Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar

(An Autonomous Institute of Government of Maharashtra)
Station Road, Osmanpura, Chhatrapati Sambhajinagar – 431005 (M.S.)
Phone – (0240) 2366101, 2366111, Fax (0240) 2332835

Curriculum for M. Tech. in Production Engineering (NEP Compliant)

(With Effect from Academic Year 2023-24)

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Vision of the Institute

- In pursuit of global competitiveness, the institute is committed to excel in engineering education and research with concern for environment and society.

Mission of the Institute

- Provide conducive environment for academic excellence in engineering education.
- Enhance research and development along with promotion to sponsored projects and industrial consultancy.
- Foster development of students by creating awareness for needs of society, sustainable development and human values.

Vision of the Mechanical Engineering Department

- To develop excellence in Mechanical Engineering.

Mission of the Mechanical Engineering Department

- Impart sound knowledge and technical skills through conducive ambiance with right attitude towards society and environment.
- Enhance research facilities, collaboration with industry and provide testing and consultancy services.
- Nurture entrepreneurial qualities, creativity and provide motivation for higher education.
- Inculcate self-learning, team work and adoptability to change.

Program Outcomes

PO1: An ability to independently carry out research investigation and development work to solve practical problems.
PO2: An ability to write and present a substantial technical report/document.
PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4: Ability to enhance experiential learning through project-based activities.
PO5: Formulate and solve production related problems by applying advanced methods.

GENERAL COURSE STRUCTURE & THEME

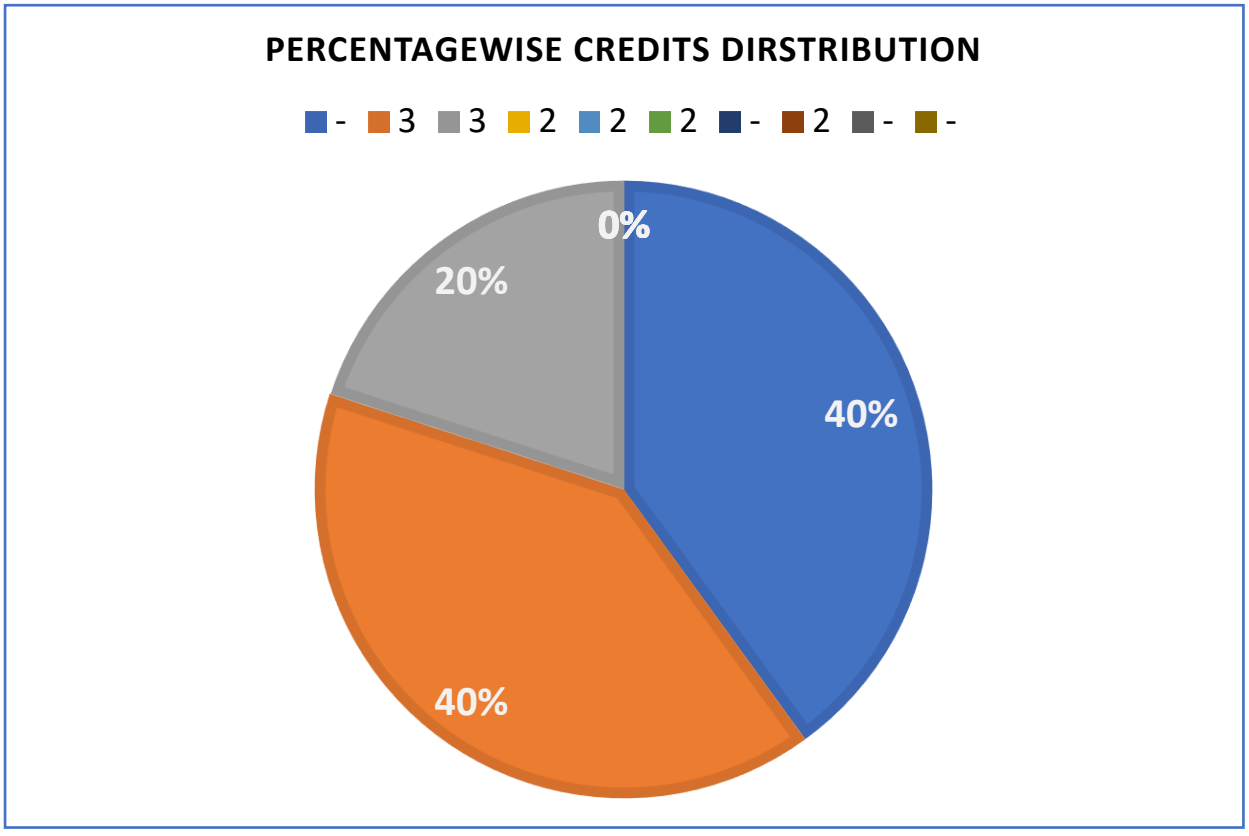
A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: M.Tech. in Production: The total number of credits proposed for the two-year full time M.Tech. in Production Engineering is kept as **82.**

C. Semester wise Credit Distribution Structure for Two-Year Full-Time PG Program in Production Engineering:

Semester		**I**	**II**	**III**	**IV**	**Total Credits**
Programme Core Course (PCC)	Program Courses	**08**	**12**	**-**	**-**	**20**
Programme Elective Course (PEC)		**08**	**06**	**-**	**-**	**14**
Open Elective (OE) Other than a particular program	Multidisciplinary Courses	**-**	**03**	**03**	**-**	**06**
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	**02**	**02**	**-**	**-**	**04**
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	**-**	**03**	**-**	**-**	**03**
Entrepreneurship/Economics/ Management Courses		**-**	**-**	**03**	**-**	**03**
Indian Knowledge System (IKS)		**-**	**-**	**02**	**-**	**02**
Research Methodology	Experiential Learning Courses	**04**	**-**	**-**	**-**	**04**
Project		**-**	**-**	**10**	**16**	**26**
Co-curricular Courses (CC)	Liberal Learning Courses	**-**	**-**	**-**	**-**	**Audit**
Total Credits (Major)		**22**	**26**	**18**	**16**	**82**



Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

D. Category-wise Courses

1. VOCATIONAL AND SKILL ENHANCEMENT COURSE (VSEC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	VSEC	Mini Project – I	I	0	0	4	**02**
2	VSEC	Mini Project – II	II	0	0	4	**02**
Total Credits							**04**

2. HUMANITIES & SOCIAL SCIENCES COURSES [HSSM]

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Ability Enhancement Course (AEC)	Technical Communication	II	3	0	0	**03**
2	Entrepreneurship/Economics/ Management Courses	Economics / Management Courses	III	3	0	0	**03**
3	Indian Knowledge System (IKS)		III	2	0	0	**02**
Total Credits							**08**

3. EXPERIENTIAL LEARNING COURSES (ELC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Research Methodology	Research Methodology	I	4	0	0	**04**
2	Project	Dissertation - I	III	0	0	20	**10**
3	Project	Dissertation - II	IV	0	0	32	**16**
Total Credits							**30**

4. LIBERAL LEARNING COURSES (CO-CURRICULAR COURSES (CC))

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	CC	Yoga/Clubs	I	0	0	2	**Audit**
Total Credits							**-**

5. OPEN ELECTIVE (OE) OTHER THAN A PARTICULAR PROGRAM

Two courses of 3 credits

Following courses are offered as Open Electives (OE) by Mechanical Engineering Department

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	OE	Robotics	II	3	0	0	**03**
2	OE	Additive Manufacturing	III	3	0	0	**03**
Total Credits							**06**

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar
(An Autonomous Institute of Government of Maharashtra)

Teaching and Evaluation Scheme from Academic Year 2023-24 as per NEP - 2020
M. Tech. Program in Production Engineering (Full Time)

Semester – I

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPCC5001	Advanced Manufacturing Techniques	3	0	0	**3**	20	20	60	**100**
2.	PCC	MEPCC5002	Lab - Advanced Manufacturing Techniques - I	0	0	2	**1**	-	25	-	**25**
3.	PCC	MEPCC5003	Advanced Mathematical Methods	3	0	0	**3**	20	20	60	**100**
4.	PCC	MEPCC5004	Lab - Advanced Mathematical Methods	0	0	2	**1**	-	25	-	**25**
5.	PEC		Programme Elective Course - I	4	0	0	**4**	20	20	60	**100**
6.	PEC		Programme Elective Course - II	4	0	0	**4**	20	20	60	**100**
7.	VSEC	MEVSE5001	Mini Project – I	0	0	4	**2**	-	25	25	**50**
8.	ELC	MERMC5001	Research Methodology	4	0	0	**4**	20	20	60	**100**
9.	CC	INCCC5001	Yoga/Club Activities#	-	-	2	-	-	-	-	-
Total				**18**	**0**	**10**	**22**	**100**	**175**	**325**	**600**

Programme Elective Course – I	**Programme Elective Course – II**
1. MEPEC5001- Flexible Manufacturing System 2. MEPEC5002 - Advance Operations Research 3. MEPEC5003 - Modern Management System	1. MEPEC5004 - Modern Engineering Materials 2. MEPEC5005 - Engineering Experimental Techniques 3. MEPEC5006 - Management Information System and Enterprise Resource Planning

 # Audit Course

Semester – II

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPC C5005	Robotics and Automation	3	0	0	**3**	20	20	60	**100**
2.	PCC	MEPC C5006	Lab - Robotics and Automation	0	0	2	**1**	-	25	-	**25**
3.	PCC	MEPC C5007	Collaborative Engineering	4	0	0	**4**	20	20	60	**100**
4.	PCC	MEPC C5008	Production Management	3	0	0	**3**	20	20	60	**100**
5.	PCC	MEPC C5009	Lab - Advanced Manufacturing Techniques - II	0	0	2	**1**	-	25	-	**25**
6.	PEC		Programme Elective Course - III	3	0	0	**3**	20	20	60	**100**
7.	PEC		Programme Elective Course - IV	3	0	0	**3**	20	20	60	**100**
8.	OE		Open Elective – I*	3	0	0	**3**	20	20	60	**100**
9.	VSEC	MEVS E5002	Mini Project – II	0	0	4	**2**	-	25	25	**50**
10.	AEC	EEAE C5001	Technical Communication	3	0	0	**3**	20	20	60	**100**
Total				**22**	**0**	**8**	**26**	**140**	**215**	**445**	**800**

Programme Elective Course – III	**Programme Elective Course – IV**
1. MEPEC5007 - Machine Tool Design 2. MEPEC5008 - Computer Aided Optimization 3. MEPEC5009 - Engineering Economics 4. MEPEC5010 - Computer Integrated Manufacturing	1. MEPEC5011 - Materials and Logistics Management 2. MEPEC5012 - Facility Planning and Material Handling System 3. MEPEC5013 - Reliability Engineering 4. MEPEC5014 - Sustainability in Materials and Design

Open Elective – I*

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be offered and shall be approved by BoS Chairman**

S.No.	Open Elective – I Course	Course Offering Department
1	AMOEC5001 - Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5002 - Professional Ethics & Cyber Law	Computer Science & Engineering
3	CEOEC5003 - Engineering Optimization	Civil Engineering
4	MEOEC5004 - Robotics (Not for Mechanical PG Students)	Mechanical Engineering
5	EEOEC5005 - Electric Vehicles (Not for Electrical PG Students)	Electrical Engineering
6	ECOEC5006 - IoT for Smart Systems	Electronics & Telecommunication

Semester – III

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	OE		Open Elective – II*	3	0	0	**3**	20	20	60	**100**
2.	HSSM		Entrepreneurship / Economics / Management Course	3	0	0	**3**	20	20	60	**100**
3.	IKS	INIKS 6001	Vedic Approach to Mathematics	2	0	0	**2**	10	10	30	**50**
4.	ELC	MEDI S6001	Dissertation – I	0	0	20	**10**	-	100	100	**200**
Total				**8**	**0**	**20**	**18**	**50**	**150**	**250**	**450**

Open Elective – II*

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be offered and shall be approved by BoS Chairman**

S.No.	Open Elective – II Course	Course Offering Department
1	AMOEC6001 - Indian Constitution	Applied Mechanics
2	CSOEC6002 - Data Science (Not for CSE PG Students)	Computer Science & Engineering
3	CEOEC6003 - Disaster Management	Civil Engineering
4	MEOEC6004 - Additive Manufacturing	Mechanical Engineering
5	EEOEC6005 - Smart Grid Systems	Electrical Engineering
6	ECOEC6006 - Soft Computing	Electronics & Telecommunication

HSSM: - Entrepreneurship / Economics / Management Course

S.No.	Open Elective – II Course	Course Offering Department
1	MEEEM6001 – Entrepreneurship Development	Mechanical Engineering
2	ECEEM6002 – Engineering Economics	Electrical Engineering
3	MEEEM6003 – Industrial Management	Mechanical Engineering

Semester – IV

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	ELC	MEDI S6002	Dissertation – II	-	-	32	**16**	-	-	150	150
Total				**0**	**0**	**32**	**16**	**0**	**0**	**150**	**150**

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar
(An Autonomous Institute of Government of Maharashtra)

Teaching and Evaluation Scheme from Academic Year 2023-24 as per NEP - 2020
M. Tech. Program in Production Engineering (Part Time)

Semester – I

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPCC5001	Advanced Manufacturing Techniques	3	0	0	**3**	20	20	60	**100**
2.	PCC	MEPCC5002	Lab - Advanced Manufacturing Techniques - I	0	0	2	**1**	-	25	-	**25**
3.	PCC	MEPCC5003	Advanced Mathematical Methods	3	0	0	**3**	20	20	60	**100**
4.	PCC	MEPCC5004	Lab - Advanced Mathematical Methods	0	0	2	**1**	-	25	-	**25**
5.	PEC		Programme Elective Course - I	4	0	0	**4**	20	20	60	**100**
6.	CC	INCCC5001	Yoga/Club Activities#	-	-	2	-	-	-	-	-
Total				**10**	**0**	**6**	**12**	**60**	**110**	**180**	**350**

Programme Elective Course – I
1. MEPEC5001- Flexible Manufacturing System
2. MEPEC5002 - Advance Operations Research
3. MEPEC5003 - Modern Management System

 # Audit Course

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Semester – II

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PEC		Programme Elective Course - II	4	0	0	**4**	20	20	60	**100**
2.	VSEC	MEVSE5001	Mini Project – I	0	0	4	**2**	-	25	25	**50**
3.	ELC	MERMC5001	Research Methodology	4	0	0	**4**	20	20	60	**100**
4.	PCC	MEPCC5008	Production Management	3	0	0	**3**	20	20	60	**100**
Total				**11**	**0**	**4**	**13**	**60**	**85**	**205**	**350**
				Programme Elective Course – II 1. MEPEC5004 - Modern Engineering Materials 2. MEPEC5005 - Engineering Experimental Techniques 3. MEPEC5006 - Management Information System and Enterprise Resource Planning						

Semester – III

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPCC5005	Robotics and Automation	3	0	0	**3**	20	20	60	**100**
2.	PCC	MEPCC5006	Lab - Robotics and Automation	0	0	2	**1**	-	25	-	**25**
3.	PCC	MEPCC5007	Collaborative Engineering	4	0	0	**4**	20	20	60	**100**
4.	PCC	MEPCC5009	Lab - Advanced Manufacturing Techniques - II	0	0	2	**1**	-	25	-	**25**
5.	PEC		Programme Elective Course - III	3	0	0	**3**	20	20	60	**100**
Total				**10**	**0**	**4**	**12**	**60**	**110**	**180**	**350**
Programme Elective Course – III 1. MEPEC5007 - Machine Tool Design 2. MEPEC5008 - Computer Aided Optimization 3. MEPEC5009 - Engineering Economics 4. MEPEC5010 - Computer Integrated Manufacturing											

Semester – IV

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PEC		Programme Elective Course - IV	3	0	0	**3**	20	20	60	**100**
2.	OE		Open Elective – I*	3	0	0	**3**	20	20	60	**100**
3.	VSEC	MEVSE5002	Mini Project – II	0	0	4	**2**	-	25	25	**50**
4.	AEC	EEAEC5001	Technical Communication	3	0	0	**3**	20	20	60	**100**
Total				**9**	**0**	**4**	**11**	**60**	**85**	**205**	**350**
				Programme Elective Course – IV 1. MEPEC5011 - Materials and Logistics Management 2. MEPEC5012 - Facility Planning and Material Handling System 3. MEPEC5013 - Reliability Engineering 4. MEPEC5014 - Sustainability in Materials and Design							

Open Elective – I*

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be offered and shall be approved by BoS Chairman**

S.No.	Open Elective – I Course	Course Offering Department
1	AMOEC5001 - Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5002 - Professional Ethics & Cyber Law	Computer Science & Engineering
3	CEOEC5003 - Engineering Optimization	Civil Engineering
4	MEOEC5004 - Robotics (Not for Mechanical PG Students)	Mechanical Engineering
5	EEOEC5005 - Electric Vehicles (Not for Electrical PG Students)	Electrical Engineering
6	ECOEC5006 - IoT for Smart Systems	Electronics & Telecommunication

Semester – V

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	OE		Open Elective – II*	3	0	0	**3**	20	20	60	**100**
2.	HSSM		Entrepreneurship / Economics / Management Course	3	0	0	**3**	20	20	60	**100**
3.	IKS	INIKS 6001	Vedic Approach to Mathematics	2	0	0	**2**	10	10	30	**50**
4.	ELC	MEDI S6001	Dissertation – I	0	0	20	**10**	-	100	100	**200**
Total				**8**	**0**	**20**	**18**	**50**	**150**	**250**	**450**

Open Elective – II*

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be offered and shall be approved by BoS Chairman**

S.No.	Open Elective – II Course	Course Offering Department
1	AMOEC6001 - Indian Constitution	Applied Mechanics
2	CSOEC6002 - Data Science (Not for CSE PG Students)	Computer Science & Engineering
3	CEOEC6003 - Disaster Management	Civil Engineering
4	MEOEC6004 - Additive Manufacturing	Mechanical Engineering
5	EEOEC6005 - Smart Grid Systems	Electrical Engineering
6	ECOEC6006 - Soft Computing	Electronics & Telecommunication

HSSM: - Entrepreneurship / Economics / Management Course

S.No.	Open Elective – II Course	Course Offering Department
1	MEEEM6001 – Entrepreneurship Development	Mechanical Engineering
2	ECEEM6002 – Engineering Economics	Electrical Engineering
3	MEEEM6003 – Industrial Management	Mechanical Engineering

Semester –VI

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	ELC	MEDI S6002	Dissertation – II	-	-	32	**16**	-	-	150	150
Total				**0**	**0**	**32**	**16**	**0**	**0**	**150**	**150**

MEPCC5001: Advanced Manufacturing Techniques		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand fundamental concepts of casting design.
2. Identify the use of rapid prototype in various operations.
3. Work out force analysis professionally at tool chip interface in super finishing operations.
4. Understand and analyze the advance chip less manufacturing process and its machine tools.
5. Acquire knowledge of advance plastic product manufacturing process and metal coating process in view of their manufacturability, constraints and practical analysis.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Recognize the fundamental concepts of casting design in practice.
CO2	Understand Rapid Prototyping Process for industrial applications
CO3	Apply knowledge of advanced chip less manufacturing process to manufacturing various products.
CO4	Enhance and develop professional skill of metal coating to improve life of product.
CO5	Apply knowledge of micro machining, nano-machining, micro and nano finishing and micro joining processes to manufacture MEMS components.

Detailed Syllabus:

Unit 1	**Casting Process:** Sand casting process, orientation of the part in the mould, design of mould cavity, selection of parting line, design of pattens and cores, design of feeding system, solidification of castings. Heat transfer in the solidification process, Riser design and location. Design for casting
Unit 2	**Rapid Prototyping:** Introduction to RPT: Design and tooling, Classification, Stereo lithography systems Direct Metal Laser Sintering (DMLS), Fusion Deposition modeling, Laminated Object manufacturing, Solid Ground Curing, 3D printers, Laser Engineering Net Shaping (LENS), Ballistic Particle manufacturing (BPM), Introduction to Rapid Tooling, Advantages, disadvantages and applications of RPT.
Unit 3	**Advanced Chip less Metal Removal Processes:** working principle, effect of process variable, performance analysis and applications of following processes. Abrasive Flow Finishing (AFF), Magnetic Abrasive Finishing (MAF), Abrasive Water Jet Machining (AWJM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM), Electron Beam Machining (EBM), Electric Discharge Machining: Die sinking and Wire Cut EDM.
Unit 4	**Metallic Coating**: Importance, Principle, application of - Chemical vapor deposition, Physical vapor deposition, Thermal spray coating, Electroplating, Electroless Coating.

Unit 5	**Micro and Nano Machining Processes:** Introduction, Micro-turning, Micro-drilling, Micro-milling, Micro and nano-grinding, Nano-grinding tools, Laser Micromachining-Laser microfabrication, Laser nanofabrication. **Micro and Nano Finishing Processes**: Need for Nano finishing, Magnetic abrasive Finishing, Magnetorheological Finish, Elastic Emission Finishing, Magnetic Float Polishing, Ion Beam finishing. **Micro Joining** Challenges, Micro Resistance welding, Ultrasonic welding, Micro TIG, Applications

Text and Reference Books

1. Prashant P. Date, "Introduction to Manufacturing Technologies", Jaico Publishing House, Mumbai, 2012
2. Bendict G. F., Dekker, "Nontraditional Manufacturing Processes", Marcel Inc., New York.
3. Weller E. J., "Non-Traditional Machining Process", Society of Manufacturing Engineers, Dearban Michigan.
4. Amsteal, Philip, Begman, "Manufacturing Processes", 8th edition, John Willey and Sons.
5. Mishra P. K., "Non-traditional Machining Processes", Narosa Publications.
6. Heine R. W., Loper C. R., Rosenthal P. C., "Principles of Metal Casting", and Tata McGraw Hill, New Delhi, 1991
7. J. Paulo Davim, Mark J. Jackson, "Nano and Micromachining", John Wiley & Sons, 2013
8. V. K. Jain, "Micro-manufacturing Processes", CRC Press, 2012
9. Mark. J. Jackson, "Micro and Nano-manufacturing", Springer, 2006
10. Kapil Gupta, "Micro and Precision Manufacturing", Springer, 2017

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2		1		2
CO2	1		2		
CO3	3	1	2		
CO4	2		2		1
CO5	2		2		

1 – Low, 2 – Medium, 3 – High

MEPCC5002: Lab - Advanced Manufacturing Techniques – I		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Objectives:

1. Understand casting design procedure.
2. Identify the use of 3D printer for industrial applications.
3. Analyze the effect of machining processes parameter in EDM and WEDM.
4. Recognize the electroplating and electroless processes.
5. Study the micro and nano machining, micro and nano finishing and micro joining processes.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Apply the fundamental concepts of casting design in practice.
CO2	Understand the effect various machining parameters on metal deposition rate and surface roughness in 3 D printing.
CO3	Identify the effect of machining parameters on Metal Removal Rate and Surface Roughness in CNC Wire Cut, CNC Die Sinking EDM and Laser Cutting.
CO4	Characterization of coating parameters by scratch tester.
CO5	Understand the use of micro and nano-machining set up, micro and nano-finishing set up and micro joining for various industrial applications.

List of the Experiments:

The student shall perform following experiments:

Sr. No.	Title of the Experiments
1	Design of mould cavity, selection of parting line, design of pattens and cores, design of feeding system, Riser design and location for a casting.
2	Experiment on 3D printer to study the effect various machining parameters on metal deposition rate and surface roughness.
3	Experiment on CNC Wire Cut, CNC Die Sinking EDM and Laser Cutting to study the effect of process parameters on Metal Removal Rate and Surface Roughness.
4	Visit to micro and nano-machining, finishing, joining industry.

Assessment:

ISE II- Continuous Assessment of individual student during each experiment.
Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II
S1	Implementation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00
Total Marks		25

Knowledge Level	ISE II
Preparation S1	04
Conduct of Experiment S2	04
Observation & analysis of Results S3	08
Record S2	03
Mini project/ Presentation/Viva Voce S3	06
Total Marks	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2		1	2	2
CO2	2		1	3	1
CO3	3		2	2	
CO4	2		2	1	
CO5	2		2	2	

1 – Low, 2 – Medium, 3 – High

MEPCC5003: Advanced Mathematical Methods		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Use differential equations for solving engineering problems.
2. Effectively use numerical techniques for solving complex engineering problems.
3. Differentiate between analytical and numerical methods.
4. Compare system's behaviour with the experimental data.
5. Apply finite difference methods to solve engineering problems.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Apply differential equations to solve engineering problems.
CO2	Solve system of equations using direct and iterative numerical methods.
CO3	Apply systems of equations to solve mechanical engineering problems.
CO4	Design and create a model using curve fitting.
CO5	Apply finite difference method for solving engineering problems.

Detailed Syllabus:

Unit 1	**Numerical Methods to Solve Partial Differential Equations:** Hyperbolic equations, parabolic equations, elliptic equations, solution of Laplace equations, solution of Poisson's equations, solution of elliptic equations by relaxation method, solution of 1-D and 2-D heat flow equation, solution of wave equation.
Unit 2	**Matrices:** Matrix inversion, Gauss elimination method, Gauss Jordan method, Crout's triangularisation method, Partition method, Iterative method, Homogeneous systems the eigen- value problem, the power method, Jacobi's method, eigen-values of symmetric matrices, transformation method, transformation of generalized eigen-value problem to standard, Thomas Algorithm for Tri-Diagonal Matrix.
Unit 3	**Solution of Algebraic and Transcendental Equations:** Basic properties of equations, Bisection method, False Position method, Secant method, Iteration method, Aitken's Δ^2 method, Newton Raphson method, Horner's method, Muller's method, Root squaring method and Comparison of iterative method.
Unit 4	**Curve Fitting:** Least square curve fitting procedures for straight line, Nonlinear curve fitting, weighted least square approximation, Method of least square for continuous function.
Unit 5	**Finite Difference Methods:** Formation of difference equation, linear difference equation, rules for finding out complementary function and particular integral, difference equations reducible to linear form, simultaneous difference equation with constant coefficients, application to deflection of a loaded string and simply supported beams or cantilevers.

Text and Reference Books

1. Kreyszig Erwin, "Advanced Engineering Mathematics", Wiley.
2. Mathews John. H., "Numerical Methods", PHI, New Delhi.
3. Rajasekaran S., "Numerical Methods in Science and Engineering", Wheeler Publications
4. Grewal B. S., "Numerical Methods", Khanna Publication, New Delhi
5. Shastry S. S., "Introductory Methods of Numerical Analysis", PHI, New Delhi.
6. Chapra S. C., Canale R. P., "Numerical Methods for Engineers", McGraw Hill Education.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	05	12
K3	Apply	10	05	12
K4	Analyze	00	05	12
K5	Evaluate	00	05	12
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2		2		2
CO2	1		2		
CO3	2		2		2
CO4	1	1			
CO5	2		2		2

1 – Low, 2 – Medium, 3 – High

MEPCC5004: Lab - Advanced Mathematical Methods		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Objectives:

1. Prepare base for understanding engineering analysis software.
2. Develop logical sequencing for solution procedure and skills in soft computing
3. Formulate algorithms and programming.
4. Prepare student with mathematical tools and techniques.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Estimate solutions for differential equations using numerical techniques.
CO2	Solve system of equations using iterative numerical methods.
CO3	Design and create a model using curve fitting.
CO4	Develop solution for engineering applications with numerical techniques.

List of the Experiments:

The student shall perform following experiments:

Sr. No.	Title of the Experiments
1	Development of codes for solving partial differential equations for a) Parabolic Equation, b) Laplace Equation
2	Development of codes for solving matrices a) Gauss Elimination Method, b) Thomas Algorithm for Tridiagonal Matrix
3	Development of codes for solving algebraic and Transcendental equations a) Bisection Method, b) False Position method, c) Newton Raphson method
4	Development of codes for curve fitting a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation
5	Coding the algorithms developed for solution of any problem selected by student from the field of Production Engineering.

Assessment:

ISE II- Continuous Assessment of individual student during each experiment.
Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II
S1	Implementation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00
Total Marks		25

Preparation S1	04
Conduct of Experiment S2	04
Observation & analysis of Results S3	08
Record S2	03
Mini project/ Presentation/Viva Voce S3	06
Total Marks	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2				2
CO2	3				2
CO3	1	2			2
CO4	2			2	3

1 – Low, 2 – Medium, 3 – High

MEPEC5001: Flexible Manufacturing Systems		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To introduce and discuss flexible manufacturing concepts.
2. To explore different types of flexible manufacturing systems
3. To study about group technology, computer aided quality control and flexible manufacturing systems.
4. To study automated inspection techniques.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Articulate basic concepts of FMS
CO2	Describe elements of automation and automation strategies
CO3	Illustrate automated flow lines in FMS
CO4	Explain group technology in FMS
CO5	Predict different AMM systems and automated storage

Detailed Syllabus:

Unit 1	**FMS Concept**: CAD-CAE-CAM, components of FMS, flexibility in manufacturing, volume variety relationship, FMS workstation, machining centers, application and benefits, building blocks of FMS, FMS control.
Unit 2	**FMS Layout**: Planning for the FMS, analysis and optimization of FMS, organization and information processing in manufacturing, production concepts and mathematical models (numerical), automation strategies.
Unit 3	**Automated Flow Lines**: Methods of work-part transport, transfer mechanisms, buffer storage, control functions, automation for machining operations, analysis of transfer lines without storage, concept of partial automation, automated flow lines with storage buffers.
Unit 4	**Group Technology:** Introduction, Definition, Reasons for Adopting Group Technology, Benefits of Group Technology Affecting Many Areas of a Company, Obstacles to Application of GT
Unit 5	**Automated Material Movement and Storage System:** Introduction, Types of AGV and Their principle of working, Advantages, Limitation and General AGV Guide path, Robots, Benefits of using Industrial Robots, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet Flotation System, Queuing Carrousels and Automatic Work Changers, Coolant and Chip Disposal and Recovery system.

Text and Reference Books

1. Kundra, Tiwari, "Computer Aided Manufacturing", Tata McGraw Hill Publications
2. Groover M. P., "Automation, Production Systems and CIM", PHI Pvt. Ltd. Publications
3. Kusiak A., "Modeling and Design of FMS", Elsevier Science Publishers
4. Raouf A., Ahmed S. I., "Flexible Manufacturing", Elsevier Science Publishers

5. Ranky P. G., "Flexible Manufacturing Cells & Systems in Cim", Guildford Survey, UK
6. Ranky Paul G., "Design and operation of FMS", Guildford Survey, UK
7. Vishwanathan N., Narhari Y., "Performance Modelling of Automated Manufacturing System" PHI Publications

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1			1		
CO2		3			
CO3			1	3	
CO4		1	1	2	2
CO5	3		2		

1 – Low, 2 – Medium, 3 – High

MEPEC5002: Advanced Operations Research		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To make the use of various operation research techniques like advanced linear programming, investment decisions
2. Dynamic programming in solving, analyzing theoretical, industrial, research and real-life problems
3. Modeling and solving LPP using spreadsheet
4. Formulation of CPM and PERT problems using spreadsheet

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Infer solutions and its implementation by using advanced operation research techniques
CO2	Solve the problems using spreadsheet
CO3	Formulate the real-life problems
CO4	Solve CPM and PERT problems using spreadsheet

Detailed Syllabus:

Unit 1	**Introduction:** History, what is Operations Research, where can OR be applied, what are OR techniques, Important steps in tackling OR problems effectively, general methods of deriving solution, limitations of OR **Advanced Linear Programming:** The techniques and its applications, definitions and mathematical formulation, problems formulations, graphical solution, simplex method, duality in LP, dual simplex method, sensitivity analysis in LP, degeneracy in LP, no feasible solution, unbounded solution. Modeling and solving LP problems using spreadsheet
Unit 2	**Goal programming:** Revised simplex method, parametric programming, integer linear programming, Branch & bound algorithm, Gomory's cutting plane algorithm.
Unit 3	**Investment Decision:** Rationale and criteria, the concept of chain of equipment, cost volume profit analysis under uncertainty, risk adjusted discounted rate, risk analysis. **Replacement Analysis:** Why to replace, replacement of items, which gradually deteriorate, sudden failure preventive replacement.
Unit 4	**Project Management:** CPM, PERT, forward pass, backward pass, critical path, Project Management using spreadsheet, Gantt Chart, project crashing using spreadsheet.
Unit 5	**Dynamic Programming:** Introduction, concept of dynamic programming, principle of optimality, stage coach problem, optimum route problem, allocation of salesman to territories, planning production of seasonal items, Markovian decision process, Toy makers problem, Taxi cab problem.

Text and Reference Books

1. Ragsdale Cliff T., "Spreadsheet modeling and Decision analysis" 5th Ed, Thomson Higher Education Natorp Boulevard Mason, USA
2. Sharma S. D., "Operation Research", 12th Ed, KedarNath Ram Nath co. publication
3. Sharma J. K., "Operation Research: theory and application", 5th Ed 2012, MACIN publication.
4. Gupta P. K., Hira D. S., "Operations Research", S. Chand Publications, New Delhi.
5. Taha H. A., "Operations Research an Introduction", Prentice Hall Inc. 2003.
6. Banerjee B., "Operations Research Techniques for Management", Business Book Publishing House.
7. Swarup Kanti, Gupta P. K., Man Mohan, "Operations Research", Sultan Chand and Sons Publishers.
8. Natarajan, Balasubramani, Tamilarasi, "Operations Research", Pearson Education, New Delhi, 2005

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1	2	1	3	2
CO2	1	1	2	2	3
CO3	1	2	2		
CO4	1	1	2		

1 – Low, 2 – Medium, 3 – High

MEPEC5003: Modern Management Systems		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Analysis of quality manufacturing techniques for improving productivity and profitability.
2. Analyze maintenance problems and its effective implementation.
3. Analyzing consumer behavior for efficient production practices.
4. Evaluate various strategies for management.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain the current state of the modern management techniques
CO2	Demonstrate latest management tools and techniques
CO3	Interpret strategic management tools and its efficient application

Detailed Syllabus:

Unit 1	**Quality Management:** Introduction to Quality management, principal of Quality management, Philosophies of various Quality Gurus, Quality planning, Quality circle, Human dimension in TQM, Quality Management Tools like Brainstorming, Histogram, check sheet, pareto diagram, Ishikawa Diagram, control chart, scatter diagram, Affinity diagram, Tree diagram, Five S theory. Quality certification, ISO 9000.
Unit 2	**Just In Time:** Element of JIT manufacturing, Advantages, limitations, plant arrangement for flexible plan, planning, control, kanban, just in time logistics, Implementation issues in JIT manufacturing, Inventory management for JIT.
Unit 3	**Consumer Behavior**: Concept, Definition and Importance -A conceptual overview of Customer and Consumers –Applying Consumer Behavior knowledge – Interdisciplinary influence on the study of Consumer Behavior – On line Consumer Behavior –Interactive Decision Aids and Electronic Satisfaction.
Unit 4	**Strategic Management:** Objectives of strategic management process, formulation of strategic intent, Strategic analysis, Formulation of strategy, Implementation of strategy, Strategic evaluation and control Types of Strategies, SWOT analysis, benchmarking, Concept, Meaning and definitions, Process and Types of Benchmarking, Advantages and Limitations of Benchmarking
Unit 5	**Contemporary Advance Management:** Digital Transformation, Design Thinking, Sustainability and Corporate Social Responsibility (CSR), Data Analytics and Business Intelligence Innovation Management, Leadership in the Digital Age Global Business Management

Text and Reference Books

1. Juran TQM, TMH Publications.
2. Introduction to TPM, Productivity Press (India).
3. Groover M. P, Automation Production System, Prentice Hall, USA.

4. Bedwarth David, Computer Integrated Design and Manufacturing, Gray Sky Book.
5. Loudon and Bitta, Consumer Behaviour, TMH, 2002.
6. Frank R. Kardes, Consumer Behaviour and Managerial Decision Making, PHI, 2003.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	04	10
K2	Understand	10	04	10
K3	Apply	00	04	15
K4	Analyze	00	04	15
K5	Evaluate	00	04	10
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1		1
CO2	1		2	2	
CO3	1	3	2	1	

1 – Low, 2 – Medium, 3 – High

MEPEC5004: Modern Engineering Materials		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Explain and interpret the structure and properties of ferrous and non-ferrous materials and their heat treatment processes.
2. Infer the properties and applications of composite material for different applications.
3. Understand the structure and application of organic materials.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Predict the heat treatment process for a particular ferrous and nonferrous material.
CO2	Determine composite material for different applications.
CO3	Select a material for design and construction.
CO4	Explain composite and organic material properties

Detailed Syllabus:

Unit 1	**Ferrous Materials:** Mechanical properties, heat treatments and applications; stainless steel and heat resisting steels, precipitation hardened able steels, valve steels, high strength low alloy steel (HSLA), micro alloyed steels, ball bearing steel, tool steels, high nitrogen steels, alloy cast-iron
Unit 2	**Nonferrous Materials:** Mechanical properties, heat treatments and applications; copper alloys (Brasses and Bronzes), Al–alloys (Al-Mg-Si, Al-Cu, Al-Si), designation system in Al – alloys.
Unit 3	**Composites:** Classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulate reinforced composites
Unit 4	**Design of composites materials:** Hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle. Analysis of an Orthotropic Lamina, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations in laminates
Unit 5	**Nanomaterial and Organic Materials:** Classification, properties, application of polymers, plastics and elastomers. **Ceramics:** Classification, properties, structures of refractories, abrasive materials, electronic ceramics, cement and concrete. **Nanomaterials:** Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties, Nanomaterials versus bulk materials

Text and Reference Books

1. Jastrezebski Z. D., The nature and properties of engineering Materials, Wiley New York.
2. Aver S. H., Introduction to Physical Metallurgy, McGraw Hill, Tokyo.
3. Sharma S. C., Composite Material, Narosa Publishing House, New Delhi.
4. DeGarmo E. P., Black J. T, Kosher R. A, Materials and processes in Manufacturing, Prentice Hall.
5. Rajput R. K., Materials Science and Engineering, Kataria and Sons.
6. Chawla K. K, Composite Materials, Springer.
7. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003
8. Koch C.C., Nanostructured Materials: Processing, Properties and Applications, William Andrew, 2006.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	04	10
K2	Understand	10	04	10
K3	Apply	00	04	15
K4	Analyze	00	04	15
K5	Evaluate	00	04	10
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	1	
CO2	1	3	2		1
CO3		1	3		
CO4	1	3	2		2

1 – Low, 2 – Medium, 3 – High

MEPEC5005: Engineering Experimental Techniques		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. **Problem Identification and Formulation**: Develop the ability to identify engineering problems that can be addressed through experimentation and to formulate relevant research questions.
2. **Hands-on Experience**: Gain practical, hands-on experience in the laboratory setting to reinforce theoretical concepts and develop a deeper appreciation for the role of experimentation in engineering.
3. **Data Collection and Analysis**: Learn how to collect accurate and reliable data during experiments, and develop proficiency in organizing, analyzing, and interpreting experimental results using statistical methods and software tools.
4. **Experimental Techniques**: Acquire practical skills in conducting experiments related to different engineering disciplines, such as mechanical, electrical, chemical, civil, or materials engineering. Understand techniques for measuring properties like stress, strain, temperature, pressure, flow rate, and more.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain dynamic measurements
CO2	Analyze experimental data
CO3	Interpret experimental observation using statistical tools
CO4	Selection of appropriate measuring equipment, measuring sensors, data acquisition and storage system

Detailed Syllabus:

Unit 1	**Basic Concepts:** Definition of terms, Calibration, Standards, Dimensions and units, the generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning, first-order and second-order responses.
Unit 2	**Analysis of Experimental Data:** Causes and types of experimental errors, uncertainty analysis, evaluation of uncertainties for complicated data reduction
Unit 3	**Statistical analysis of experimental data:** probability distributions, the Gaussian, normal error distribution, probability graph paper, the Chi-square test of Goodness of fit, The method of least squares, the correlation coefficient, standard deviation of the mean, t-distribution, Graphical analysis and curve fitting, general considerations in data analysis.
Unit 4	**Force Torque and Strain Measurements:** Mass balance measurements, elastic elements of force measurements, torque measurement, stress strain measurements, various types of strain gauges, **Motion and Vibration measurement:** Simple vibration instruments, principles of the seismic instruments, practical considerations of seismic instruments, sound measurements. Pressure, Temperature, Heat flux, Thermal conductivity measurement, various transducers, selection of measuring instruments.

Unit 5	**Data Acquisition and Processing:** The general data acquisition system, signal conditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic.

Text and Reference Books

1. Jain R. K., "Mechanical Measurements", Khanna Publishers, New Delhi, 2018
2. Sawhney A. K., "A course in electrical and electronic measurement and instrumentation", Dhanpat Rai pub, Delhi, 2012
3. Nakra B. C., Chaudhary K. K., "Instrumentation Measurement and Analysis", McGraw-Hill Publication, 4th edition, 2016
4. Ernest O. Doebelin, "Measurement system", 6th edition, McGraw-Hill Publication, 2017
5. Holman J. P., "Experimental Methods for Engineers", 9th Ed, McGraw Hill Publications, New York, 2015

Useful Links:

6. https://nptel.ac.in/courses/112105117/13
7. https://nptel.ac.in/courses/112105117/4
8. https://nptel.ac.in/courses/112105166/28

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	00	00	00
K2	Understand	10	05	20
K3	Apply	10	10	20
K4	Analyze	00	05	20
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2				
CO2	1	2	1	3	2
CO3	1			3	2
CO4		1	1	2	

1 – Low, 2 – Medium, 3 – High

MEPEC5006: Management Information Systems & Enterprise Resource Planning		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To enables new approaches to improve efficiency and efficacy of business models.
2. To understanding of role, advantages and components of an Information System.
3. To understand the basic concept of ERP systems
4. To study the steps and activities in the ERP life cycle
5. To develop a process driven thinking towards business processes

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Describe the use and function of management information systems;
CO2	Describe the different roles of people in information systems
CO3	Demonstrate a good understanding of the basic issues in ERP systems
CO4	Interpret the strategic options for ERP identification and adoption
CO5	Design the ERP implementation strategies

Detailed Syllabus:

Unit 1	**Basic Concepts of Information System** Role of data and information, Organization structures, Business Process, Systems Approach and introduction to Information Systems**.**
Unit 2	**Types of Information System** Resources and components of Information System, integration and automation of business functions and developing business models. Role and advantages of Transaction Processing System, Management Information System, Expert Systems and Artificial Intelligence, Executive Support Systems and Strategic Information Systems.
Unit 3	**Introduction to ERP** Introduction, evolution, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules of ERP, Advantage of ERP, Integrated Management Information, Business Modeling, ERP for Small Business
Unit 4	**ERP and Related Technologies** ERP and Related Technologies, Business Process Reengineering (BPR), Management Information System (MIS), Executive Information System (EIS), Decision support System (DSS), Supply Chain Management (SCM)
Unit 5	**ERP Implementation Lifecycle** Issues in Implementing ERP Packages, Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation, Team Training, Testing, Going Live, End-User Training, Post Implementation (Maintenance Mode). **Future Directions in ERP** New Markets, New Channels, Faster Implementation Methodologies
	Expert lecture on topics related to practical tools in the field to be arranged.

Text and Reference Books

1. Effy OZ, Thomson Leaning, Management Information Systems, Vikas Publications.
2. James A. O' Brein, Management Information Systems, Tata McGraw-Hill.
3. W. S. Jawadekar, Management Information System, Tata Mc Graw Hill Publication.
4. David Kroenke, Management Information System, Tata Mc Graw Hill Publication.
5. Christian N. Madu, ERP and Supply Chain Management, CHI Publisher
6. Glynn C. Williams, Implementing SAP ERP Sales & Distribution, McGraw-Hill

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course outcomes with Program outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		3	1		
CO2	2			3	1
CO3			3		
CO4		2	1	3	
CO5			2		

1 – Low, 2 – Medium, 3 – High

MEVSE5001: Mini Project – I		
Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 02	**ESE**	**25 Marks**

Course Objectives:

1. To make the student conversant with industrial activities / project execution activities
2. To exemplify various industrial aspects in manufacturing processes and industrial design
3. Student will able to analyze and solve industrial mini problem / work on in-house project

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate industrial project / in-house project
CO2	Identify industrial problems / in-house
CO3	Integrate and apply the knowledge gained through different courses into practical problems
CO4	Prepare a consolidated report

Detailed description:

1. Student shall identify and collect pragmatic industrial information / in-house project / social problem as a Mini Project – I.
2. Student shall obtain a solution by applying suitable techniques
3. Student has to exhibit the continuous progress review through regular reporting and presentations (at least two during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
4. The candidate shall submit the report on Mini Project – I in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:

ISE II- Continuous Assessment of individual student
Maximum Marks-25
ESE – Viva Voce based on presentation and report
Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	04	04
S2	Manipulation	03	03
S3	Precision	14	14
S4	Articulation	04	04
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	ISE II	ESE
Preparation S1	04	04
Articulation of problem S4	04	04
Observation S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	**25**	**25**

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	1
CO2	2	1	1	3	1
CO3	1	1	1	3	1
CO4		3		1	

1 – Low, 2 – Medium, 3 – High

MERMC5001: Research Methodology		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews.
2. To develop a comprehensive understanding of various research methods, both qualitative and quantitative
3. To facilitate students in analysing, evaluating, and creating research proposals.
4. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes.
5. To Equip students with the skills to proficiently create and present diverse research reports, encompassing various formats, oral delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Develop the ability to comprehend core research concepts, define key elements like variables and hypotheses, and critically evaluate literature to identify research gaps.
CO2	Justify their chosen research methods and explain their advantages and limitations.
CO3	Create well-structured research proposals that include clear research objectives, methods, and expected outcomes.
CO4	Proficient in using data analysis techniques relevant to their chosen research methods, such as statistical analysis for quantitative research or thematic analysis for qualitative research.
CO5	Create comprehensive research reports in diverse formats, such as academic papers, presentations, and technical reports.

Detailed Syllabus:

Unit 1	**Introduction to RM:** Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.
Unit 2	**Methods of Research:** Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.) field and laboratory experimental studies. Characteristics of methods and their implications in research area.
Unit 3	**Development of research proposal:** Research proposal and its elements Formulation of research problem-criteria of sources and definition Development of objectives and characteristics of objectives. Development hypotheses and applications.

Unit 4	**Methods of data collection:** Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, opinionnaire, observation, interviews, scales and tests etc. **Methods of data analysis:** Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphs etc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests. Validity and delimitations of research findings.
Unit 5	**Interpretation and Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

1. Garg B. L., Karadia R., Agarwal F. and Agarwal U. K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
4. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	02	06
K2	Understand	10	08	24
K3	Apply	00	03	09
K4	Analyze	05	04	12
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3		
CO2	2	2	2		
CO3	2		3	1	
CO4	1		3	1	
CO5	1	3	2		2

1 – Low, 2 – Medium, 3 – High

INCCC5001: Yoga / Club Activities		
Teaching Scheme	**Examination Scheme**	
Practicals: 02 Hrs. / Week	**Audit Course**	
Credits: 00		

Course D**escription**: Co-curricular activities are activities that take place outside of a course's curriculum but are related to academics in some way. Although involvement is not part of classroom instruction, it does supplement and enhance a student's academic experience.

Yoga - In today's stressful life, there is much more need to experience relaxation and remain focused. The inner connect is very much needed to retain stability. Beyond physical exercise there is much more to do in the field of Yoga. The content of this course includes Yoga, Pranayam, Meditation, Relaxation, rejuvenation and connection with our own self. The introduction of such an experiential course helps to boost self-confidence and with regulation of mind through meditation improves concentration. Meditation is basically training of mind and helps to regulate it. Along with experiential learning, the students are also exposed to learnings contained in the supported literature.
The student shall perform: a) Perfection in at least 3 types of Yoga-asanas (Trikonasan, Konasan and Ushtrasan) b) Perfection in at least 3 types of Pranayama (Anulom-Vilom, Bhramari and Kapalbhati) c) Regular practice of Yoga-asanas, Pranayam and Meditation for 10 minutes during the allotted periods as per the time table and daily at home.

The evaluation is based on participating and performing Yoga, Pranayam and meditation regularly and perfectly under the guidance by Yoga Teachers. Meditation trainers will observe intrinsic goodness, right attitude and happy and joyous way of doing things.

Club activities: Government Engineering College Chhatrapati Sambhajinagar has various clubs that focus on specific interests such as robotics, coding, literature, environment, etc. These clubs often organize events, workshops, and competitions that provide students with opportunities to learn new skills and showcase their talents. Students will participate in Club Activities throughout semester. Faculty coordinators will coordinate along with students bodies the activities of club.

The faculty coordinators will certify at the end of semester about participation of students.

MEPCC5005: Robotics and Automation		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics.
2. To know the different sensors, gripers their selection and dynamic performance analysis.
3. To accustom with robot programming and its use in casting, welding, machining industry.
4. To know the CNC, PLC and DC servo systems and machine interfacing.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain robot anatomy and robot performance
CO2	Illustrate robot force and motion for particular case and knowledge for sensor and gripper selection
CO3	Classify different controllers of robots and compute the gripper operations
CO4	Illustrate PLC's programming for particular industrial systems

Detailed Syllabus:

Unit 1	**Automation and Robotics:** Definition, need of the robotics, market and future prospects, differentiation of robots from other automation systems, near relations to robots, robot usages and conditions for its application, robot anatomy and characteristics: classification, point to point and continuous path system, control loops of robot system, work volume, speed of movement, dynamic performance, accuracy and repeatability, drive system, sensors used in robotics, letter symbol, coding and kinematics arrangement
Unit 2	**Transformations and Kinematics:** Coordinate transformation -vector operations – basic transformations matrices - properties of transformation matrices- homogeneous transformations– forward solution, DH algorithm - inverse kinematic solution, brief robot dynamics
Unit 3	**Controls and End Effectors:** Control system concepts - analysis - control of joints -adaptive and optimal control – end effectors - classification - mechanical - magnetic - vacuum - adhesive - drive systems and controls- force analysis and gripper design
Unit 4	**Robot Applications:** Work cell control and interlocks, robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection, etc., introduction to robotics technology of the future, future applications.
Unit 5	**Automation:** Introduction, types of automation, types of automation systems, Programmable Logic Controllers, parts of a typical PLC system, programming of PLC, example applications of PLC in a CNC machine.

Text and Reference Books

1. Groover M. P., Willis, "Industrial Robotics", McGraw Hill.
2. Aures R. U. and Miller S. M., "Robotics applications and implications", Ballinger Publishing Co., Cambridge
3. Groover M. P. and Zimmer E. W., "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi
4. "Machatronics", HMT Limited, Tata McGraw Hill Publications, New Delhi
5. David G., "Machatronics", Tata McGraw Hill Publications, New Delhi
6. Handbook of Industrial Robotics

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1			2	1
CO2	1	1		1	2
CO3	1	1		2	
CO4	1	2		1	2

1 – Low, 2 – Medium, 3 – High

MEPCC5006: Lab – Robotics and Automation		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Objectives:

1. To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics.
2. To know the different sensors, their selection and dynamic performance analysis.
3. To accustom with robot programming
4. To know the CNC, PLC and DC servo systems and machine interfacing.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate Robot Anatomy
CO2	Demonstrate different robot sensors and grippers
CO3	Illustrate robot programme methods for particular industrial applications
CO4	Explain PLC programming for particular industrial applications

List of the Experiments:

The student shall perform following experiments:

Sr. No.	Title of the Experiments
1	Study of robot anatomy
2	Experiment on various robotic sensors and its use in practice
3	Robot programming methods and languages
4	PLC: Various hardware types of PLC (CPU and I/O modules). Centralized configuration of PLC.
5	Visit to an automation industry

Assessment:

ISE II- Continuous Assessment of individual student during each experiment.
Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II
S1	Implementation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00
Total Marks		25

Knowledge Level	**ISE II**
Preparation S1	04
Conduct of Experiment S2	04
Observation & analysis of Results S3	08
Record S2	03
Mini project/ Presentation/Viva Voce S3	06
Total Marks	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2			1	1
CO2	1	1		1	
CO3	1	2		1	2
CO4	1		1	1	2

1 – Low, 2 – Medium, 3 – High

MEPCC5007: Collaborative Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Develop concepts of cross functional team, Conceptual design, QFD for Design for Assembly
2. Identify the various key parameters in Product Design for casting, molding, welding, forging, sheet mental operations
3. Work out force Analysis Analyze professional product design on basis of Cost, reliability, Value, safety, ergonomics, environment etc.
4. Acquire knowledge of various software's of PLM, DFM, for new product design

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate product life management, Conceptual design, QFD
CO2	Infer the design considerations in casting, moulding, welding, forging, sheet metal operations.
CO3	Compute Cost, reliability, Value, quality house of product and experiment DFA on new product.
CO4	Explain soft tools used for product developments

Detailed Syllabus:

Unit 1	**Collaborative PLM:** Concept – product development through cross-functional teams supported by information and communication technologies, Product innovation, Product lifecycle, Product definition using QFD, Conceptual design, Concept evaluation.
Unit 2	**Design for Manufacture:** Design for moulding, Design for forging and welding, Design for sheet metal forming, Design for machining.
Unit 3	**Design for Assembly:** Design for use (ergonomics), Design for safety and reliability, Design for service/maintenance, Design for environment.
Unit 4	**Design for Quality and Cost:** Design for quality, Design to cost, Product cost estimation, Product lifecycle cost, important aspects affecting market competitiveness, Value engineering (self-study).
Unit 5	**Product Lifecycle Engineering:** Product data management, Product structure and storage, Workflow and project management, Change management, Distributed product data management, Web-based collaboration, Knowledge management, Collaborative engineering team, PDM/PLM systems, DFM/PLM software demonstration, Intelligent CAX/PLM, Future evolution.

Text and Reference Books

1. Bralla J. G., "Handbook of Product Design for Manufacturing", McGraw-Hill, New York, 1986.
2. W. D. Li, S. K. Ong, Andrew Y. C. Nee, Chris McMohan, Collaborative Product Design and Manufacturing Methodologies and Applications, Springer
3. Emad S. Abouel Nasr, Collaborative Engineering: Theory and Practice, Springer, USA.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1		1	1
CO2	1	1		3	
CO3	1		2	2	1
CO4	1			2	2

1 – Low, 2 – Medium, 3 – High

MEPCC5008: Production Management		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Able to understand production / operation management objectives and various manufacturing strategies.
2. Able to develop new product design concept and technology forecasting and development also able to design process
3. Analyze the capacity planning and strategies and various balancing methods
4. Carry out process flow analysis
5. To apply the concepts of supply chain management and forecasting techniques analysis

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implementation of various manufacturing strategies and able to work out manufacturing excellence
CO2	Development of product design procedures and implementation of forecasting techniques and various design processes
CO3	To derive capacity strategies of various processes and its implementation
CO4	Enable to develop the use of various process flow charts and balancing methods
CO5	Implementation and execution of SCM concepts and forecasting techniques

Detailed Syllabus:

Unit 1	**Operation Management:** Introduction to Operations Management, Operations Strategy in a global economy, Operations Management and Productivity, Types and Characteristics of Manufacturing and Service Systems, Product Design
Unit 2	**Product Design:** New product concept, strategies for new product development process, concurrent engineering, designing for costumer, Quality function deployment, designing products for manufacturing and assembly, technology forecasting and technology development process. **Process Design**: Choice of technology, process flow characteristics, process selection decisions, process strategies, use of Break-even analysis in process/machine selection
Unit 3	**Project Management:** Total Productive Maintenance, Introduction to Project Management, PERT and CPM, Project Risk Management
Unit 4	**Quality Management:** Nature of Quality, Evolution of Quality Management, Modern Quality Management, Total Quality Management, Statistical Concepts in Quality Control
Unit 5	**Supply Chain Management:** Supply chain, outsourcing, make or buy decision, value density, supplier selection, JIT purchasing, global sourcing and distribution. **Forecasting:** Time series analysis techniques, linear regression, moving average, exponential smoothing, casual relationship forecasting, forecast error, choice of forecasting techniques, aggregate planning, operation planning overview, production planning environment, production strategies and aggregate planning strategies

Text and Reference Books

1. Telsang Martand, "Industrial Engineering and production Management", S. Chand and co. Ltd. New Delhi.
2. Monks Joseph, “Operation Management Theory and problems”, McGraw Hill Inc. New York.
3. "Production and Operation Management (Manufacturing & Services)", TMH New Delhi.
4. Korgaonkar, "Just in Time Manufacturing", Tata McGraw Hill Co. Ltd. New Delhi
5. Panneenselvam R., "Production and Operation Management", PHI New Delhi.
6. Riggs James, "Production System: Planning, Analysis and Control", John-Wiley and Sons New York

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	04	10
K2	Understand	10	04	10
K3	Apply	00	04	15
K4	Analyze	00	04	15
K5	Evaluate	00	04	10
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		1		2	
CO2	1	2	2	1	
CO3		2	1		
CO4					
CO5	2	2	3		

1 – Low, 2 – Medium, 3 – High

MEPCC5009: Lab –Advanced Manufacturing Techniques – II		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Objectives:

1. Understand the use of CMM for measurement of dimensions.
2. Identify the use of 3D scanner for industrial applications.
3. Analyze the effect of machining processes parameter in CNC Turning.
4. Recognize the CNC Milling process.
5. Study various types of 3D printers.
6. Understand TIG and MIG welding process.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Inferring of CMM for practical measurement purpose
CO2	Interpret the use of 3D scanner for measurement.
CO3	Predicting the effect of machining parameters on Metal Removal Rate and Surface Roughness in CNC Turning
CO4	Predicting the effect of machining parameters on Metal Removal Rate and Surface Roughness in CNC Milling
CO5	Implementing 3D Printers used for various industrial applications.
CO6	Illustrating the use of TIG and MIG Welding.

List of the Experiments:

The student shall perform following experiments:

Sr. No.	**Title of the Experiments**
1	Industrial visit to a nearby industrial hub to demonstrate Measurement of dimensions of a component by using CMM.
2	Measurement of dimensions of a component by using 3D scanner
3	Manufacturing a component by using CNC Turning
4	Manufacturing a component by using CNC Milling
4	Programming and manufacturing of product using 3D Printer
6	Experimentation on advanced Joining processes like TIG and MIG Welding

Assessment:

ISE II- Continuous Assessment of individual student during each experiment.

Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE II**
S1	Implementation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00
Total Marks		25

Knowledge Level	**ISE II**
Preparation S1	04
Conduct of Experiment S2	04
Observation & analysis of Results S3	08
Record S2	03
Mini project/ Presentation/Viva Voce S3	06
Total Marks	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2		1	2	2
CO2	2		1	3	1
CO3	3		2	2	
CO4	2		2	1	
CO5	2		2	2	
CO6			2	3	

1 – Low, 2 – Medium, 3 – High

MEPEC5007: Machine Tool Design		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand fundamental concepts machine tool design, drives, various transmission systems of machine tools.
2. Identify the importance of feed and speed regulation in machine tools.
3. Recognize the significance of machine tool design structures**.**
4. Understand design procedure of Guide ways, Power screws and spindles.
5. Know working of Numerical Control of Machine Tools**.**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Associating the concepts of transmission system
CO2	Implement the knowledge to develop machine tool
CO3	Articulate and formulate Engineering problems in Machine tool Design
CO4	Execution of analytical skill on working with Numerical Control of Machine Tools.

Detailed Syllabus:

Unit 1	**Machine Tool Drives and Mechanism and design of cutting tools:** Working, Auxiliary Motions in Machines tools, Calculation of machining times for turning, External relief, Chamfer, Knurling, Forming, Facing, Drilling, Boring, Undercutting, Shaping, Planning, Slotting, Broaching, Sawing, Milling, Grinding, Threading and Tapping. Machine tool drives, Hydraulic transmission, mechanical transmission, different types of driving mechanisms used in machine tools, requirements of machine tool design, Engineering design process applied to Machine Tools,
Unit 2	**Regulation of Speed and Feed Rates in Machine Tools:** Speed and feed rates regulation, design of speed box, design of feed box, Machine tool drives in multiple speed motors, special cases, gearing diagram, determination of number of teeth.
Unit 3	**Design of Machine Tool Structures:** Materials of machine tool structures, Design criteria for machine tool structures, Materials of machine tool structures, Static and Dynamic stiffness, Profiles of Machine Tool Structures, Basic design for procedure of Machine Tool Structures, Design of beds, columns, housings, bases and tables, Model technique in design of machine tool structures
Unit 4	**Design of Guide ways, Power screws and spindles:** Functions and types of guide ways**,** Design of slideways, design criteria and calculations for slideways, guideways operating under liquid friction conditions, design of aerostatic slideways, design of anti-friction guideways, combination guide ways, protecting devices of slide ways, design of power screws, design calculations of spindles. Antifriction bearings and sliding bearings, stability of machine tools, forced vibrations of machine tools
Unit 5	**Numerical Control of Machine Tools:** Fundamental Concepts, Classification and Structures of Numerical Control Systems, Manual Part Programming, Computer

	Aided Part Programming, Distributive Numerical Control, Computer Numerical Control, Machining Centres, CNC Programming.

Text and Reference Books

1. Basu S. K., "Design of Machine Tools", Allied Publishers
2. Acharkan, "Metal Cutting Machine Tools", Technical Publishing House
3. Bhattacharya A., Sen G. C., "Principles of Machine Tools", New Central Age, New Delhi
4. Mehta N. K., "Machine Tool Design", Tata McGraw-Hill
5. Brandon C. Gegg , C. Steve Suh, Albert C. J. Luo, Machine Tool Vibrations and Cutting Dynamics, Springer New York, NY, 2014
6. P. Bézier, Numerical control: Mathematics and applications, Wiley, London

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		2	1		
CO2	1	3	2		
CO3			1	3	
CO4	3		2		

1 – Low, 2 – Medium, 3 – High

MEPEC5008: Computer Aided Optimization		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To develop a strong command of single-variable optimization algorithms for engineering applications.
2. To excel in implementing multivariable optimization techniques using computer programs.
3. To competently apply constrained optimization methods, including Kuhn-Tucker conditions and gradient-based approaches.
4. To acquire expertise in specialized optimization algorithms such as genetic algorithms and simulated annealing, through hands-on programming.
5. To attain a deep understanding of Operations Research optimization concepts, including linear programming, simplex method, and sensitivity analysis.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Formulate optimal problems, address engineering optimization challenges, and apply a variety of single-variable optimization algorithms.
CO2	Proficiently utilize multivariable optimization algorithms.
CO3	Analyze constrained optimization methods aided by computer programs for real-world problem-solving.
CO4	Apply special optimization methods with practical computer program implementation across diverse applications.
CO5	Implement optimization strategies within Operations Research, encompassing linear programming, execution of the simplex method, and utilization of artificial variable techniques.

Detailed Syllabus:

Unit 1	**Introduction:** Optimal problem formulation, engineering optimization problems, optimization algorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.
Unit 2	**Multivariable Optimization Algorithms:** Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.
Unit 3	**Constrained Optimization Algorithms:** Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.
Unit 4	**Special Optimization Algorithms:** Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.
Unit 5	**Optimization in Operations Research:** Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis

Text and Reference Books

1. Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi
2. Rao S. S., "Engineering Optimization", John Wiley, New Delhi.
3. Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	00	02	06
K2	Understand	05	02	06
K3	Apply	15	10	30
K4	Analyze	00	03	09
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3		2		2
CO2		2	2		2
CO3	2		1		2
CO4	2	2	1	2	2
CO5	3	2	2	2	2

1 – Low, 2 – Medium, 3 – High

MEPEC5009: Engineering Economics		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To build up the knowledge of managerial economics and analysis of project considering economical concepts.
2. Expertise in costing, finance and accounting related to the organization. Able to execute corporate planning.
3. Assess the best feasible investment proposal among the alternatives based on the common index.
4. Acquire basic concepts of cost accounting relevant for managerial decision making.
5. Explores the relationship, which exists between costs, revenue, output levels and resulting profit.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implement the knowledge of economics to the production engineering
CO2	Evaluate investment opportunities using engineering economy factors
CO3	Perform a replacement study considering inflation and indirect cost allocation
CO4	Estimate the cost of component and total cost of operation
CO5	Perform breakeven analysis and profitability analysis under different conditions.

Detailed Syllabus:

Unit 1	**Engineering Economics and Estimation:** The principle and use of economic analysis in engineering practice. Discounted cash flow analysis, corporate tax and investment, Depreciation and economic studies, replacement analysis, valuation of assets. Estimating: Importance and aim, objectives, functions, Estimating Procedure, Constituents of Estimation. Concept of direct tax, indirect tax as GST.
Unit 2	**Depreciation & break-even analysis:** Introduction, purpose, methods for calculating depreciation-straight line method, diminishing balance method, sum of year digit method, machine hour basis method. **Break even analysis:** Introduction, assumptions in break-even analysis, important terms and definitions, calculation of breakeven point, advantages and limitations.
Unit 3	**Economic analysis of projects**: analysis of risks and uncertainty, elements of demand analysis and forecasting, production function, output and pricing decisions **Comparison of Alternative Proposals**: Formulating alternatives, Bases of comparison- present worth amount, annual equivalent amount, future worth amount, rate of return, Defining mutually exclusive alternatives, Decision criteria for selection of investment proposals, Comparison of alternatives with unequal service life, Sensitivity analysis
Unit 4	**Costing:** Definition, aims, procedure for Costing, types of costs, Costing controls, Control of Costs, Profit and Pricing Policy. Costing methodology for raw materials, Products and Services, Nature of Costs-Direct, Traceable and Non traceable. Determining of Cost of manufactured products, methods of overhead allocation

Unit 5	**Corporate Planning:** Corporate objectives, goals and policies, process of corporate planning, SWOT analysis, GAP analysis, strategy formulation, investment evaluation, capital budgeting, industrial dynamics, Business case development.

Text and Reference Books

1. Owler W., Brown J. L., "Cost Accounting and Cost Methods", McDonald and Evans Publications
2. Kuchal S. C., Financial Management - An Analytical and Conceptual Approach", Chaitanya Publishing House
3. Shukla M. S. and Grewal T. S., "Advance Accounts", S. Chand and Co., New Delhi
4. Sinha B. P., Mechanical Estimating and Costing, Tata McGraw Hill Publishing Co. Ltd. N. Delhi
5. Banga T. R. and Sharma S. C., Mechanical Estimating and Costing, Khanna Publishers, Delhi-6
6. Sharma S. K., Savita Sharma, Industrial Engineering & Operations management, Kataria publishers
7. Kesoram R. & others, Process Planning & Cost Estimation, New Age International Pub., New Delhi
8. Dennis Lock, Handbook of Engineering Management, Butter work & Heinemanky Ltd.
9. Theusan G. J., "Engineering Economics", PHI, New Delhi
10. Dean Joel, "Managerial Economics", PHI, New Delhi
11. Hussey D. D., "Introducing Corporate Planning", Pergamon Press, New York

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	03	04	10
K2	Understand	04	04	15
K3	Apply	03	03	10
K4	Analyze	04	04	10
K5	Evaluate	03	03	10
K6	Create	03	02	05
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	
CO2	3	2	3		2
CO3	2	3	2	3	3
CO4	1			3	
CO5		2	3	2	

1 – Low, 2 – Medium, 3 – High

MEPEC5010: Computer Integrated Manufacturing		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Develop an understanding of classical production system, management technology.
2. Develop an understanding of computer integrated manufacturing and its impact on productivity, product quality.
3. Obtain an overview of computer technologies including computers, database and data collection networks, machine control etc.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Proficiency in analyzing the computer integrated manufacturing
CO2	Utilize the knowledge of database networking for manufacturing.
CO3	Competency in accounting the measures and evaluation of CIM systems
CO4	Develop the ability of Planning & Implementation of CIM

Detailed Syllabus:

Unit 1	**Introduction to CAD, CAM and CIM:** Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM, Concurrent Engineering-CIM concepts, Computerized elements of CIM system, Types of production, Manufacturing models and Metrics, Mathematical models of Production Performance, Simple problems, Manufacturing Control, Simple Problems, Basic Elements of an Automated system, Levels of Automation, Lean Production and Just-In-Time Production.
Unit 2	**Integration of Manufacturing:** Integration of manufacturing activities and operations, CIM architecture, various models, CAD-CAM integration, CAPP, Automatic inspection systems, use of CMM, application of principals of Artificial Intelligence (AI) and expert systems to CAPP
Unit 3	**DBMS in CIM:** Data base management system in CIM, data acquisition, factory data collection system, data processing, data distribution, database file structure, organization and control, data structure models (hierarchical, network, relational and three schemes). Use of internet in manufacturing and business functions, E-commerce and future trends.
Unit 4	**Economics of CIM:** Strategic benefits of CIM and accounting measures, evaluation of CIM systems, breakeven analysis, return on investment in the context of CIM, CIM feasibility analysis. socio-techno economic aspects of CIM.
Unit 5	**Planning & Implementation of CIM:** Key aspects of planning and implementation, process management considerations. Various phases and steps in CIM implementation. Interfacing of computers to real life system such as machine tools, robots and other handling devices such as AGV, RGV and storage system

Text and Reference Books

1. Teicholz Eric, Norr Joel, "CIM Handbook", McGraw Hill International.
2. Harrington J., "Computer Integrated Manufacturing", Krieger Pub Co
3. Richard N. Stover, "An analysis of CAD/CAM application: with an introduction to CIM", Prentice Hall.
4. Bedworth David, "Computer Integrated Design and Manufacturing", McGraw Hill.
5. Warren S. Seames, "Computer Numerical Control: Concepts and Programming", 4th edition, Delmar Thomson Learning Inc.
6. Scholz B and Reiter, "CIM Interfaces", Chapman and Hall

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		1		2	
CO2	1	2	2	1	
CO3		1	2		2
CO4		1	2		2

1 – Low, 2 – Medium, 3 – High

MEPEC5011: Materials and Logistics Management		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand and analyze the material related functions, planning and decisions in the industry
2. Able to understand purchase policies and procurement of inventory and vendor development in the legal aspects of purchasing
3. To know the buying procedures, rate and running contract, stores procedures
4. To understand international buying procedures and licensing
5. To illustrate need of inventory, Genesis of logistics

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Decide material policies and planning in industry
CO2	Execute purchase policies and procurement and vendor development
CO3	Implement buying procedures, running contract and store procedures
CO4	Analyze various inventory models and execute logistic decisions

Detailed Syllabus:

Unit 1	**Material Management**: Concepts, objective and scope, organizing for materials function, various administrative practices. Interaction with production and sales, material management planning and budgeting, various techniques, ABC analysis, standardization and codification, make and buy decision
Unit 2	**Purchasing Scheme**: Purchasing system, ordering, post purchase activity, price forecasting and analysis, purchasing under uncertainty vendor development and evaluation, purchase negotiation and pricing, purchasing of capital equipment tendering, purchase aerosol lease, import substitution, import regulations and procedure, legal aspects of purchasing
Unit 3	**Public Buying and Stores Management:** Buying procedure related to various governmental organizations like DGS and D registration of suppliers, rate and running contracts, indenting procedure Purchase of stores location and layout, various types of stores, stores procedures, stores accounting and stock checking management of scrap, obsolete, damage and unwanted stocks.
Unit 4	**International Buying and Import Purchasing**: Import procedures and documents, categories of import, import duties, basics of licensing, Import purchasing procedures, Registration of licenses at port
Unit 5	**Logistics Management and Inventory**: Genesis of logistics-logistics decision on facility location, need for inventory and its control, types of inventories, cost of inventory, determination of safety stock, EOQ, Q system or re-order point system, P system or replenishment system, S policy, store keeping and inventory control

Text and Reference Books

1. Dobler Bunt, "Purchasing and Material Management", TMH Publications
2. Farrel, Heinritz, Smith, "Purchasing Principle and Application", Prentice Hall of India.
3. Gopalkrishnan and Sudershan, "Purchasing and Material Management", PHI Publications
4. Smolik, Nostrands, "The Material Requirements of Manufacturing", Van Nost, Reinhold, U.S.
5. Ballou Ronald H., "Business Logistics Management", Prentice Hall of India.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	03	04	10
K2	Understand	04	04	15
K3	Apply	03	03	10
K4	Analyze	04	04	10
K5	Evaluate	03	03	10
K6	Create	03	02	05
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	
CO2	1	2			2
CO3	1	3	2	3	3
CO4	1		2	3	
CO5		2	1	2	

1 – Low, 2 – Medium, 3 – High

MEPEC5012: Facility Planning and Material Handling Systems		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To understand the overall facilities planning process.
2. To educate product, process and schedule design and their effects on the facility layout.
3. To introduce concepts of material handling and safety in industries.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Assess the value of facility planning on the strategy of a firm
CO2	Develop a systematic plant layout
CO3	Articulate the environmental and economic aspects in facility planning
CO4	Interpret various material handling systems
CO5	Contrasting different conveying machinery industry

Detailed Syllabus:

Unit 1	**Design and Layout:** Design of layout of factories, Office, Storage area etc. on consideration of facility of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning, Design of Assembly lines, Line balancing methods.
Unit 2	**Computer applications in layout designs**, ALDEP, CORELAP, CRAFT, BLOCPLAN, etc. Warehouse operations: function, storage operations. Manufacturing operation: JIT, TQM, AM, CIM, SCM, Facility systems, Quantitative models: Layout model, waiting line, AS/RS, simulation model, etc. Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air etc. Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.
Unit 3	**Material handling systems:** Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.
Unit 4	**Components of material handling:** Flexible hoisting appliances - fastening methods - Load handling attachments – Classification of hooks, forged - eye hook - Appliances for suspending hooks- crane grab for unit and piece loads- electric lifting magnet - vacuum lifter - Grabbing attachment for loose materials - crane attachment for handling liquids - Arresting gear – brakes - construction - working - electromagnetic shoe brakes - construction - use - thruster operated shoe brakes - control brakes
Unit 5	**Conveying machinery:** Traction type conveyors - Working - belt conveyors- chain conveyors-bucket elevators- escalators Working of traction less type conveyors - gravity type conveyors, vibrating and oscillating conveyors, screw conveyors - pneumatic - hydraulic conveyors – hoppers - gates and feeders - Surface transport equipment - functions - working of trackless equipment - hand operated trucks - powered trucks - tractors, AGV (Automatic Guided Vehicle) - industrial trailers -

	functions - working - cross handling equipment – winches – capstans – turntables - transfer tables - monorail conveyors.

Text and Reference Books

1. A. W. Peymberton, Plant layout and Material Handling, John Wiley
2. James A. Apple, Plant layout and Material Handlin, Krieger Pub Co.
3. John A. Sehbin, Plant layout and Material Handling, John Wiley
4. K. C. Arora & Shinde, Aspects of Material handling, Edition, 1st edition, Laxmi Publications
5. R. B. Chowdary, G. N. R. Tagore, Material Handling Equipment, Khanna Publishers, Delhi.
6. Allegri T. H., Material Handling Principles &Practice, CBS Publisher, Delhi

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		2	1		
CO2					
CO3	2			3	
CO4		1	1	2	3
1CO5					

1 – Low, 2 – Medium, 3 – High

MEPEC5013: Reliability Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To inculcate the knowledge of reliability and its applications to various engineering problems, with the use of probability theories matrices and decision-making using event tree analysis, AGREE, ARINC techniques.
2. To analyze engineering design using reliability concepts.
3. Use of accelerated methods in reliability testing and FMEA

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Infer reliability technique and its execution.
CO2	Carry out decision making process using event tree analysis and other methods
CO3	Explain methods of reliability analysis in life cycle cost
C04	Analyze FMEA procedure to solve a product development problem

Detailed Syllabus:

Unit 1	**Introduction to Reliability:** Applications to engineering, discussions on Reliability failure rate, Patters of Failure Distribution and Bathtub curve, Failure data collection and life estimation and Monte Carlo simulation of cumulative probability of failure of consistent components.
Unit 2	**Reliability Methods:** Survival probabilities of various systems having subsystems in series, parallel or combined configuration, Assessment of overall reliability by various methods: - Star Delta, set theory, Conditional Probability, Matrix Method, Event Tree Analysis, Allocation of Reliability through programming and other algorithms, through proper appointment of unreliability's, AGREE, ARINC and other methods
Unit 3	**Reliability in Engineering Design:** Carter's concept of reliability, and Safety Margin in a structural mechanical design, Hazard Analysis through RPN & Graph theory, Through stacking of dimensional tolerance, Reliability Effort Function, Reliability, Availability, Maintainability and Safety (RAMS), Life Cycle Cost – algorithms, mathematical models & nomograms, Non-Parametric Analysis: Mean and Median Ranking Statistics
Unit 4	**Accelerated Method of Reliability Testing:** Variable, attribute and K Statistic, Truncated Test, Reliability Centered Maintenance (RCM): Predictive Preventive Maintenance, Diagnostic Techniques used in PPM, Condition Monitoring leading to CBM, HUM
Unit 5	Failure Modes and Effect Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA)

Text and Reference Books

1. James E Brenman, Chittaranjan Sahay, Elmer E Levis., "Introduction to Reliability Engineering, 3rd Edition Wiley Series, New York, April 2022.

2. Dhillon Balbir S., "Reliability Engineering in Systems Design & Operation", N.Y. Van Nostrand Reinhold, 1983
3. "Handbook of Reliability Engineering & Management", McGraw Hill, New York, 1988
4. Shrinath L. S., "Reliability Engineering", 3rd Edition, Revised Affiliated East West Press, 1991
5. Misra K. B., "Reliability Analysis and Prediction: A Methodology Oriented Treatment", Elsevier Science Ltd
6. D. H. Stamatis., "Failure Mode Effect Analysis: FMEA from theory to Execution, ASQ Quality Press, 2003
7. Lev M. Klyatis., "Accelerated Reliability and Durability Testing Technology, Wiley Series, New York, 2012

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1	2	1		1
CO2	2		1		2
CO3	1	1		2	
CO4	2	1		1	

1 – Low, 2 – Medium, 3 – High

MEPEC5014: Sustainability in Materials and Design		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understanding the concept of sustainability
2. Understanding and analysis of Lifecycle of materials
3. Analysis of carbon footprints of materials
4. System development and problem solving by using GaBi
5. Modeling and performance analysis of smart materials

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Comparative analysis of product sustainability
CO2	Analysis and use of LCA for material selection
CO3	Understanding and analysis of carbon footprints of various materials
CO4	Selection and use materials for sustainable development

Detailed Syllabus:

Unit 1	**Introduction to Sustainability:** Sustainability Manufacturing, Product Sustainability, Introduction to GaBi, Introduction to Life cycle analysis, Global sustainability standard.
Unit 2	**Carbon footprint analysis:** calculation of carbon footprint, Materials for environment, Life cycle analysis of ecofriendly materials
Unit 3	**Green supply chain:** Sustainability through unit process and enterprise level, Design for disassemble, Product design for better environment, Numerical on Product design.
Unit 4	**Sustainable smart materials:** green machining and numerical, Material selection with life cycle analysis, Sustainable smart manufacturing with Industry 4.0 approach
Unit 5	**Sustainability with additive manufacturing:** Sustainable ergonomics, Minimum level lubrication (MQL) sustainability, Numerical on LCA of PET bottle, Cement etc.

Text and Reference Books

1. Maddock M. and Uriarte L., Brand New: Solving the Innovation Paradox - How Great Brands Invent and Launch New Products, Services and Business Models, John Wiley & Sons, Inc., Hoboken, New Jersey, 2011.
2. Burkus D., The Myths of Creativity: The Truth About How Innovative Companies and People Generate Great Ideas, Jossey-Bass, A Wilery Brand, San Francisco, California, 2014.
3. Goos P. and Jones B., Optimal Design of Experiments: A Case Study Approach. John Wiley & Sons, Ltd. Chichester, West Sussex, United Kingdom, 2011.
4. Ries E., The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Publishing Group, New York, NY, 2011.

5. Sawyer K., Explaining Creativity: The Science of Human Innovation, 2nd Edition, Oxford University Press, New York, NY, 2012.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	04	10
K2	Understand	10	04	10
K3	Apply	00	04	15
K4	Analyze	00	04	15
K5	Evaluate	00	04	10
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	
CO2	1	2	2		3
CO3	1	3	2	2	3
CO4	2	3	1		1

1 – Low, 2 – Medium, 3 – High

MEOEC5004: Open Elective – I (Robotics)		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand robot configuration, structure, basic components, work space and generation of robots
2. Get acquainted with performing spatial transformations and solve kinematics of robot
3. Learn about various sensors and actuators
4. Acquire knowledge of robot drive systems and grippers

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain robot degree of freedom and classifications
CO2	Illustrate robot force and motion for particular case
CO3	Classify different sensors and controllers of robots
CO4	Illustrate selections of drives and grippers of robots

Detailed Syllabus:

Unit 1	**Introduction to robots and robotics:** History of robotics, different components of a robotic system, method of determining degrees of freedom, classifications of the robots, Workspace analysis of manipulators, Economic analysis Applications
Unit 2	**Kinematic Analysis:** forward and inverse kinematics analysis with problems, smooth variation of joint angles of the robot, trajectory planning schemes, velocity analysis, Jacobian matrix, inverse dynamics problems of robots, Lagrange-Euler formulation, motion planning algorithms
Unit 3	**Robot Controls**: Sensors used in robots, actuators and transmission, Controls in robot, joint torques, manipulators, analysis on wheeled and multi-legged robots, robot vision
Unit 4	**Robot drive systems and grippers** - Selection of joint motors, servo motors for manipulators and gears for robot systems, different types of grippers, design considerations and force, torque requirements, analysis of gripper, Applications of robots in different areas like in manufacturing units, medical science, space etc

Text and Reference Books

1. Groover M. P., “Industrial Robotics: Technology Programming and Applications, McGraw Hill Education
2. Aures R. U. and Miller S. M., “Robotics applications and implications”, Ballinger Publishing Co., Cambridge
3. Groover M. P. and Zimmer E. W., “Computer Aided Design and Manufacturing”, Prentice Hall of India Ltd, New Delhi
4. “Mechatronics”, HMT Limited, Tata McGraw Hill Publications, New Delhi
5. David G., “Mechatronics”, Tata McGraw Hill Publications, New Delhi
6. I. K. Mittal, R. J Nagrath, "Robotics Mechanics and Control", McGraw Hill Education

7. Ramchandran Nagarajan, " Introduction to Industrial Robotics", Pearson Education India

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1	1			2
CO2	1			1	2
CO3	2	1	1	1	
CO4	2	1		1	2

1 – Low, 2 – Medium, 3 – High

MEVSE5002: Mini Project – II		
Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 02	**ESE**	**25 Marks**

Course Objectives:

1. To make the student conversant with industrial activities / project execution activities
2. To exemplify various industrial aspects in manufacturing processes and industrial design
3. Student will be able to analyze and solve industrial mini problem / work on in-house project

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate industrial project / in-house project
CO2	Identify industrial problems / in-house
CO3	Integrate and apply the knowledge gained through different courses into practical problems
CO4	Prepare a consolidated report

Detailed description:

1. Student shall identify and collect pragmatic industrial information / in-house project / social problem as a Mini Project – II.
2. Student shall obtain a solution by applying suitable techniques.
3. Student has to exhibit the continuous progress review through regular reporting and presentations (at least two during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
4. The candidate shall submit the report on Mini Project – II in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:

ISE II- Continuous Assessment of individual student
Maximum Marks-25
ESE – Viva Voce based on presentation and report.
Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	04	04
S2	Manipulation	03	03
S3	Precision	14	14
S4	Articulation	04	04
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	ISE II	ESE
Preparation S1	04	04
Articulation of problem S4	04	04
Observation S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	25	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	1
CO2	2	1	1	3	1
CO3	1	1	1	3	1
CO4		3		1	

1 – Low, 2 – Medium, 3 – High

EEAEC5001: Technical Communication		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the nature and objective of Technical Communication relevant for the work place as Engineers.
CO2	Utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions
CO3	Enhance confidence in face of diverse audience.
CO4	Evaluate their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Detailed Syllabus:

Unit 1	**Fundamentals of Technical Communication:** Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.
Unit 2	**Forms of Technical Communication:** Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Key-Note Speech: Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.
Unit 3	**Technical Presentation:** Strategies & Techniques Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.
Unit 4	**Technical Communication Skills:** Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.
Unit 5	**Kinesics & Voice Dynamics: Kinesics:** Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent; Linguistic features of voice control: Vowel & Consonant Sounds.

Text and Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
6. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
7. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

MEOEC6004: Open Elective – II (Additive Manufacturing)		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Gain a foundational understanding of additive manufacturing principles, including the various techniques, processes, and terminology used in the field.
2. Learn about different types of software technologies and tools, materials used in additive manufacturing, their properties, and how they impact the final product.
3. Develop the skills to design 3D printable models, taking into consideration design constraints, support structures, and optimization for additive manufacturing processes.
4. Study real-world case studies and applications of additive manufacturing across various industries, including aerospace, medical, automotive, and consumer goods.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the concept of additive manufacturing and evaluation of its process sequence
CO2	Understand the materials required for AM and its molecular structures
CO3	Apply the knowledge of software tools for additive manufacturing
CO4	Develop the 3D component using additive manufacturing process

Detailed Syllabus:

Unit 1	**Introduction to Additive Manufacturing (AM):** General overview Introduction to reverse engineering Traditional manufacturing vis AM Computer aided design (CAD) and manufacturing (CAM) and AM Different AM processes and relevant process physics AM process chain Application level: Direct processes – Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing
Unit 2	**Software Technologies and Tools:** Design/Fabrication Processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing **Materials science for AM:** Discussion on different materials used Use of multiple materials, multifunctional and graded materials in AM Role of solidification rate Evolution of non-equilibrium structure property relationship Grain structure and microstructure
Unit 3	**AM technologies:** Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting. involvement). Printing processes (droplet-based 3D Solid-based AM processes - extrusion based fused deposition modelling object Stereolithography Micro- and nano-additive
Unit 4	**Process Selection planning, control for AM:** Selection of AM technologies using decision methods Additive manufacturing process plan: strategies and post processing. Monitoring and control of defects, transformation.
Unit 5	**Applications of AM:** Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing

Text and Reference Books

1. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009
2. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
3. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005
4. Gibson, Advanced Manufacturing Technologies for Medical Applications. Wiley, 2005.
5. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: principles and applications, 3rd Edition, World Scientific, 2010
6. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech, 2012.
7. J. D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, e-ISBN:978-3-642- 28359-8.

Useful Links

1. https://additivemanufacturing.com/basics/
2. https://www.ge.com/additive/additive-manufacturing
3. https://www.additive.sandvik/en/

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1		3		2
CO2	1		3		2
CO3		1	3	3	2
CO4	2		3	2	1

1 – Low, 2 – Medium, 3 – High

MEEEM6001: Entrepreneurship Development (Entrepreneurship Course)		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Interpreting information about support systems, skill sets, financial and risk covering institutions and other for building an enterprise so that a budding entrepreneurs can make right decisions for starting and running a venture.
2. Articulating the entrepreneurial process of creating new businesses, role of Creativity and innovation in Entrepreneurial start-ups
3. Preparing a context of social innovation and social entrepreneurship and issues and practices of financing entrepreneurial businesses., and live cases of social, techno, women entrepreneurs

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Articulate the value proposition of an Entrepreneurial venture.
CO2	Evaluate a business plan to determine if it is complete and of investment grade;
CO3	Demonstrate key entrepreneurial leadership qualities
CO4	Determine the competitiveness of their business versus direct competitors by creating a competitive matrix

Detailed Syllabus:

Unit 1	Introduction to Entrepreneurship. Business ideas, Development of a Business plan
Unit 2	Establishing a small-scale enterprise, Functional strategies for new business, Overview of financial markets – Meaning and scope
Unit 3	Social entrepreneurship, Sustainability of non-profit organizations, Financing and risks in social enterprises, Business Strategies and Scaling up
Unit 4	Entrepreneurial Management, managing growth, expansion and winding up of business, Valuation of a new company, corporate entrepreneurship, Entrepreneurship in the era of Globalization: Environment and Strategy
Unit 5	Entrepreneurship, Creativity and Innovation, Centre of Innovation, Incubation and Entrepreneurship- An expert Interview, Entrepreneurship: Role of stimulating creativity, Creative teams and managerial responsibilities, Innovation and entrepreneurship: types and sources of innovation, Creativity and Innovations in Start Ups, Start-up Case Studies

Text and Reference Books

1. Eric Ries, "The Lean Startup" Crown Business, USA
2. Alexander Osterwalder and Yves Pigneur, "Business Model Generation" Pigneur Publications
3. Bill Aulet, "Disciplined Entrepreneurship: 24 Steps to a Successful Startup", 1st edition, Wiley
4. Steve Blank and Bob Dorf, "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company", Strategyser Publishing

5. Bruce R. Barringer and R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures", Pearson Global Edition

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	04	10
K2	Understand	10	04	10
K3	Apply	00	04	15
K4	Analyze	00	04	15
K5	Evaluate	00	04	10
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	
CO2	1	2	2		3
CO3	1	3	2	2	3
CO4	1		1		

1 – Low, 2 – Medium, 3 – High

MEEEM6003: Industrial Management (Management Course)		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Provide an overview of the principles, concepts, and importance of industrial management in modern business environments.
2. Examine techniques for maintaining and improving product and service quality.
3. Develop skills in formulating and implementing strategic plans for industrial organizations to achieve long-term objectives and stay competitive in the market.
4. Provide an overview of the role and importance of Management Information Systems in modern organizations, including their impact on decision-making, efficiency, and competitive advantage.
5. Introduce students to the fundamental concepts, theories, and models that underlie human resource development, including adult learning principles, organizational development, talent management, and performance improvement.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understanding of fundamental concepts and theories related to industrial management.
CO2	Acquire the ability to analyze complex industrial challenges
CO3	Evaluate methodologies to ensure consistent product quality and process improvement.
CO4	Examining human resources in various industrial setting
CO5	Formulate and implement strategic plans that align with organizational goals and adapt to changing market dynamics.

Detailed Syllabus:

Unit 1	**Basics of Management**: Introduction, Definition of management, characteristics of management, functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F. W. Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization- Line, Line –staff etc. Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society, Govt. Sector etc., concept of Globalization
Unit 2	**Quality Management:** Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard- ISO 27001:2005 Information Security Management System.

Unit 3	**Strategic Management:** Military origins of strategy Evolution - Concept and Characteristics of strategic management –Defining strategy – Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy - Strategic Management Process.
Unit 4	**Management Information Systems:** Concept of data and information, characteristics of information, types of information, Definition of MIS, Need, Purpose and Objectives, Contemporary Approaches to MIS, Components of an information system, need to study information systems, Classification of information systems, Decision-making models, Types of decisions, Decision 3 Support Systems
Unit 5	**Human Resource Development (**HRM): Objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system. Talent acquisition; recruitment and selection strategies, career planning and management, training and development, investment in training Programme; executive development.

Text and Reference Books

1. O. P. Khanna, "Industrial Engineering and Management", Dhanpat Rai publications Ltd, New Delhi.
2. L. C. Jhamb, Savitri Jhamb, Industrial Management – I, Everest Publishing House.
3. Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Cengage Learning, Second Edition, USA.
4. B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions.
5. Azar Kazmi, "Strategic Management & Business Policy", Tata McGraw Hill, New Delhi
6. Kenneth C. Laudon and Jane P. Laudon, ""Management Information Systems", Eighth Edition, Pearson Education
7. K. Shridhara Bhat, "Materials and Logistics Management", Himalaya Publishing House, Mumbai
8. M. Y. Khan and P. K. Jain, "Financial Management", Tata McGraw Hill, New Delhi
9. Ravi M. Kishore, "Project Management", Tata McGraw Hill

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	03	04	10
K2	Understand	04	04	15
K3	Apply	03	03	10
K4	Analyze	04	04	10
K5	Evaluate	03	03	10
K6	Create	03	02	05
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		1	3	2	3
CO2	1	2	2	3	2
CO3	2	1	2	2	3
CO4	1		2	3	
CO5	1	2	3	2	

1 – Low, 2 – Medium, 3 – High

INIKS6001: Vedic Approach to Mathematics		
Teaching Scheme	**Examination Scheme**	
Lectures: 2 Hrs. / Week	ISE I	10 Marks
Credits: 2	ISE II	10 Marks
	End Semester Examination	30 Marks

Course description: This course is planned as Ability enhancement course. It is an exposure to the engineering students about Vedic Mathematics. Vedic Mathematics is a collection of Techniques/Sutras to solve mathematical arithmetic in easy and faster way. It consists of 16 Sutras (Formulae) and 13 sub-sutras (Sub Formulae) which can be used for problems involved in arithmetic, algebra, geometry, calculus, conics. By using Vedic Mathematics, the problems are solved mentally with the use of few or some of steps which increase accuracy and reduce mistakes. Through the application of the sutras, it ensures both speed and accuracy and enhances computational skills. In this course some of the topics from Vedic Mathematics are introduced which are use full to Engineering Students.

Course Objectives:

1. Multiply two- or three-digits numbers.
2. Compute the division by two- and three-digit divisors.
3. Check the divisibility by two- or three-digit numbers without actual division.
4. Evaluate square, cubes, square roots and cube roots of larger numbers within no time.
5. To factorize the quadratic expressions of single variable.
6. To find the Solution of Linear Simultaneous Equations.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Do multiplication and division of two- and three-digit numbers by applying Sutras in Vedic Mathematics.
CO2	To factorize and find LCM/HCF of numbers by applying Sutras in Vedic Mathematics.
CO3	To solve Simultaneous Linear Equations by applying Sutras in Vedic Mathematics.

Detailed Syllabus:

Unit 1	**Multiplication:** 1. Ekadhikenpurven method (multiplication of two numbers of two digits) 2. Eknunenpurven method (multiplication of two numbers of three digits) 3. Urdhvatiragbhyam method (multiplication of two numbers of three digits) 4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits)
Unit 2	**Division and Divisibility:** **Part A: Division** 1. Nikhilam Navtashchramam Dashtaha (two digits divisor) 2. Paravartya Yojyet method (three digits divisor) **Part B: Divisibility** 1. Ekadhikenpurven method (two digits divisor) 2. Eknunenpurven method (two digits divisor)
Unit 3	**Factorisation /LCM/HCF**

Unit 4	**Solution of Linear Simultaneous Equations:** Simple equations, Simultaneous Simple Equations, Quadratic Equations, Cubic Equations, Simultaneous Quadratic Equations.
Unit 5	**Power and Root Power:** (i) Square (two-digit numbers), (ii) Cube (two-digit numbers). (iii) Square root (four-digit number) (iv) Cube root (six digit numbers) [Self Study and assignments]

Text and Reference Books

1. Vedic Mathematics, Jagadguru Swami Sri BHARATI KRSNA TIRTHAJI MAHARAJA, Motilal Banarsi Das Publishing House, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi

Assessment:

ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects.

ISE II: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE1	ISEII	ESE
Kl	Remember	05	05	10
K2	Understand	05	05	20
K3	Apply	-	-	-
K4	Analyze	-	-	-
KS	Evaluate	-	-	-
K6	Create	-	-	-
Total Marks 50		**10**	**10**	**30**

Assessment table

Assessment Tool	K1, K2	K1, K2	K1, K2
	CO1	CO2	CO3
ISE I (10 Marks)	10	-	-
ISE II (10 Marks)	-	10	-
ESE (30 Marks)	10	10	10

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1					2
CO2					2
CO3					2

1 – Low, 2 – Medium, 3 – High

MEDIS6001: Dissertation – I		
Teaching Scheme	**Examination Scheme**	
Practical: 20 Hrs. / Week	**ISE II**	**100 Marks**
Credit: 10	**ESE**	**100 Marks**

Course description:
The dissertation shall consist of a report on research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a work related to production engineering that the candidate has to execute. The dissertation will consist of two parts as dissertation – I and dissertation – II.

Course Objectives:

1. To acquaint with the process of undertaking literature survey / industrial visit and identifying the problem
2. Able to define precise problem
3. To specify objectives on the basis of problem statement
4. To identify the research methodology processes and its implementation.

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Identify a practical problem from industry or research problem
CO2	Review literature to identify gaps and define objectives & scope of the work to decide the problem definition
CO3	Interpret the problem

Detailed description:

1. Dissertation – I is an integral part of the dissertation work. In this, the student shall complete the preliminary work of the dissertation which will consist of problem statement, literature review, scheme of implementation, Layout and Design of the Set-up. The student is expected to complete the dissertation at least up to the design phase.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations (at least three during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
3. The candidates have to validate their work undertaken by submitting and/or publishing it at standard platforms – conference and/or peer reviewed journal.
4. The candidate shall submit the report of dissertation – I in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:
ISE II- Continuous Assessment of individual student
Maximum Marks-100
ESE – Viva Voce based on presentation and report
Maximum Marks-100

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE II**	**ESE**
S1	Implementation	10	10
S2	Manipulation	00	00
S3	Precision	70	70
S4	Articulation	20	20
S5	Naturalization	00	00
Total Marks		100	100

Knowledge Level	**ISE II**	**ESE**
Preparation S1	10	10
Literature analysis and summarization of Results S3	50	50
Record and Articulation S4	20	20
Mini project / Presentation / Viva Voce S3	20	20
Total Marks	100	100

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	3	1

1 – Low, 2 – Medium, 3 – High

MEDIS6002: Dissertation – II		
Teaching Scheme	**Examination Scheme**	
Practical: 32 Hrs. / Week	**ISE II**	**150 Marks**
Credit: 16	**ESE**	**150 Marks**

Course Objectives:

1. To excel in progress review and follow schedule meticulously to meet the objectives of proposed work
2. To test the hypothesis rigorously before deployment of system
3. To validate the work undertaken
4. To consolidate the work as furnished report

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implement suitable research methodology
CO2	Carryout experimentation responsibly and ethically
CO3	Evaluate data and evidence of work
CO4	Synthesize and write the project work

Detailed description:

1. In Dissertation – II, the student shall consolidate and complete the remaining part of the dissertation which will consist of selection of research methodology, installations, implementations, testing, results, measuring performance, discussions using data tables considered for the improvement with existing / known algorithms / systems, comparative analysis, characterization and validation of results and conclusions.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations (at least three during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
3. The investigations and findings need to be validated appropriately at standard platforms one at conference and other in peer reviewed journal.
4. The candidate shall submit the report of dissertation – II in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, results and conclusion, contribution, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Format for Dissertation Report:

1. The total No. of minimum pages shall not be less than 70.
2. Plagiarism check by standard and approved software is must, and certificate shall be enclosed with the report.

3. Three report copies, loosely bound, shall be submitted in the department, one for examiner, one for supervisor and one for department.
4. The report shall be both side print hard bound. A hardbound report shall be made after examination by completing the examiner and guide's expected correction, before that report must be loosely bound.
5. For standardization of the reports the following format shall be strictly followed.

   Page size: A4
   Top Margin: 1"
   Bottom Margin: 1"
   Left Margin: 1.5"
   Right Margin: 1.5"
   Para Text: Times New Roman 12-point font
   Line Spacing: 1.5 Lines
   Page Numbers: Right aligned at footer. Font 10-point Times New Roman
   Headings: 14-Points, Times New Roman, Boldface.

Index of Report

1. Title Sheet
2. Certificate (Institution) as per standard format. Certificate shall have signatures of Guide, External Examiner, HoD and Principal.
3. Certificate (Company, if sponsored by company)
4. Undertaking by candidate as per standard format
5. Acknowledgement
6. Table of Contents
7. List of abbreviations
8. List of Figures
9. List of Photographs / Plates
10. List of Tables
11. Abstract of the Dissertation
12. Introduction
13. Literature Survey / Theory
14. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
15. Observation, Results Analysis and validation
16. Conclusion
17. References
18. List of papers published
19. Plagiarism check report

Assessment:

ISE II- Continuous Assessment of individual student
Maximum Marks-150
ESE – Viva Voce based on presentation and report
Maximum Marks-150

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	10	10
S2	Manipulation	60	60
S3	Precision	80	80
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks		150	150

Knowledge Level	ISE II	ESE
Preparation S1	10	10
Conduct of Experiment S2	30	30
Observation & analysis of Results S3	50	50
Record S2	30	30
Mini project/ Presentation/Viva Voce S3	30	30
Total Marks	150	150

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	3	2
CO2	2		1	2	
CO3	3	2	3	3	3
CO4	1	3	2	2	

1 – Low, 2 – Medium, 3 – High