VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SCHEME OF TEACHING AND EXAMINATION FOR

M.TECH. Tool Engineering

I SEMESTER **CREDIT BASED**

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work / Assignment/ Tutorials		I.A.	Exam		
16MDE11	Applied Mathematics	4	2	3	50	100	150	4
16MST12	Finite Element Method	4	2	3	50	100	150	4
16MTE 13	Press Tool Design	4	2	3	50	100	150	4
16 MTE 16	Cutting Tools Theory and Design	4	2	3	50	100	150	4
	Elective - I	4	2	3	50	100	150	4
16 MCM 16	Manufacturing Engineering Lab 1	--	3	--	25	50	75	2
16 MTE 17	SEMINAR	--	3	--	25	--	25	1
Total		**20**	**13**	**15**	**300**	**550**	**850**	**23**

ELECTIVE-I

16MTE151	Non Traditional Machining	16MTE153	Plastic Processing
16MTE 152	Gauges and Measurements	16MTE154	Tooling for Manufacture in Automation

APPLIED MATHEMATICS

(Common to MDE, MMD, MEA, CAE, MCM, MAR, IAE, MTP, MTH, MTE, MST)

Sub Code	:	16MDE11	IA Marks	:	50
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	50	Exam Marks	:	100

Course Objectives:

The main objectives of the course are to enhance the knowledge of various methods in finding the roots of an algebraic, transcendental or simultaneous system of equations and also to evaluate integrals numerically and differentiation of complex functions with a greater accuracy. These concepts occur frequently in their subjects like finite element method and other design application oriented subjects.

Course Content:

1. Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering. **06 Hours**

2. Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.
   Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.**12 Hours**

3. Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae **06 Hours**

4. System of Linear Algebraic Equations And Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods.
   Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method .**16 Hours**

5. Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering

Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets, Orthogonal projections, The Gram-schmidt process, Least Square problems, Inner product spaces. **12 Hours**

Text Books:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata Mcgraw Hill, 4th Ed, 2002.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

Reference Books:

1. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
2. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

Course Outcomes:

The Student will be able to

1. Model some simple mathematical models of physical Applications.
2. Find the roots of polynomials in Science and Engineering problems.
3. Differentiate and integrate a function for a given set of tabulated data, forEngineering Applications

FINITE ELEMENT METHOD

(Common to MTE,MST)

Sub Code	**:**	**16MST12**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objectives

1. Introduce the various aspects of FEM as applied to engineering problems .

2. Apply the fundamental concepts of mathematical methods and theory of elasticity to solve simple continuum mechanics problems.

Course Content:

1. Introduction to Finite Element Method : Engineering Analysis, History, Advantages, Classification, Basic steps, Convergence criteria, Role of finite element analysis in computer-aided design., Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods

6 Hours

2. One-Dimensional Elements-Analysis of Bars and Trusses, Basic Equations and Potential Energy Functional,1D Bar Element, Admissible displacement function, Strain matrix, Stress recovery, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain, Assembly Procedure, Boundary and Constraint Conditions, Single point constraint, Multi-point constraint, Truss Element, Shape functions for Higher Order Elements, C^o, C^1 elements

   Two-Dimensional Elements-Analysis of Plane Elasticity Problems: Three- Triangular Element, Four-Noded Quadrilateral Element (QUAD 4), Shape functions for Higher Order Elements (LST, QUAD 8), Lagrange element, Strain-Displacement [B] matrix, Stiffness[K] matrix and Jacobian of CST and QUAD4 elements.

13 Hours

3. Axi-symmetric Solid Elements-Analysis of Bodies of Revolution under axi-symmetric loading: Axisymmetric Triangular and Quadrilateral Ring Elements. Strain-Displacement [B] matrix, Stiffness[K] matrix.

   Three-Dimensional Elements-Applications to Solid Mechanics Problems: Basic Equations and Potential Energy Functional, Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family. Shape functions for Higher Order Elements

16 Hours

4. Beam Elements-Analysis of Beams and Frames: 1–D Beam Element, Problems.
   Heat Transfer /Fluid Flow: Steady state heat transfer, 1 D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1 D heat transfer in thin fins. Basic differential equation for fluid flow in pipes, around solid bodies, porous media.

11 Hours

5. Dynamic Considerations: Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar

element, truss element, beam element. Lumped mass matrix, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

6 Hours

Text Books:

1. Chandrupatla T. R., "Finite Elements in engineering"- 2nd Edition, PHI, 2007.
2. Lakshminarayana H. V., "Finite Elements Analysis"– Procedures in Engineering, Universities Press, 2004

Reference Books:

1. Rao S. S. "Finite Elements Method in Engineering"- 4^{th} Edition, Elsevier, 2006
2. P.Seshu, "Textbook of Finite Element Analysis"-PHI, 2004.
3. J.N.Reddy, "Finite Element Method"- McGraw -Hill International Edition.
4. Bathe K. J. Finite Elements Procedures, PHI.
5. Cook R. D., et al. "Conceptsand Application of Finite Elements Analysis"- 4^{th} Edition, Wiley & Sons, 2003.

Course Outcome: Students will be able to

1. Define the element properties such as shape function and stiffness matrix for the various elements.
2. Formulate element properties for 1D and 2D elements.
3. Develop skill to solve simple beam problems using the steps of FEM.

PRESS TOOL DESIGN

Sub Code	**:**	**16MTE13**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50:**	**Exam Marks**	**:**	**100**

Course Objective:

The course makes students to learn intricacies involved in design of press tools and understand various tools used in practice.

Course Content:

1. Introduction: Elements of press tools, classification of press, High speed presses, press brakes, shearing theory, cutting force, elements of press tool, clearance between punch and die, shut height and daylight, press tonnage calculation.

Strip Layout: Basic rules, economic layout, bridge size, calculation of plug point/center of pressure.

Press Tool Operations: Piercing, blanking, slitting, cropping, trimming, shaving, lancing, bending, curling, calibrating, drawing, Embossing, coining, flanging, fine blanking.

12 Hours

2. Design of Press Tool Elements: Die plates, punches, punch holder plates, stripper plates, and calculation of stripping force, bolster plates, pilots, ejectors, shedders, material s ops, pillar, bush, slender punches, Stock guides, stock feeding device and die sets.

Types of Press Tools: Progressive tools, stage tools, compound tools, combination tools, cam actuated die, horn dies, sub press dies, inverted dies, bulging dies, levering dies, trimming dies, shaving dies, riveting dies, assembly dies, lamination dies.
Extrusion: Forward, backward, combined extrusion, Modem metal forming techniques.

16 Hours

3. Bending and Forming Dies: Theory of bending, development of bend, spring back, correcting spring back, bending tools, U -bending, V - bending, forming tools, bending on press brake,' bending force calculation.

6 Hours

4. Drawing: Theory of drawing, blank development, strain factor, calculation of number of stages of drawing, circular draw, rectangular draw, draw force calculation, lubrication. Defects and remedies, ironing.

6 Hours

5.Preparation and Presentation of Typical Designs in the Form of Drawings for the Following

1. Piercing & blanking tool.
2. Progressive tool
3. Stage tool
4. Bending tool
5. Compound tool

12 Hours

Text Books:

1. D. Eugene Ostergaard,"**Basic die design",** McGraw-Hill, 1963

Reference Books:

1. DALLAS B. DANIEL, **"Progressive Dies",** Springer publication, 2005.
2. **Michigan** -SME Mining Engineering Handbook, 3rd Edition by peter darling, 2011.
3. **Die Design Hand Book** -SMITH A. DAVID.SME 3rd edition, 1990.

Course Outcome:

Students will be in a position to understand press tool types ,its design and press tool operations which makes them aware of type applications for which this knowledge can be applied.

CUTTING TOOL THEORY AND DESIGN

Sub Code	:	16MTE16	IA Marks	:	50
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	50	Exam Marks	:	100

Course Objective:

The course aims at giving exposure to students on metal cutting theory and its practice in industries.

Course Content:

1. Mechanism of chip formation Review of deformation mechanism, Fracture, Mechanism of yielding, overview of chip formation, concept of shearing strain. Mechanism of Metal Cutting, Force system during turning - velocity relationships – Force analysis in turning, milling, drilling etc.. **12 Hours**

2. Measurement of cutting forces and dynamometer Tool wear mechanisms, types and causes of wear.

Turning Tools: Indexable Inserts, Chip breakers, ISO classification of inserts and tool holders.

12 Hours

3. Milling Cutters: Standardization, geometry, Face Mills, Shoulder Mills, End Mills, Deep shoulder Mills, T-Slot cutters.

Drilling: Drills with index able inserts, Deep hole drills, carbide tipped drills, Core drills, Counter pores, and Counter sinks.

12 Hours

4. **Boring:** Types of boring tool, Boring heads, Cartridges. REAMER Types of reamers, Geometry of flutes. TOOLS FOR CNC.

6 Hours

5. **Design Exercise:** Design of Single point tool, Drill, Broach, Form tools, Reamer.

8 Hours

Text Books:

1. **Metal Cutting and Tool Design,Dr**.B.J.Ranganath,Vikas Publishing House Pvt.Ltd.,New Delhi, Second Revised Edition,2009.
2. **Metal Cutting Theory and Cutting Tool Design**, Arshinov M I R Publications.

Reference Books:

1. **All about Machine Tools**, Heinrich Gerling,New Age International (P) Limited, 2007**Production Technology**, HMT.
2. **Tool Design**, Herman W. Pollack, Prentice Hall PTR, 1988.
3. **Modelling of Metal Forming and Machining Processes**- Prakash M Dixit, Uday S dixit, Springer and verlag publication, 2008
4. **Machining Technology, Machine Tools and operations**- Helmi A. Youssef, Hassan El Hofy, Taylor and Francis group, 2008.

Course Outcome: Students will be able to understand mechanism of chip formation, measurement of cutting forces and its importance in cutting tool design, design of various cutting tools.

Elective-I

NON-TRADITIONAL MACHINING

(Common to MTE,MST,MCM,IAE,MAR)

Sub Code	**:**	**16MTE151**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course learning objectives:

1. To demonstrate the need for development of newer/ non-traditional machining processes.
2. The student will be able to identify different energy sources like fluid motion, electric current, high speed electrons, high energy radiation, etc.
3. To analyse the concept, mechanism, parameters associated with the processes.
4. To demonstrate the operational principles, advantages applications, limitations of the various non-traditional machining processes.

Course Content:

1. Introduction: Need for non-traditional machining processes, Process selection, classification, comparative study of different processes.

Ultra Sonic Machining: Definition, Mechanism of metal removal, elements of the process, Tool feed mechanisms, Theories of mechanics, effect of parameters, Different types of concentrators, horn design, applications, Limitations**.**

Abrasive Jet Machining: Principle, Process parameters, Influence of process parameters on MRR , applications, advantages and disadvantages.

Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of water Jet machinery.

12 Hours

2. Thermal Metal Removal Processes: Electric discharge machining, Principle of operation, mechanism of metal removal, basic EDM circuitry, spark erosion generators, Analysis of relaxation type of circuit, material, removal rate in relaxation circuits, critical resistance parameters in Ro Circuit, Die electric fluids, Electrodes for spark erosion- surface finish, applications. **Electro Chemical machining (ECM)**: Classification of ECM process, Principle of ECM, Chemistry of the ECM process, parameters of the process, Determination of the metal removal rate, dynamics of ECM process, Hydrodynamics of ECM process, polarization, Tool Design, advantages and disadvantages-applications. Electro Chemical grinding, Electro Chemical honning, Electrochemical deburring.

16 Hours

3. Chemical Machining: Introduction, fundamental principle types of chemical machining, Maskants, Etchants, Advantages and disadvantages, applications, chemical blanking, chemical milling (contour machining), Hydrogen embrittlement.

Plasma arc Machining: Introduction, Plasma, Generation of Plasma and equipment, Mechanism of metals removal, PAM parameters, process characteristics, types of torches, applications.

Electron beam machining(EBM): Introduction, Equipment for production of Electron beam, Theory of electron beam machining, Thermal & Non thermal type, Process characteristics, applications. **12 Hours**

4. Laser Beam Machining: Introduction, principles of generation of lasers, Equipment and Machining Procedure, Types of Lasers, Process characteristics, advantages and limitations, applications of laser beam machining. CO_2 Laser: Principle, Equipment, Applications.

Ion Beam Machining: principle, equipment, working, sputtering rate, applications.

6 Hours

5. High Velocity forming processes: Introduction, development of specific process, selection, comparison of conventional and high velocity forming methods.

Types of high velocity forming methods: explosion forming process, electro-hydraulics forming, magnetic pulse forming. Applications, Advantages and limitations. **6 Hours**

Text Books:

1. **Modern Machining Process -** P.C Pandy& H.S Shan Tata McGraw Hill.
2. **Modern Machining Processes -** P.K Mishra
3. **Thermal Metal Cutting Processes**- Dr.B.J.Ranganath, I K International,New Delhi.

Reference Books:

1. **New technology -** Bhattacharya, Institution of Engineers, India
2. **Production technology -** HMT Tata McGraw Hill.
3. **Metals hand book** - ASM Vol-3.
4. **High velocity forming of metals -** F.M Wilson ASTME PreticeHall.
5. **Modern Manufacturing Methods -** Adithan

Course Outcomes:

1. Student will be in a position to appreciate the merits of non traditional machining and its application in Industries.
2. Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.

3. Students will be able to decide a process suitable for a particular material based on the availability of the sources.

GAUGES AND MEASUREMENTS

Sub Code	:	16MTE152	IA Marks	:	50
Hrs/ Week	:	04	Exam Hours	:	03

Total Hrs. : 50 Exam Marks : 100

Course Objective:
The course aims at making students learn about various gauges and measurement techniques.

Course Content:
1. Introduction: Definition and objectives of metrology Linear measurement: neutral axis significance, imperial standard yard, international standard meter, airy points, Basel points, line, end & wave length standards, Slip Gages.
Angular Measurement: introduction, caparison with linear measurement sine bar: principle, types, advantages & limitations, uses, problems on sine bar angle blocks (angle gauges),practical uses, material, construction ,limitations problems on angle blocks.
10 Hours
2. Geometric Dimensioning &Tolerancing (Gd&T) Introduction, ANSI, ASME & ISO systems of GD&T, functional dimensioning, feature & feature of size, advantages & limitations, feature control frame, fourteen characteristic symbols, form controls, profile controls, orientation controls, location controls, runout controls, datum.

Limits, Fits And Tolerance: Definitions, need of tolerance, types of tolerance, tolerance analysis (addition & subtraction of tolerances) interchangeability & selective assembly, representation of holes & shaft as per I.S. class & grade of tolerance,-difference between allowance & tolerance. **16 Hours**
3. Fits: Definition, types of fits,(clearance, interference& transition), tolerance disposition chart, problems (calculation of fits) hole base system & shaft base system, procedure for solving on finding the hole & shaft tolerance upper & lower limits. **8 Hours**
4. Design Of Gauges: Taylor's principle, MMC & LMC of hole & shaft types of gauges(plain, threaded, limit, single end ,double end, progressive, position, etc) important points for gauge design, limitations of gauges,-problems on gauge design.
6 Hours
5. Design Exercise: Design of Plug Gauge, Ring Gauge, Snap Gauge, Indicator Gauge, Taper plate Gauge, Taper Plug Gauge, Thread Gauge and Position Gauge. **12 Hours**
Text Books:
1. **Engineering Metrology** - R.K. Jain
2. **Westermann Tables for metal trade** – Juts scharkus, New age international Publishers

Reference Books:
1. **Engineering Metrology,** K.J.Hume.
2. **Geometric Dimensioning and Tolerancing**. A Self Study Workbook By Alex Krulikowski.
3. **Fundamentals of Geometric Dimensioning and Tolerancing.** ASME Y 16.5 M-1994.By Alex Krulikowski.
4. **Geometric Dimensioning and Tolerancing for Mechanical Design.** McGraw Hill

Course Outcome:

Students will be able to understand specification of limits, fits and tolerance ,design of gauges and its uses.

PLASTIC PROCESSING
(Common to MST,MTE)

Sub Code	**:**	**16MST153**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

The course aims at providing knowledge about various aspects of plastic processing.

Course Content:

1. **Plastic Processing:** Basic principle of processing, shape and size, processing parameters, their effect and behavior, Rheology of ideal fluids, and real polymers, Effects of melt behavior on processing and product performance.

Injection Moulding: Principles, process variables, moulding cycle, machinery used, parts and function, specification, construction and maintenance of injection moulding machine, start up and shut down procedure, cylinder, nozzles, interaction of moulding variables, press capacity, projected area, shot weight, concepts and their relationship to processing, trouble shooting in injection moulding, microprocessors controlled injection moulding machines. **16 Hours**

2. **Extrusion:** Basic principles of extruders, and extrusion process, different types of extrudes i.e. barrel, screw, drive mechanics, head, constructional features of dies, sizing and haul-off equipment for extruders of mono filaments and tubes, blown film lines, wire and cable covering system, pipe profile extrusion, co-extrusion, process variables in extrusion like heating, temperature control, dies well, and melt fracture, spacing and orientation, treating, printing and sealing, quality of extruder products, fault, causes and remedy.

Compression and Transfer Moulding: Techniques, various types of compression moulds, machinery used, and common moulding faults and remedies. Transfer moulding, its advantage over compression moulding, equipment used, press capacity, integral mold, and auxiliary mould, moulding cycle, ram pressure, clamping pressure, faults and remedies.
12 Hours

3. **Blow Moulding:** Blow moulding process, processing parameter, materials used, hand operated and automatic blow moulding machine, extrusion blow moulding, moulding cycle, faults and remedies**.**

Thermo Forming: Basic principles, types of thermoforming, thermoforming moulds, processing parameters, faults and remedies.

Rotational Moulding: Basic principle, charge size, wall thickness, temperature control, fault causes and remedies.

12 Hours

4. **Calendaring**: Basic principle, process variable, end product properties and applications, secondary processing techniques like powder coating, casting, machining, and joining of plastics, metalizing, printing.

   6 Hours

5. **Processing of Engineering Plastics:** precautions, and start up procedure, preheating, shutdown procedure, quality control, and waste management. Ram Extrusion of PTFE, Processing of reinforced plastics, like filament winding, Hand-lay-up, spray moulding, SMC, DMC, Centrifugal casting, pultrusion, resin transfer moulding.

   6 Hours

TEXT BOOKS:

1. Plastic Processing Data Hand Book – Dominic V Rosato P.E.
2. Modern Plastics Hand Book – Charles A Harper.

REFERENCE BOOKS:

1. Injection Mould Design, Pye R.G. W. - New York-John Wiley & Sons 12th Ed.1989.
2. Injection Moulding Theory & Practice, Rubin. J. Irvin, New York John Wiley & Sons.
3. Blow Moulding Hand Book, Rosato, New York-Oxford University-Hanser Publishers.
4. Principles of Rotational Moulding Process, Bruins.

Course Outcome:

Students will demonstrate their understanding of plastic processing, injection moulding, extrusion and thermo forming.

TOOLING FOR MANUFACTURING IN AUTOMATION

(Common to MTE,MCM,MAR,IAE,MCS)

Sub Code	:	16 MTE154	IA Marks	:	50
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	50	Exam Marks	:	100

Course Objective:

Students are introduced to metal cutting principles, cutting tool materials, types of cutting tools and its nomenclature. Students get orientation into clamping methods and jigs used in automated environment.

Course Content:

1. **Mechanics of metal cutting:** Introduction, measurement of cutting forces and chip thickness, force components, chip formation and primary plastic deformation, shear plane and slip line theories for continuous chip formation.

Modern Cutting tool materials: Material properties, HSS related materials, sintered tungsten carbide, cermets, ceramics, polycrystalline tools, tool coatings, coating methods, conventional coating materials, diamonds and CBN

Cutting tools: Basic types of cutting tools, turning tools, indexable inserts, groove geometry, edge preparation, wiper geometry, insert clamping methods, tool angles, threading tools, grooving and cut off tools, milling tools, types of milling cutters, milling inserts and edge clamping methods. Selection and application of Single point cutting tool and multipoint cutting tools.

12 Hours

2. **Optimization:** Machining cost and production rate verses cutting speed, role of computerized optimization system, economic considerations, optimization of machining system, machining conditions, constraints, depth of cut feed and speed.

Tooling Requirements for CNC Machines: Tool holding systems modular and quick change tool holding system, tool holder spindle connection, cutting tool clamping systems, milling cutter driver, side lock type chuck, collet chucks, hydraulic chucks, milling chucks. Tool magazines, Automatic Tool Changers, robotized tool assembly, tool management system. Tool monitoring, presetting and offsets, wear and radius compensation **12 Hours**

3. **Location and Clamping Methods:** Basic principles of locating, locating methods & devices, Basic principles of clamping, clamping methods.

Fixtures: Definitions, General considerations, Machine considerations, Process considerations, Product considerations, Types of fixtures, Vise fixtures, Milling fixtures, Boring fixtures, Broaching fixtures, Lathe fixtures, Grinding fixtures, Steps involved in designing a fixture.

12 **Hours**

4. **Fixtures for Automation**: Work holders for CNC, Fixturing in FMS: Part holding on Pallets, standard fixtures, pallet changers, pallet pool, flexible fixturing – principles and methodologies, modular fixturing system: Tslot based, dowel pin based, fixturing components, computer aided fixture design – locating and clamping, use of GT in fixture design, fixture database.

8 Hours

5. **Plastics for tooling materials:** Introduction, Commonly used plastics for tooling, Epoxy plastics tools, Construction methods, Urethane dies, Force calculation for Urethane pressure pads.

6 Hours

Textbooks:

1. Cyrol Donaldson, **Tool Design -**, Tata McGraw Hill, India.
2. Edward G Hoffman, **Fundamentals of Tool Design** -, SME, USA.
3. Joshi, **P.H., Jigs & Fixtures**, Second Edition, Tata McGraw-Hill Publishing Company Limited,New, Delhi 2004
4. Hiram E Grant, **Jigs and Fixture** Tata McGraw-Hill, New Delhi, 2003

Reference Books:

1. William E Boyes, **Handbook of Jigs & Fixtures Design -**, SME, USA.
2. G.R. Nagpal, **Tool Engineering & Design** -, Khanna publications.
3. David A.Stephenson, John S. Agapiou, **Metal cutting theory and practice,** , Second edition CRC taylor and Francis publishers.
4. Dr. B.J. Ranganath, **Metal cutting and tool design**, Vikas publishing house
5. ASTME**; Die Design Hand book**; McGraw Hill.
6. **Metal cutting applications Engineering course material** – by Kennametal.

Course Outcome:

Students are able to decide a type of tool appropriate for machining a material, decide on nomenclature parameters and be able to design a clamping method.

Manufacturing Engineering Lab 1

Subject Code:16MCM 16 | Hours/Week : 6
IA Marks : 25 | Exam Hours:3
Total Hours : 84 | Exam Marks : 50

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Exercises:

1. Optimizing machining time to produce mild steel components on a CNC turning Centre.
2. Characterize surface roughness of High carbon steel using a grinding machine.
3. To determine power required to machine a chosen component and evaluate suitability of the machine to manufacture the same.
4. To compare surface characteristics produced by conventional and CNC turning machines.
5. To Estimate the accuracy of taper produced on a shaft by grinding.
6. To measure cutting forces during machining of High carbon steel and optimize machining parameters.
7. To optimize a single point cutting tool for machining HC steel and to arrive at parameters like rake angle, relief angle, nose radius etc.
8. To study type of chips produced in machining Al/Composites materials/ HC alloy steels and to characterize chip thickness.
9. Construction of merchant circle diagram for turning operation of mild steel and to compute power requirement for turning operation.

10. Perform cutting/drilling/turning operations on mild steel/ high carbon steel/ composite material components and estimate power required for cutting/drilling/turning.
(Ex: for the hole, dia& feed values are provided, Student has to find the volume of metal removed and energy consumed)
11. Determine the true taper and actual taper mathematically and perform turning operations (roughing cuts) on lathe and estimate the tool life of tool on similar cuts at different speeds.