SunRise University

Approved by Govt. of Rajasthan vide Sunrise University Act, 2011
Recognized by UGC Act, 1956 u/s 2 (f)

COURSE SCHEME AND SYLLABUS

M. TECH.

PRODUCTION ENGINEERING

M. Tech.
Production Engineering
Teaching and Examination Scheme
1st Year –I Semester

THEORY												
		Course		Contact hrs/week			Marks				Cr
SN	Category	Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	PCC	1MEMPE1-01	Forming Processes & Analysis	3	-	-	3	20	80	**100**	**3**
2		1MEMPE1-02	Cutting Processes & Analysis	3	-	-	3	20	80	**100**	**3**
3		1MEMPE1-03	Micro & Nano Manufacturing	3	-	-	3	20	80	**100**	**3**
4	PEC-I	1MEMPE2-04	Casting Processes	3	-	-	3	20	80	**100**	**3**
		1MEMPE2-05	Welding Processes								
		1MEMPE2-06	Plastic Manufacturing Processes								
		1MEMPE2-07	-	-	-	-	-	-	-	-	-
5	PEC-II	1MEMPE2-08	Industrial Metrology	3	-	-	3	20	80	**100**	**3**
		1MEMPE2-09	Quality Assurance								
		1MEMPE2-10	Maintenance Engineering								
		1MEMPE2-11	-	-	-	-	-	-	-	-	-
6	OES	1MEMPE3-12	Human Values and Professional Ethics	2	-	-	3	20	80	**100**	**2**
			Sub Total	17						**600**	**17**
PRACTICAL & SESSIONAL											
7	PCC	1MEMPE1-13	Manufacturing Process Analysis Lab	-	-	2	-	60	40	**100**	**2**
8	FW	1MEMPE4-14	Field Work	-	-	2	-	60	40	**100**	**2**
9	AC	1MEMPE5-15	Human Values Practice School	-	-	2	-	30	20	-	-
			Sub- Total			6				**200**	**4**
			TOTAL OF I SEMESTER	17		6				**800**	**21**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*
ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

PCC: Program Core Courses

PEC: Program Elective Courses

Electives Courses (3-4Nos.) should be relevant to the chosen specialization/branch

OES: Other Emerging Subjects: (i) Human Values and Professional Ethics
(ii) Research Methodology

It is decided common for all branches.

FW: Field Work

Student is required to work in the organization/industry concerned with his/her course.

AC: Audit Course

It is mandatory to pass the audit course. However, credit shall not be awarded.

M. Tech.
Production Engineering
Teaching and Examination Scheme
1st Year –II Semester

THEORY												
SN	Category	Course Code	Course Title	Contact hrs/week L	T	P	Marks Exam Hrs	IA	ETE	Total	Cr
1	PCC	2MEMPE1-01	Analysis of Newer Machining Processes	3	-	-	3	20	80	**100**	**3**
2		2MEMPE1-02	Computer Aided Manufacturing	3	-	-	3	20	80	**100**	**3**
3		2MEMPE1-03	Machine Tool Design	3	-	-	3	20	80	**100**	**3**
4	PEC-I	2MEMPE2-04	Production Management	3	-	-	3	20	80	**100**	**3**
		2MEMPE2-05	Supply Chain Management								
		2MEMPE2-06	Manufacturing Strategies								
		2MEMPE2-07	-	-	-	-	-	-	-	**-**	**-**
5	PEC-II	2MEMPE2-08	Industrial Robotics	3	-	-	3	20	80	**100**	**3**
		2MEMPE2-09	Mechatronics								
		2MEMPE2-10	Advanced Operations								
		2MEMPE2-11	-	-	-	-	-	-	-	**-**	**-**
6	OES	2MEMPE3-12	Research Methodology	2	-	-	3	20	80	**100**	**2**
		Sub Total		17						**600**	**17**
PRACTICAL & SESSIONAL											
7	PCC	2MEMPE1-13	CAM & Robotics Lab	-	-	2	-	60	40	**100**	**2**
8	FW	2MEMPE4-14	Field Work	-	-	2	-	60	40	**100**	**2**
		Sub- Total				4				**200**	**4**
		TOTAL OF II SEMESTER		17		4				**800**	**21**

M. Tech.
Production Engineering
Teaching and Examination Scheme
2nd Year –III Semester

PRACTICAL & SESSIONAL											
SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	PSD	3MEMPE6-16	Industrial/Field Project	-	-	28	-	360	240	**600**	**14**
2	PSD	3MEMPE6-17	Seminar	-	-	4	-	60	40	**100**	**2**
		TOTAL OF III SEMESTER				32				**700**	**16**

PSD: Industrial/Field Project, Seminar, Dissertation

M. Tech.
Production Engineering
Teaching and Examination Scheme
2nd Year –IV Semester

PRACTICAL & SESSIONAL											
SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	PSD	4MEMPE6-18	Dissertation	-	-	32	-	420	280	**700**	**16**
		TOTAL OF IV SEMESTER				32				**700**	**16**

M. Tech.
Production Engineering
Syllabus

1MEMPE1-01: FORMING PROCESSES AND ANALYSIS

Metal Forming: Classification of forming processes, mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants, forming defects.
Rolling: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, defects in rolling, torque and power calculations.
Forging: Classification of forging processes, forging of plate, forging of circular disc, open die and closed die forging, forging defects and powder metallurgy.
Extrusion: Classification, hot and cold extrusion, analysis of extrusion process, defects in extrusion, extrusion of tubes, and production of seamless pipes.
Drawing: Drawing of rods and wires, tube drawing process, and deep drawing.
Sheet Metal Forming: Forming methods, bending, stretch forming, spinning, and advanced techniques of sheet metal forming, forming limit criteria, defect in formed parts.
Advanced Metal Forming Processes: High energy rate forming, electro-magnetic forming, explosive forming, electro hydraulic forming, stretch forming, and contour roll forming.
Introduction to Press Tool Design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming, and drawing dies.

Suggested Readings:

1 G. E. Dieter, Mechanical Metallurgy, Tata McGraw Hill.
2 Sunder Kumar, Principles of Metal Working, Oxford & IBH Publishing Company.
3 G.W. Rowe, Principles of Metal Working Processes, CBS Publishers & Distributors
4 Roy A. Lindberg, Processes & Materials of Manufacture, Prentice Hall India Learning Private Limited.
5 S. Dalela, Manufacturing Science & Technology Vol- I , **S** Chand & Company Pvt Ltd
6 S. Kalpajian, Schmit, Manufacturing Processes for Engineering Materials, Pearson Publications.
7 A. Ghosh, A. K. Mallik, Manufacturing science, East-West Press Pvt Ltd

1MEMPE1-02: CUTTING PROCESSES AND ANALYSIS

Metal Cutting: Basic description of conventional machining processes, mechanism of chip formation, detailing on chip formation mechanism of brittle and ductile work material, shear angle, built-up edge, orthogonal machining, oblique machining, single and multipoint point cutting tool geometry, concept of machinability.
Force Analysis in Metal Cutting: Cutting forces in turning, angle relationships, identification of cutting forces on orthogonal plane, interrelations between cutting forces, merchant's circle diagram, effect of cutting parameters on surface roughness.
Tool wear and tool life: Tool wear, types of tool wear, concept of tool life, Taylor’s tool life equation, cutting fluids, different tool materials and applications including effect of tool coating, estimation of machining time in turning operation.

Machine Tools: Classification of machine tools, lathe, drilling, shaper, planer, slotter, milling machine types and their elements, milling cutters, milling operations, dividing head and indexing methods, milling mechanics, machining time and power estimation for each process.

Suggested Readings:

1. Pandey, Shah, Modern machining process, Tata Mc-Graw Hill.
2. A. Bhattacharya, Metal cutting theory and practice, New Central Book Agency.
3. A Ghosh, A K Mallik, Manufacturing and science, East-West Press Pvt. Ltd .

1MEMPE1-03: MICRO AND NANO MANUFACTURING

Introduction: Basic definition, size scales, scaling analysis, technology change, lithographic processes- optical and X-ray, Machining Analysis: Geometry of cutting edge, energy models, and comparison with micro-scale machining.

Diamond Micromachining: Introduction, tool material, diamond machining, micro-mechanical applications, diamond machining as a micro-mechanical process research method, and ductile regime grinding.

Micro-milling: Micro-milling tools, process results and micro-milling applications- micromechanically milled X-ray masks, micro-milled mask materials, mask absorption, quantification, and exposure quantification.

Micro-drilling: Micro and macro-drilling techniques.

Laser Micromachining: Laser optics, laser ablation, heat affected zone and laser polymerisation, LIGA, and S-LIGA

Hybrid Machining Processes: ECDM, USEDM, GAECM etc.

Micro-Welding: Micro welding in similar and dissimilar materials; welding processes like ultrasonic, EB, LB; applications

Micro-Casting: Casting processes like vacuum, semi-solid state; applications

Suggested Readings:

1. Kluwer, A new direction in manufacturing, Academic Publishers, London.
2. Kalpakjian, Manufacturing Engineering & Technology, Addison – Wesley
3. A Debitson, Hand Book of Precision Engineering.
4. J. A. Mc Geough, Advanced Methods of Machining, Chapman and Hall.
5. V. K Jain, Introduction to Micromachining, Narosa Publishers
6. M. Madou, Fundamentals of Microfabrication, CRC Press.
7. R. L. Murthy, Precision Engineering Manufacturing, New Age International.
8. H.S. Shan, Non-Conventional Manufacturing Processes, Tata Mc-Graw Hill.

1MEMPE2-04: CASTING PROCESSES

Production of Moulds and Cores: Mould production - equipment for moulding, moulding technique, pattern utilisation, hand and machine compaction, machine moulding, mould drying and hardening. Cores and core making - core boxes, compaction, core hardening, closing of moulds.

Melting and Pouring: Melting practice- classification of melting furnaces, brief description of construction and operation of various furnaces - cupola and its design, electric arc furnaces, electric induction furnaces, Melting charge, melting conditions, melting losses, special melt treatment, melt quality control and recent development in metal melting, Pouring: metal temperature, pouring equipment and techniques.

Detailed Study of Casting Techniques**:** Shell moulding - basic operation, production systems, characteristics of shell moulded casting and process, Investment casting, expandable pattern process, Pattern production, Factors influencing casting quality, characteristics of precision investment casting, Die-casting - gravity die-casting, pressure-die casting, die-casting machines, casting techniques, characteristics of die – castings, Centrifugal casting-fundamental principles, methods, production techniques, characteristics of centrifugal casting.

Solidification of Castings: Concept of progressive and directional solidification, solidification time and derivation of Chvorinov's equation, influence of mould characteristics and cast metal, Properties on solidification, process numerical methods for heat flow analysis.

Feeding of Castings: feeding characteristics of alloys, geometric influences on solidification, gating technique, casting temperature and pouring speed, design and location of feeder heads, Aids to feeder head efficiency, junction of feeder head and casting, use of padding, chills and insulators.

Advanced Casting Processes: Metal mould casting, continuous casting, squeeze casting, vacuum mould casting and evaporative pattern casting, ceramic shell casting.

Suggested Readings:

1. P.R., Beeley, Foundry Technology, Buttersworth Pub.
2. Heine and Rosenthal, Principles of Metal Cutting, Tata Mc-Graw Hill.
3. Metal Casting, ASME Handbook
4. P. C. Mukherji, Metal Casting Technology, Oxford & IBH Pub. Co.

1MEMPE2-05: WELDING PROCESSES

Welding Power Sources: Types of power sources, external V-I characteristics for constant current and constant voltage power sources, rectifiers, solid-state rectifiers, inverter systems, duty cycle.
Arc Welding Consumables: Types of electrodes, AWS and Indian system of classification and coding of covered electrode for mild steel, shielding gases and associated mixtures, Metal transfer: short circuit/ dip transfer, free flight, globular type, spray type, forces affecting metal transfer, weld bead geometry and shape factors, weld dilution.

Electric arc welding principle, MIG welding: equipment and processes, shielding gas, types of metal transfer, Tungsten inert gas arc welding (GTAW): welding equipment, electrodes, inert gases and torches. Submerged arc welding (SAW): Principle of processes, applications, fluxes and welding electrodes used, CO_2 welding, principle of operation, equipment, welding parameters and applications.

Solid State Welding: Introduction, main features and applications of ultrasonic welding, friction

welding and explosive welding, Resistance welding
Welding of plastics: difficulties in welding of plastics, processes for welding of plastics.
Weldability of specific materials: stainless steel, aluminium, titanium alloys and cast iron.
Thermal spraying: introduction, procedures, applications, advantages and disadvantages. Thermal cutting of metals: introduction, types, principle and operation of flame and plasma cutting, Under Water Welding: Introduction, methods and applications.

Automation in Welding: introduction, semiautomatic welding, automatic welding, welding mechanization, flexible automated welding, robotic welding, types of welding robots, robot selection mechanics, joint tracking system.
Advanced welding processes: electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW) and hybrid welding processes.

Suggested Readings:

1. H. B. Cary, Modern Welding Technology, Prentice Hall publications
2. A. C. Devis, Welding Technology, Cambridge University Press
3. Richard L Little, Welding and Welding Technology, Tata Mc-Graw Hill.
4. R. S. Parmar, Welding Technology, Khanna Publishers.
5. AWS Welding Handbook, IV – VI Edition
6. Sindo Kou, Welding Metallurgy, John Wiley and Sons Inc., Publication.

1MEMPE2-06: PLASTIC MANUFACTURING PROCESSES

Engineering plastics, selection of plastics, mechanical properties, degradation, wear resistance, frictional properties, special properties, structural features, plastics as packaging material.
viscoelastic behaviour, mathematical models for viscoelastic behaviour, deformation behaviour of plastics, reinforced plastics, analysis of polymer melt flow, Newtonian and non-Newtonian fluid flow, flow in circular section, flow in rectangular section etc.
Overview and analysis of various plastics forming operations, extrusion, injection moulding, thermo-forming, calendaring, compression moulding, blow moulding, transfer moulding, processing of reinforced plastics, and die design for simple components.

Suggested Readings:

1. S Kalpakjian, S. R. Schmid, Manufacturing Engineering & Technology, Pearson Education Canada
2. James F. Stenvension, Innovation in Polymer Processing Moulding, Hanser Publishers, New York.
3. R. J. Crawfortd, Plastic Engineering, Elsevier Pub.
4. E.B Seamour, Modern Plastics Moulding, John Wiley.

1MEMPE2-08: INDUSTRIAL METROLOGY

Introduction to dimensional metrology, limits, fits and tolerances, application of tolerances, limit gauging, design of gauges, measuring instruments, comparators and their design considerations.

Angular measurements, autocollimators and interferometers, application of dimensional inspection, measurement of screw threads, thread gauges for internal and external threads, gear inspection.

Inspection of surface quality, parameters for assessing surface finish and experimental methods of surface finish measurements, feature inspection, straightness, flatness, parallelism, squareness, circularity and roundness, automated dimensional measurements, automatic gauging, automatic measuring machines for inspecting multiple workpiece dimensions, measurement with coordinate measuring machines.

Suggested Readings:

1. R. K. Jain, Engineering Metrology, Khanna Publishers.
2. Allan S Morris, The Essence of Measurement, Prentice Hall of India.
3. S. C. Gupta, Engineering Metrology, Dhanpat Rai Publications
4. A. K. Jayal, Instrumentation and Mechanical Measurements, Galgotia Publications.

1MEMPE2-09: QUALITY ASSURANCE

Evolution of quality paradigms, Concept of quality control, quality assurance and total quality management.

Cost of quality, linkage between quality and profit, Quality characteristics (QC), variable and attribute, On-line and Off-line quality control.

Design and application of statistical process control charts for variables QC, Design and application of statistical process control charts for attribute QC, Design and application of sampling plans for off-line quality control.

Process capability and six sigma, design of experiments and Taguchi approach, Case study applications and use of DOE software packages.

Suggested Readings:

1. M. Mahaja, Statistical Quality control, Dhanpat Rai & Co
2. Douglas C. Montogomery, Introduction to Statistical Quality Control, Wiley Pub, U.K.
3. E. L. Grant, Statistical Quality Control, Tata Mc Graw Hill
4. Juran, Quality Planning and Analysis, Tata Mc Graw Hill.
5. Amitava Mitra, Fundamentals of Quality Control and Improvement, Wiley Pub, U.K.

1MEMPE2-10: MAINTENANCE ENGINEERING

Failure data analysis, Reliability, availability and maintainability analysis, Approaches to determine and improve system reliability, Fault tree analysis, FMECA.

Objectives and functions of maintenance, Classification of maintenance systems, Maintenance planning and scheduling.

Maintenance of production equipments, Replacement versus reconditioning assessment, Individual and group replacement decisions, Spare parts inventory control.

Suggested Readings:

1. W. Grant Ireson, F Clyde, Hand Book of Reliability, Mc Graw Hill.
2. Anthony Kelley, Maintenance Planing and Control, East-west press.
3. S. K. Srivastava, Industrial Maintenance Management, S Chand & Co.
4. L. R. Higgins, Maintenance Engineering Handbook, Mc Graw Hill.
5. K. Venkataramana, Maintenance Engineering and management, P H I Learning Pvt. Ltd.

1MEMPE3-12: HUMAN VALUES AND PROFESSIONAL ETHICS

Need, Basic Guidelines, Content And Process For Value Education:
Understanding the need, basic guidelines, Self Exploration - its content and process; Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity- Human Aspirations, Right understanding, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Understanding Harmony in The Human Being - Harmony in Myself:
Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha Understanding the Body as an instrument of 'I', Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

Understanding Harmony in the Family And Society- Harmony in Human-Human Relationship:
Understanding harmony in the Family, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) , meaning of Vishwas; Difference between intention and competence, meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, harmony in the society , Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals ,Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family.

Understanding Harmony in the Nature And Existence - Whole Existence As Coexistence:
Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all pervasive Space. Holistic perception of harmony at all levels of existence

Implications of the Above Holistic Understanding of Harmony on Professional Ethics. Natural Acceptance of Human Values:
Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. Case studies related to values in professional life and individual life.

Suggested Readings:

1. R. R. Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books.
2. R. Subramanian, Professional Ethics includes Human Values, Oxford Univ. Press.
3. A. N. Tripathy, Human Values, New Age International Publishers.

4. M. Govindrajran, S. Natrajan, V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
5. B. P. Banerjee, Foundations of Ethics and Management, Excel Books.
6. B. L. Bajpai, Indian Ethos and Modern Management, New Royal Book Co.

1MEMPE1-13: MANUFACTURING PROCESS ANALYSIS LAB

1. Analysis of Forming Process, Slab method, Upper & lower bound, FEM based simulation, slip line theory,
2. Use of CAE platform for Die Design and Simulation.
3. Machining practice and parametric analyses on USM, EDM, ECM, AJM.
4. Measurement of forces, surface roughness and temperature in case of milling and grinding operations.
5. Exercises in modelling and drafting of mechanical components - Assembly using parametric and feature based packages like Autodesk Inventor® / HyperWorks® etcas per availability.
6. Analysis of mechanical components – Use of software like Hyperworks® etc., Exercises shall include analysis of:
   i) Mould flow analysis
   ii) Forming analysis .

1MEMPE4-14: FIELD WORK

Student is required to work in the organization/industry concerned with his/her course.

1MEMPE5-15: HUMAN VALUES PRACTICE SCHOOL

This practice school in first semester will have two parts -

I. Industry Interaction

In this, students will start his industry interaction in the very first semester of the M.Tech. Course. He/ She has to visit an organization for 3 hours /week in any industry finalized/selected by competent authority. This interaction will give him feel and insight to the real time working.

A. This 3 hours /work will be after the classroom studies
B. Selection criteria of organisation:
   1. Have turnover more than 20 lakhs.
   2. Have more than 20 employees.
C. During these hours, student will observe following points in the organisation:
   1. Organisational structure and hierarchy.
   2. Different kind of jobs/works done by the employees at all levels in the company.
   3. Working of different departments.
   4. Types of skills required to work in an organisation.
   5. Ways of internal and external communication.
   6. Formal dressing and attitude.
   7. Coordination and team work.

II. Social Responsibility

To make students understand his role and responsibility in society & nature and co-existence as whole, student has to take an initiative towards contribution in any relevant social and environmental issue.

A. This work will be performed after the time of regular classes

B. Student will perform one or more of the following activities after the approval of mentor and HOD:

1. Making contribution in increasing the income of any street vender or any needy person from under privileged section
2. Cleanliness Campaign
3. Donation of his/her belongings which is of no use to him/her to needy ones
4. Plantation and care for nature (soil, natural resources, plants and animals)
5. Girl child and women safety, education and empowerment.
6. Blood donations and help of needy people at hospitals
7. Helping the under – privileged section of the society
8. Educating the street children or in schools when and where needed.
9. Nukkad Natak on any topic of social or environmental concern.
10. Any other relevant activities.

2MEMPE1-01: ANALYSIS OF NEWER MACHINING PROCESSES

Introduction to Non-traditional machining processes: Classifications of material removal processes, need for non-conventional or non-traditional processes, characteristics of non-traditional material removal (machining) processes.

Non-traditional machining processes (Chemical & Electrochemical): Chemical and photo-chemical machining, electrochemical machining, electrochemical grinding their working principles, equipment, process parameters, advantages, disadvantages and applications.

Non-traditional machining processes (Mechanical): Ultrasonic machining, Abrasive jet machining, Water jet machining, Abrasive water jet machining, their working principles, equipment, process parameters, advantages, disadvantages and applications.

Non-traditional machining processes (Thermal): Electric discharge machining, Laser beam machining, Electron beam machining, Plasma machining their working principles, equipment, process parameters, advantages, disadvantages and applications.

Suggested Readings:

1. G.F. Benedict, Non-traditional Manufacturing Processes, Marcel Dekker, Inc. New York.
2. Vijay K. Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi.
3. S. Kalpakjian, Manufacturing Engineering & Technology, Pearson Education Asia.
4. E. P. DeGarmo, J. T Black, R. A. Kohser, Materials and Processes in Manufacturing, , Prentice Hall of India, New Delhi
5. A. Ghosh, and A. K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd. New Delhi.
6. P.C. Pandey, H. S. Shan, Modern Machining Processes, Tata McGraw-Hill, New Delhi.

2MEMPE1-02: COMPUTER AIDED MANUFACTURING

Concept and scope of CIM, components of CIM, benefits, limitations, selection criteria for CIM. Introduction to CAD-CAM hardware and softwares.

Introduction CNC and Robotics: NC, CNC and DNC, machining centers, adaptive control, Robots and

their application.
Introduction to Group Technology, limitations of traditional manufacturing systems, Characteristics and design of groups, benefits of GT and issues in GT, Part families, classification and coding, Production flow analysis, machine cell design.
Introduction and components of FMS, computer control and functions, Planning, scheduling and control of FMS , Automated material handling systems, AS/RS, general considerations, selection, evaluation and control. CAD/CAM considerations, planning FMS database, case studies and practical applications.
Inspection and quality control, CAQC, CMM types, working and applications.
Process planning in the manufacturing cycle, process planning and production planning; process planning and concurrent engineering, CAPP, variant process planning, generative approach, Forward and backward planning, input format, logical design of a process planning, implementation and considerations in manufacturing system.
Computer integrated production management, ERP, Simulation and AI in CIM systems, CIM and beyond.

Suggested Readings:

1. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley & Sons.
2. M.P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Prentice-Hall of India Pvt. Ltd.
3. N. K. Jha, Handbook of Flexible Manufacturing Systems, Academic Press Inc.
4. J. L. Burbidge, Group Technology in Engineering Industry, Mechanical Engineering pub.
5. S. A. Irani, Cellular Manufacturing Systems, Hand Book.
6. A.K. Kamrani, H. R. Parsaei, D. H. Liles, Planning, Design and analysis of cellular manufacturing systems, Elsevier.
7. Gideon Halevi, Roland D. Weill, Principles of Process Planning, A logical approach, Chapman & Hall.

2MEMPE1-03: MACHINE TOOL DESIGN

Design requirements of machine tools, A design approach for machine tools, Identification and quantification of objectives and constraints in machine tool design.
Estimation of power requirements and selection of motor for metal cutting machine tool spindles, Design of gearbox, spindle and guideways, Principles of design of structural components- head stock, tail stock, carriage, table, knee, column and over arms to achieve desired static and fatigue strength, stiffness, dynamic characteristics and other requirements.

Suggested Readings:

1. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley & Sons.
2. N. K. Mehta, Machine Tool Design, Tata Mc-Graw Hill.
3. N. Acharka, Machine Tool Design, Oxford and IBH Publishing Co. Pvt. Ltd.
4. S. K.Basu, D. K. Pal, Design of Machine Tools, University Press of the Pacific.

2MEMPE2-04: PRODUCTION MANAGEMENT

Historical evolution of production management, Production Strategies, Competitiveness and Productivity, Product and Service design, Process selection, Process types, Product and process matrix.

Process analysis, Defining and measuring capacity, Determinants of effective capacity, Capacity strategy and planning process, determining capacity requirements.

Cost-Volume analysis for capacity alternatives evaluation, Production layouts - product, process, fixed position and cellular layouts.

Designing product and process layouts, Production planning at long, medium and short range, production control in job-shop, batch and mass production systems.

Suggested Readings:

1. N. G. Nair, Production and Operations Management, Tata Mc-Graw Hill
2. Martand Telsang, Production management, S. Chand Publications.
3. R. Panneerselvam, Production and Operations Management, Prentice Hall India Learning Private Limited.
4. Sushil Gupta, Martin Starr, Production and Operations Management Systems, CRC Press.
5. M. Mahajan, industrial Engineering and Production Management, Dhanpat Rai and co.
6. E.S. Buffa, Modern Production and Operation Management, Dennis Publication.
7. S. N. Chary, Production and Operations Management, Tata Mc-Graw Hill

2MEMPE2-05: SUPPLY CHAIN MANAGEMENT

Historical evolution of SCM, Inbound logistics, Operations, Outbound logistics

Forecasting, Inventory strategy, Transportation strategy, Warehouse management, Information strategy for SCM,

Performance management, Organization design and structure for effective supply chain, Supply chain integration and coordination strategies.

Suggested Readings:

1. S. Chopra, P. Meindl, D. V, kalra, Supply Chain Management, Pearson Education India.
2. B. Cetinkaya, R. Cuthbertson**,** G. Ewer**,** T. Klaas-Wissing**,** W. Piotrowicz**, C.**Tyssen**,** C, Sustainable Tata Mc-Graw Hill, Springer.
3. Martin Christopher, Logistics and Supply Chain Management, Prentice Hall.
4. J. John Coyle, Supply Chain Management, South-Western Cengage.

2MEMPE2-06: MANUFACTURING STRATEGIES

Manufacturing and operations strategy, relevance and concepts, strategic issues in manufacturing and operations, Linkage of manufacturing strategy with financial and marketing strategies, Push and pull manufacturing strategies.

Focused manufacturing strategies such as lean and agile, Concept of reconfigurable manufacturing and seru production, Manufacturing competitiveness.

Evaluation of manufacturing strategies based on cost, quality, delivery time and mass customization attributes, Sustainable and smart manufacturing, IOT in manufacturing.

Suggested Readings:

1. Terry Hills, Manufacturing Strategy, McGraw-Hill/Irwin.
2. John. Milten Burg, Manufacturing Strategy, CRC Press.
3. Per Lindberg, Christopher A. Voss, Kathryn L. Blackmon, International Manufacturing Strategies: Context, Content and Change, Springer Science.
4. C. A . Voss, Manufacturing Strategy, Chapman and Hall.
5. Steve Brown, Manufacturing the Future, Prentice Hall.

2MEMPE2-08: INDUSTRIAL ROBOTICS

Review of serial robotic manipulators, Classification of parallel robots (Stewart platform, wheeled mobile robots, walking machines, etc.), Algorithms for inverse and forward kinematic/dynamic analyses of parallel robots.

Kinematic design of serial and parallel robots based on singularity, workspace, manipulability, dexterity etc., Mechanical design of robot links and joints, Introduction to control of robotic systems.

Suggested Readings:

1. Groover, Weiss, Nagel, Industrial Robotics, McGraw Hill International.
2. YoramKoren, Robotics for Engineers , McGraw Hill International.
3. R. K Mittal, I. J. Nagrath, Robotics and Control, tata Mc-Graw Hill.
4. K. S Fu, R. C. Gonzalex, Robotics Control and Sensing, Vision and Intelligence, Mc-Graw Hill Book Co.

2MEMPE2-09: MECHATRONICS

Introduction to mechatronic systems and components, Principle of basic electronics, Microprocessors and their applications, integrated circuits, sensors, actuators, and other electrical/electronic hardware in mechatronic systems.

Principles of electronic/system communication, Interfacing, DA and AD converters, software and hardware principles and tools to build mechatronic systems, Selection of mechatronic systems, sensors like encoders and resolvers.

Stepper and servomotors; Solenoid like actuators, Transmission elements like Ball screw, and Controllers, Analysis and synthesis of mechatronic systems with applications to robotics, CNC systems, and others.

Suggested Readings:

1. W. Bolton, Mechatronics-Electronic Control Systems in Mechanical and electrical engineering, Longman Publishers.
2. C. Godfrey, Onwu Bolu, Mechatronics Principles and Applications, Elsevier.

3. David G. Alciatore, Michael B. Histand, Introductuon to Mechatronics and Measurement Systems, Tata Mc-Graw Hill.
4. G. S Hedge, Mechatronics, Jones and Bartlett Publishers.

2MEMPE2-10: ADVANCED OPERATIONS RESEARCH

Mathematical model formulations, Linear programming and sensitivity analysis, Integer programming, Non-linear programming, Quadratic programming, Geometric programming, Separable programming.

Decision making, Goal programming, TOPSIS and AHP, Case study applications and use of OR software packages.

Suggested Readings:

1. P.K. Gupta, D. S. Hire, Operations research, S. Chand Publications.
2. J.K. Sharma, Operation Research theory and Applications, Macmillan.
3. Havinal Veerabhadrappa, An introduction to Operation Research, New Age International Publishers.
4. Hamdy A. Taha, Introduction to Operation Research, Mc-Graw Hill.

2MEMPE3-12: RESEARCH METHODOLOGY

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chisquare, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids, Intellectual property, Plagiarism. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Suggested Readings:

1. C.R Kothari, Research Methodology, Methods & Technique, New Age International Publishers, 2004.
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004.
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009.
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
7. Naval Bajjai, Business Research Methods, Pearson 2011.
8. Prahalad Mishra, Business Research Methods, Oxford 2016.

2MEMPE1-13: CAM AND ROBOTICS LAB

1. Manual part programming using G and M codes for Turning, step turning, taper turning, thread cutting and radius turning on cylindrical components.
2. Given a component drawing to write the manual part programming and execute on CNC lathe and milling machine.
3. Programming and simulation of machining using the following features.(i) Linear and Circular interpolation(ii) Pocket milling, slotting, peck drilling and other fixed canned cycles.
4. Design and developing a CAD model for a product/part and generating automatically a program for CNC machine.
5. Exercises on robot with programming.

List of facilities required

1. CNC Lathe with Fanuc® / Siemens® Control.
2. CNC Milling Machine with Fanuc® / Siemens® control.
3. Master CAM® / Machining module of Hyperworks® software or any other with similar features.
4. Computer Workstations.

2MEMPE4-14: FIELD WORK

Student is required to work in the organization/industry concerned with his/her course.