Faculty of Engineering & Technology

Syllabus

For

Master of Technology (M. Tech.)

in

Mechanical Engineering

(Production Engineering)

(Program Code: MT0151ME)

***Approved by the Academic Council vide resolution no ……**

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1. INTRODUCTION

The quality of higher education in M. Tech. should be improved in such a manner that post graduates are able to compete in this field globally in terms of their knowledge and skills, for this purpose Learning Outcome-based Curriculum Framework (LOCF) is developed.

Incorporation of Learning Outcome-based Curriculum Framework (LOCF) in the Post Graduate M. Tech. programme makes it student-centric, interactive and outcome-oriented to achieve well-defined aims, objectives and goals. The learning outcomes are attained by students through skills acquired during a programme of study. Programme learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies. It would also focus on knowledge and skills that prepare students for further study, employment and society development. LOCF help ensure comparability of learning levels and academic standards across colleges/universities.

At present, the goal of higher education in M. Tech. may be achieved using the following measures:

i. Curriculum reform based on learning outcome-based curriculum framework (LOCF).

ii. Improving learning environment and academic resources.

iii. Elevating the quality of teaching and research.

iv. Involving students in discussions, problem-solving and out of box thinking about various ideas and their applicability, which may lead to empowerment and enhancement of the social welfare.

v. Motivating the learners to understand various concepts of their educational programme keeping in view the regional context.

vi. Enabling learners to create research atmosphere in their colleges/ institutes/ universities.

vii. Teach courses based on Choice Based Credit System (CBCS).

2. LEARNING OUTCOME-BASED APPROACH TO CURRICULUM PLANNING

The Master's Degree is awarded to the students on the basis of knowledge, understanding, skills, values and academic achievements. Hence, the learning outcomes of this programme are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for knowledge.

The LOCF have designed courses of M. Tech. in the light of post graduate attributes, description of qualifications, courses and program learning outcomes. It may lead to all round development and delivery of complete curriculum planning. Hence, it provides specific guidelines to the learners to acquire sufficient knowledge during this program.

The programme has been planned in such manner that there is scope of flexibility and innovation in

i. Modifications of prescribed syllabi.

ii. Teaching-learning methodology.
iii. Assessment technique of students and knowledge levels.
iv. Learning outcomes of courses.
v. Addition of new elective courses subject to availability of experts in colleges/institutes/universities across the country.

2.1. Nature and Extent of Master's Programme

As a part of effort to enhance employability of M. Tech. Post Graduates expected learning outcomes are very essential in present day perspective. Therefore, higher education degrees must formulate Post Graduate Attributes (PGAs), qualification descriptors, learning outcomes and course learning outcomes which will help in curriculum planning and development in the form of design and delivery of courses. The overall formulation of the degree programme must equip learner to have competencies to provide deliverables to the industry. It also delivers exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraint. Analyze, design and create computing solutions for scientific and multidisciplinary engineering challenges, also communicate effectively and observes ethical behavior. Demonstrate an exceptional involvement and active participation in Research and Development leading to new innovations and optimized solutions.

2.2. Aims of Master's programme in M. Tech.

The overall aims of M. Tech are to

i. Exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraint. Develop broad and balanced knowledge and understanding of definitions, concepts and principles.

ii. Familiarize the students with suitable tools related to M. Tech programme.

iii. Enhance the ability of learners to apply the knowledge and skills acquired by them during the M.Tech programme to solve specific problems of their courses.

iv. Provide learners sufficient knowledge and skills enabling them to undertake further studies in M. Tech. and its allied areas.

v. Encourage the students to develop a range of generic skills helpful in employment, internships and social activities.

2.3. Motive behind curriculum planning and development

The committee considered and discussed the following factors for LOCF for the graduates:

i. Framing of syllabi
ii. Learners attributes
iii. Qualification descriptors
iv. Programme learning outcomes
v. Course learning outcomes

vi. Necessity of having elective courses
vii. Academic standards

3. PROGRAM EDUCATIONAL OBJECTIVES (PEO'S):

1. To provide students with a foundation in engineering areas required to formulate, solve and analyse engineering problems. **(Fundamental Knowledge)**
2. To analyse real life problems; apply the knowledge gained from modern design methodologies to address issues in a manner i.e., technically sound, economically feasible and socially acceptable. **(Professional Skill & Society).**
3. To inculcate ethical attitude, effective communication skills, teamwork in their profession and adapt to current trends by engaging in lifelong learning needed for a successful professional career. **(Ethics & Lifelong Learning)**

4. POST GRADUATE ATTRIBUTES (PGAs)

The post graduate attributes in M. Tech. are the summation of the expected course learning outcomes mentioned in the end of each course. Some of them are stated below:

PGA1: Discipline-specific Knowledge:

Capability of demonstrating comprehensive knowledge of M. Tech program and understanding of core branch so that it forms a foundation for a Post Graduate program of study.

PGA2: Research-related skills:

To develop a sense of inquiry and capability for asking relevant and intelligent questions, problem identification, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PGA3: Critical Thinking & Analytical Reasoning:

Ability to employ critical thinking in understanding the concepts relevant to the various branches of technical courses. Analytical reasoning refers to the ability to look at information, be it qualitative or quantitative in nature, and discern patterns within the information.

PGA4: Problem Solving:

Capability to solve problems by using research-based knowledge and research methods including innovative thinking, design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PGA5: Usage of Modern Tools (Information/digital literacy)& Self-directed learning:

To create, select, and apply appropriate techniques, resources, and modern science and IT tools including prediction and modeling to complex science activities with an understanding of the limitations. Self – directed learning is to provide ability to work independently and do in-depth study of various problems and requirements of society.

PGA6: Communication skills:

i. Ability to communicate various concepts of technical education effectively using practical approach and their geometrical visualizations.

ii. Ability to use courses as a precise language of communication in other branches of human knowledge.

iii. Ability to resolve unsolved problems and requirements of industries and societies.

iv. Ability to show the importance of their technical knowledge as precursor to various scientific developments since the beginning of the civilization.

PGA7. Leadership Readiness/Qualities and Employability Options:

Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision and using management skills to follow the mapped path to the destination in a smooth and efficient way. This program will also help students to enhance their employability through self employment (Entrepreneur) or by opting jobs in various sectors like industries, Government offices, PSUs, corporate etc.

PGA8. Multicultural Competence:

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PGA9: Moral and ethical awareness/reasoning:

Ability to identify unethical behavior such as falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of their program.

PGA10: Lifelong learning:

Life-long learning provides the ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

5. QUALIFICATION DESCRIPTORS (QDs)

The qualification descriptor suggests the generic outcomes and attributes to be obtained while obtaining the degree of M. Tech. The qualification descriptors indicate the academic standards on the basis of following factors:

i. Level of knowledge

ii. Understanding
iii. Skills
iv. Competencies and attitudes
v. Values.

These parameters are expected to be attained and demonstrated by the learners after becoming graduates in this programme. The learning experiences and assessment procedures should be so designed that every graduate may achieve the programme learning outcomes with equal opportunity irrespective of the class, gender, community and regions. Each post graduate should be able to:

i. Demonstrate fundamental systematic knowledge and its applications. It should also enhance the subject specific knowledge and help in creating jobs in various sectors.

ii. Demonstrate educational skills in areas of their programme.

iii. Apply knowledge, understanding and skills to identify the difficult/unsolved problems in courses of their programme and to collect the required information in possible range of sources and try to analyze and evaluate these problems using appropriate methodologies.

iv. Apply one's disciplinary knowledge and skills in newer domains and uncharted areas.

v. Identify challenging problems and obtain well-defined solutions.

vi. Exhibit subject-specific transferable knowledge relevant to job trends and employment opportunities.

6. PROGRAMME LEARNING OUTCOMES (PROGRAM OUTCOMES)

Students post graduating with the M. Tech degree should be able to acquire with following **PLOs**

PLO1. Apply knowledge, skills, and current tools, recent computing technologies of Engineering innovatively to different applications

PLO2. Enhance thinking skills to design and conduct experiments, as well as to analyze and interpret data and address the research gaps to produce solutions with the help of tools, technology and products.

PLO3. Understand the contemporary research, security issues in the different areas of engineering.

PLO4. An ability to identify, analyze, design, develop, implement and integrate based systems.

PLO5. Enhance critical thinking by acquiring the skills in modern techniques, methodologies and tools to be innovative and creative.

PLO6. An ability to communicate effectively, express /present ideas in an impressive and professional manner, both in written and verbal forms.

PLO7. An ability to work in multidisciplinary and multicultural environment, become entrepreneur.

PLO8. An ability to understand leadership and entrepreneurship qualities.

PLO9. An ability to understand health, ethical, legal, financial, and professional responsibilities.

PLO10. To recognizes the need for self-motivation and ability to engage in lifelong learning through continuing education, research and professional development.

Mapping of Graduate Attributes (PGAs) and Programme Learning Outcomes (PLOs):

PLO/PGA	PGA1	PGA2	PGA3	PGA4	PGA5	PGA6	PGA7	PGA8	PGA9	PGA10
PLO1	■									
PLO2		■								
PLO3			■							
PLO4				■						
PLO5					■					
PLO6						■				
PLO7							■			
PLO8								■		
PLO9									■	
PLO10										■

7. PROGRAM SPECIFIC OUTCOMES (PSO's) :

PSO1: Engage in sustainable development and to demonstrate engineering skills for effective interpretation and decision to solve real world problems.

PSO2: To make a strong combination of technical and leadership qualities for successful professional career in industry or in entrepreneurship.

8. TYPES OF COURSES

1. Courses in a program may be of four kinds: Core, Elective, Open Elective and Audit Courses. Details of the Courses are available with respective discipline.

a) Core Course:-

There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a requirement to complete the programme in a said discipline of study.

b) Elective Course:-

Elective course is a course which can be chosen from a pool of papers. It may be

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

c) Ability Enhancement Compulsory Courses (AECC):-

AECC courses are based upon the content that leads to knowledge enhancement, for example: English Communication, Environment Science/ Studies, etc.

Audit course: Audit Courses provide value based and/or skill based knowledge and may content both Theory and Lab/Training/Field Work. The main purpose of these courses is to provide students life- skills in hands- on mode so as to increase their employability.

d) Skill Enhancement Courses (SEC):-

SEC Courses provide value based and/or skill based knowledge and may content both Theory and Lab/Training/Field Work. The main purpose of these courses is to provide students life- skills in hands- on mode so as to increase their employability.

2. List of Courses:-

Core Courses:-

- Computer aided process planning
- Quality Management Systems
- Ergonomics and Work System Design Lab
- Manufacturing Lab
- Enterprise Resource Planning
- CNC Technology & Programming
- CNC Technology Lab
- Robotics Lab
- Mini Project with Seminar
- Dissertation-I /Industrial Project
- Dissertation II

Elective Courses

- Ergonomics and Work System Design
- Energy Management
- Machine tool design
- Lean Manufacturing
- Product Engineering
- Mechatronics
- Reliability, Maintenance Management & Safety
- Cryogenic Systems
- Inventory management
- Cellular manufacturing systems
- Concurrent Engineering
- Robotics
- Automated material handling systems
- Supply chain practice & procedure
- Business Analytics
- Industrial Safety
- Operations Research
- Cost Management of Engineering Projects
- Composite Materials
- Waste to Energy

Ability Enhancement Compulsory Course (AECC)

- Audit Course
- ANANDAM

Computation of Workload:

Lecture (L) : 1 Credit = 1 Theory period of one hour duration

Tutorial (T) : 1 Credit = 1 Tutorial period of one hour duration

Practical (P) : 1 Credit = 1 Practical period of two hour duration

9. PROGRAM STRUCTURE M.Tech. (MEPE)

Semester - I

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE101	Computer aided process planning	Core	50	100	150	3	0	0	3
MTMEPE102	Quality Management Systems	Core	50	100	150	3	0	0	3
MTMEPE103A	Ergonomics and Work System Design	Elective	50	100	150	3	0	0	3
MTMEPE103B	Energy Management	Elective	50	100	150	3	0	0	3
MTMEPE103C	Machine tool design	Elective	50	100	150	3	0	0	3
MTMEPE104A	Lean Manufacturing	Elective	50	100	150	3	0	0	3
MTMEPE104B	Product Engineering	Elective	50	100	150	3	0	0	3
MTMEPE104C	Mechatronics	Elective	50	100	150	3	0	0	3
MTMEPE 105	Research Methodology and IPR	Core	50	100	150	2	0	0	2
MTMEPE 106	Audit Course – **1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	0	0	0	2	0	0	0
Practical/Viva Voce		**Type**	**Internal Marks**	**External Marks**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE107	Ergonomics and Work System Design Lab	Core	60	40	100	0	0	2	2
MTMEPE108	Manufacturing Lab	Core	60	40	100	0	0	2	2
MTMEPE109	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**420**	**630**	**1050**	**18**	**0**	**5**	**20**

Semester – II

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE201	Enterprise Resource Planning	Core	50	100	150	3	0	0	3
MTMEPE202	CNC Technology & Programming	Core	50	100	150	3	0	0	3
MTMEPE203A	Reliability, Maintenance Management & Safety	Elective	50	100	150	3	0	0	3
MTMEPE203B	Cryogenic Systems	Elective	50	100	150	3	0	0	3
MTMEPE203C	Inventory management	Elective	50	100	150	3	0	0	3
MTMEPE204A	Cellular manufacturing systems	Elective	50	100	150	3	0	0	3
MTMEPE204B	Concurrent Engineering	Elective	50	100	150	3	0	0	3
MTMEPE204C	Robotics	Elective	50	100	150	3	0	0	3
MTMEPE 205	Audit Course – **2** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	0	0	0	2	0	0	0
Practical/Viva Voce		**Type**	**Internal Marks**	**External Marks**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE206	CNC Technology Lab	Core	60	40	100	0	0	2	2
MTMEPE207	Robotics Lab	Core	60	40	100	0	0	2	2
MTMEPE208	Mini Project with Seminar	Core	60	40	100	2	0	0	2
MTMEPE209	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**420**	**430**	**570**	**15**	**0**	**5**	**20**

Semester - III

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE301A	Automated material handling systems	Elective	50	100	150	3	0	0	3
MTMEPE301B	Supply chain practice & procedure	Elective	50	100	150	3	0	0	3
MTMEPE 302A	Business Analytics	Elective	50	100	150	3	0	0	3
MTMEPE 302B	Industrial Safety	Elective	50	100	150	3	0	0	3
MTMEPE 302C	Operations Research	Elective	50	100	150	3	0	0	3
MTMEPE 302D	Cost Management of Engineering Projects	Elective	50	100	150	3	0	0	3
MTMEPE 302E	Composite Materials	Elective	50	100	150	3	0	0	3
MTMEPE 302F	Waste to Energy	Elective	50	100	150	3	0	0	3
Practical/Viva Voce		**Type**	**IA**	**EA**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE303	Dissertation-I /Industrial Project	Core	60	40	100	0	0	10	10
MTMEPE304	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**210**	**290**	**500**	**7**	**0**	**11**	**18**

Semester - IV

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE401	Dissertation II	Core	300	400	700	-	-	16	16
MTMEPE402	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**350**	**450**	**800**	**1**	**-**	**17**	**18**

Note:

- A student is required to obtain min. 40% marks in individual paper & 50% in aggregate to pass.
- The total credit of M.Tech. (ME) Programme is 76. However, the minimum credit required for award of degree shall be 70.
- The credit relaxation will be applicable only on the elective course (i.e. the student can opt out only elective subject).
- Out of the total credits, 20% of the credits may be earned by the student through MOOCs (SWAYAM, NPTEL, Coursera etc.). However, the choice of online courses to be approved in advance by Dean/ HoD and Coordinator SWAYAM keeping in view the latest guidelines of the UGC/ respective regulatory body guidelines.

10. COURSE-WISE LEARNING OBJECTIVES, STRUCTURES AND OUTCOMES (CLOSOs)

Semester - I

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE101	Computer aided process planning	Core	50	100	150	3	0	0	3
MTMEPE102	Quality Management Systems	Core	50	100	150	3	0	0	3
MTMEPE103A	Ergonomics and Work System Design	Elective	50	100	150	3	0	0	3
MTMEPE103B	Energy Management	Elective	50	100	150	3	0	0	3
MTMEPE103C	Machine tool design	Elective	50	100	150	3	0	0	3
MTMEPE104A	Lean Manufacturing	Elective	50	100	150	3	0	0	3
MTMEPE104B	Product Engineering	Elective	50	100	150	3	0	0	3
MTMEPE104C	Mechatronics	Elective	50	100	150	3	0	0	3
MTMEPE 105	Research Methodology and IPR	Core	50	100	150	2	0	0	2
MTMEPE 106	Audit Course – **1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	0	0	0	2	0	0	0
Practical/Viva Voce		**Type**	**Internal Marks**	**External Marks**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE107	Ergonomics and Work System Design Lab	Core	60	40	100	0	0	2	2
MTMEPE108	Manufacturing Lab	Core	60	40	100	0	0	2	2
MTMEPE109	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**420**	**630**	**1050**	**18**	**0**	**5**	**20**

MTMEPE101: Computer aided process planning

Course Objective:

The general objectives of the course are to enable the students to

1. To learn the concepts of effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances.
2. Understand the various types of Structure of Automated process planning system.
3. Apply modern computational, analytical, tools and techniques to face the challenges in CAPP.
4. Design and develop CAPP systems using the knowledge of mathematics, science, engineering and IT tools.

Course Content:

Unit-I: **Introduction to CAPP:** Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

Unit-II: **Generative CAPP System:** Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

Unit-III: **Retrieval CAPP System:** Significance, group technology, structure, relative advantages, implementation, and applications.

Unit-IV: **Selection of Manufacturing Sequence:** Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

Unit-V: **Determination of Manufacturing Tolerances:** design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

Reference books:

1. Automation , Production systems and Computer Integrated Manufacturing System – Mikell P.Groover
2. Computer Aided Design and Manufacturing – Dr.Sadhu Singh.
3. Computer Aided Engineering – David Bedworth

Course Outcome:

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

CO1: Explain the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation

CO2: Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence

CO3: Explain the effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances

CO4: Explain the generation of tool path and solve optimization models of machining processes

CO5: Create awareness about the implementation techniques for CAPP

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

ourse Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**L**	**L**	**-**	**L**	**M**
CO2	**L1**	**H**	**H**	**M**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**M**	**M**	**M**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**L**	**M**	**L**	**M**	**-**	**M**	**-**	**M**	**L**	**L**
CO5	**L3**	**H**	**M**	**L**	**M**	**M**	**L**	**L**	**L**	**L**	**-**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO1, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE102: Quality Management Systems

Course Objective

1. Understand the principles of quality management and applied quality engineering methods.
2. Learn methods of statistical process control
3. Understand sampling problems and learn acceptance sampling plans methods.
4. To use Modern tool of quality checking in the industries.

Course Content:

Unit-I: **Review of Quality Control:** Quality assurance, Total Quality Management (TQM), Core concepts, Quality gurus and their contribution, Quality costs and measurement.

Unit-II: **Total Quality Control (TQC):** TQC concepts, Responsibility, Learning from the west, TQC concepts categorized, Goals, Process control, Easy to see quality control as facilitator, Small lot sizes, Housekeeping, daily machine checking, Full proof devices, Tools of analysis, QC circles, TQC in Japanese-owned US electronics plant, TQC in Japanese-owned automotive plants.

Unit-III: **Taguchi Methods:** Review of design of experiments, Process optimization and robust product design using orthogonal arrays, Taguchi loss functions quality level, Taguchi online feed back quality control, Manufacturing tolerance design course will include software applications and industry case studies.

Unit-IV: **Total Quality Management (TQM):** philosophy of TQM, Customer focus, Organization, Top management commitment, Teamwork, Goal setting and bench marking, TQM systems-Quality policy deployment, Quality function deployment, Standardization, Designing for quality, manufacturing for quality, implementation-KAIZEN, POKA YOKE, Six sigma etc

Unit-V: **Quality System and Standards:** ISO 9000 system QS 9000, ISO 14000- need, Advantages, Clauses, Implementation, Quality auditing, Case studies,

Reference Books :

1. Total Quality Control A.V. Feigenbaum McGraw Hill
2. Total Quality Management-A Practical Approach H. All Wiley eastern

Course Outcome:

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

CO1: Implement quality concepts in industrial environments and its management.

CO2: Develop control charts for variables and attributes.

CO3: Explain sampling plans using multiple and sequential sampling.

CO4: Use of Modern tools like implementation-KAIZEN, POKA YOKE, Six sigma etc

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L1**	**H**	**H**	**H**	**H**	**-**	**M**	**L**	**L**	**L**	**-**	**H**	**M**
CO2	**L2**	**H**	**H**	**-**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**M**	**H**	**M**	**M**	**M**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L3**	**H**	**M**	**M**	**H**	**M**	**M**	**-**	**M**	**-**	**M**	**H**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO3, CO4
CD4	Self- learning advice using internets	CO2, CO3, CO4
CD5	Industrial visit	CO1, CO4

MTMEPE103A: Ergonomics and Work System Design

Course Objective

The general objectives of the course are to enable the students to

1. To Describe the breadth of how ergonomics is used in today's society.
2. To Distinguish between the various standards organizations (i.e. CSA, ANSI, ISO, etc.)
3. To Design/development of solutions for Man Machine Systems, Man machine communication, design and arrangements of controls and displays.
4. To Apply the knowledge of science, engineering fundamentals
5. To analyze problems of Man machine communication, design and arrangements of controls and displays

Course Contents:

Unit-I: **Method Study:** Process Analysis, Process and Activity Charts, Operation Analysis, Basic procedure, Micro Motion Study, Principles of Motion Economy. Work Measurement: Purposes and uses, Basic procedure, Techniques

Unit-II: Procedures for work sampling study; Random, systematic, stratified and zone sampling techniques; Practical applications, Evaluation and improvements; Performance sampling.

Motion pattern used in MTM; MTM data and its installation.

Unit-III: **Ergonomics and Production:** Ergonomics and product design, ergonomics in automated systems; Expert systems for ergonomic design; Anthropometrics data and its applications in ergonomic design; Limitations of anthropometric data, Use of computerized database; Case study.

Unit-IV: **Man Machine Systems:** Human factors affecting work, energy requirements for men; Effects of noise, light, heat and humidity, Monotony and fatigue on operator performance Case studies, man machine system characteristics; system components and its reliability, Man machine communication, design and arrangements of controls and displays,

Unit-V: **Control and Displays:** Shapes and sizes of various controls and displays- Multiple displays and control situations; design of major controls in automobiles, machine tools. Visual Effects of Line and Colour: The mechanics of seeing; Psychology of seeing.

Reference Books:

1. Engineering Work Measurement Karger & Bayha Industrial Press
2. Work Sampling Barnes John Wiley
3. Methods Engineering Krick John Wiley
4. Human Factors Engineering Mc Cormic McGraw Hill
5. Ergonomics Murrel Chapman & Hall

Course Outcome

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

CO1: Describe the breadth of how ergonomics is used in today's society.

CO2: To understand distinguishes between the various standards organizations (i.e. CSA, ANSI, ISO, etc.)

CO3: Design/development of solutions for Man Machine Systems, Man machine communication, design and arrangements of controls and displays.

CO4: Apply the knowledge of science, engineering fundamentals

CO5: To analyze problems of Man machine communication, design and arrangements of controls and displays

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	**H**	**H**	**-**	**-**	**M**	**M**	**L**	**L**	**L**	**-**	**M**	**M**
CO2	**L2**	**H**	**H**	**-**	**-**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**M**	**L**	**L**	**L**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**M**	**L**	**L**	**L**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L3**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE103B: Energy Management

Course Objective

The general objectives of the course are to enable the students to

1. Understand the importance of Energy storage.
2. To learn the techniques of heat recovery systems.
3. Learn the methods of energy management and audits.
4. Able to play a role as an engineer in the society by understanding the economics and management
5. Problem analysis ofElectrical Load and Lighting Management

Course Content:

Unit-I: **Introduction:** Energy sources; Instrumentation and measurements. Principles of Energy Management and Energy Audit: General principles, planning and program; Introduction to energy audit; General methodology; Site surveys; Energy systems survey, energy audit; Instrumentation.

Unit-II: **Heating and Cooling Management:** General principles of energy managements in HVAC systems; Human comforts and health requirements; HVAC systems; Boiler and heat sources; Chillers, fans, pumps, cooling towers, Energy management opportunities; Modeling of heating and cooling loads in buildings.

Unit-III: **Electrical Load and Lighting Management:** General principles; Illumination and human comfort; Lighting systems; Electrical load analysis; Peak load controls. Steam generation and distribution, Hot water and pumping, Compressed air; Energy storage for process industries.

Unit-IV: **Integrated Building systems:** General principles; Environment conformation; Passive design considerations; Building envelope design consideration, Integration of building system, Energy storage-cold storage techniques, Economic analysis.

Unit-V: **Economic Aspects of Energy Management:** General considerations; Economic analysis methods; Life-cycle costing, Break even analysis, benefit cost analysis, payback period analysis, present worth analysis, equivalent annual cost analysis.

Reference Books:

1. Rural Energy Management S Kaushik, T Verma ,Deep and Deep Publs.
2. Energy Management W R Murphy; G Mckay, B.S. Publications
3. Renewable Energy and Energy Management S C Patra; B C Kurse; R Kataki, International Book Co.
4. Operations and Maintenance Manual for Energy Management J Piper, Standard

Course Outcome

Successfully completing this course, students will be able to:

CO1: Understand the importance of Energy storage for process industries.

CO2: Learn the techniques of heat recovery systems.

CO3: Learn the methods of energy management and audits.

CO4: Able to play a role as an engineer in the society by understanding the economics

CO5: Problem analysis of Electrical Load and Lighting Management

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Leve	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**L**	**M**	**M**	**L**	**L**	**L**	**-**	**M**	**M**
CO2	**L1**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L1**	**H**	**M**	**M**	**L**	**L**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L3**	**H**	**M**	**L**	**L**	**L**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE103C: Machine tool design

Course Objective

1. To learn the concepts of machining.
2. To understand the various types of Guide-ways and power Screws.
3. Know about tool life, MRR, Cutting forces and surface finish in different machining process.
4. Understand the concept of Design of Machine Tool Structure.
5. Realize the importance of Dynamic characteristics of cutting process**.**

Course Content:

Unit-I: **Machine Tool Drive:** working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

Unit-II: **Regulation of Speed and Feed Rates:** Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Unit-III: **Design of Machine Tool Structure:** Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Unit-IV: **Design of Guide-ways and power Screws:** Function and type of guide-ways, design of slide-ways, Protecting devices for slide-ways, Design of power screws. Design of Spindles and Spindle Supports**:** Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Unit-V: **Dynamics of Machines Tools:** General procedure of assessing dynamic stability of EES, Cutting processing, Closed loop system, Dynamic characteristics of cutting process, Stability analysis.

Reference books:

1. Machine Tool Design N.K. Mehta Tata McGraw Hill
2. Machine Tool design Handbook - CMTI Banglore

Course Outcome

CO1: Classify the different types of guide ways and power screws.

CO2: Explain principles and process of Forging, Rolling, Extrusion, drawing and designing of die

CO3: Analyse the tool life, MRR, Cutting forces and surface finish

CO4: Apply the knowledge of science in fundamentals of machine tool structures and their requirements and material

CO5: Understand the modern technique of Dynamics of Machines Tools

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	**M**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**-**	**L**	**M**
CO2	**L2**	**M**	**H**	**H**	**L**	**-**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L3**	**M**	**H**	**L**	**M**	**-**	**-**	**-**	**M**	**-**	**L**	**M**	**L**
CO4	**L3**	**H**	**M**	**L**	**L**	**L**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO4, CO5
CD3	Seminars	CO3, CO4, CO2
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE104A: Lean Manufacturing

Course Objectives

1. To understand lean management principles & provides an understanding of factors that contribute to organizational wastes, examining ways to eliminate wastes, & developing & implementing an improved organizational processes, for significant impact on society.
2. To understand how lean management today represents a profound change in the competitive business culture and a leading indicator of excellence in the organization.
3. To understand how lean management principles is developed from Toyota Production System (TPS)
4. Developing an understanding of basic principles of Shortening Of Production Lead Times.
5. To understand how by implementing lean management organizations can improve product & processes without adding any more money, people, equipment, inventory or space and aim for perfection.

Course Content:

Unit-I: **Just In Time Production System:** JIT Logic -Pull system, Japanese approach to production elimination of waste, JIT implementation requirements, JIT application for job shops

Unit-II: **Kanban System:** Kanban rules supplier Kanban and sequence schedule used by supplier, Monthly information & daily information, Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table -problems & counter measures in applying Kanban system to subcontractors - Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office.

Unit-III: **The Rise & Fall of Mass Production:** Mass production, work force, organization, tools, product –logical limits of mass production, Sloan as a necessary compliment to Ford

Unit-IV: **The Rise of Lean Production:** Birthplace, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production.

Unit-V: **Shortening Of Production Lead Times:** Reduction of setup times, practical procedures for reducing setup time. Standardization of operations, Machine layout, multi function workers and job rotation, Improvement activities to reduce work force and increase worker morale, foundation for improvements.

Reference Books:

1. Chasel Aquilino, “Productions and Operations Management”

2. Yasuhiro Monden, “Toyoto Production System -An integrated approach to Just in Time”,Engineering and Management Press, Institute of Industrial Engineers, Norcross Georgia.

3. James P Womack, Daniel T Jones, and Daniel Roos, “The Machine that changed the World. The Story of Lean Production”,

Course Outcomes

On completion of this course, the students will be able to

CO1: To understand issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution for improving organizational performance.

CO2: Apply lean techniques to bring competitive business culture for improving organization performance.

CO3: Analyze how Just In Time Production System techniques can be applied to manufacturing & service industry.

CO4: To develop lean management strategy for changing customer demand, dealing with the customer, future of lean production.

CO5: To apply ethical principles by analyzing how lean technique can increase worker morale, foundation for improvements.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**L**	**L**	**-**	**M**	**M**
CO2	**L1**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**
CO3	**L2**	**H**	**H**	**H**	**M**	**M**	**M**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**H**	**M**	**M**	**M**	**-**	**M**	**-**	**M**	**M**	**L**
CO5	**L1**	**H**	**H**	**H**	**M**	**M**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE104B: Product Engineering

Course Objective

1. To introduce the objectives of product design and the requirements of a good product design.

2. To expose the students to different design principles like designing for function, production, installation and handling, maintenance, packaging etc.

3. To expose them to the latest Materials Handling for **long life** achievements.

Course Content:

Unit-I: **Product Design Process:** Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees.

Unit-II: **Materials Selection:** Problem of Materials Selection, Performance Characteristics of Materials, Materials Selection Process, Sources of Information on Materials, Economics of Materials, Evaluation Methods for Materials Selection, Cost versus Performance Relations, Weighted Property Index, Cost Comparison, Value Analysis, Materials Systems, Materials Substitution

Unit-III: **Interaction of Materials, Processing, and Design:** Role of Processing in Design, Classification of Manufacturing Processes, Economics of Manufacturing, Design for Castings, Forgings, Sheet-Metal Forming, Machining, Powder Metallurgy, Welding. Residual Stresses in Design, Design for Heat Treatment, Design for Assembly.

Unit-IV: **Transport Documentation** and Transport Functionality – Bill of Lading, Freight Bill, Shipping Manifest. Responsibilities of Traffic Department. Product Movement, Product Storage, Participants in Transportation Decision – Shippers, Carriers, Government, Public.

Unit-V: **Materials Handling, Packaging and Warehouse Functionality:** Fork Lift Trucks, Pallet Trucks, Tow Tractor, Conveyors, Carousels. Automated & Semi Automated Handling Procedure. Consumer Packaging, Industrial Packaging, Importance of Packaging, Function of Packaging. Warehouse Operating Principles, Classification – (1) Private, (2) Public, (3) Contract Warehouse, Planning the distribution warehouse.

Reference Books :

1 Engineering Design , George E. Dieter, McGRAW-HILL

2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag

3. The Product Management Handbook, Richard S. Handscombe, McGRAW-HILL

Course Outcome

The student will be able to

CO1: Apply the principles of product design to modify existing engineering systems or to develop new artifacts.

CO2: Design a system taking into consideration the concepts of ease of production, maintenance, handling, installation etc.

CO3: Translate the concepts of economics in design, optimization of design and human factors approach to product design.

CO4: Able to recognize the long life learning experience by Materials Handling, Packaging and Warehouse Functionality

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**L**	**L**	**M**	**M**	**M**
CO2	**L4**	**H**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**
CO3	**L2**	**M**	**H**	**L**	**M**	**M**	**-**	**M**	**M**	**-**	**L**	**M**	**L**
CO4	**L1**	**M**	**H**	**L**	**L**	**H**	**M**	**-**	**M**	**-**	**M**	**M**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO3, CO4
CD4	Self- learning advice using internets	CO2, CO3, CO4
CD5	Industrial visit	CO1, CO3, CO4

MTMEPE104C: Mechatronics

Course Objective

1.To learn about various sensors and microcontrollers.

2.To be able to build automated solutions using advance techniques.

3.To use Architecture of intelligent machines.

4.To understand the application of sensors in manufacturing system.

Course Content:

Unit-I: **Introduction:** Definition of Mechatronics products, design considerations and trade offs. Overview of Mechtronic products. Intelligent machine Vs Automatic machine economic and social justification.

Unit-II: **Actuators and drive systems:** Mechanical, Electrical, hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

Unit-III: **Architecture of Intelligent Machines:** Introduction to Microprocessor and Microcontrollers. Programmable logic controls and identification of systems. System design classification, motion control aspects in design.

Unit-IV: **Machine Vision:** Feature and pattern recognition methods, concepts of perception and cognition in decision-making.

Unit-V: **Sensor interfacing and Machine Vision:** Analog and digital sensors for motion measurement, digital transducers, human-Machine and machine- Machine inter facing devices and strategy.

Reference Books :

1 Kuo. B.C. D.C. Motors and Control systems; S.R.I., Publishing Co., 1979

2 Kuo. B.C. Step Motors and Control systems; S.R.I., Publishing Co., 1979

3 C.W. De Silva, Mechatronics: An Integrated Approach by Publisher: CRC;

Course Outcome

CO1: Select and use appropriate Transducers & Sensors for automated solutions.

CO2: They should be able to design and implements digital logics using various gates.

CO3: Program and implement solutions using various Microcontrollers and Microprocessor

CO4: Program and automated solutions using PLC.

CO5: Use of modern tool with engineering knowledge in Analog and digital sensors for motion measurement.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L1**	**H**	**M**	**H**	**M**	**L**	**M**	**L**	**L**	**L**	**L**	**M**	**M**
CO2	**L2**	**H**	**M**	**H**	**H**	**M**	**L**	**L**	**L**	**L**	**-**	**M**	**M**
CO3	**L3**	**H**	**M**	**M**	**L**	**M**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**H**	**M**	**L**	**M**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L3**	**H**	**H**	**L**	**H**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE105: Research Methodology and IPR

Course Objective:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology,
5. but tomorrow world will be ruled by ideas, concept, and creativity.
6. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
7. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Content:

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

Unit-II: Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit-III: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

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

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

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcome

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today's world is controlled by Computer, Modern Mathematical Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	**M**	**M**	**H**	**H**	**L**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**L2**	**M**	**M**	**H**	**H**	**L**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**M**	**L**	**M**	**M**	**M**	**L**	**L**	**M**	**L**	**L**	**L**
CO4	**L2,L3**	**L**	**M**	**L**	**L**	**M**	**M**	**M**	**L**	**L**	**L**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO3, CO4
CD4	Self- learning advice using internets	CO2, CO3, CO4
CD5	Industrial visit	CO1, CO3, CO4

MTMEPE107: ERGONOMICS AND WORK SYSTEM DESIGN LAB

Course Objective:

This laboratory aims to carry out education, research, and community service in order to produce an effective, safe, healthy and efficient work system that can improve human work productivity. This effective, safe, healthy and efficient work system is formed from the design of a good work system in the sense of fulfilling the ergonomic aspects of the existing work environment

LIST OF EXPERIMENTS:

1. To study the activities of the machine and the operator by micro motion technique
2. To prepare the layout of shop floor and working areas or work stations by method study
3. To study how principles of motion economy work to minimizing the physical and perceptual loads imposed on people engaged in any type of work.
4. To study how work performance and machine utilization by direct observation takes place by work sampling
5. To study the various work sampling practical applications
6. To study how to optimize the integration of man and machine so as to improve the work rate and accuracy
7. To study various ergonomics aspects in automated systems
8. To study how the various human factors affecting work
9. To study how the noise, light, heat and humidity affect the human performance
10. To study shapes and sizes of various controls and displays in any work station for better performance

COURSE OUTCOMES :

CO1: Develop a case for productivity improvement in any manufacturing or service industry scenario

CO2: Independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place

CO3: Develop time standards for operations, identify production bottlenecks and improvise operations

CO4: Apply principles of good ergonomic design of work areas and equipment

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L5	H	H	M	H	L	**M**	**M**	**L**	**-**	**-**	**L**	**L**
CO2	L4	H	H	H	H	M	**M**	**M**	**L**	**L**	**-**	**L**	**M**
CO3	L2	L	M	M	L	M	**M**	**L**	**M**	**-**	**-**	**L**	**M**
CO4	L1	M	M	L	L	H	**M**	**M**	**M**	**L**	**L**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE108: Manufacturing Lab

Course Objective:

Impart knowledge to students in the latest technological topics on Production and Industrial Engineering and to provide them with opportunities in taking up advanced topics in the field of study.

LIST OF EXPERIMENTS:

1. To Study the Various Machining practice and parametric analyses on USM.
2. To Study the Various Machining practice and parametric analyses on EDM.
4. To Study the Various Machining practice and parametric analyses on ECM.
5. To Study the Various Machining practice and parametric analyses on AJM.
6. To Study the Various Measurement of forces, surface roughness and temperature in case of milling and grinding operations.

COURSE OUTCOMES :

CO1: Develop a case for productivity improvement in any manufacturing or service industry scenario by usm.

CO2: Independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place by ecm

CO3: Develop time standards for operations, identify production bottlenecks and improvise operations

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	H	M	H	L	**M**	**L**	**L**	**L**	**-**	**L**	**L**
CO2	L2,L3	H	H	H	H	M	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	L2	L	M	M	-	L	**-**	**-**	**M**	**-**	**L**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE 109: ANANDAM

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be expected to engage in individual and group acts of service and goodness.

Action Plan:

Students will be expected to

- Do at least one act of individual service each day
- Record this act of service in a dedicated Register / Personal Diary
- Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
- Undertake one group service project for 64 hours every semester (outside college hours)
- Upload the report on the group project on the Anandam platform
- Participate in a sharing and presentation on the group service in the discussion sessions held once in week
- There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester – II

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE201	Enterprise Resource Planning	Core	50	100	150	3	0	0	3
MTMEPE202	CNC Technology & Programming	Core	50	100	150	3	0	0	3
MTMEPE203A	Reliability, Maintenance Management & Safety	Elective	50	100	150	3	0	0	3
MTMEPE203B	Cryogenic Systems	Elective	50	100	150	3	0	0	3
MTMEPE203C	Inventory management	Elective	50	100	150	3	0	0	3
MTMEPE204A	Cellular manufacturing systems	Elective	50	100	150	3	0	0	3
MTMEPE204B	Concurrent Engineering	Elective	50	100	150	3	0	0	3
MTMEPE204C	Robotics	Elective	50	100	150	3	0	0	3
MTMEPE 205	Audit Course – **2** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	AECC	0	0	0	2	0	0	0
Practical/Viva Voce		**Type**	**Internal Marks**	**External Marks**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE206	CNC Technology Lab	Core	60	40	100	0	0	2	2
MTMEPE207	Robotics Lab	Core	60	40	100	0	0	2	2
MTMEPE208	Mini Project with Seminar	Core	60	40	100	2	0	0	2
MTMEPE209	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**420**	**430**	**570**	**15**	**0**	**5**	**20**

MTMEPE201: Enterprise Resource Planning

Course Objective

1. To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning Technology.

2. To focus on a strong emphasis upon practice of theory in Applications and Practicaloriented approach.

3. To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth.

4. To aim at preparing the students technological competitive and make them ready to self-upgrade with the higher technical skills.

Course Content

Unit-I: **Introduction to ERP:** Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages /disadvantages of ERP, Evaluation of ERP, Various Modules in ERP

Unit-II: **Modules in ERP:** Finance and Controlling, Sales and Distribution, Materials Management, Production Planning and Control, Quality Management, Planet Maintenance, Human Resource

Unit-III: **Business Processes:** Order To Cash, Procure To Pay, Plan To Produce, Make To Stock, Make To Order and Assemble To Order, Difference in Discrete and Process industries

Unit-IV: **Manufacturing Process Knowledge:** Auto Industry, Hi Tech, FMCG, Pharma and Chemical.

Unit-V: **ERP Projects:** Project types, Implementation methodology, Various steps in the project Implementation, Project Preparation, Business Blueprinting, As Is – To Be Study, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training, Issues during implementation

Reference Books:

1. Alexis Leon, Enterprise Resource Planning
2. V.K. Garg & N.K. Venkitakrishnan, ERP Ware: ERP Implementation framework
3. V.K. Garg & N.K. Venkitakrishnan, ERP Concepts and Planning
4. APIC's material on ERP

Course Outcome

After completing this course, student will be able to

CO1: Make basic use of Enterprise software, and its role in integrating business functions

CO2: Analyze the strategic options for ERP identification and adoption.

CO3: Design the ERP implementation strategies.

CO4: Create reengineered business processes for successful ERP implementation.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L1**	**H**	**H**	**H**	**M**	**L**	**M**	**L**	**L**	**L**	**-**	**L**	**M**
CO2	**L3**	**H**	**H**	**M**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L4**	**H**	**M**	**L**	**L**	**M**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**M**	**L**	**L**	**H**	**M**	**M**	**-**	**M**	**L**	**M**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO2, CO3, CO4
CD5	Industrial visit	CO1, CO4

MTMEPE202: CNC Technology & Programming

Course Objective

1 To learn the concepts and principles of Computer aided Manufacturing (CAM).

2 To understand the various types of CAM Software's like Fanuc, Siemen's, etc. and their practical usage in manufacturing applications.

3 Understand concepts of machining for selection of appropriate machining parameters, and cutting tools for CNC milling and turning jobs.

4 Develop industrial components by interpreting 3D part models/ part drawings.

5 Understand the concepts of CAM Software, CNC technology, to convert a CNC-lathe into a CNC-Milling machine and vice-versa

Course Content:

Unit-I: **Introduction to CNC Machine tools:** Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.

Unit-II: **Feedback devices:** Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.

Unit-III: **APT programming:** APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.

Unit-IV: **Economics and Maintenance of CNC machine tools:** Introduction, factors influencing selection of CNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines, Preventive maintenance, Documentation, Spare parts, Training in Maintenance.

Unit-V: **Control Systems and interface:** Open and closed loop systems, Micro processor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

Reference Books:

1. Computer Numerical Control Machines – Dr.Radha Krishnanan, New Central Book Agency
2. Computer Numerical Control Machines – Hans B.Keif and T. Frederick Waters Macmillan/McGraw Hill
3. CNC Machines – B.S. Aditahn and Pabla
4. CNC Machining technology– Verlag , – Springer
5 Computer Numerical Machine tools - G.E. Thyer, NEWNES

Course Outcome

CO1: Apply the concepts of machining for selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.

CO2: Create and validate NC part program data using manual data input (MDI) for manufacturing of required component using CNC milling or turning applications Through CAM Software's like Fanuc, Siemen's, Unimat etc.

CO3: Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.

CO4: Apply the concepts of CNC technology to convert a CNC-lathe into a CNC-Milling machine and vice-versa and also to carry out machining using programmed part programs.

CO5: Develop prototype models by interpreting 3D part model/ part drawings

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**M**	**M**	**-**	**L**	**-**	**L**	**L**
CO2	**L2**	**H**	**M**	**H**	**M**	**L**	**L**	**L**	**L**	**M**	**L**	**L**
CO3	**L1**	**H**	**M**	**M**	**M**	**-**	**-**	**-**	**M**	**L**	**M**	**L**
CO4	**L2**	**H**	**L**	**M**	**L**	**M**	**M**	**M**	**M**	**-**	**M**	**M**
CO5	**L1**	**M**	**L**	**M**	**L**	**H**	**L**	**L**	**-**	**L**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE203A: Reliability, Maintenance Management & Safety

Course Objective

1. To learn the essentiality of reliability engineering, reliability prediction
2. To apply the knowledge of implementation of total productive maintenance
3. Students to understand the Safety Aspects in industry.
4. Understand the complex problems of Maintenance Planning and Replacement

Course Content:

Unit-I: **Reliability Engineering:** System reliability - series, parallel and mixed configuration, Block diagram, Solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability.

Unit-II: **Maintainability, Availability & Failure Analysis:** Maintainability & Availability – Introduction, formulae, Techniques available to improve maintainability & availability, Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

Unit-III: **Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Fixed time maintenance, Total productive maintenance.

Unit-IV: **Condition Monitoring:** Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies.

Unit-V: **Safety Aspects:** Importance of safety, Factors affecting safety, Safety aspects of site and plant, Hazards of coMTMErcial chemical reaction and operation, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.

Reference Books:

1. Concepts in Reliability Engineering L.S. Srinath, Affiliated East West Press
2. Maintainability and Reliability Handbook Editors: Ireson W.A. and C.F. Coombs, McGraw Hill Inc.
3. Failure Diagnosis and Performance Monitoring L.F. Pau, Marcel Dekker
4. Industrial Maintenance Management S.K. Srivastava, S. Chand & Co Ltd.

Course Outcome

CO1: Problem solving and decision making (analysis and synthesis, analytical and system thinking, intuition, judgment, result interpretation).

CO2: Advanced technical competence (engineering science, modeling, simulation, testing, correlation, validation, result interpretation).

CO3: Explain Professional, legal and ethical standards (safety, environmental, quality).

CO4: Assess your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system.

CO5: Empower students with the skills to manage a manufacturing system to achieve continuous system availability for production

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	**L2**	**H**	**H**	**H**	**H**	**M**	**M**	**-**	**L**	**-**	**L**	**L**
CO2	**L2**	**H**	**M**	**H**	**M**	**L**	**L**	**L**	**L**	**M**	**L**	**L**
CO3	**L1**	**H**	**M**	**M**	**M**	**-**	**-**	**-**	**M**	**L**	**M**	**L**
CO4	**L2**	**H**	**L**	**M**	**L**	**M**	**M**	**M**	**M**	**-**	**M**	**M**
CO5	**L1**	**M**	**L**	**M**	**L**	**H**	**L**	**L**	**-**	**L**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars	CO1, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE203B: Cryogenic Systems

Course Objective

1. To understand the basic concepts of temperature and it application in practical uses.
2. To design and analyze the critical component of refrigeration system.
3. To study different types of refrigerators
4. To apply latest techniques in refrigeration systems
5. To understand practical applicability of the refrigeration systems

Course Content:

Unit-I: **Introduction & Low Temperature properties of Engineering Materials:** Historical background, Present area involving cryogenics, Mechanical properties; Thermal properties; Electrical and Magnetic properties; properties of Cryogenic fluids.

Unit-II: **Gas Liquefaction System:** Joule Thompson effect; Adiabatic expansion; Simple Linde-Hampson, Precooled Linde- Hampson system; Liquid dual pressure system; Cascaded system; Claude system, Kapitza system, Collins helium liquefaction system.

Unit-III: **Critical Component of Liquefaction System:** Effect of heat exchanger; Effectiveness of system performance, Effect of compressor and expander efficiency on system performance; effect of heat transfer to the system.

Unit-IV: **Cryogenic Refrigeration System:** Phillips refrigerator, Importance refrigerator, effectiveness for Phillips refrigerator, Gifford-McMahan refrigerator. Measurement System of Low Temperature: Temperature measurement, Flow rate measurement, Liquid level measurement.

Unit-V: **Cryogenic Storage & Transfer System:** Cryogenic fluid storage vessels, Insulation, Cryogenic transfer system. Vacuum Technology: Importance of Vacuum technology in cryogenics, Calculation of pump down time for a vacuum system, Components of vacuum systems, Mechanical vacuum pumps, Vacuum gauges & valves.

Reference Books:

1. Cryogenic Systems Barron Randall F Oxford University
2. A Text Book of Cryogenics Valery V Kostiouk Discovery Publishing House
3. Cryogenic Technology and Applications A R Jha -
4. Thermodynamic Properties of Cryogenic Fluids R T Jacobsen Plenum Publishing Corpn.

Course Outcome

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

CO1: To understand and apply the concept of the Mechanical properties; Thermal properties; Electrical and Magnetic properties; properties of Cryogenic fluids in cryogenic process.

CO2: To study Liquid dual pressure system; Cascaded system; Claude system, Kapitza system, Collins helium liquefaction system etc.

CO3: To apply latest techniques in cryogenic like Measurement System of Low Temperature: Temperature measurement, Flow rate measurement, Liquid level measurement.

CO4: To design and apply the Effect of heat exchanger; Effectiveness of system performance.

CO5: To understand practical applicability in Cryogenic Storage & Transfer System: Cryogenic fluid storage vessels, Insulation, Cryogenic transfer system. Vacuum Technology.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**	**L**	**-**	**L**	**M**
CO2	**L1**	**H**	**H**	**H**	**L**	**H**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L3**	**H**	**H**	**H**	**M**	**LM**	**-**	**M**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**M**	**M**	**H**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE203C: Inventory management

Course Objective

1. To introduce the objectives of inventory system for cost saving.
2. To expose the students to different Inventory Control Model.
3. To expose them to understand Inventory Control Process.
4. To enhance the capability to analyze Multi echelon Inventory Model

Course Content:

Unit-I: Definition, Importance, Function, Classification of Inventory, Inventory related Cost, Objectives of Inventory Control, Planning for Inventory Control, Types of Inventory Situations .

Unit-II: Selective Inventory Control Model- ABC Analysis, VED, XYZ, FSN, SOS, GOLF, EOQ Model, P & Q System, Concept of JIT.

Unit-III: Inventory Control Process – Perpetual Review, Periodic Review, Modified Control,Distribution Requirement Planning (DRP), Process of DRP, Benefits & limitation of DRP.

Unit-IV: Classification of W.I.P Inventories, Factors influencing, W.I.P inventory, Problems,Controlling Method.

Unit-V: Factors influencing Finished Goods inventory, Requirement of inventory control Systems, Multi echelon Inventory Model, Use of Information Technology in Inventory Management.

Reference books:

1. Inventory Management – K. Shridhara Bhat, Himalaya Publishing House
2. Logistical Management-The integrated Supply Chain Process –Donald. J. Bowersox & Donald. J. Claoss, TATA Mc-Graw Hill
3. Inventory Management – L.C. Jhamb, Himalaya Publishing House

Course Outcome

The student will be able to

CO1: Apply the principles of inventory system for cost saving.

CO2: Design a system taking into consideration the most suitable inventory control model.

CO3: Apply experimental technique of Modified Control, Distribution Requirement Planning (DRP) in inventory system.

CO4: Able to recognize the long life learning experience by Requirement of inventory control Systems.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**M**	**M**	**M**	**M**	**M**	**L**	**L**	**L**	**-**	**L**	**L**
CO2	**L4**	**H**	**M**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**M**	**L**	**L**	**M**	**-**	**-**	**M**	**-**	**L**	**M**	**M**
CO4	**L2**	**H**	**M**	**L**	**L**	**M**	**M**	**-**	**M**	**-**	**M**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO3, CO4
CD4	Self- learning advice using internets	CO2, CO3, CO4
CD5	Industrial visit	CO1, CO4

MTMEPE204A: Cellular manufacturing systems

Course Objective

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

1. Concepts and applications of Cellular manufacturing systems
2. Traditional and non-traditional approaches of Problem solving
3. Performance measurement
4. Human and economical aspects of CMS.

Course Content:

Unit-I: **Cellular manufacturing:** Introduction, Group machining Concept, Principle, Terminology, characteristics, Perspectives, Objectives, Techniques, Applications, Factors to be considered for implementation, factors influencing the success of cellular manufacturing.

Unit-II: **Cell formation techniques:** Design and Manufacturing Attributes, Cell Design and Representation of the Problem. Cell Formation Techniques – Traditional methods, Similarity coefficient methods, Array based methods. Cell Design Considerations, Data Structure and Influence on the Solution.

Unit-III: **Processing the Exceptional Components:** Introduction, Processing Exceptional Components, Models for Eliminating Exceptional Components.

Unit-IV: **Evaluation of Cellular Manufacturing Solutions:** Introduction, Static Evaluation of Cells, Measure of flexibility (MF), Selection of Solution, VEDO Analysis, Comparison of Different Methods.

Unit-V: **Line Balancing in Cellular manufacturing:** Line balancing for cells, Design Factor in Line Balancing, Bowl Phenomena in Cellular Manufacturing environment, effect on production rates.

Reference books:

1. B S Nagendra Parashar, “Cellular Manufacturing systems” PHI Learning Pvt Ltd, 2009
2. Andrew Kusaik, “Intelligent Manufacturing System”
3. MP Groover, “Automation, Production Systems, CIM”
4. Irani SA, “Cellular Manufacturing systems”
5. Kamrani AK, Parsaei HR and Liles DH, “Planning, Design and Analysis of Cellular Manufacturing systems”

Course Outcome

After successful completion of Cellular manufacturing systems course, the student will beable to

CO 1: Understand the effect of manufacturing automation strategies and derive production metrics and Develop manual and APT part programs for 2D complex profiles and test the programs through simulation.

CO 2: Analyze automated flow lines and assembly systems, and balance the line.

CO 3: Design automated material handling and storage systems for a typical production system.

CO 4: Design a manufacturing cell and cellular manufacturing system and Develop VEDO Analysis, Comparison of Different Methods.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	**H**	**M**	**M**	**L**	**M**	**L**	**L**	**-**	**L**	**M**	**L**	**L**
CO2	**L3**	**H**	**M**	**M**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**
CO3	**L2**	**H**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**-**	**L**	**L**	**L**
CO4	**L2**	**H**	**M**	**M**	**M**	**M**	**-**	**-**	**M**	**-**	**M**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE204B: Concurrent Engineering

Course Objective

The general objectives of the course are to enable the students to

1. Understand integrated product development, concurrent engineering and product models.
2. Learn general and computational architecture of concurrent engineering environment.
3. Learn design for manufacturing & assembly and developmment of intelligent information system.
4. To be able to use of Information Technology

Course Content:

Unit-I: **Introduction:** Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development.

Unit-II: **Use of Information Technology:** IT support, Solid modeling, Product data management, Collaborative product coMTMErce, Artificial Intelligence, expert systems, Software hardware component design.

Unit-III: **Design Stage:** Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, Automated analysis Idealization control, CE in optimal structural design, Real time constraints.

Unit-IV: **Need for PLM:** Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers, Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize.

Unit-V: **Components of PLM:** Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards.

Reference Books:

1. Integrated Product Development M.M. Anderson and L Hein, IFS Publications
2. Design for Concurrent Engineering J. Cleetus CE Research Centre, Morgantown
3. Concurrent Engineering Fundamentals: Integrated Product Developmen Prasad, Prentice hall India
4. Concurrent Engineering in Product Design and Development Moustapha, New Age International.

Course Outcome

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

CO1: Develop computational architecture for concurrent engineering development architecture.

CO2: Design database for integrated manufacturing and develop knowledge base for product and process.

CO3: To apply the knowledge and use of Components of PLM

CO4: To understand the Importance of PLM

CO5: To understand and apply the knowledge of recent techniques like RP (Rapid prototyping), TD (Total design)

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**M**	**H**	**M**	**H**	**L**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**L4**	**M**	**H**	**M**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**M**	**M**
CO3	**L3**	**M**	**L**	**L**	**L**	**L**	**M**	**-**	**M**	**-**	**-**	**L**	**L**
CO4	**L2**	**M**	**M**	**L**	**L**	**M**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**M**	**H**	**L**	**M**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE204C: Robotics

Course Objective

1. Toclassify the robots and robotic arm.
2. To know the application of various sensors.
3. To design and compute kinematics of robotics.
4. To make computer program used in robotics.

Course Content:

Unit-I: **Fundamentals of Robots:** Introduction, definition of robot, classification of robots, History of robotics, robot components, degree of freedom, robot joints, robot coordinates, reference frames, programming modes, robot characteristics, robot work space, robot languages, advantages, disadvantages and applications of robots.

Unit-II: **Dynamic analysis and forces:** Introduction, Lagrangian mechanics, Effective moments of inertia, dynamic equations for multi-degree of freedom robots-kinetic energy, potential energy, the Lagrangian, robot's equations of motion, static force analysis of robots.

Unit-III: **Trajectory planning:** Introduction, path Vs trajectory, basics of trajectory planning, joint space trajectory planning-third order polynomial trajectory planning, fifth order polynomial trajectory planning, Cartesian-space trajectories.

Unit-IV: **Robot Actuators:** Introduction, characteristic of Actuating systems-weight, power to weight ratio, operating pressure, stiffness Vs compliance,comparision of actuating systems, hydraulic devices, pneumatic devices, servomotors, stepped motors.

Unit-V: **Robot sensors:** Introduction, sensor characteristics, LVDT, Velocity sensors-Encoders, Tachometers, Accelerating sensors, strain gauges, Torque sensors, light and infrared sensors, touch and tactile sensors, optical proximity sensors, Ultrasonic proximity sensors.

Reference books:

1. Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI Publications
2. Industrial Robotics – Mikell P. Groover & Mitchell Weiss, Roger N. Nagel,Nicholas G.Odrey – Mc Graw Hill, 1986

Course Outcome

After successful completion of Robotics course, the student will be able to

CO 1: Classify robots based on joints and arm configurations and Design application specific end effectors for robots.

CO 2: Understand the application of various sensors for direct contact and non-contact Measurements and Understand many modern devices and technologies used in sensors.

CO 3: Compute forward and inverse kinematics of robots and determine trajectory plan apply the knowledge in Robot anatomy, end effectors, sensors, vision systems, and kinematics

CO 4: Program robot to perform typical tasks including Pick and Place, Stacking and Welding.

CO 5: Design and select robots for Industrial and Non-Industrial applications.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**M**	**M**	**L**	**M**	**L**	**L**	**L**	**-**	**M**	**M**
CO2	**L2**	**H**	**M**	**M**	**M**	**-**	**L**	**L**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**M**	**L**	**M**	**L**	**M**	**-**	**M**	**-**	**L**	**L**	**L**
CO4	**L1**	**H**	**L**	**L**	**M**	**L**	**M**	**-**	**M**	**-**	**M**	**M**	**M**
CO5	**L3**	**H**	**L**	**L**	**M**	**L**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

CNC Technology Lab (MTMEPE206)

Course Objective:

The student is introduced to CNC programming fundamentals such as: Measurement Fundamentals; Basic Principles of CNC Machining; Programming Systems; Programming Words; the Programming Process; Machines Using CNC; and the Advantages of CNC.

List of experiments:

1. Study of different feedback devices used in cnc systems.
2. Study of nc, cnc & dnc hardware systems
3. Study of apt programming language structure.
4. Write an apt program for lathe machine operation.
5. Write an apt program for milling operation.
6. Study of vertical machining center.
7. Study of horizontal machining center.

Course Outcome

CO1: Read the given orthographic views; i.e. visualize the 3- Dimensional model of the object shown to its orthographic views and create its CAD model.

CO2: Describe the various manufacturing processes for material removal and understand the appropriate technology for each of the cutting processes

CO3: Compare and distinguish the difference between the operation and programming of a CNC machine tool using manual programming and the operation and programming of CNC machine tool using CAM systems.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**H**	**H**	**M**	**M**	**-**	**M**	**M**	**L**	**L**	**L**	**M**	**M**
CO2	**L1**	**H**	**L**	**H**	**H**	**M**	**L**	**M**	**L**	**L**	**L**	**M**	**M**
CO3	**L2**	**H**	**M**	**L**	**M**	**L**	**M**	**L**	**M**	**M**	**L**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE207:Robotics Lab

Course Objective:

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

List of experiments:

1. To study the various parts of robots and fields of robotics.
2. To study the various kinematics and inverse kinematics of robots.
3. To study the Euler, Lagrangian formulation of Robot dynamics.
4. To study the trajectory planning for robot.
5. To study the control of robots for some specific applications.
6. To study the different type of motors used in robot .
7. To study the Velocity sensors-Encoders for robot

Course Outcome

CO1: Identify a Robot for a specific application.
CO2: Interface various Servo and hardware components with Controller based projects.
CO3: Develop small automatic / autotronics applications with the help of Ro
CO4: Test the robotics circuit.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L1**	**H**	**H**	**M**	**M**	**-**	**M**	**L**	**L**	**L**	**-**	**M**	**L**
CO2	**L2**	**H**	**L**	**H**	**H**	**M**	**L**	**L**	**L**	**L**	**L**	**M**	**L**
CO3	**L4**	**H**	**M**	**L**	**M**	**L**	**-**	**-**	**M**	**-**	**L**	**M**	**L**
CO4	**L2**	**H**	**L**	**H**	**H**	**M**	**M**	**-**	**M**	**-**	**M**	**M**	**M**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE 209: ANANDAM

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be expected to engage in individual and group acts of service and goodness.

Action Plan:

Students will be expected to

- Do at least one act of individual service each day
- Record this act of service in a dedicated Register / Personal Diary
- Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
- Undertake one group service project for 64 hours every semester (outside college hours)
- Upload the report on the group project on the Anandam platform
- Participate in a sharing and presentation on the group service in the discussion sessions held once in week
- There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester - III

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE301A	Automated material handling systems	Elective	50	100	150	3	0	0	3
MTMEPE301B	Supply chain practice & procedure	Elective	50	100	150	3	0	0	3
MTMEPE 302A	Business Analytics	Elective	50	100	150	3	0	0	3
MTMEPE 302B	Industrial Safety	Elective	50	100	150	3	0	0	3
MTMEPE 302C	Operations Research	Elective	50	100	150	3	0	0	3
MTMEPE 302D	Cost Management of Engineering Projects	Elective	50	100	150	3	0	0	3
MTMEPE 302E	Composite Materials	Elective	50	100	150	3	0	0	3
MTMEPE 302F	Waste to Energy	Elective	50	100	150	3	0	0	3
Practical/Viva Voce		**Type**	**IA**	**EA**	**Total**	**L**	**T**	**P**	**Credits**
MTMEPE303	Dissertation-I /Industrial Project	Core	60	40	100	0	0	10	10
MTMEPE304	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**210**	**290**	**500**	**7**	**0**	**11**	**18**

MTMEPE301A: Automated material handling systems

Course Objective

1. To understand automated material handling systems and integration of material handling and storage.
2. To Design automated material handling and storage systems for a typical production system.
3. To understand the latest technology in the material handling system.
4. To use and analyze the transport and storage system.

Course Content:

Unit-I: **Introduction to Material Handing** - Overview of material handling equipment, considerations in material handling system design, the ten principles of material handing

Unit-II: **Material Transport Systems** - Industrial trucks, automated guided vehicle systems (AGVS), vehicle guidance technology, vehicle management and safety, monorails and other rail guided vehicles, conveyor systems, types of conveyors, conveyor operations and features, cranes and hoists, analysis of material transfer systems.

Unit-III: **Storage Systems** - Storage system performance, storage location strategies, conventional storage methods and equipment, automated storage systems, automated storage/retrieval systems (AS/RS), types of AS/RS and applications, carousel storage systems, engineering analysis of storage systems

Unit-IV: **Material Handing and Storage System in FMS/CIM** - Functions of the handing system, FMS layout configurations material handing equipment

Unit-V: **Robot Technology** - Robot anatomy, need, purpose and motives for robot use in industry, elements of a robotic system, need for using robots, robot physical configurations, robot motions, motion planning, trajectory planning, technical features, drive systems.

Reference Books:

1. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi
2. P. Radhakrishnan & S. Subramanyan " CAD/CAM/CIM" Willey Eastern Limited New Delhi
3. Mikell P. Grover and Enory W. ZiMTMErs Jr. " CAD/CAM", Pearson Education, New Delhi.
4. Mikell P. Grover "Industrial Robotics

Course Outcome

CO1: To understand automated storage, transportation, Lay out of the plant

CO2: To apply the knowledge of the robots and monorails system in the plant lay out.

CO3: To design the plant layout as per the current demand by using the latest equipment that is used for the transport and storage.

CO4: To study the basic principles of material handling and apply them in practical uses.

CO5: Use of latest technology in the plant layout with the help of knowledge of the robots.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**H**	**M**	**L**	**M**	**L**	**M**	**-**	**L**	**L**	**-**	**L**	**L**
CO2	**L3**	**H**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**M**	**L**
CO3	**L3**	**H**	**L**	**L**	**L**	**L**	**-**	**-**	**M**	**-**	**L**	**L**	**L**
CO4	**L2**	**H**	**M**	**L**	**L**	**-**	**M**	**L**	**M**	**-**	**M**	**M**	**M**
CO5	**L2**	**H**	**M**	**L**	**L**	**-**	**L**	**L**	**-**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE301B: Supply chain practice & procedure

Course Objective

1. To recognize the relationship and motivations of suppliers and distributors to ensure supplies and Importance of supply chain
2. To Utilize information technology and various quantitative and qualitative approaches and logistics management
3. To Design factors of supply chain and Develop applied research skills
4. Sourcing and revenue management
5. To Acquire familiarity and a working knowledge.

Course Content:

Unit-I: Concept of supply chain, Integrated supply chain, Growth of Supply chain, Strategic decision in supply chain.

Unit-II: Definition of Supply Chain Management, Scope, Supply Chain Management as a Management Philosophy, Function of SCM, Why Supply Chain Management, Value chain for Supply Chain Management.

Unit-III: Customer focus in Supply Chain Management, Buyers Perspective, Suppliers Perspective, Stages of Development in Supplier Relations.

Unit-IV: Supply Chain Strategies – (i) Cycle View (ii) Push & Pull View. Achievement of strategic fit through different steps, Obstacles to achieving Strategic Fit.

Unit-V: Role of Forecasting in a supply chain, Factors of Demand Forecast, Basic approach to Demand Forecasting, Role of Aggregate Planning in a Supply Chain, Problems, Planning Strategies.

Reference books:

1. Supply Chain Management – Sunil Chapra & Peter Meindl, PHI
2. Essentials of Supply Chain Management – Dr. R.P. Mohanty & Dr. S.G. Deshmukh, Jaico Publishing House
3. Designing & Managing The Supply Chain, David Simchi-Levi , Philip Kamiusky, Edith Simchi-Levi, TATA Mc-Graw Hill

Course Outcome

After successful completion of Supply Chain Management course, the student will be able to

CO 1: Develop a systematic framework for analyzing the behavior of large and complex supplychain networks.

CO 2: Recognize the relationship and motivations of suppliers and distributors to ensure suppliesof raw materials and markets for finished goods.

CO 3: Utilize information technology and various quantitative and qualitative approaches thatreduce production, inventory and transportation costs, and improve service levels andprofitability.

CO 4: Develop applied research skills which can help you in the analysis of emerging supply chain management issues.

CO 5: Acquire familiarity and a working knowledge of the principles and practice of operations management as applied to the service industries.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO 4	PO 5	PO 6	**PO 7**	**PO 8**	PO 9	PO1 0	PSO 1	PSO 2
CO1	**L3**	**H**	**M**	**L**	**L**	**M**	**L**	**M**	**M**	**L**	**-**	**M**	**M**
CO2	**L1**	**H**	**M**	**L**	**L**	**M**	**M**	**M**	**M**	**L**	**L**	**M**	**M**
CO3	**L2**	**M**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**L**	**L**	**L**
CO4	**L3**	**M**	**M**	**M**	**L**	**M**	**M**	**L**	**L**	**-**	**M**	**M**	**M**
CO5	**L1**	**M**	**L**	**M**	**L**	**M**	**L**	**L**	**L**	**L**	**-**	**L**	**L**

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

MTMEPE302A: Business Analytics

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: Business analytics: Overview of Business analytics, Scope of Business analytics,Business Analytics Process, Relationship of Business Analytics Process andorganization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit-2: Trendiness and Regression Analysis: Modeling Relationships and Trends in Data,simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business AnalyticsTechnology.

Unit-3: Organization Structures of Business analytics, Team management, ManagementIssues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling,nonlinear Optimization.

Unit-4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit-5: Decision Analysis: Formulating Decision Problems, Decision Strategies with thewithout Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference:

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

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Student will get the knowledge about the business and their Analytics Process and relationship.

CO2: Student will be able to design and Analysis the Business Analytics Processand data modeling, sampling.

CO3: Student will get the knowledge about the various Designing Information Policy and Organization Structures of Business, team management.

CO4: Student will develop the different technique and model for business forecasting Techniquesand Risk Analysis.

CO5: Student will be able to take the Decision about business marketing data Analysis and Outcome Probabilities.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE302B: Industrial Safety

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-2: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-3: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reductionmethods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition,principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-4: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree forproblems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-5: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing,cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, efinition,need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel enerating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Enging Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Students will be Understand the role of occupational health and safety in the workplace in the prevention of incidents, Injury and illness.

CO2: Students will develop an understanding about the role of plant layout, housekeeping and machine guards to assurehealth and safety in workplaces.

CO3: They have knowledge about the different types of effective personal protective gears used in industry forspecific operations, their maintenance and disposal methods.

CO4: Students will get the knowledge about Hazard assessment studies and ways to handle hazard situations in industryacting as Environment and Safety officers.

CO5: Students know the structure and function of Disaster management group to handle emergency situations. Understand the economics of safety regarding individual and family, organization and society.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE302C: Operations Research

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit-2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit-3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit-4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

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

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Students will get the knowledge the Optimization Techniques and model.

CO2: They will be analysis the various methods and formula for programming.

CO3: Students will design and program the new problem of project management.

CO4: Students will be get knowledge about the Scheduling and sequencing.

CO5: Students will know the theory of Elementary Graph Theory, Game Theory Simulation.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L3**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE302D : Cost Management of Engineering Projects

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2: Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member.

Unit-3: Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach.

Unit-4: Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

2. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

3. Charles T. Horngren and George Foster, Advanced Management Accounting

4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

5. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

6. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Students will be get knowledge and find out the about various cast of engineering project and control their cost.

CO2: Students will get the information various project and their use in engineering work.

CO3: Students will analysis and planning the project and control their cost.

CO4: Students will be able to management the project and their planning.

CO5: Students will design and Programming of various problem and budgets.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE302E: Composite Materials

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: **Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit-2: **Reinforcements**: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

Unit-3: **Manufacturing of Metal Matrix Composites**: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit–4: **Manufacturing of Polymer Matrix Composites**: Preparation of Molding compounds and prepress – hand layup method – Autoclave method – Filament winding method – Compression molding – Reaction injection molding. Properties and applications.

Unit–5: **Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.

COURSE OUTCOMES OF Composite Materials

At the end of the course, the student will be able to:

CO1: Introduction and understanding of Composite materials.

CO2: Knowledge of different reinforcements and Mechanical Behavior of composites.

CO3: Students should able to get knowledge of Manufacturing of Metal Matrix Composites and Liquid Metal Infiltration.

CO4: Students should able to get knowledge of Preparation of Moulding and apply it.

CO5: Understanding Strength of Composite materials.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE302F: Waste to Energy

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content:

Unit-1: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit-2: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-3: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kineticconsideration in gasifier operation.

Unit-4: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design,construction and operation - Operation of all the above biomass combustors.

Unit-5: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifies.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE303: Dissertation-I /Industrial Project

Mid Sem Evaluation weightage - 30%

End Sem Evaluation weightage - 70%

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Course Outcomes

At the end of the course, the student will be able to:

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO1, CO3
CD3	Seminars / Presentations	CO2, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE 304: ANANDAM

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be expected to engage in individual and group acts of service and goodness.

Action Plan:

Students will be expected to

- Do at least one act of individual service each day
- Record this act of service in a dedicated Register / Personal Diary
- Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
- Undertake one group service project for 64 hours every semester (outside college hours)
- Upload the report on the group project on the Anandam platform
- Participate in a sharing and presentation on the group service in the discussion sessions held once in week
- There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester - IV

Code	Subject/Paper	Type	Internal Marks	External Marks	Total	L	T	P	Credits
MTMEPE401	Dissertation II	Core	300	400	700	-	-	16	16
MTMEPE402	ANANDAM	AECC	50	50	100	1	-	1	2
Total			**350**	**450**	**800**	**1**	**-**	**17**	**18**

MTMEPE401: Dissertation II

Guidelines:
It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

COURSE OUTCOMES
At the end of the course, the student will be able to:
CO1: Handle research problems and use modern research tools/methods.
CO2: Analyze and review the existing literature on a research problem.
CO3: Design and conduct experiments.
CO4: Write dissertation and technical reports.
CO5: Publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3
CD2	Tutorials/Assignments	CO1, CO3
CD3	Seminars / Presentations	CO2, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

MTMEPE 402: ANANDAM

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be expected to engage in individual and group acts of service and goodness.

Action Plan:

Students will be expected to

- Do at least one act of individual service each day
- Record this act of service in a dedicated Register / Personal Diary
- Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
- Undertake one group service project for 64 hours every semester (outside college hours)
- Upload the report on the group project on the Anandam platform
- Participate in a sharing and presentation on the group service in the discussion sessions held once in week
- There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Audit Courses (Common for all)

AUDIT 1 and 2 : ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVE

- To understand that how to improve your writing skills and level of readability
- To learn about what to write in each section
- To understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Content:

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

Unit-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

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

Unit-III: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when Writing a Review of the Literature.

Unit-IV: skills are needed when writing the Methods, skills needed when writing the Results, Skills are needed when writing the Discussion; skills are needed when writing the Conclusions.

Unit-V: useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

Suggested Studies:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

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

CO1: Students should know how to Plan and Prepare research paper.

CO2: Knowledge of Paraphrasing, Plagiarism and Literature review.

CO3: Knowledge and understanding of write every aspect and part of thesis like Abstract, Literature review, Title, etc,.

CO4: Discussion and skills developed in students when writing the Conclusions.

CO5: Ensuring students to write the paper first- time and also giving them knowledge about the quality of paper and procedure of Submission.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	M	H	M	-	L	M	L	L	M	L	L
CO2	L1	M	-	L	L	M	-	H	H	M	M	L	L
CO3	L1,L2	L	H	L	M	H	L	H	M	H	L	L	L
CO4	L2	M	M	-	L	H	M	-	M	M	-	L	L
CO5	L1	M	L	L	L	M	L	M	L	-	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO1, CO4, CO5

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objective

- To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Content:

Unit-I: **Introduction :** Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

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

Unit-III: **Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Unit-IV: **Disaster Preparedness and Management:** Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-V: **Risk Assessment:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies For Survival.

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

Suggested Studies:

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

Course Outcomes:

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

CO1: Knowledge of disaster and its types.

CO2: Knowledge of Repercussions of Disasters And Hazards.

CO3: Study of Seismic Zones and Disaster Prone Areas In India.

CO4: Study of Disaster Preparedness and Management.

CO5: Understanding Disaster Risk Situation, Risk Assessment and Disaster Mitigation in India.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO1	PSO2
CO1	L1	H	M	H	L	-	L	M	L	L	M	L	L
CO2	L1	M	H	L	L	M	M	-	-	M	L	L	L
CO3	L2	-	M	L	M	L	M	-	M	H	M	L	L
CO4	L2	M	H	-	L	M	L	-	M	M	M	L	L
CO5	L2	M	M	L	H	M	L	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objective

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To do Learning of Sanskrit to improve brain functioning
- To have thorough Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- To enhance the memory power
- To explore the huge knowledge from ancient literature

Course Content:

Unit-I: Alphabets in Sanskrit.

Unit-II: Past/Present/Future Tense.

Unit-III: Simple Sentences Order.

Unit-IV: Introduction of roots.

Unit-V: Technical information about Sanskrit Literature, Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Studies:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Knowledge of Alphabets in Sanskrit.

CO2: Knowledge of Past/Present/Future Tense.

CO3: Study of Simple Sentences Order.

CO4: Introduction of roots and its knowledge.

CO5: Understanding Technical information and concepts about Sanskrit Literature and related Engineering concepts.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	-	L	L	M	-	H	M	M	L	L	L
CO3	L2	L	H	L	M	H	M	L	M	H	M	L	L
CO4	L1	M	H	-	L	M	L	-	-	M	L	L	L
CO5	L2	-	M	L	L	M	M	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : VALUE EDUCATION

Course Objective

- To understand value of education and self-development
- To imbibe good values in students
- To let the should know about the importance of character

Course Content:

Unit-I: Values and self-development –Social values and individual attitudes.

Work ethics, Indian vision of humanism.

- Moral and non- moral valuation. Standards and principles.
- Value judgments

Unit-II: Importance of cultivation of values.

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

Unit-III: Personality and Behavior Development - Soul and Scientific attitude.

- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labor.
- Universal brotherhood and religious tolerance.

Unit-IV: Positive Thinking. Integrity and discipline. Positive Thinking. Integrity and discipline.

- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

Unit-V: Character and Competence –Holy books vs. Blind faith.

- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence ,Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively.

Suggested Studies:

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

Course Outcomes:

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

CO1: Knowledge of Values and self-development.

CO2: Understanding the Importance of cultivation of values.

CO3: Study of Personality and Behavior Development.

CO4: Understanding and inculcating Positive Thinking.

CO5: Study of Character and Competence.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L2	M	H	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	M	L	L	M	L	M	-	M	L	L	L
CO3	L2	L	H	L	M	M	M	M	L	H	-	L	L
CO4	L2	M	H	-	L	M	-	-	L	M	L	L	L
CO5	L2	-	M	L	L	M	L	L	L	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : CONSTITUTION OF INDIA

Course Objective

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

Course Content:

Unit-I: History of Making of the Indian Constitution:

History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble Salient Features.

Unit-II: Contours of Constitutional Rights & Duties:

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

Unit-III: Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor

- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit-IV: Local Administration:

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

Unit-V: Election Commission:

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

Suggested Studies:

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

Course Outcomes:

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

CO1: Knowledge of History and Philosophy of the Indian Constitution.

CO2: Understanding the Contours of Constitutional Rights & Duties.

CO3: Study of Organs of Governance.

CO4: Understanding the Local Administration.

CO5: Study of Election Commission.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	H	H	L	-	L	M	L	L	M	L	L
CO2	L2	M	M	L	M	M	-	M	M	M	H	-	-
CO3	L2	L	M	L	M	L	M	H	M	H	M	-	-
CO4	L2	-	H	-	L	M	H	-	M	M	-	L	-
CO5	L2	L	M	L	L	M	L	L	-	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2 : PEDAGOGY STUDIES

COURSE OBJECTIVE

- To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- To identify critical evidence gaps to guide the development.

Course Content:

Unit-I: Introduction and Methodology:

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

Unit-II: Thematic overview:

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

- Curriculum, Teacher education

Unit-III: Evidence on the effectiveness of pedagogical practices

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

Unit-IV: Professional development: alignment with classroom practices and follow up support

- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit-V: Research gaps and future directions

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact

Suggested Studies:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

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

CO1: Knowledge of Theories of learning and Conceptual framework.

CO2: Understanding the Pedagogical practices.

CO3: Interpretating the Theory of change when pedagogical practices are done.

CO4: Understanding the Professional development and Barriers to learning.

CO5: Study of Research gaps and future directions.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	-	M	M	L	L	L
CO3	L2	H	H	L	M	M	M	M	M	H	M	L	L
CO4	L2	L	H	-	L	M	-	M	-	M	M	L	L
CO5	L2	L	M	L	L	M	L	L	L	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

COURSE OBJECTIVE

- To achieve overall health of body and mind
- To overcome stress

Course Content:

Unit-I: Definitions of Eight parts of yog (Ashtanga).

Unit-II: Yam and Niyam: Do`s and Don't's in life.

Unit-III: Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwar pranidhan.

Unit-IV: Asan and Pranayam

I) Various yog poses and their benefits for mind & body

Unit-V: Regularization of breathing techniques and its effects-Types of pranayam.

Suggested Studies:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

Course Outcomes:

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

CO1: Knowledge of Eight parts of yog (Ashtanga).

CO2: Understanding the Do`s and Don't's in life.

CO3: Knowledge and application of Ahinsa, satya, astheya, bramhacharya, aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

CO4: Pracicing Asan and Pranayam..

CO5: Regularization of breathing techniques and its effects.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	H	-	M	-	L	L
CO3	L1,L3	L	H	L	M	L	M	M	M	H	M	L	L
CO4	L3	M	H	-	L	M	M	-	M	M	M	-	-
CO5	L1,L2	L	M	L	L	M	L	H	L	L	L	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO3, CO4, CO5
CD4	Project Discussions	CO2, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

COURSE OBJECTIVE

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Content:

Unit-I: Neetisatakam - Holistic development of personality

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

Unit-II: Approach to day to day work and duties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47, 48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit-III: Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Unit-IV: Personality of Role model. Shrimad BhagwadGeeta:

- Chapter2-Verses 17,
- Chapter 3-Verses 36, 37, 42,
- Chapter 4-Verses 18, 38, 39
- Chapter18 – Verses 37, 38, 63

Suggested Studies:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

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

CO1: Knowledge of Neetisatakam - Holistic development of personality.

CO2: Approach to day to day work and duties.

CO3: Understanding the Theory of Statements of basic knowledge.

CO4: Understanding the Personality of Role model. Shrimad Bhagwad Geeta.

CO5: Study of Personality Development through Life Enlightenment Skills.

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars / Presentations
CD4	Project Discussions
CD5	Self- learning advice using internets

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	M	M	M	L	-	L	M	L	L	M	-	-
CO2	L1,L2	M	H	L	L	M	M	-	H	M	L	-	-
CO3	L2	L	H	L	M	M	L	M	L	H	L	-	-
CO4	L2	M	L	-	L	L	M	M	M	M	-	-	-
CO5	L2	M	M	L	L	M	L	L	L	L	M	-	-

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO3, CO4, CO5
CD3	Seminars / Presentations	CO4, CO5
CD4	Project Discussions	CO1, CO3, CO4, CO5
CD5	Self- learning advice using internets	CO2, CO4, CO5

11. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of technical program in a canonical manner. In this context, applications of technical program and linkage with the theory constitute a vital aspect of the teaching-learning process. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teaching learning process are summarized in the following heads.

1. **Class room Lectures:** The most common method of imparting knowledge is through lectures.There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.

2. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern ofstudy, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.

3. **Practical:** To provide scientific visualization and obtaining results of Technical program inpractical sessions. These sessions provide vital insights into scientific concepts and drawlearner's attention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.

4. **Choice based learning/Open elective:** LOCF in this undergraduate program providesgreat flexibility both in terms of variety of courses and range of references in each course.

5. **Field based learning:** Students may enhance their knowledge through field based learningwhile understanding the practical importance.

6. **Textbooks learning:** A large number of books are included in the list of references of eachcourse for enrichment and enhancement of knowledge.

7. **E-learning:** Learner may also access electronic resources and educational websites for betterunderstanding and updating the concepts.

8. **Self-study materials:** Self-study material provided by the teachers is an integral part oflearning. It helps in bridging the gaps in the classroom teaching. It also provides scope for teachers to give additional information beyond classroom learning.

9. **Assignment/Problem solving:** Assignments at regular intervals involving applications oftheory are necessary to assimilate basic concepts of courses. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.

10. **Internships:** The teaching-learning process needs to be further supported by other activitiesdevoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.

11. **Institute visits:** Institute visit by a learner is also a part of learning process. During suchvisits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.
12. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power of mathematical ideas and their translation in problem solving.
13. **Training programs:** Training programs organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.

12. ASSESSMENT AND OUTCOME MESUAREMENT METHODS (AOMM):

A range of assessment methods which are appropriate to test the understanding of various concepts of courses will be used. Various learning outcomes will be assessed using time-bound examinations, problem solving, assignments and viva-voce examination. For various courses in this programme, the following assessment methods shall be adopted:

i. i Scheduled/unscheduled tests
ii. Problem solving sessions aligned with classroom lectures
iii. Practical assignments
iv. Regular chamber consultation with faculty members
v. Mid semester examination and semester end comprehensive examination

Examination and Evaluation:

I. The medium of instructions and examination shall be English.
II. Candidates shall be examined according to the scheme of examination and Course Content: as approved by the BOS and Academic Council from time to time.
III. To pass each semester examination, a candidate must obtain at least 40% marks in each written paper, practical work semester examination.
IV. Each theory paper for the respective semester examination shall be set and evaluation of the answer books shall be done as per the University rules.
V. The assessment of External Evaluation i.e. End Term Semester Examination will be made out of 70 (Seventy) marks in theory Papers and Internal Evaluation of 30 (Thirty) marks.

Criterion for awarding Grading System:

Criterion for Awarding SGPA and CGPA: The criterion for awarding the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) for the entire professional programme shall be as follows:

a) The criterion for passing in a subject is that a student should secure minimum pass marks in the total of Internal Evaluation and End Term Examination as laid down in Appendix-I. A Student will earn the credits assigned for a subject if he/she passes in that subject.

b) A student obtaining less than pass marks as specified in Appendix-I, in each subject (sum of internal and End-Term examinations) he will be declared fail in that subject and will have to re-appear in a End-Term examination of the course in subsequent odd / even semester end term examination, subject to maximum permissible period of n+2 years / n+4 semesters to complete the course.

c) The University has adopted Absolute Grading System for converting marks into grades. The formula of 10- point grading system for conversion of marks obtained into Letter Grades and converting Letter Grades to Grade Point is given below:

Table 1: Marks, Letter Grades and Grade Points

Marks	**Letter Grade**	**Grade Points**
91-100	O (Outstanding)	10
81-90	A+(Excellent)	9
71-80	A(Very Good)	8
61-70	B+(Good)	7
51-60	B(Above Average)	6
46-50	C(Average)	5
40-45	P (Pass)*	4
0-39	F(Fail)	0
-	AB (Absent)	0

*For BBA, MBA, B.Com, M.Com, Diploma in Engg., B.Tech, BCA, MCA, M.Tech, B.Sc, B.Sc(Ag.)-Hons., B.A LL.B, BBA.LL.B – 40% in individual paper (See Apendix-I)

For B.Arch, M.Plan, LL.M – 45% in individual paper (See Apendix-I)

d) ***While converting the marks into Letter Grade, the rounding off marks must be considered.***

e) A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

f) For non credit courses "Satisfactory" or Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

Computation of SGPA and CGPA

The university has adopted UGC recommended procedure for computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the papers/ courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ (Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course. The university shall issue Semester Grade Card to the student.

a) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = Σ (Ci x Si) / Σ Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

b) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of Computation of SGPA and CGPA and Format for Transcripts

a) Computation of SGPA and CGPA

Illustration for SGPA

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade)**
Course/Paper 1	3	A	8	3x8=24
Course/Paper 2	4	B+	7	4x7=28
Course/Paper 3	3	B	6	3x6=18
Course/Paper 4	3	O	10	3x10=30
Course/Paper 5	3	C	5	3x5=15
Course/Paper 6	4	B	6	4x6=24
	20			**139**

Thus, SGPA= 139/20= 6.95

b) Illustration for CGPA

Semester-1	Semester-2	Semester-3	Semester-4	Semester-5	Semester-6
Credit: 20 SGPA:6.9	Credit: 22 SGPA:7.8	Credit: 25 SGPA:5.6	Credit: 26 SGPA:6.0	Credit: 26 SGPA:6.3	Credit: 25 SGPA:8.0

Thus, CGPA= 20x6.9+22x7.8+25x5.6+26x6.0+26x6.3+25x8.0

---------- = **6.73**

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13. TEACHERS TRAINING (TT):

Learning Outcomes Based Curriculum Framework (LOCF) Quality initiative of UGC based on Outcome Based Education (OBE) is being implemented by the University Grants Commission to enhance the Quality of Higher Education and that of Higher Education Learners and Teachers. Therefore, university arrange following activities for teachers training:

1. Workshops for LOCF implementation.
2. Seminar for LOCF implementation.
3. FDP on LOCF.
4. Outcome based higher education and understanding the learning objectives, learning outcomes, new approaches in the area of outcome measurement, preparing future ready teachers and students.
5. Developing a battery of quality speakers/educators to become resource persons to play role for Training of Trainers (TOT).

14. KEY WORDS:

LOCF, CBCS, Course Learning Outcomes, Employability, Post Graduate Attributes Communication Skills, Critical Thinking, and Descriptors.

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Annexure - 1

Bloom Levels

Level of Taxonomy	Definition	Action Verbs	
Creating L6	Generating new ideas, products, or ways of viewing things Designing, constructing, planning, producing, inventing	Act Arrange Assemble Combine Compose Construct Create Design Develop Devise Formulate	Generate Improve Infer Invent Imagine Plan Predict Prepare Revise Show Write
Evaluating L5	Justifying a decision or course of action Checking, hypothesizing, critiquing, experimenting, judging	Argue Assess Choose Compare Conclude Criticize Debate Decide Defend	Determine Evaluate Justify Prioritize Rate Recommend Support Tell why Value
Analyzing L4	Breaking information into parts to explore understandings and relationships Comparing, organizing, deconstructing, interrogating, finding	Calculate Categorize Classify Compare Contrast Diagram Differentiate Discover Distinguish Examine Experiment	Group Interpret Investigate Order Organize Question Relate Research Sequence Solve Survey
Applying L3	Using information in another familiar situation Implementing, carrying out, using, executing	Adapt Apply Calculate Change Compute Demonstrate Dramatize Draw Experiment Illustrate	List Make Manipulate Practice Produce Sequence Show Solve Teach Use

Understanding L2	Explaining ideas or concepts Interpreting, summarizing, paraphrasing, classifying, explaining	Ask Calculate Convert Describe Discuss Explain Give examples Identify Locate	Observe Recognize Report Research Retell Review Summarize Tell
Remembering L1	Recalling information Recognizing, listing, describing, retrieving, naming, finding	Choose Cite Define Describe Give example Group Know Label List Listen Locate	Match Memorize Name Quote Recall Recite Record Repeat Select Underline

Annexure-2:

Mapping of PO with Bloom Level

Pos	Action Verb(s) in POs	Bloom's level(s) for POs
PO1	Apply	L3
PO2	Interpret	L4
	Improve	L6
	Research	L2
PO3	Improve	L6
	Develop	L3, L6
PO4	Analyze	L2
PO5	Identify	L2
	Analyze	L2
	Design	L6
PO6	Listen	L1
PO7	Understand	L2
PO8	Understand	L2
PO9	Understand	L2
PO10	Recognize	L 2
	Recall	L1