Old Scheme & Syllabi

for

M.Tech.
(Mechanical Engineering)

(Total Credits =70)

Department of Mechanical Engineering

Guru Jambheshwar University of Science & Technology,
Hisar-125001
October, 2011

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1 :	To impart knowledge to students in the latest technological topics on Mechanical Engineering and to provide them with opportunities in taking up advanced topics in the field of research.
PEO2 :	To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary research.
PEO3 :	To broaden and deepen their capabilities in analytical and experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation of their research work.
PEO4 :	To provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research.
PEO5 :	To equip students with integrity and ethical values so that they become responsible technocrats.

PROGRAMME OUTCOMES

PO1 : Acquiring fundamental knowledge and understanding in the field of Mechanical Engineering.

PO2 : Formulating relevant research problems; conducting experimental and/or analytical work and analyzing results using modern mathematical and scientific methods.

PO3 : Reviewing and documenting the knowledge developed by scholarly predecessors and critically assess the relevant technological issues.

PO4 : Designing and validating technological solutions to defined problems and write clearly and effectively for the practical utilization of their work.

PO5 : Ability to use the techniques, skills, and modern engineering tools necessary for mechanical engineering practice.

PO6 : Ability to function effectively on multidisciplinary teams

M.Tech. (*Scheme*)

Scheme - M.Tech. (1st year)

FIRST SEMESTER

Code	Subject	L	T	P	Credit
MELP-711	Advanced Mechanics of Solids	3	-	4	5.0
MELP-712	Advanced Engineering Materials	3	-	4	5.0
MELP-713	Automation in Manufacturing	3	-	2	4.0
MELP-714	CNC Technology and Programming	3	-	4	5.0
MELP-715	Engineering Mathematics	4	-	0	4.0
	Total	**16**	**-**	**14**	**23.0**

SECOND SEMESTER

Code	Subject	L	T	P	Credit
MELP-721	Advanced Machine Design	3	-	4	5.0
MELP-722	Computer Aided Product Design	3	-	4	5.0
MELP-723	Instrumentation and Measuring Systems	3	-	4	5.0
MELP-724	Finite Element Methods	3	-	4	5.0
MELP-725	Tool Engineering	3	-	0	3.0
	Total	**15**	**-**	**16**	**23.0**

Scheme - M.Tech. (2nd year)

THIRD SEMESTER

Code	Subject	L	T	P	Cr.
MELP-	Programme Elective –I (List attached)	3	-	4	5.0
MELP-	Programme Elective –II (List attached)	3	-	2	4.0
MES-730	Seminar	--	--	6	3.0
MED-740	Thesis (starts)	--	--	6	3.0
	Total	**6**	**-**	**18**	**15.0**

FOURTH SEMESTER

Code	Subject	L	T	P	Cr.
MED-741	Thesis	--	--	18	**9.0**

PROGRAMME ELECTIVE-I

Code	Subject	L	T	P	Cr.
MELP-731	Robotics	3	-	4	5.0
MELP-732	Tribological Practices	3	-	4	5.0
MELP-733	Flexible Manufacturing Systems	3	-	4	5.0
MELP-734	Mechatronics	3	-	4	5.0

PROGRAMME ELECTIVE -II

Course No.	Title	L	T	P	Cr.
MELP-735	Optimal Design of Thermal Systems	3	-	2	4.0
MELP-736	Computational Fluid Dynamics	3	-	2	4.0
MELP-737	Advanced Thermodynamics	3	-	2	4.0
MELP-738	Heat Exchanger Analysis and Design	3	-	2	4.0

M.Tech. (1st year)

(*Scheme & Syllabi*)

Scheme - M.Tech. (1st year)

FIRST SEMESTER

Code	Subject	L	T	P	Credit
MELP-711	Advanced Mechanics of Solids	3	-	4	5.0
MELP-712	Advanced Engineering Materials	3	-	4	5.0
MELP-713	Automation in Manufacturing	3	-	**2**	4.0
MELP-714	CNC Technology and Programming	3	-	4	5.0
MELP-715	Engineering Mathematics	4	-	0	4.0
	Total	**16**	**-**	**14**	**23.0**

SECOND SEMESTER

Code	Subject	L	T	P	Credit
MELP-721	Advanced Machine Design	3	-	4	5.0
MELP-722	Computer Aided Product Design	3	-	4	5.0
MELP-723	Instrumentation and Measuring Systems	3	-	4	5.0
MELP-724	Finite Element Methods	3	-	4	5.0
MELP-725	Tool Engineering	3	-	0	3.0
	Total	**15**	**-**	**16**	**23.0**

M.Tech. (Semester- 1st)

(*Syllabi*)

MELP-711 ADVANCED MECHANICS OF SOLIDS

L	T	P	Credit
3	---	4	5.0

Course Objectives

- *To understand the concepts of stress and strain, strength and stiffness, deformation and displacement and energy theorems.*
- *To predict the behaviour of the solid bodies subjected to various types of loading.*
- *To design machine elements using theories of deformable bodies.*

Three dimensional stress and strain:

Principal stresses and strains, Mohr's circle representation of triaxial stresses and strains.

Unsymmetrical bending:

Shear centers for sections with one axis of symmetry, shear center for any unsymmetrical Section, stress and deflection of beams subjected to unsymmetrical bending.

Bending of plates:

Basic definition, stress curvature and moment relations, deferential equation of plate deflection.boundry conditions, simply supported rectangular plates, axis symmetric loaded Circular plates.

Contact stresses:

Point and line contact.

Buckling of columns:

Beam columns single concentrated load, number of concentrated loads, continuous lateral Load, end couple, couples at both ends triangular loads.

Stress concentration:

Stress concentration in tension or compression members. Stresses in a plate with a circular hole, elliptical hole, small semi circular grooves.

Beam on Elastic Foundations:

General theory, infinite, semi infinite, finite beams classification of beams .Beam supported by equally spaced elastic elements.

Course Outcomes:

Students will be able to

1. *Solve the problems related to the theory of elasticity, concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy, and load carrying capacity.*
2. *Predict the behaviour of the solid bodies subjected to various types of loading.*
3. *Design machine elements using theories of deformable bodies.*

Books recommended:

1. Advanced strength and applied elasticity by R.C. Ugural, S.K. Fenster, Elsevier.
2. Advanced mechanics of solids by Hugh ford Longmans.
3. Strength of material part-11 by S.Timoshenko affiliated East-West press pvt.Ltd, .N. Delhi
4. Mechanics of Solids By L.S Srinath
5. Strength of Material By G.H Ryder
6. Mechanics of Solid By Abdul Muubeen

MELP-712 ADVANCE ENGINEERING MATERIALS

L	T	P	Credit
3	---	4	5.0

Course Objectives

- *To understand significance of material science and its role in manufacturing.*
- *To analyze the importance of various engineering materials (metals, polymers, ceramics, composites, Semi-conductor).*
- *To recite ceramics and composites, their manufacturing techniques, properties and applications.*
- *To propose appropriate plastics and polymers for different applications.*

The Structures of Materials:

Metals, Ceramics, Polymers and Composites;

Properties: Chemical, Physical, Mechanical and Dimensional Properties;

Ferrous Alloys:

Heat Treatments, Selective and Surface-Hardening, Specifications, Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Cast irons;

Non-ferrous Alloys: Copper and its alloys, Aluminium and its alloys, Nickel, Zinc, Titanium, Magnesium and Refractory Metals;

Shape Memory Phenomenon and Alloys; Ceramics, Cermets, Glass and Carbon Products;

Engineering Plastics, Polymeric Coatings and Adhesives;Failure Prevention; and The Selection Process

Course Outcomes:

Students will be able to

1. *Understand significance of material science and its role in manufacturing*
2. *Analyze the importance of various engineering material (metals, ceramics, polymers, Semi-conductor).*
3. *Describe phase diagram and heat treatment processes.*
4. *Recite ceramics and composites, their manufacturing techniques, properties and applications.*
5. *Propose appropriate plastics and polymers for different applications.*

Books recommended:

1. Engineering Design; A Materials and processing approach by Dieter, G.E., McGraw Hill,1991
2. Materials selection in Mechanical Design by Ashby, M.F., Pergamon press, 1992
3. Plastics Technology, Theory, Design and Manufacture by Patton, W.J., Lenton Publishing Co.

4. Introduction To Engineering Materials & Manufacturing Processes by NIIT, Prentice-Hall of India.
5. Kenneth G. Budinski, Engineering Materials Properties and Selection, Prentice Hall of India
6. R.A. Higgins, Engineering Metallurgy Part 1, Edward Arnold
7. Gladius Lewis, Selection of Engineering Materials, Prentice-Hall, New Jersey, USA

MELP-713 AUTOMATION IN MANUFACTURING

L	T	P	Credit
3	---	2	4.0

Course Objectives

- *To inculcate the ability to design of hydraulic, pneumatic and electro-pneumatic logic circuits for automating processes in manufacturing, demonstrate problem-solving skills in automation and safely use the machines in the industries. Also, to explore the use of different sensors, control valves, controllers and actuators for electro-pneumatic & hydraulic circuits.*

Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing, different types of production systems and automation, hard/ fixed automation including process automation, Rapid prototyping and tooling. Hydraulic and pneumatic actuators, their design and control devices, sequence operation of hydraulic/pneumatic actuators, designing of complete systems with hydraulic, electro-hydraulic and digital control devices, applications in manufacturing, material handling systems, feeders, orienting and escapement devices, their analysis and design, Automatic assembly machines, designing for automatic assembly.

Course Outcomes:

Students will be able to

1. *Develop advanced machining processes.*
2. *Justify need of various advanced manufacturing processes and their comparison to traditional machining processes*
3. *Impart basic knowledge on principle, process parameters, equipments, mechanics and applications of advanced manufacturing methods.*

Books recommended:

1. Automation, Production Systems and Computer Integrated Manufacturing by Grover, Prentice Hall.
2. Performance Modelling of Automated Manufacturing Systems By Kiffe,et al
3. Industrial Automation and Maintanenance By V.D.S Narang

MELP-714 CNC TECHNOLOGY AND PROGRAMMING

L	T	P	Credit
3	---	4	5.0

Course Objectives

- *To understand fundamentals of the CNC technology.*
- *To understand the programming methods in CNC machines.*

Introduction:

Basics and need of CNC machines, NC, CNC and DNC systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines.

Constructional Details of CNC Machines:

Machine structure ,Slide –ways ,Motion transmission elements ,Swarf removal and safety considerations ,Automatic tool changers and multiple pallet systems,Sensors and feedback devices in CNC machines ,Constructional detail of CNC turning center and CNC machining center ,Classification of CNC control systems.

CNC Part Programming

Axis identification and coordinate systems ,Structure of CNC part program ,Programming codes ,Programming for 2 and 3 axis control systems ,Manual part programming for a turning center ,Programming using tool nose radius compensation ,Tools offsets ,Do loops, sub routines and fixed cycles.

Computer Aided CNC Part Programming

Need for computer aided part programming, Tools for computer aided part programming, APT, COMPACT II, CAD/CAM based part programming.

Tooling of CNC Machines

Tooling requirements of CNC machines, Pre-set and qualified tools, Work and tool holding devices in CNC machines.

Course Outcomes:

Students will be able to

1. *Learn Standard terminologies, conventions, and types of standard CNC machine tools.*
2. *Know CNC programing used for two axis turning centers and three axis vertical milling centers used universally in CAM systems.*
3. *Understand the theoretical concepts of Automatic/ Computer Assisted NC Tool Path Planning for multi-axis machines as well as virtual CAM environment using professional software for complicated machining applications.*
4. *Learn constructional details of NC machine tools, selection of standard components used for NC machine tools for accuracy and productivity enhancement.*

PRACTICAL WORK

1. Study and operation of CNC lathe
2. Part programming and operation of CNC lathe for facing, turning and threading operations.
3. Study and operation of CNC Machining Center
4. Part programming and operation of CNC machining Center
5. Part programming for CNC Wire-cut machine.

Books recommended:

1. Pabla, B.S. & Adithan, M. "CNC Machines", New Age Publishers, New Delhi
2. Ploywka, John & Gabrel, Stanley, "Programming of Computer Numerically Controlled Machines" Industrial Press Inc., New York.
3. Rapello. Ralph. "Essentials of Numerical Control", Prentice Hall, NJ.
4. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall. NJ.
5. Seams, Warren, "Computer Numerical Control: Concepts & Programming", Delmar Publisher Inc. New York .
6. Kundra, Rao and Tewari, "Numerical Control and Computer Aided Manufacturing" Tata McGraw-Hill, New Delhi.

MELP-715 ENGINEERING MATHEMATICS

L	T	P	Credit
4	---	0	4.0

Course Objective:

- *To Study and solve one-dimensional and multi-dimensional optimization problems.*
- *To Develop Analytical and Graphical solutions of LP problems, Simplex Method Computer Programming:*

Basics of C programming, control structures, functions, array, strings, structure variable & operations, standard library, file operations file handling.

Solution of equations:

Solution of linear equation; bisection method; regula falsi method, convergence or interactive techniques, Newton Rapson method, Quotient- difference method,

Solution of non-linear equations, solution of linear simultaneous equations.

Interpolation:

Introduction: interpolation techniques- Newton's formulae, Gauss formulae, Sterling's, Bessel's and Everett's formulae, LaGrange's & hermit's formulae.

Newton's general formulae

Course Outcomes:

Students will be able to

1. Study as well as solve one-dimensional and multi-dimensional optimization problems.
2. Develop Analytical and Graphical solutions of LP problems, Simplex Method
3. Understand the basic concepts of Multi-Objective optimization and Genetic Algorithms.

Books recommended

1. Numerical analysis by SS Sastri
2. The c programming Language by Dennis M Ritchie, Brian W Kernighan1988,PHI
3. C Programming – A modern approach by K.N.King 1996, WW Norton & Co.
4. Applied Numerical Analysis By Gerald
5. Computer Oriented Numerical Methods By Rajaraman

M.Tech. (Semester- 2nd)

(*Syllabi*)

MELP-721 ADVANCED MACHINE DESIGN

L	T	P	Credit
3	---	4	5.0

Course Objectives:

- *To understand the concept of design and its considerations for manufacturing, assembly, aesthetics, ergonomics, fatigue and creep.*

Statistical consideration in design : Frequency distribution -Histogram and frequency polygon- Normal distribution -Units of measurement of central tendency and dispersion -standard variable -population combinations- Design and natural tolerances -Mechanical reliability and factor of safety.

Design for Manufacture: General principles of design for manufacture and assembly (DFM & DMFA). Principles of design of casting and forging-Design for machining-Design for powder metallurgy Design for welding.

Optimum design: Objective of optimum design - Johnson 's method of Optimum Design (MOD). Adequate and optimum design . Primary , subsidiary and limit equations. Optimum design with normal specification of simple machine elements like tension bar, transmission shaft, helical spring-Introduction to optimum design with redundant specification.

Aesthetic and ergonomic consideration in design of products : Basic types of product forms-Designing for appearance -Shape , features , materials and finishes, Ergonomic consideration - Relation between man, machine and environmental factors. Design of display and controls. Practical eg. Of product or equipments using ergonomic and aesthetic design principles.

Course Outcomes:

Students will be able to

1. *Describe the best combinations of man, machine and working stations in industries to enhance production and efficiency.*
2. *Design for Manufacturing and Assembly (DFMA).*
3. *Accept the engineering challenges regarding the needs of human beings in daily life about machines and systems which are possible for the discomforts in machines and systems.*
4. *Understand the processes, methods and develop experimental setups for the measurements of working conditions, environment, postures and space etc.*

Books recommended:

1. Shigley J.E. and Mischke C.R. “Mechanical Engineering Design"
2. Spotts M.F. and Shoup T.E. "Design of Machine Elements"
3. Bhandari V. B. "Design of machine Elements"
4. Black P. H. and O. Eugene Adams, -"
5. William C. Orthwein , " Machine components Design"
7. Juvinal R.C. " Fundamentals of Machine Components Design"
8. Hall A. S. Holowenko A. R. and Laughlin H. G. “Theory and problems of Machine Design"'
9. Johnson R.C. Mechanical Design Synthesis with optimization applications

MELP-722 COMPUTER AIDED PRODUCT DESIGN

L	T	P	Credit
3	---	4	5.0

Course Objectives

- *To understand the basic parametric fundamentals that are used to create and manipulate geometric models.*

Design Methodology, Quality Function Deployment, Understanding real need, Future needs projection, requirement tree, objective tree, Product design specification.

Computer Graphics : Two dimensional geometric and co-ordinate transformation, translation, rotation, scaling, mirror reflection, inverse co-ordinate transformation ,matrix description of basic transformation . CAD/CAM Data Exchange -Introduction to Data exchange formats, IGES/PDES files, Graphics Standards.

Geometric Modeling: Wire frame modelling ,Surface modelling, Solid modelling ,parametric solid modelling , Solid modelling based applications.

Simulation : Need of simulation , concept of a system, Model and its purpose , Types of simulation approaches-Event Scheduling Approach (ESA) , Activity Scanning Approach (ASA), Process Interaction Approach (PI A), Steps in a simulation study , advantage s disadvantages and pitfalls of simulation ,Simulation Languages.

Computer Aided Manufacturing : CNC machine tools, principle of operation of CNC , Steps in manufacturing , construction features including structure and drives, Direct numerical control (DNC) and its application , advantages and limitations of CNC systems. CNC part programming, axes of CNC machines, manual part programming using G code, use of subroutines, computer aided part programming using APT or any other language.

Automation : Concept of automation , types of automation ,computer integrated manufacturing, advantages and limitation of automation , automation strategies in manufacturing industries, flexible manufacturing system (FMS) , types of FMS, machining centres.

Course Outcomes:

Students will be able to

1. *Use standard parametric 3D CAD softwares to model and design mechanical components, assemblies, mechanisms and make production drawings of them.*
2. *Apply standard parametric CAD/CAE software to perform analysis for mass properties, kinematic, dynamic, deflection, stress, etc. outputs expected from a mechanical design of components/ assemblies, and to conduct sensitivity, feasibility and optimization studies to redesign for desired outputs.*

Books recommended:

1) Computer Aided and Integrated Manufacturing Systems by Cornelius Leondes
2) Product Design for Manufacture and Assembly by G Boothroyd, Peter Dewhurst, Winston Knight
3) Computer-Aided Fixture Design by Yiming Rong, Yaoxiang Zhu

4) CAD/CAM Theory and Practice by Ibrahim Zeid
5) Principles of CAD/CAM/CAE Systems by K Lee
6) Computer aided mechanical design and analysis by Ramamurti V.

MELP-723 INSTRUMENTATION AND MEASURING SYSTEMS

L	T	P	Credit
3	---	4	5.0

Course Objectives:

- *The course is intended to give students a thorough understanding of a measuring system, different transduction principles, error analysis response etc. and various other issues related to instrumentation system.*

Generalized Configuration of Measuring System:

Functional elements of a basic measuring system; different types of measurands, description of functional elements. Input-output configuration of a measuring system interfering and modifying inputs; methods for correction for interfering and modifying inputs.

Characteristics of Instruments:

Objective of studying the characteristics of the instruments. Static characteristics accuracy precision, error, sensitivity, hysterisis, threshold, drift, span, static stiffness etc. Dynamic characteristics - time domain and frequency domain characteristics terms input-output impedance's and meaning of impedance mismatching. Concept of mechanical loading.

Response of Instruments:

Description of mathematical model for the generalized configuration of a measurement system. Order of the systems, response of zero, first and second order systems of step, ramp and sinusoidal inputs. Transfer function method to study the response of the system.

Errors:

Classification of various types of errors and statistical analysis of experimental data.

Principles of Transduction and Transducers:

Description of various types of transduction principles. Trandducers based on variable resistance, variable inductance, variable capacitance and piezo-electric effects. Displacement transducers - wire wound potentiometers, LVDT, strain g ages, strain gage designation system. Signal conditioners - filters, low, high, band pass and charge amplifiers.

Microcomputer:

An overview of microprocessor system, number system, codes, binary mathematics logic circuits and microprocessor architecture.

DAS and Signal Analysis:

Data acquisition system via computers. The components of Data acquisition system, DAS Hardware, selection criteria for choosing a DAS. Techniques for signal analysis.

Course Outcomes:

Students will be able to

- *Temperature Measurement, Pressure measurement, Displacement measurement, Load measurement (tensile/compressive), Torque measurement, Speed measurement, Stress & strain measurement.*

Recommended books:

1. Measurement systems, Application and Design ByDoeblin,McGraw Hill
2. Mechanical Measurement ByBeckwith and Buck,Wesley
3. Instrumentation Devices and SystemsBy Rangan, Sharma,Tata McGraw
4. Instrumentation Measurement and Analysis By Nekra & Chaudhry,Tata MCGraw
5. Data Acquisition & Signal Analysis By Beauchamp and George, AllenYuen and Unwin Ltd.

MELP-724 FINITE ELEMENT METHOD

L	T	P	Credit
3	---	4	5.0

Course Objectives:

• *To develop the knowledge and skills needed to apply Finite Element Methods to problems in Mechanical Engineering*

Introduction to Finite Element Method :

Basic concept, Historical background, engineering applications, comparison with other methods.

Integral Formulations And Variation Methods:

Need for weighted – integral forms, relevant mathematical concepts and formulae, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach.

Finite Element Techniques:

Model boundary value problem, finite element dicretization, element shapes, sizes And node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing,

Compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Langrange and Hermit Polynomials.

Applications to solid and structural mechanics problems:

External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, axis symmetric and three dimensional stress-strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.

Application to heat transfer problem:

Variational approach, Galerkin approach, one-dimensional and two-dimensional steady state problems for conduction, convection and radiation, transient problems.

Application to fluid mechanics problems:

In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream function-vorticity formulation, solution of incompressible and compressible fluid film lubrication problems.Additional Applications:Steady-state and transient field problem

Course Outcomes:

Students will be able to

1. *Identify mathematical model for solution of common engineering problems.*
2. *Formulate simple problems into finite elements.*
3. *Solve structural, thermal, fluid flow and impact problems.*

Books recommended:

1) Introductory Finite Element Method by Chandrakant S Desai, Tribikram Kundu
2) The Finite Element Method: Volume 2 by O C Zienkiewicz, R L Taylor
3) Building Better Products With Finite Element Analysis by Vince Adams, Abraham Askenazi

4) Finite Element Implementation by Y K Cheung
5) Finite Element Analysis With Personal Computers by Champion, J M Ensminger, Edward R Champion
6) Programming the Finite Element Method by Ian M. Smith, Vaughan Griffiths
7) The Finite Element Method for Engineers by Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith, Ted G. Byrom
8) The Finite Element Method and Its Reliability by Ivo Babuska, T Strouboulis

MELP-725 TOOL ENGINEERING

L	T	P	Credit
3	---	0	3.0

Course Objectives

- *To understand the mechanics of various advanced machining processes including the material removal, tool design, effect of process parameters on the output responses.*
- *To impart depth knowledge on principle involved, accuracy involved, tooling requirement and knowledge about the process capability.*
- *To develop knowledge and skills design of various jigs and fixtures to increase the production rate.*

Cutting Tool Materials

Introduction and desirable properties ,Carbon and Medium-Alloy Steels ,High-Speed Steels ,Cast-Cobalt Alloys ,Carbides ,Coated Tools,Alumina-Based Ceramics ,Cubic Boron Nitride,Silicon-Nitride Based Ceramics ,Diamond ,Reinforced Tool Materials ,Cutting-Tool Reconditioning

Design of Cutting Tools

Basic Requirements ,Mechanics and Geometry of Chip Formation ,General Considerations for Metal Cutting ,Design of single point Cutting Tools ,Design of Milling Cutters ,Design of Drills and Drilling ,Design of Reamers,Design of Taps,Design of Inserts ,Determining Shank Size for Single-point Carbide Tools,Determining the Insert Thickness for Carbide Tools ,Chip Breakers ,Design of form tools

Gages and Gage Design

Limits fits and tolerances,Geometrical tolerances-specification and measurement.,Types of gages ,Gage design, gage tolerances ,Material for Gages

Work Holding Devices

Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping : Principles, methods and devices

Drill Jigs

Definition and types of Drill Jigs ,Chip Formation in Drilling ,General Considerations in the Design of Drill Jigs,Drill Bushings ,Drill Jigs, and Modern Manufacturing

Design of Fixtures

Fixtures and Economics ,Types of Fixtures ,Milling Fixtures ,Boring Fixtures ,Broaching Fixtures ,Lathe Fixtures ,Grinding

Tool Design for Numerically Controlled Machine Tools

Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control ,Tool-holding Methods for Numerical Control

Course Outcomes:

Students will be able to

1. *Understand the mechanics of various advanced machining processes including the material removal, tool design, effect of process parameters on the output responses.*
2. *Impart depth knowledge on principle involved, accuracy involved, tooling requirement and knowledge about the process capability.*
3. *Develop knowledge and skills design of various jigs and fixtures to increase the production rate.*

Books recommended:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall of India Pvt. Ltd.
2. Donaldson. “Tool Design”, Tata-McGraw Hill
3. Machine Tool Practices By Kiffe,et al
4. Machine Tool Technology By K S Yadav

M.Tech. (2nd year)

(*Scheme & Syllabi*)

Scheme - M.Tech. (2nd year)

THIRD SEMESTER

Code	Subject	L	T	P	Cr.
MELP-	Programme Elective –I (List attached)	3	-	4	5.0
MELP-	Programme Elective –II (List attached)	3	-	2	4.0
MES-730	Seminar	--	--	6	3.0
MED-740	Thesis (starts)	--	--	6	3.0
	Total	**6**	**-**	**18**	**15.0**

FOURTH SEMESTER

Code	Subject	L	T	P	Cr.
MED-741	Thesis	--	--	18	**9.0**

PROGRAMME ELECTIVE-I

Code	Subject	L	T	P	Cr.
MELP-731	Robotics	3	-	4	5.0
MELP-732	Tribological Practices	3	-	4	5.0
MELP-733	Flexible Manufacturing Systems	3	-	4	5.0
MELP-734	Mechatronics	3	-	4	5.0

PROGRAMME ELECTIVE -II

Course No.	Title	L	T	P	Cr.
MELP-735	Optimal Design of Thermal Systems	3	-	2	4.0
MELP-736	Computational Fluid Dynamics	3	-	2	4.0
MELP-737	Advanced Thermodynamics	3	-	2	4.0
MELP-738	Heat Exchanger Analysis and Design	3	-	2	4.0

M.Tech. (Semester- 3rd)

(*Syllabi*)

Programme Elective-I

MELP-731, ROBOTICS *(Elective – I)*

L	T	P	Credit
3	-	4	5.0

Course Objectives

- *To introduce the students to the basic terminologies, applications, design specifications, and mechanical design aspects both kinematics and dynamics of industrial robotics/ manipulator along with various types and working of sensors and actuators used in robotic applications*

Introduction

A sense of history, a sense of design, manipulators and manipulations, robot analysis
And control in a nutshell**.**

Kinematics I: Geometry

Mathematics preliminary, position and orientation of a rigid body, co-ordinate transformation, Euler angle, homogeneous transformations. Kinematics modeling of manipulator arms, open kinematic chains, the denairt-Hartenberg notation, kinematics equations. Inverse kinematics: introduction, solving the kinematic equation for the 5
RIP manipulators, solvability.

Kinematics II: Differential Motion

Kinematic modeling of instantaneous motions, differential relations, infinitesimal relations, computation of the manipulators, Jacobian, inverse instantaneous kinematics:
Resolved motion rate, redundancy, optimal solutions.

Static's

Force and moment anylysis, equivalent joint torques, duality, transformations of force and moments. Stiffness, introduction, endpoint compliance analysis, the principal transformation of compliance matrices.

Dynamics:

Newton-Euler formulation of equation of motion, basic dynamic equation, closed form Dynamic equations, physical interpretation of the dynamic equation. Longrangian
Formulation of the manipulator dynamics, LaGrange dynamics, the manipulators inertia tensor, deriving LaGrange motion equation, transformations of generalized co-ordinates.
Inverse dynamics; introduction, recursive computation, moving co-ordinates, walker Paul's algorithm.

Trajectory control:

Introduction, position control, load scheme work, trajectory control, sliding surfaces,
Perfect tracking using switched control laws, continous control law to approximate switched control. robust trajectory control for robot manipulators, practical evaluation of parametric uncertainities, the modeling/performance trade-off.

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students would be able to

- *Work individually and/or with an interdisciplinary team for the purpose of manipulator design for a specific need using mechanical kinematic structure along with the understanding of requirements from robotic work cell controller and its programming, for enabling robotic*

manipulator to work in an integrated automated industrial environment.

- *Understand, create and demonstrate the technical reports for robotic automation.*

Books Recommended:

1. Robotics by J. Baillieul, D.P. Martin, R.W. Brockett, Bruce R. Donald
2. Robotics: Designing the Mechanisms for Automated Machinery by Ben-Zion Sandler
3. Computational Principles of Mobile Robotics by Michael Jenkin, Gregory Dudek
4. Error Detection and Recovery in Robotics by Bruce R Donald – Technology
5. Remote Control Robotics by Craig Sayers
6. Handbook of Industrial Robotics edited by Shimon Y.

MELP-732, TRIBOLOGICAL PRACTICES *(Elective – I)*

L	T	P	Credit
3	-	4	5.0

Course Objectives

- *The course has been designed to give an understanding of tribological phenomena, industrial lubricants and additives.*

Introduction

History of Tribology, Introduction to Friction, Wear and Lubrication, Characteristic features of tribological systems, Surface topography, environmental and Economic aspects of tribology.

Friction

Causes of friction, Adhesion theory, Abrasive theory, Junction growth theory, Laws of rolling friction, Modeling of friction.

Wear

Wear mechanisms, Adhesive wear, Abrasive wear, Corrosive war, Fretting wear, Modeling of wear.

Lubrication and Lubricants

Dry friction, Boundary lubrication, Mixed lubrication, Hydrodynamic, Aerodynamic, Hydrostatic, Aerostatic and Elastohydrodynamic lubrication, functions of lubricants, types and properties of lubricants, lubricant additives.

Materials for Tribo-Systems

Metals, Polymers, Elastomers, Ceramics, Composites.

Modeling of Tribo-Systems

Reynolds equations, Importance of fluid compressibility, Elastic deformation, effect of variation temperature and behavior of lubrication on viscosity, Journal bearings.

Tribo measurement and instrumentation

Measurement surface topography, Friction measurement, Wear measurement, Online monitoring of Tribo-systems.

Course Outcomes:

Students will be able to

1. *Aware of tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings.*
2. *Realize the importance of proper choice of tribological elements*
3. *Apply the knowledge of friction, wear and lubricants for different applications*

Books Recommended:

1. Introduction to Tribology of Bearings by B.C. Majumdar
2. Principles of Tribology by J. Halling, Macmillan
3. Friction, Wear, Lubrication (A textbook in Tribology) by Kenneth C Ludema. CRC Press
4. Engineering Tribology by Gwidon W. Stachowiak and Andrew W. Batchelor, Elsevier
5. Applied Tribology by Michael M. Khonsari and E. Richard Booser, *John Wiley & Sons, Inc.,*
6. Principles of Lubrication by A. Cameron, Longmans
7. Mechanics and Chemistry in lubrication by Dorinson and Ludema, Elsevier
8. Friction and wear of Materials by E. Robinowicz, John Wiley
9. Friction and Wear of Materials, E Rabinowicz, *John Wiley & Sons, Inc.,*
10. Principles and applications of Tribology, Bharat Bhushan, *John Wiley & Sons Inc.,*

MELP-733 FLEXIBLE MANUFACTURING SYSTEMS *(Elective – I)*

L	T	P	Credit
3	-	4	5.0

Course Objectives

- *Learn the concepts and technologies associated with Flexible Manufacturing System.*

Introduction

Introduction to Manufacturing Systems, Different types of manufacturing systems, Volume Variety relationships for understanding manufacturing systems

Flexibility and automation

Different types of flexibility in manufacturing, Different types of FMS building blocks. , Work station, Storage retrieved system, material handling systems, computer control system.

Machining system of FMS

Horizontal machining Centers, Vertical machining Centers, Integrated Material Handling, Automated Guided Vehicles, Automatic Storage and Retrieved System

Group technology

Part classification and coding, production flow analysis, Machine Cell design, Computer Aided Process Planning. ,Layout consideration for flexible manufacturing ,Scheduling of flexible manufacturing system. , FMS simulation

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students will be able to

1. *Impart knowledge about the integration of interdisciplinary fields of computer aided design, computer aided manufacturing, sensor system, automatic identification system etc. as a whole.*
2. *Develop knowledge and skills in design and analysis of various automatic material handling systems and automatic storage & retrieval system used in the modern day computer integrated manufacturing.*
3. *Make the students aware about various techniques of reverse engineering, used in present day design and manufacturing industry. It helps to understand the importance of reverse engineering for improving product life cycle and product quality.*

Books recommended:

1. Automation, Production Systems and Computer integrated Manufacturing by MP. Groover.
2. Hand-book of Flexible Manufacturing Systems by Nand K. Jha.

MELP-734, MECHATRONICS *(Elective – I)*

L	T	P	Credit
3	-	4	5.0

Course Objectives:

- *The course deals with basic principles of Mechatronics involving sensors, actuators, control systems, and microprocessor systems. The aim of this course to make a bridge between Mechanical, Electronics, Instrumentation, Computer and Controls field.*

Introduction to Mechatronics - Overview of mechatronic products and their functioning. Survey of mechatronical components. Selection and assembly for precision-engineering applications. Study of electromechanical actuators and tranducers. Load analysis and actuator selection for typical cases such as computer peripherals. Study of electronic controllers and drives for mechanical products. Interfacing of mechanical and electronic systems. Design assignments and practical case studies.

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students would be able to

1. *understand the basic elements of any Mechatronic device.*
2. *develop the mathematical model of any physical model from any engineering domain.*
3. *understand the key inputs and outputs of any physical device, different sensors and transducers to measure the outputs, interfacing of the sensors and actuators to the computers.*

Books recommended:

1) Mechatronics by Laurie Kelly, Clarence W De Silva
2) The Mechatronics Handbook by Robert H Bishop – Technology
3) International Conference on Mechatronics edited by R.M Parkin, A Al-Habaibeh, M.R. Jackson
4) Mechatronics in Engineering Design and Product Development by Popovic Vlacic
5) Recent Trends in Mechatronics edited by Nadine Lefort-Piat, Alain Bourjault
6) Mechatronics and the Design of Intelligent Machines and Systems by D A Bradley, D Dawson, S Burge, D Seward

Programme Elective-II

MELP-735: Optimal Design of Thermal Systems ***(Elective – II)***

L	T	P	Credit
3	---	2	4.0

Course Objectives:

- *To know and understand the different thermal systems and to get familiar with their design, thermal modeling, objectives, simulation, and economic analysis.*
- *To understand the optimization, its role, and methods in the analysis and design of various types of thermal systems and equipment's.*

Introduction

Engineering design, design as part of engineering undertaking; Basic considerations in design: formulation of the design problem, conceptual design, steps in the design process, computer aided design.

Economic analysis

Calculation of interest, worth of money as a function of time, series of payments, depreciation.

Modeling of thermal systems

Types of models, mathematical modeling, curve fitting, linear algebraic systems, numerical model for a system, system simulation, methods for numerical simulation.

Acceptable design of thermal systems

Initial design, design strategies, design of systems from different application areas, additional considerations for large practical systems.

Thermal systems optimization

Optimization methods, practical aspects in optimal design, Lagrange multipliers, search methods, geometric, linear and dynamic programming.

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students will be able to

1. *Understand about the thermal interactions and its role in many like processes,*
2. *Develop the means to tackle the various thermal problems.*
3. *Design and selection of the materials/equipments for a particular application based upon its thermal response.*
4. *Analyze and optimize the thermal problems.*

Recommended books:

1. W. F. Stoecker, design of thermal systems, McGraw-Hill

2. Y. Jaluria, design and optimization of thermal systems, CRC Press
3. A. Bejan, G. Tsatsaronis and M. J. Moran, Thermal design and optimization, John Wiley and Sons.
4. N. Suryanarayana and O. Arici, Design and simulation of thermal system, McGraw-Hill

MELP-736: Computational Fluid Dynamics *(Elective – II)*

L	T	P	Credit
3	---	2	4.0

Course Objectives:

- *To impart the knowledge of governing equations for fluid flow.*
- *To learn about the Numerical methods used to solve the partial differential equation.*
- *To solve the fluid flow problem using CFD analysis.*

Introduction; Governing equations and discretizations / integration fundamentals: compressible Navier-Stokes/ Euler equations, incompressible Navier-Stokes/ Euler equations, potential equations, Cartesian grid, structured grids and unstructured grids;

Numerical solutions of the potentials equations: potentials equations, finite element methods, numerical solution of a linear system ; Numerical solution of the compressible Euler equations: mathematical properties of Euler equations , finite volume methods, upwind methods, boundary conditions, extension to higher order accuracy, explicit time – stepping methods; Numerical solution of the compressible Navier-Stokes equations: discretization of viscous and heat conduction terms, implicit time stepping methods, construction of Jacobian matrices, numerical solution of a linear system; Discontinuous Galerkin methods for hyperbolic problems.

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students will be able to

1. *acquire adequate knowledge of various types of fluid flow governing equations.*
2. *analyze the internal fluid flow phenomena of any Engineering system.*
3. *acquire enough knowledge to design of the Engineering systems using computational fluid dynamics.*

Recommended books:

1. Computational fluid flow and heat transfer by K. Muralidhar and T. Sundararajan, Narosa Publishing house.
2. fundamentals of computational fluid dynamics by Sengupta, Tapan K., universities press
3. Computational fluid mechanics and heat transfer by Anderson, Tannehill and Pletcher, Published by Taylor and Francis.

MELP-737: Advanced Thermodynamics ***(Elective – II)***

L	T	P	Credit
3	---	2	4.0

Course Objectives:

- *To impart knowledge on the fundamentals of theory of energy, its quality and significance for the applications of thermal systems. To impart knowledge on the analysis of simple compressible and multicomponent systems.*
- *To impart knowledge on the different thermodynamic property relations, applications, power, refrigeration cycles and use of thermodynamics in daily life.*

Basic concepts, work, heat and first law of thermodynamics, the second law of thermodynamics. Analysis of simple compressible systems, and other simple systems, analysis of open systems, exergy and irreversibility. Multicomponent systems, phase equilibrium in multicomponent systems, reactive mixtures, power cycles, refrigeration cycles, non equilibrium thermodynamics, thermodynamics in daily life.

Students have to make a Project and have to submit Project Report

Course Outcomes:

Students will be able to

- *understand theoretical principles of energy and exergy analysis, behavior of real and ideal gases, thermodynamic property relations and reactive systems.*
- *analyze thermodynamic processes in daily routine life and in various industries.*

Recommended books

1. Engineering Thermodynamics- a generalized approach by P.L Dhar, Elsevier publication.
2. Engineering thermodynamics by Wan Wylen
3. Engineering thermodynamics by G. Rogers and Y. Mayhow
4. Engineering thermodynamics by Obert

MELP-738: Heat Exchanger Analysis and Design ***(Elective – II)***

L	T	P	Credit
3	---	2	4.0

Course Objectives

- *To study and understand the role of different types of heat exchangers, their design, functioning and related concepts.*

Classification, temperature distribution for parallel flow, counter flow, cross flow, heat exchanger, evaporators and condensers, concept of LMTD and overall heat transfer coefficient.

Fouling of heat exchangers, NTU method for gauging exchanger performance, LMTD for parallel, counter and cross flow heat exchangers, effectiveness for parallel and counter flow exchangers.

Important design considerations: material selection and optimization of heat exchangers, analysis of regenerative heat exchangers. Vibrations induced by flow, International Standards for heat exchangers.

Thermal and Mechanical Design of: Shell & tube heat exchangers, Double pipe, Extended surface, Condensers & evaporators, Boilers & feed water heaters, Air preheaters, Dictators, Heat exchanger for nuclear application.

Students have to make a Project and have to submit Project Report

Course Outcomes

Students will be able to

- *aquire adequate knowledge about working and design concepts of heat exchanger.*
- *analyze the heat transfer & pressure drop analysis.*
- *aquire adequate knowledge about heat transfer augmentation Techniques used in heat exchangers*

Recommended books

1. Heat exchangers design and theory by N.H. Afgan and Schliinder, MGH
2. Compact heat exchangers by W.M Kays and A.L. London, MGH
3. Heat exchangers by Sadik Kakac and Hongtan Hiu, CRC press
4. Design of Heat Exchanger by Kern
5. Principles of Heat Transfer by Kreith Bohn
6. Heat Exchanger Design Handbook by Begell House Inc.

MES-730 SEMINAR

L	T	P	Credit
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Course Objectives

- *To prepare students for the method of literature survey, realization of journal papers outcomes, expose them to the world of research and compilation/review of a research area of current era and prepare them for presentation of literature summary.*
- *Presentation on advanced topics in the field of Mechanical Engineering.*

The student will select a topic of seminar in emerging areas of Mechanical Engineering and study the same independently. The topic of the seminar should not be the part of the curriculum. Each student is required to give a seminar talk on the same before the committee constituted by the head of the dept. as per the guidelines decided by the department from time to time.

Course Outcomes:

Students will be able to

1. *To prepare students for the method of literature survey, realization of journal papers outcomes, expose them to the world of research and compilation/review of a research area of current era and prepare them for presentation of literature summary.*
2. *Presentation on advanced topics in the field of mechanical engineering*

MED-740 THESIS (Starts)

L	T	P	Credit
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Course Objectives

- *To identify research issue/problem on advance engineering topics related to Mechanical Engineering.*
- *To gain knowledge on the research problems identified through extensive literature survey.*
- *To understand the tools required to carry out research work.*

The Thesis work should be of Research nature only and it should be started during the third semester. The following work should be completed during the semester.

- Literature Survey
- Problem Formulation

Around 35% of the Thesis work should be completed in this semester. The remaining 65% work will be carried out in the fourth semester. Each student is required to submit a detailed report about the work done on topic of Thesis as per the guidelines decided by the department. The Thesis work is to be evaluated through Presentations and Viva-Voce during the semester and at the end of semester as per the guidelines decided by the department from time to time.

The research work must be carried out in GJUS& T, Hisar. If a candidate choose any co-supervisor from outside the university then prior permission from competent authority is required. The outside co-supervisor must be an eminent scholar of international fame from the reputed institution like IITs or equivalent only.

Course Outcomes:

Students will be able to

1. *Ability to identify research issue/problem on complex engineering topics related to Mechanical Engineering.*
2. *Gain knowledge on the research problem identified through extensive literature survey.*
3. *Ability to work in group and mange and understand research papers/literature related to research topic through group-discussion.*
4. *Understanding of professional & ethical research issues*
5. *Ability to present/communicate effectively the research topic though synopsis presentation.*
6. *Understanding of simulator tools required to carry out research work.*

M.Tech. (Semester- 4th)

(*Syllabi*)

MED-741 THESIS

L	T	P	Credit
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Course Objectives

- *Ability to bring ideas into practice through simulation of analysis of research topic.*
- *Ability to identify specific industrial problems in the form of research objectives.*
- *Ability to propose a novel idea/modified technique/new interpretation after analyzing the existing research work.*

Around 35% of the Thesis work should be completed in third semester. The remaining 65% work will be carried out in this semester. Each student is required to submit a detailed Thesis report about the work done (III Sem + IV Sem) on topic of Thesis as per the guidelines decided by the department. The Thesis work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time.

The candidate should present/publish or communicated one paper in national/international conference/seminar/journal of repute is must before submission. Research work should be carried out at GJUS&T, Hisar. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.

The research work must be carried out in GJUS& T, Hisar. If a candidate choose any co-supervisor from outside the university then prior permission from competent authority is required. The outside co-supervisor must be an eminent scholar of international fame from the reputed institution like IITs or equivalent only.

Course Outcomes:

Students will be able to

1. *Ability to bring ideas into practice through simulation of analysis of research topic.*
2. *Ability to identify specific problems/issues in the form of research objectives.*
3. *Ability to propose a novel idea/modified technique/new interpretation after analyzing the existing research work.*
4. *Ability to contribute towards the knowledge up gradation of scientific community and society in general.*
5. *Imposed communication skills (oral as well as writing) through seminars, group discussions, thesis writing and research paper writing.*
6. *Understating of significance of ethical and research professional.*
7. *Ability to stay updated through continuous learning.*
8. *Understanding of research techniques and simulation tools for detected analysis of research issues.*
9. *Interpretation and compilation of simulation result to issue at a meaningful conclusion.*