen participation Gamification as an enabler of mutual learning in complex health care systems, Decision-making support: A smart city perspective
3	**Smart City Intelligent Buildings And Urban Spaces** Intelligent buildings and urban spaces in smart cities Intelligent urban spaces– automatic real-time responses to people behavior Occupancy in smart buildings of smart cities – case hospital smart lighting Mobile

	augmented reality for building maintenance Autonomous management system for buildings and districts
4	**Multi Objective Optimization- Smart City** Multi-objective optimization for the minimization of environmental and economic impacts on buildings at district level Intelligent Street lights adapt to conditions City mills leading the positive change in recycling.
5	**Multi Objective Optimization- Smart City** Distributed renewable energy and energy management Highlights from the Smart Grids and Energy Systems programme. Active distribution networks with full integration of demand and distributed resources Integration of variable power generation into urban energy systems Future district heating solutions for residential districts Smart metering cyber security ICT for neighborhoods‟ energy management Energy-Hub for residential and commercial districts and transport ICT-supported business in energy positive neighborhood's Renewable energy and energy efficiency in new districts – how to accelerate systemic change towards smart cities Internet of Energy: Electric Mobility with Smart Grids.

C. RECOMMENDED STUDY MATERIAL:

S.No	Title of Book	Author
1.	Building smart cities-Analytics, design building and thinking	Carol l. Stimmel
2.	Smart City- Foundation, principles and application	Houbing Song
3.	Smart city and urban development of India	N. Mani
Important Web Links:		
1.	https://nptel.ac.in/courses/105/105/105105160/	
2.	https://nptel.ac.in/courses/124/107/124107007/	
3.	https://swayam.gov.in/nd1_noc20_ce43/preview	
4.	https://www.youtube.com/watch?v=8G8ewFxE_V8	
5.	http://www.digimat.in/nptel/courses/video/105105160/L41.html	

Code: MULEEE3113	**Renewable Energy**	**4 Credits [LTP:4-0-0]**

COURSE OVERVIEW AND OBJECTIVES The course should enable the students to : 1. Understand the various forms of conventional energy resources. 2. Learn the present energy scenario and the need for energy conservation 3. Explain the concept of various forms of renewable energy 4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application 5. Analyse the environmental aspects of renewable energy resources.

COURSE OUTCOME

The student would be able to

CO03113.1 Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations

CO03113.2 Know the need of renewable energy resources, historical and latest developments.

CO03113.3 Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc

CO03113.4 Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.

CO03113.5 Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Classification Of Energy	9
2.	Applications Of Solar Energy	10
3.	Bio Energy Sources	8
4.	Wind Energy & Small Hydro Power Systems	10
5.	Ocean & Geothermal Energy	7

B. DETAILEDSYLLABUS

1	**CLASSIFICATION OF ENERGY** Energy chain and common forms of usable energy- Present energy scenario-World energy status-Energy scenario in India - Introduction to renewable energy resources Introduction to Solar Energy-Energy from sun-Spectral distribution of Solar radiation- Instruments for measurement of solar radiation-Solar radiation data analysis

2	**APPLICATIONS OF SOLAR ENERGY** Thermal applications -Introduction to Solar thermal collectors- Types - Principle of operation of different collectors - Flat plate- Evacuated tube collectors-Compound parabolic collectors- Solar air heaters - Solar dryers-solar cookers- solar stills - Solar ponds - concentrating collectors- line type - point type - Methods of Solar power generation - Power towers. Physics of solar cells - Cell and module Characteristics of cells and module - Performance parameters -BoS- PV System applications - Stand- alone- Grid connected systems
3	**BIO ENERGY SOURCES** Energy through various processes - Energy through fermentation - Gasification - various types of gasifiers -Pyrolysis - Fixed bed and fast Pyrolysis - Bio energy through digestion - Types of Digesters- Factors affecting the yield of products
4	**WIND ENERGY & SMALL HYDRO POWER SYSTEMS** Resource assessment - types of wind turbines - selection of components - blade materials - power regulation - various methods of control - wind farms - site selection - off shore wind farms - Solar Wind Hybrid energy systems.Introduction - types - system components, discharge curve and estimation of power potential- Turbines for SHP
5	**OCEAN & GEOTHERMAL ENERGY** Power generation through OTEC systems - various types - Energy through waves and tides - Energy generation through geothermal systems - types

C. RECOMMENDED STUDYMATERIAL:

S. No	Title of the Book	Author
1.	Energy Science: Principles, technologies and impacts	Oxford Universities press.
2.	Renewable Energy, power for a sustainable future	CRC Press
3.	Renewable Energy Systems, Advanced conversion technologies and applications	CRC Press
4.	Wind Turbine technology	CRC Press
5.	Solar Photovoltaics, fundamentals, technologies and applications	Prentice Hall India.

Important Website Link

1. https://www.act.edu.om/media/2091/renewable-energy.pdf
2. https://www.nrdc.org/stories/renewable-energy-clean-facts
3. https://www.journals.elsevier.com/renewable-energy
4. https://www.eia.gov/energyexplained/renewable-sources/
5. https://www.google.co.in/search?q=renewable+energy+examples&sa=X&ved=2ahUKEwiW58_qy

Code: MCECCE 3301 DISSERTATION PART-I 3 Credits [LTP:0-0-6]

Unit	Content
	• Dissertation Part I consist of Finalization of thesis title based on literature review carried out duringSemester I and II • Objective finalization &presentation • Design & experimentation details • Experimentation work (partial) • Part I thesis preparation • Presentation and submission of research prepare based on experimentation carried out.

Syllabus – Semester 4

Code: MCECCE 4301 DISSERTATION PART-II 3 Credits [LTP:0-0-6]

Unit	Content
	• Dissertation Part II consist of Finalization of thesis • Objective finalization &presentation • Design & experimentation details • Experimentation work (partial) • Part II thesis preparation • Presentation and submission of research prepare based on experimentation carried out.