

**UTTARAKHAND TECHNICAL UNIVERSITY,
DEHRADUN**



**M .TECH (MANUFACTURING SCIENCE AND
ENGINEERING)**

MMST-101	METAL FORMING TECHNIQUES	L	3	T	1	P	0	Credit 04
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OBJECTIVES:

- To understand the behavior of materials during forming
- To learn the various metal forming process and their applications
- To study about powder metallurgy and modern forming process
- To learn various surface treatment processes

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation - Yield criteria - Teresa and Von-misses - Distortion energy - Stress-strain relation - Mohr's circle representation of a state of stress - cylindrical and spherical co-ordinate system - upper and lower bound solution methods - Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 9

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing - Effect of friction - calculation of forces, work done - Process parameters, equipment used - Defects - applications - Recent advances in Forging, Rolling, Extrusion and Drawing processes - Design consideration in forming.

UNIT III SHEET METAL FORMING

Formability studies - Conventional processes - H E R F techniques – Super plastic forming techniques - Hydro forming - Stretch forming - Water hammer forming - Principles and process parameters - Advantages, Limitations and applications

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES

Overview of Powder Metallurgy technique - Advantages - applications - Powder perform forging - powder rolling - Tooling, process parameters and applications. - Orbital forging - Isothermal forging - Hot and cold isostatic pressing - High speed extrusion - Rubber pad forming - Fine blanking - LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9

Experiment techniques of evaluation of friction in metal forming selection - influence of temperature and gliding velocity - Friction heat generation - Friction

Between metallic layers - Lubrication carrier layer - Surface treatment for drawing, sheet metal forming, Extrusion and hot and cold forging.

Processing of thin Al tapes - Cladding of Al alloys - Duplex and triplex steel rolling - Thermo mechanical regimes of Ti and Al alloys during deformation - Formability of welded blank laser structured steel sheet Formability of laminated sheet.

TOTAL: 45 PERIODS

REFERENCES-

1. UDAY S DIXIT R METAL FORMING TECHNOLOGIES BY TATA MC GRAW HILLS INDIA
2. B.L JUNEJA FUNDAMENTAL OF METAL FORMING PROCESS NEW AGE INTERNATIONAL
3. SHIROKOBAYASHI SOO-IK-OH-ALTAN T METAL FORMING AND FINITE ELEMENTS METHOD OXFORD UNIVERSITY PRESS4. ALTAN T METAL FORMING-FUNDAMENTALS AND APPLICATIONS-AMERICAN SOCIETY OF METALS

MMST-102	Manufacturing management	L	3	T	1	P	0	Credit 04
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Objectives:To understand the concepts of manufacturing management and its various functions

Unit i plant engineering

7

Plant location - factors affecting plant location - techniques - plant layout - principles - types - comparison of layouts - materials handling - principles - factors affecting selection of materials handling system - types of materials handling systems - techniques.

Unit-ii work study

8

Principles of motion economy - steps in method study - tool and techniques – work measurement - purpose - stop watch time study - production studies - work sampling - ergonomics - value analysis.

Unit-iii- process planning and forecasting

9

Process planning - aims of process planning - steps to prepare the detailed work sheets for manufacturing a given component - break even analysis - forecasting - purpose of forecasting - methods of forecasting - time series - regression and correlation - exponential smoothing - forecast errors.

Unit-iv scheduling and project management

12

Scheduling - priority rules scheduling - sequencing - Johnson’s algorithm for job sequencing - n job m machine problems - project network analysis - pert/ cpm - critical path -floats - resource leveling - queuing analysis.

Unit-v personnel and marketing management

9

Principles of management - functions of personnel management - recruitment - training - motivation - communication - conflicts - industrial relations - trade union - functions of marketing - sales promotion methods - advertising - product packaging - distribution channels - market research and techniques.

Total: 45 periods

References-

1. R-panneerselvam “production and operation management” prentice hall of india
2. Martund t. Telsang “production management” s chand&company
3. Thomas e mortan “production and operation management” vikash publication

MMST-103	APPLIED MATERIALS ENGINEERING	L	3	T	1	P	0	Credit 04
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OBJECTIVES:

To study the elastic, plastic and fracture behavior of engineering materials.

To study the various modern material, properties and their applications

To understand the selection of metallic and non-metallic materials for various engineering applications.

UNIT I ELASTIC AND PLASTIC BEHAVIOR

7

Elasticity in metals and polymers An elastic and visco-elastic behavior - Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior - Super plasticity - Deformation of non crystalline materials.

UNIT II FRACTURE BEHAVIOUR

10

Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, cracks initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials - Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS

10

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance - Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications - Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS

10

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel - Intermetallics, Ni and Ti aluminides - smart materials, shape memory alloys - Metallic glass and nano crystalline materials.

UNIT V NON METALLIC MATERIALS

10

Polymeric materials - Formation of polymer structure - Production techniques of fibers, foams, adhesives and coating - structure, properties and applications of engineering polymers -

Advanced structural ceramics, WC, TiC, TaC, Al₂O₃, SiC, Si₃N₄ CBN and diamond - properties, processing and applications.

TOTAL: 45 PERIODS

REFERENCES-

1. GEORGE E, DIETER, Mechanical METALLURGY, MC Graw HILL, 1998
2. THOMAS H COURTNEY, mechanical behavior of materials (2 EDITION) McGraw HILL, 1998

MMST-104	ADVANCED WELDING TECHNOLOGY	L	3	T	1	P	0	Credit 04
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Unit-I **9**

Introduction: Importance and application of welding, classification of welding process.

Selection of welding process.

Review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding.

Resistance welding. Electro slag welding, Friction welding etc. Welding of MS, CI, Al, Stainless

Steel & Maurer/Schacfflar Diagram. Soldering & Brazing.

Unit-II **9**

Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

Unit-III **9**

Advanced welding Techniques (continued) : Principle and working and application of Advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray welding / Metalizing, Hard facing.

Unit-IV **9**

Weld Design : Welding machines/equipments and its characteristics. Weld defects and Distortion and its remedies, Inspection/testing of welds, Macrostructure & microstructure of Welds, HAZ, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.

Unit-V **9**

Thermal and Metallurgical CONSIDERATION. Thermal considerations for welding, temperature

Distribution, Analytical analysis, heating & cooling curves. Metallurgical consideration of weld,

HAZ and PARENT METAL, micro & macro structure. Solidification of weld and pr

REFERENCES-

1. O.P KHANNA-ADVANCED WELDING TECNOLOGY DHANPAT RAI PUBLICATION
2. R.K RAJPUT WELDING TECHNOLOGY LAXMI PUBLICATION
3. ASHUTOSH S ADVANCED WELDING TECHNOLOGY GYAN BOOKS PVT LTD

MMSP-101	CIM LAB	L	0	T	0	P	2	Credit 02
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OBJECTIVES:

To learn about modeling of 2D and 3D components using advanced CAD software

To learn the programming and machining of various components using CAM software and CNC machines

CAM LABORATORY

Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle

Exercise on CNC Milling Machine: Profile Milling Mirroring Scaling and canned cycle

CAD LABORATORY

2D modeling and 3D modeling of components such as

Bearing

Couplings

Gears

Sheet metal components

Jigs, Fixtures and Die assemblies.

TOTAL : 30 PERIODS

MMST-201	AUTOMATED AND COMPUTER INTEGRATED MANUFACTURING	L	3	T	1	P	0	Credit 04
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OBJECTIVES:

To understand basic concepts of CIM system

To learn the various concepts of automated manufacturing system.

To study the computer aided process planning and control and techniques.

UNIT I INTRODUCTION 9

Introduction to CAD/CAM and CIM - Evolution of CIM - CIM wheel and cycle - Production concepts - CIM hardware and software - Major elements of CIM system -Implementation of CIM -- Computer networks for manufacturing - The future automated factory - Management of CIM - Impact of CIM on personnel.

UNITIIAUTOMATED MANUFACTURING SYSTEM 9

Automated production line -system configurations, work part transfer mechanisms - Fundamentals of Automated assembly system-System configuration, Part delivery at workstations - Design for automated assembly - Overview of material handling equipments - Consideration in material handling system design. Automated Guided Vehicle system - Automated storage/Retrieval system and Carousel storage system.

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families - Visual - Parts classification and coding - Production flow analysis - Grouping of parts and Machines by rank order clustering method - Benefits of GT - Case studies. FMS-Components -workstations-FMS layout configurations - FMS planning and implementation issues - Architecture of FMS - flow chart showing various operations in FMS -FMS applications Benefits.

UNIT IV PROCESS PLANNING 9

Typical process sheet - case studies in Manual process planning. Computer Aided Process Planning - Process planning module and data base Variant process planning - Two stages in VPP - Generative process planning Flow chart showing various activities in generative PP - Semi generative process planning.

UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE9

Introduction to process model formulation -linear feedback control systems - Optimal control - Adaptive control -Sequence control and PLC. Computer process control - Computer process interface hardware - Computer process monitoring - Direct digital control and Supervisory computer control. Overview of Automatic identification methods - Bar code technology - Other Automatic data capture technologies.

TOTAL: 45 PERIODS

MMST-202	FINITE ELEMENT METHOD	L	3	T	1	P	0	Credit 04
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UNIT-I

Introduction

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Historical background-matrix approach-application to the continuum-discretisation-matrix algebra Gaussian elimination-governing equation for continuum-classical techniques in fem-weighted residual method Ritz method.

Unit-ii

One dimensional problems finite element moulding-coordinates and shape function potential energy approach-galarkin approach-assembly of stiffness matrix and load vector-finite element equation-quadratic shape functions application stop lane trusses.

Unit-iii

9

Two dimensional continuums

Introduction finite element modeling-scalar valued roblem- Poisson equation-Laplace equation-triangular element –element stiffness matrix-force vector-galarkin approach-stress calculation-temperature effect.

Unit-iv

9

Ax symmetric continuum ax symmetric formulation-element stiffness matrix and force vector-body forces and –boundary conditions-application to cylinders under internal or external pressures-rotating discs.

Unit-v

Isoperimetric elements for two dimension continuum the four mode quadrilateral-shape function-numerical integration-stiffness integration-stress calculation-four mode quadrilateral for axis symmetric problems.

References-

1. Chandrupatla t r and belegundaa.d –introduction to finite elements
2. J n reddy introduction to finite elements McGraw-hill education
3. Ssbhavakatti finite elements analysis new age publisher

TOTAL :

45 PERIODS

MMST-203	LEAN MANUFACTURING SYSTEM AND IMPLEMENTATION	L	3	T	1	P	0	Credit 04
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OBJECTIVES:

To introduce the concepts of lean manufacturing system

To study the various tools for lean manufacturing and case studies

UNIT I-

INTRODUCTION TO LEAN MANUFACTURING 8

Conventional Manufacturing versus Lean Manufacturing - Principles of Lean Manufacturing
- Basic elements of lean manufacturing - Introduction to LM Tools.

UNIT II-CELLULAR MANUFACTURING, JIT, TPM 9

Cellular Manufacturing - Types of Layout, Principles of Cell layout, Implementation. JIT - Principles of JIT and Implementation of Kanban . TPM - Pillars of TPM, Principles and implementation of TPM.

UNIT III SET UP TIME REDUCTION, TQM, 5S, VSM 9

Set up time reduction - Definition, philosophies and reduction approaches. TQM - Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV 9

SIX SIGMA

Six Sigma - Definition, statistical considerations, variability reduction, design of experiments
- Six Sigma implementation

UNIT V

CASE STUDIE 10

Various case studies of implementation of lean manufacturing in industries.

TOTAL: 45 PERIODS

REFERENCES-

1. ronald g. askin&jeffrey b gold berg design and analysis of lean production system
johnwiley& sons.2003

MMST-204	ADVANCED Manufacturing Process	L	3	T	1	P	0	Credit 04
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Unit-1

Advanced Machining Theory And Practices :Review of orthogonal cutting –mechanism of chip formation, shear angle relations, theoretical determination of cutting forces, analysis of turning, drilling, and milling operation, mechanics of grinding, dynamometry, thermal aspects of machining, tool wear and extended tool life equation, mach inability, economics of machining.

Unit2

Advanced Machining Process: Introduction, process, principle, material removal mechanism, parametric analysis, and application of process such ultrasonic machining(USM), abrasive jet machining(AJM), water jet machining(WJM), abrasive water jet machining(AWJM), electrochemical machining(ECM),electro discharge machining(EDM),electron beam machining(EBM), and laser beam machining(LBM)process

Unit -3

Advanced Casting Process: PERMANENT mould casting, continuous, casting, squeeze casting, vacuum mould casting, shell molding, gating system design

Unit-4

Rapid prototype (RP):Process chain in RP, layering techniques, stereoithography, fused deposition modeling, laminated object manufacturing, repetitive masking and depositing.

Unit -5

Advanced Metal Forming Processes: DETAILS of high energy rate forming (HERF) PROCESS, electro-magnetic forming, explosive forming, electro –hydraulic FORMING, stretch forming, contour roll forming.

Suggested Books:

Bhattacharya,A, “Metal Cutting Theory And Practices”, New Central Book Agency

P L Jain, ‘Principle Of Foundry Technology’ McGraw Hill

Ghosh, A and Malik ,A.K, “Manufacturing Science”, Affiliated East -West Press

P.C Pandey, Modern Manufacturing Processes’ TMH

Jain, V K “Advanced Machining Process” Allied Publishers.

MMSP-201	AUTOMATION LAB	L	0	T	0	P	2	Credit 02
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To simulate the various hydraulics and pneumatics circuits

1. Study of Sensors and Transducers. Potentiometer, Strain gauge, Torque, LVDT, Hall-effect, speed, Vibration, Pressure.
2. Study of Temperature Transducer.
3. Study of optical Transducer.
4. Exercises on Operational amplifier circuits.
5. Study of Fiber optic sensors.
6. Electronic Power controls of DC and AC motors.
7. Study of Hydraulic and Pneumatic components.
8. Exercise on Hydraulic circuits.
9. Exercise on Electro hydraulic circuits.
10. Study of Electro Pneumatic Sequencing circuits.
11. Study of Hydraulic and Pneumatic Circuits using simulation software.
12. Exercise on Hydraulic and Pneumatic circuits using PLC.

MMST-301	MODERN MANUFACTURING PROCESSES	L	3	T	1	P	0	Credit 04
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Metal cutting: Need for rational approach to the problem of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers, Lathe tool dynamometer ,Drill, Milling and grinding dynamometer, Heat distribution in machining-Effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.

Tool Materials, Tool Life and Tool Wear & Wear Mechanisms: Essential requirements of tool materials, Developments in tool materials, ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests, Concepts of mach inability and mach inability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force vs Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Mach inability data systems.

Sheet Metal Forming & Special Forming Processes: Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and Process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold iso-static pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.

Unconventional and special Welding Processes and Automation: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots, Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding.

Special Casting Processes & Recent Advances in Casting: Shell moulding, precision investment casting, CO2 moulding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mould casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.

- Books:1. Metal Cutting Principles M.C. Shaw Oxford Clarendon Press
2. Metal Cutting Theory and Practice Bhattacharya New Central Book Agency
3. Fundamentals of Metal Cutting and Machine Tools B.L. Juneja and G.S. Sekhon New Age International

MMST-302	ADVANCE MACHINING PROCESSES	L	3	T	1	P	0	Credit 04
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Introduction: Limitations of Conventional machining processes, Need of advanced machining processes and its classification. Mechanical Type Metal Removal Processes: Ultrasonic machining; Elements of the process; Tool design and economic considerations; Applications and limitations, Abrasive jet and Abrasive water jet machining principles; Mechanics of metal removal; Design of nozzles; applications, Abrasive finishing process, Magnetic abrasive finishing process

Thermal Type Advance Machining Processes: Classification, General principles and applications of Electro discharge, Plasma arc, Ion beam, Laser beam, Electron beam machining, Mechanics of metal removal in EDM, selection of EDM pulse generator dielectric, machining accuracy, surface finish and surface damage in EDM, Generation and control of electron beam for machining applications, advantages and limitations

Chemical and Electro-chemical Type Metal Removal Processes: Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing

Hybrid Unconventional Machining Processes: Introduction to ECDM, ECAM, Abrasive EDM etc.

Books:

1. Advance Machining Processes V.K. Jain New Age
2. Modern Machining Processes P.C. Pandey New Age
3. Manufacturing Processes Degarmo -
4. Manufacturing Processes Kalpakjian Tata McGraw-Hill International

