Scheme of M. Tech in CAD/CAM

SEMESTER-I						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC701	Computer Aided Design	4	0	0	4.0
2.	MEC702	Advanced Mechatronics	4	0	0	4.0
3.	MEC703	Computer Integrated Manufacturing System	4	0	0	4.0
4.	MEC704	Rapid Prototyping	4	0	0	4.0
5.	MEC705	Robotics	4	0	0	4.0
6.	MEC706	Computer Aided Design Lab	0	0	4	2.0
		Total	**20**	**0**	**4**	**22.0**

SEMESTER-II						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC711	Computer Control of Machine Tools	4	0	0	4.0
2.	MEC712	Finite Element Methods in Engineering	4	0	0	4.0
3.		Elective -I	4	0	0	4.0
4.	MEC713	Machine Tool Design	4	0	0	4.0
5.	MEC714	Design Analysis Lab	0	0	4	2.0
6.	MEC715	Research Methodology	4	0	0	4.0
		Total	**20**	**0**	**4**	**22.0**

SEMESTER-III						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.		Elective -II	4	0	0	4.0
2.		Elective -III	4	0	0	4.0
3.	MEC795	Dissertation Phase-I	0	0	12	6.0
4.	MEC730	CNC Lab	0	0	4	2.0
		Total	**8**	**0**	**16**	**16.0**

SEMESTER-IV						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC796	Dissertation Phase-II	0	0	24	12.0
		Total	**0**	**0**	**24**	**12.0**

Elective I						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC721	Industrial Automation	4	0	0	4.0
2.	MEC722	Computational Fluid Dynamics	4	0	0	4.0
3.	MEC731	Programming in Mat Lab	4	0	0	4.0
4.	MEC752	Advanced Manufacturing Processes	4	0	0	4.0
5.	MEC755	Product Design and development	4	0	0	4.0

Elective II						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC723	Computer aided Production Planning	4	0	0	4.0
2.	MEC725	Non Destructive Testing	4	0	0	4.0
3.	MEC726	Advanced Tool Design	4	0	0	4.0
4.	MEC790	Instrumentation and Control	4	0	0	4.0

Elective III						
S. No.	**Subject Code**	**Name of Subject**	**L**	**T**	**P**	**Credits**
1.	MEC727	Design of Hydraulic and Pneumatic Systems	4	0	0	4.0
2.	MEC728	Micro Electro Mechanical Systems	4	0	0	4.0
3.	MEC729	Quality and Reliability Engineering	4	0	0	4.0
4.	MEC788	Optimization Techniques	4	0	0	4.0

Course Title : Computer Aided Design
Paper Code : MEC 701
Objective:

L	T	P	Credits
4	-	-	4

- To impart knowledge about the applications and benefits of CAD.
- To impart knowledge about mathematical basics for geometric modelling of curves, surfaces, solid models and geometric transformations.

UNIT-A

Introduction to CAD/CAM, Computer Graphics: Computer Aided Design: Definition, Fundamentals of CAD, The Design Process, Computers Applications in Design, Introduction to CAD/ CAM hardware, input and output devices, Software configuration of a Graphics system, Functions of a Graphics package, Coordinate Systems, Geometric modelling and its types, Data Base Structure and Content, CAD applications, DDA, Bresenham's /Mid-point Line, Circle and Ellipse drawing algorithms, Windowing and Clipping, Lighting and shading, Hidden lines/surface removal.

UNIT –B

Geometric Modelling of Curves: Types of models, Construction of Wire frame Models, Wire frame Entities, Curve Representation methods. Review of Vector Algebra, Parametric Representation of Analytic Curves - Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics, Parametric Representation of Synthetic Curves - Hermite Cubic Splines, Bezier Curves, B-Spline Curves, Rational Curves and Blending of curves.

UNIT –C

Geometric Modelling of Surfaces and Solids: Introduction Surface Models, Surface Entities, Surface Representation, Parametric Representation of Analytic Surfaces - Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder, Offset Surface, Triangular Patches, Parametric Representation of Synthetic Surfaces - Hermit Bicubic Surface, Bezier Surface, B-Spline Surface, Coons Surface, Solid Modelling, solid modelling schemes, Boundary representations, Constructive solid Geometry, Sweep Representations, half spaces, comparison of representations, assembly modelling.

UNIT –D

Geometric Transformations and CAD/CAM Data Exchange: Need for geometric transformations, Two Dimensional and Three dimensional geometric transformations including Translation, Rotation, Scaling, overall scaling, Reflection, orthographic and perspective projections, Homogeneous Transformations, Concatenated transformations, CAD/ CAM data exchange formats, evolution of exchange formats including shape based, product based formats, Graphics and computing standards– Open GL Data Exchange standards – IGES, PDES etc.

References:

1. Zeid Ibrahim and Sivasubramaniam R., *CAD/ CAM Theory and Practice*, 2nd Edition, Tata McGraw Hill, India, 2009
2. Singh Sadhu, *Computer aided design and manufacturing*, Khanna Publishers, Fifth Edition, 2010.
3. Mortenson Micheal E., *Geometric Modeling*, Wiley, 1997.
4. Saxena Anupam, Sahay Birendra, *Computer aided Engineering design*, Springer, 2010.
5. Rogers, D. F. and Adams, J. A.*, Mathematical Elements for Computer Graphics,* McGraw Hill, 1989.

Course Title: Advanced Mechatronics
Paper Code: MEC 702

L	T	P	Credits
4			4

Objective:

- To introduce the students with the sensor technology, signal conditioning, digital electronics and control systems.
- To learn how to apply the Principles of Mechatronics and Automation for the development of productive and efficient manufacturing systems.
- To study the hydraulic and pneumatic systems employed in manufacturing industry.
- To learn the CNC technology and industrial robotics as applications of Mechatronics in manufacturing automation.

UNIT -A

Introduction: Definition of Mechatronics, Mechatronics in Manufacturing, Products and Design, Review of Fundamentals of Electronics. Digital Electronics: Digital Logic, Number Systems, Logic Gates, Boolean algebra, Karnaugh Maps, Sequential Logic. Data Conversion Devices, Sensors, Micro sensors, Transducers, Signal Processing Devices, Relays, Contactors and Timers

Sensor Technology: Sensor and Transducers, Terminology, Displacement, Position, Proximity - Encoders, Velocity – Tacho Generators, Force - Strain Gauges, Pressure, Temperature-Thermocouples, RTDs, Thermistors, Light Sensors - Photoelectric Sensors, IR Sensors, Sensor Selection.

UNIT - B

Signal Conditioning& Data presentation system: Introduction D-A and A-D Converters, Operational Amplifier, Protection, Filtering, Wheatstone Bridge, Digital Signals, Multiplexers, Data Acquisition, Digital Signal Processing, Pulse-Modulation, Data Presentation Systems- Display, Data Presentation Elements, Magnetic Recording, Testing Calibration, Interface D-A and A-D Converters.

Precision Mechanical Actuation: Pneumatic Actuation Systems, Electro-Pneumatic Actuation Systems, Hydraulic Actuation Systems, Electro-Hydraulic Actuation Systems, Mechanical Systems, Types of Motion, Kinematics, Inverse Kinematics, Timing Belts, Ball Screw and Nut, Linear Motion Guides, Linear Bearings, Harmonic Transmission, Bearings, Motor / Drive Selection.

UNIT - C

Drives: Stepper Motors, Servo Drives. Ball Screws, Linear Motion Bearings, Cams, Systems Controlled by Camshafts, Electronic Cams, Indexing Mechanisms, Tool Magazines and Transfer Systems. Relays and Solenoids, Stepper Motors, DC Brushed and Brushless Motors, DC Servo Motors, AC / DC Motors for Non-Servo Motion Drives, Braking Methods, Pulse Width Modulated, Bipolar Driver, Mosfet Drives, SCR Drives, Variable Frequency Drives.

UNIT - D

Control System: System Transfer Function, Laplace Transformation and its Applications, Continuous and Discrete Processes, Proportional Control, Integral Control, Differential Control, PID Control, Digital Controllers, Control System Performance, Controller Tuning, Adaptive Control, Frequency Response, PLC, PMC, Mechatronics Design Approach, Possible Mechatronics Design Solution for Timed Switch, Wind screen, Wiper Motion, Bathroom Scale, Pick and Place Robot, Automatic Camera, Engine Management System and Bar Code Recorder.

References:

1. Nitaigour Premchand Mahalik. *Mechatronics: Principles Concepts and Applications.* New Delhi, McGraw Hill education, 2015 Print.
2. Kamm. *Understanding Electro-Mechanical Engineering: An Introduction to Mechatronics.* New Delhi: Prentice-Hall of India, 1995Print.
3. Koren*. Computer Control of Manufacturing System.* New Delhi: Tata McGraw Hill. 1999 Print.
4. Groover. *Production Systems and CIM.* New Delhi: PHI. 2007 Print.
5. Kuo, B.C*. Feedback Control Systems*. New Delhi: PHI.2003 Print
6. Bolton, W. Mechatronics: *Electronic Control Systems in Mechanical and Electrical Engineering.* Longman, Singapore, 2004 Print.
7. Billingsley, J. *Essentials of Mechatronics.* John Wiley & Sons.2006 Print.

Course Title: Computer Integrated Manufacturing System
Paper Code: MEC 703

L	T	P	Credits
4			4

Objective: In this course, the student will:

- Develop an understanding of Classical and State-of-the-Art Production Systems, Control Systems, Management Technology, Cost Systems and Evaluation Techniques.
- Obtain an overview of Computer Technologies including Computers, Database and Data Collection, Networks, Machine Control etc, as they apply to Factory Management and Factory Floor Operations.
- Describe the Integration of Manufacturing Activities into a Complete System.
- Acquire sensitivity to Human-Factors related issues as they affect decision making in the Factory Environment.

UNIT-A

Introduction: Introduction, Automation definition, Types of Automation, Processing in Manufacturing, Production Concepts, CIM Wheel, Evolution of CIM, Financial Justification of CIM, Challenges and Trends, Benefits of CIM, Fundamentals of Computer Technology, Need of CIM, NC, CNC, DNC, FMC, Management of CIM, Impact of CIM on personnel.

UNIT –B

Flexible Manufacturing System: FMS Concept, Components, Layouts, Planning and Implementation, Tool Management Systems-Tool Monitoring, Work Holding Devices-Modular Fixturing, Flexible Fixturing, Flexibility, Quantitative Analysis of Flexibility, Application and Benefits of FMS, Automated Material Handling System –AGVs, Guidance Methods, Automated storage and Retrieval Systems, Computer Aided Quality Control - Objectives of CAQC, QC and CIM, Contact, Non-Contact Inspection Methods, CMM and Flexible Inspection Systems.

UNIT –C

Group Technology and Computer Aided Process Planning: Group Technology, Types of Coding Systems, Production Flow Analysis, Benefits, Computer Aided Process Planning, Retrieval Types of Process Planning, Generative Type of Process Planning, Material Requirement Planning, Fundamental Concepts of MRP inputs to MRP, Capacity Planning.

UNIT –D

Manufacturing database and communication: Data-Manufacturing, Data Types, Sources, Structure of Data Models, Data Base and DBMS- Requirement, RDBMS, Shop Floor Control, Data Logging and Acquisition, Automated Data Collection, Control Types, Fundamentals of Communication, Communication Matrix, Network Architecture.

References:

1. Kant Vajpayee. S., *Principles of Computer Integrated Manufacturing*, Prentice Hall of India, 1999
2. Radhakrishnan.P, Subramanyan. S, *CAD/CAM/CIM*, New Age International publishers, 2000
3. David Bedworth, *Computer Integrated Design and Manufacturing*, TMH, New Delhi, 1st Edition 1999
4. Ranky, Paul G., *Computer Integrated Manufacturing*, Prentice Hall International 1999
5. M.P. Groover, *Automation, Production systems and Computer Integrated Manufacturing*, Prentice Hall of India, New Delhi, 2013

Course Title : Rapid Prototyping
Paper Code : MEC 704

L	T	P	Credits
4			4

Objective:

- To Provide the Students with an Understanding of the Basic Fundamentals of Rapid Prototyping, its Fabrication Techniques, Materials and Various areas of Defects and Improvements in Rapid Prototyping.

UNIT-A

Introduction: Classification of Manufacturing Processes, Different Manufacturing Systems, Introduction to Rapid Prototyping (RP), Need of RP in Context of Batch Production, FMS and CIM and its application; Basic Principles of RP, Steps in RP, Process Chain in RP in integrated CAD-CAM environment, Advantages of RP.
Classifications of Different RP Techniques: Based on Raw Material, Based on Layering Technique (2D or 3D) and Energy Sources.

UNIT –B

Process Technology in RP: Comparative study of Stereo-Lithography, Selective Laser Sintering, Fused Deposition Modeling, Laminated object Manufacturing, Solid Ground Curing, , Beam Inference Solidification, Laser Engineered Net Shaping , 3D Printing.

UNIT –C

CAD Data and Programming Techniques for RP: Transformations, Solid Modeling for RP, Surface Modeling, STL File Generation, Defects in STL Files and Repairing Algorithms, Interface Formats, Slicing Methods, Design of Support Structures, Internal Hatching and Surface Skin Fills.
Materials for RP: Materials used for different RP Processes, Selection Criterions for Materials for different Processes, Advantages and limitations of Different Types of Materials.

UNIT –D

Reverse Engineering: Introduction to Reverse Engineering and its Integration with Rapid Prototyping.
Business Opportunities and Future Directions: Introduction, New type of Products and Employment, Digiproneurship.
Research Assignment: The students will be given different Assignments to write their codes in MATLAB for constant slicing, Adaptive Slicing, Transformations, Parametric Curves and Surfaces Involved in Rapid Prototyping.

References:

1. Chua, C.K., Leong, K.F., *Rapid Prototyping: Principles and Applications in Manufacturing*, John Wiley and Sons Inc., 2000.
2. Pham, D.T., Demov, S.S., *Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling*, Springer, 2001.
3. Cooper, K.G., *Rapid Prototyping Technology- Selection and Application*, Marcel Dekker, Inc., 2001
4. Venuvinod, P.K., Weiyin M., *Rapid Prototyping- Laser Based and Other Technologies*, Kluwer Academic Publishers, 2004.

Course Title: Robotics
Paper Code: MEC 705

L	T	P	Credits
4			4

Objectives:

- To impart exposure to basic Robot Configurations, Sensors, Actuators.
- To impart knowledge about Kinematics/ Dynamics, Control and Programming of Robots.

UNIT-A

Introduction to Robotics: Introduction to Automation and Types, Robot Definition, Brief History, Classification of Robots on the basis of Configuration and other Aspects, Control Method of Teaching etc, Specifications of Robot Systems, Spatial Resolution, Accuracy, Repeatability, Robot Anatomy, Work Volume, Drive Systems, Power Transmission System, Joint Notation Scheme, Control Systems, Robot End Effectors, Mechanism of Operation, Mechanical and other Types of Grippers, Tools as End Effectors, End Effectors Interface.

UNIT –B

Robot Actuators Sensors and controllers: Actuator and Drive Elements, Hydraulic, Pneumatic and Electrical Drives, Criteria for Selection of Drives, Sensors like Displacement, Proximity and Range Sensors, Touch, Force Sensors, Machine Vision etc, Robot cell layouts, Design of Work Cells and Control, Proportional, Integral, Derivative, PID Control, Robot as a work cell controller, Use of Interlocks.

UNIT –C

Kinematics and Dynamics: Coordinate Frames, Mapping and Transformation, Forward kinematics of Robots, D-H Algorithm, Solution of Problems using D-H Algorithm, Introduction to inverse Kinematics, Existence of Solutions, Uniqueness of Solutions, Solutions Techniques, Acceleration of a Rigid Body, Mass Distribution, Newton's Equation, Iterative Newton Euler Dynamic Formulation, Lagrangian Formulation of Manipulator Dynamics.

UNIT –D

Programming and Applications: Methods of Robot Programming, Lead through Programming, Motion Interpolation, Use of Branching, Textual Robot Languages, Structure, Motion Commands, Speed Control, End Effectors and Sensor Commands, Application of Robots in Industrial Environments such as in Assembly, Welding, Spray Painting, Machine Loading and Unloading etc.

References:

1. Deb, S.R., *Robotics Technology and flexible automation*, Tata McGraw-Hill Education., 2009
2. Groover, Mikell P., Odrey Nicholas G, Mitchel Weiss, Roger N Nagel, Dutta Ashish, *Industrial Robotics, Technology programming and Applications*, McGraw Hill, 2012
3. Klafter Richard D. R, A. Thomas, Elewski Chris, Negin, Michael, *Robotics Engineering an Integrated Approach*, Phi Learning., 2009.
4. Mittal and Nagrath, *Robotics and control*, , Tata McGraw Hill, 2010
5. Nagy, Francis N., Siegler, Andras, *Engineering foundation of Robotics*, Prentice Hall Inc., 1987.

Course Title: Computer Aided Design Lab
Paper Code: MEC 706

L	T	P	Credits
-	-	4	2

Objectives: To impart knowledge on how to prepare Drawings for various Mechanical Components using any commercially available 3D Modelling software.

List of Experiments:

1. Introduction to Creo.
2. Introduction to various commands in Sketcher mode and exercises.
3. Introduction to Feature manipulation- Copy, Edit, Pattern, Suppress, History operations, Constraints etc.
4. Introduction to various commands in Part Mode and exercises.
5. Introduction to various commands in advance Part Mode and exercises.
6. Introduction to various commands in Surface Modelling and exercises.
7. Introduction to various commands in Assembly.
8. Drafting-Layouts, Standard & Sectional Views, Detailing & Plotting.

Student is expected to do a project work related to modelling of a mechanical component assembly at the end of the semester.

Course Title: Computer Control of Machine Tools
Paper Code: MEC 711

L	T	P	Credits
4	-	-	4

Objective: The aim of this course is to

- Teach the applications of various Computer Numerical Control Machines.
- Computer Aided Manufacturing- Processes, Operations.
- Design and Operational Characteristics of Key Hardware Components and Programming Techniques.
- Merits and Demerits of Computer Numerical Controlled (CNC) Machines.

UNIT-A

Elementary concepts in Numerical control: Requirement of Machine Tools and its Advantages over Conventional Manufacturing. Structure of NC System Economics of NC for m/c tools, Constructional details of N.C. m/c tools, MCU Structure and Functions, Technique and Procedure of Recuperating Accuracy and Productivity using NC.

UNIT –B

Machine Actuation and control: Numerical Control Machine Actuation and Control Drives, Feedback Devices, Counting Devices, DAC and ADCs Interpolator systems along with the Optical, Pneumatic, Hydraulic, Electro- Mechanical and Electromagnetic Control Systems. Control Loop Circuit Elements in PTP system, Contouring System, Incremental and Absolute Systems, Definition and Designation of Control Axes, Tool and Zero Presetting, Work Holding and Setting up of NC M/c.

UNIT –C

CNC , DNC and Adaptive Control systems: Types and functions of Computer Numeric Control (CNC), Types and functions of Direct Numeric Control (DNC), Need of Adaptive Control Types, Functions and Types of Adaptive Control-its uses & benefits, Advantages of Combined CNC/DNC Systems. Control systems for Positional Control and Tool Changing Systems, Digital Computer and its Functioning for m/c control, Microprocessor in CNC.

UNIT –D

NC Part Programming: NC part programming in FANUC system for Mechanical Components. Flexible Tooling, Tool Path Simulation on lathe and milling, Advanced Programming Features. Block Format and Codes, Tool Length and Radius Compensation, Computer Assisted Part Programming, the APT Language- Geometric, Motion, Post Processor and Auxiliary Statements.

References:

1. Koren, Yoram, *Computer control of manufacturing systems*, McGraw Hill, Singapore, 1983.
2. Kundra, T.K., Rao, P.N., Tewari, N.K., *Numerical control and computer aided manufacture*, Tata McGraw Hills, New Delhi, 1993.
3. Pabla, S., Adithan, M., *CNC Machines*, Willey Eastern, New Delhi.
4. Thyer, G.E., *Computer Numerical Control of Machine Tools*, Industrial Press, Incorporated, USA.1988, Second Edition.

Course Title: Finite Element Methods in Engineering
Paper Code: MEC 712

L	T	P	Credits
4	-	-	4

Objective: Students will learn about

- Basic concepts of FEM,
- One and Two Dimensional Problems in FEM
- Problems of Static, Scalar Field and Dynamics

UNIT-A

Introduction: Historical Background, Stresses and Equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Matrix Algebra and Gaussian Elimination. Classification of Differential Equations, Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method, Variational Formulation.

UNIT –B

One and Two Dimensional Problems: Introduction, Coordinates and Shape Functions, Potential Energy Approach, Galerkin Approach, Assembly of the global Stiffness Matrix and Load Vector , FEM equations and treatment of Boundary Conditions, Quadratic Shape Functions, Finite Element Modeling, Constant Strain Triangle (CST), Problem Modeling and Boundary Conditions.

Two Dimensional Isoperimetric Element: The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle.

UNIT –C

Truss, Beams and Frames: Plain and Three Dimensional Trusses, Beams on Elastic Support, Plain and Three Dimensional Frames, Beams and Frames in various Boundary Conditions.

Three Dimensional Problems in Stress Analysis: Stress Calculations, Mesh Preparation, Higher Order Elements, Frontal Method.

UNIT –D

Scalar Field Problems: Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in Ducts.

Dynamic Considerations: Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors.

Computer Implementation: Introduction; Computer Program Organization for Calculation of System Matrices.

References:

1) Chandrupatla T.R. and Belegundu A.D*. Introduction to finite Elements in Engineering.* 4th Edition. Pearson, New Delhi 2012 Print.

2) Cook, R.D. Malkus, D.S. Plesha, M.E. and Witt, R.J. *Concepts and Applications of Finite Element Analysis.* Wiley 2002 Print.

3) Bathe, J.K. *Finite Element Procedures in Engineering Analysis.* Prentice Hall 2007 Print

4) Reddy, J. *An Introduction to Finite Element Method.* Tata McGraw Hill, 2005 Print

Logan, D. L. *A First Course in the Finite Element Method* Cengage Learning 2012 Print.

Course Title: Machine Tool Design
Paper Code: MEC 713

L	T	P	Credits
4	-	-	4

Objective: Students will learn about

- Machine tool elements and its design, its construction features
- Drives, controls and vibrations in the structure of machine tool.

UNIT-A

Introduction: Machine Body, Elements of Design, Section of Machine Body, Guide ways, Materials for Machine Body and Guide ways, Stick Slip Motion in Guides, Slide ways Design, Spindles and Spindles Bearings. Design features of Spindles. Mountings of Spindle.

UNIT –B

Basic Principles of Designs for Strength and rigidity: Comparative Evaluation of various Materials used in M/C Tool construction by weight, Optimum Design criterion, Dependence of Process Capability on the Rigidity of M/C Tool. Static Compliance of a Machine Tool, Design of Lathe Bed. Columns of machines tools, Methods for Increasing Rigidity, Use of Reinforcing stiffeners in lathe Bed.

UNIT –C

Motions in M/C Tools: Group vs Individual, Mechanical drive-design layout of Mechanical Stepped Drivers. Step less drive, Selecting the Maximum and Minimum Cutting Speeds and Feeds, Series of Spindle Speed -G.P, SL standard values of ø. Ray Diagrams, Electrical Drives, Hydraulic Drives i.e. step less Drives. Advantages and Disadvantages of Drives.

UNIT –D

Latest trends in Machine Tool Design: NC in M/C Tools, Fluidic Control, Adoptive control. M/C Tool Vibrations:-Introduction, Effects of Vibrations on M/C tool, parameters on W/P. Tool life , Source of Vibration, Machine Tool Chatter.

References:

1. Sen G.C., &Bhattacharya A., *Principle of Machine tools* by, New Central Book Agency; 2nd revised edition 2009.
2. Sharma P.C., *Production Eng.,* S Chand and company pvt. Ltd. New Delhi.
3. Mehta N.K., *M/C Tool Design*, McGraw-Hill Inc., US; New edition 1990
4. Basu S.K., & Pal D.K., *Design of machine tools*, Oxford & IBH Publishing Co Pvt. Ltd, India.
5. Acherkan N., *Machine Tool Design* , Mir publisher, Moscow
6. Koenigsburger A, Pergamon, *Design principles of Metal cutting & Machine Tools, Pergamon, 2013*.

Course Title: Design Analysis Lab
Paper Code: MEC 714

L	T	P	Credits
-	-	4	2

List of Experiments:

A. Modeling of stress analysis using Nastran software for:

1. Bars of Constant Cross Section Area and Tapered Cross Section Area.
2. Two Bar and Four Bar Trusses.
3. Beams – Simply supported, Cantilever and Beams with UDL.
4. Two dimensional rectangular plate with a circular Hole.
5. Find the Deformation and Stress Distribution in the wall of the Open Ended Cylinder using Axisymmetric Element.
6. A Three Dimensional body is fixed at one End and Loaded at the other. Find the deflection at the Load and Maximum Principal Stresses.

B. Modeling of thermal analysis using Nastran software for:

1. 1D, 2D and 3D problem with conduction and convection boundary conditions.

C. Modeling of dynamic analysis using Nastran software for:

1. Determine the frequency response of the 2D rectangular plate.
2. Determine the transient frequency response of the 2D rectangular plate.

Course Title: Research Methodology
Paper Code: MEC 715

L	T	P	Credits
4	-	-	4

Objective: The course is designed to introduce the students to research methodology and application of research techniques and procedures. The primary goal of this course is to develop a sound understanding of research methods.

Learning Outcomes: The students will be able to apply the various research methods to solve the real life problems.

UNIT – A

Introduction to Research: Objectives and Types of Research, Research Approaches, Significance and process, Criteria of Good Research, Selecting the Problem, Necessity of Defining the Problem and Technique Involved in Defining a Problem.

Research Design: Research Design and its need, Features of a Good Design, Different Research Designs, Basic Principles of Experimental Designs, Factors affecting RDs, Relation among RDs, Developing a Research Plan.

UNIT – B

Sampling Design: Census and Sample Survey, Steps in Sampling Design, Sampling Procedure, Characteristics and Different Types of Sample Designs, Selection of a Random Sample, Complex Random Sampling Designs.

Measurement and Scaling Techniques: Measurement in Research, Measurement Scales, Sources of Error in Measurement, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques.

UNIT – C

Methods of Data Collection: Collection of Primary Data, Observation Method, Interview Method, Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Processing and Analysis of Data: Measures of Central Tendency, Dispersion, Asymmetry (Skewness), Measures of Relationship Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes, Other Measures.

Sampling Fundamentals: Need for Sampling, Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean, Estimating Population Proportion, Sample Size and its Determination.

UNIT – D

Testing of Hypotheses (Parametric or Standard Tests of Hypotheses): Basic Concepts and Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means,

Hypothesis Testing for Differences between Means, Hypothesis Testing for Comparing Two Related Samples, Hypothesis Testing of Proportions, Hypothesis Testing for Difference between Proportions, Hypothesis Testing of Correlation Coefficients.

Design of Experiments and Analysis of Variance and Covariance: Taguchi and RSM, Analysis of Variance (ANOVA), The Basic Principle of ANOVA, ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA, ANOVA in Latin-Square Design, Analysis of Co-variance (ANOCOVA), ANOCOVA Technique, Assumptions in ANOCOVA.

References:

1. Kothari, C.R. *Research Methods and Techniques*, New Age Publishers, 2014 Print.
2. Srivastava, T.N. *Business Research Methods*, TMH, 2017 Print.
3. Bajpai Naval, *Business Research Methods*, Pearson Publications, 2010 Print.
4. Malhotra, Naresh K. *Marketing Research: An Applied Orientation*, 5th Edition. Pearson/ Prentice-Hall, 2007 Print.
5. Proctor Tony, *Essentials of Marketing Research*, Prentice Hall, 4th Edition, 2005 Print.

Course Title: CNC Lab
Paper Code: MEC 711

L	T	P	Credits
-	-	4	2

List of Experiments:

1. To learn and study of working Principle and Parts of CNC Lathe.
2. To Generate the N.C code of the Drawing consisting turning and Facing Operations To Generate the N.C code of the Drawing consisting Taper Turning, Grooving, Drilling and Threading Operations
3. To Study the different types of Tooling used and Re-Circulating Ball Screw used in Lathe Machine.
4. To study the N.C coordinate system of different N.C system.
5. To study the working principle and parts of CNC Milling Machine.
6. To Generate the N.C code of the Drawing Consisting Contour Milling Operations
7. To study the different Sensors and Stepper Motors used in CNC Machines.
8. To study the Open and Closed Loop Systems.

Course Title: Industrial Automation
Paper Code: MEC 721

L	T	P	Credits
4	-	-	4

Objective:

After successful completion of the course, student will be able to

- To identify potential areas for automation and justify need for automation
- To select suitable major control components required to automate a process or an activity
- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.
- To identify suitable automation hardware for the given application.
- To recommend appropriate modeling and simulation tool for the given manufacturing application.

UNIT-A

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Artificial Intelligence and expert system: Intelligence**,** Artificial Intelligence, Background, Definition and its Application in Manufacturing. Expert system and its Industrial Application. A.I. Programming for expert systems.

UNIT –B

Automated High volume Manufacturing Systems: Automation in Manufacturing and Assembly System, Automation Production or Transfer Lines. Concept of Line Balancing and Line Balancing Methods. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies.

UNIT –C

Control Technologies in Automation: Industrial Control Systems, Process Industries versus Discrete- Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms.

Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, and SCADA Systems & RTU.

Distributed Control System: Functional Requirements, Configurations & some Popular Distributed Control Systems.

UNIT –D

Modeling and Simulation for Plant Automation: Introduction, Need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants.

References:

1. Jain .K.C. *Automation and advanced manufacturing system*, Khnna Publishers, 1st edition, 2004.
2. Groover M.P., *Automation, Production Systems and Computer Integrated Manufacturing*, Pearson Education 5th edition, 2009.
3. Kant Krishna, *Computer Based Industrial Control*, EEE -PHI, 2nd edition, 2010.
4. A. WyskRichard, ChangTiess Chiu, *An Introduction to Automated Process Planning Systems.*
5. Viswanandham, *Performance Modelling of Automated Manufacturing Systems*, PHI, 1st Edition, 2009.

Course Title: Product Design and Development
Paper Code: MEC755

L	T	P	Credits
4	-	-	4

Objective:

- To introduce the Objectives of product design and the Requirements of a Good Product Design.
- To expose the students to different Design Principles like Designing for function, Production, Installation and Handling, Maintenance, Packaging etc.

UNIT-A

The Process of Product Design: Design by evolution, Limitations of evolutionary method in modern design situation, Structure of design process, Morphology of design, Specifications and Standards of performance, Environmental factors, Creativity techniques in design problem.

UNIT –B

Strategies for Search of Design Concepts: Physical reliability, Economic and Financial Feasibility, Designing for Function, Designing for Production, Tolerance Analysis, Use, Maintenance, Designing for handling and installing, Economics of Design, Human factors in design, Optimization of design, Reverse Engineering of Ergonomic Shape Designs and Visual Design.

UNIT –C

Use of CAD / CAM /CAE: Software for Concurrent Engineering Design. Case studies in design of products for Manufacture, Aesthetics, Surface styling and shaping tools in CAD software, Exercises in Design, Reverse Engineering and Surface Design and Review Software.

UNIT –D

Elements of testing: Qualitative and Quantitative Methods including survey, measurement of customers' response, Intellectual Property: Elements and outline, patenting procedures, Claim Procedure. Design for Environment: Impact, regulations from government, ISO system.

References:

1. Gupta, V. and Murthy, P.N., *Introduction to Engineering Design Method*, McGraw Hill 1980.
2. Chitale, A. K. and Gupta, R. C., *Product Design and Manufacturing*, Prentice Hall of India 2004.
3. Ulrich, K. T. and Eppinger, S. D., *Product design and development*, Tata McGraw Hill Publications.
4. Kelvin, O. and Krista, W., *Product design*, Pearson Education, Delhi, 2001.
5. Bruce, M. and Rachel, C., *Creative product design,* Johan Willey & sons Ltd., New York, 2000.

Course Title: Advance Manufacturing Processes

Paper Code: MEC752

L	T	P	Credits
4	-	-	4

Objective: Students will learn about

- Non-Conventional Machining Processes, its Construction features, Comparison of its Aspects.
- Principles, Analysis, Control Parameters and its effect on the response Parameters.

UNIT-A

Introduction: Need of Non- Conventional Machining Processes, Classification of Modern Machining Processes, Process Selection, The Benefits and Limitations over Conventional Machining Processes.

Mechanical Energy based processes: Working principles, Elements of the process, Process parameters, Analysis of machining, Response characteristics, Applications of the Abrasive Jet Machining, Water Jet Machining, Abrasive water Jet Machining, Ultra Sonic Machining.

UNIT –B

Electro Chemical and chemical based processes: Working principles, elements of the process, process parameters, analysis of machining, response characteristics, Applications of the electro chemical and chemical processes. Electro chemical grinding, Electrochemical deburring, Electrochemical honing.

UNIT –C

Electrical energy based processes: Working principles, Elements of the process, Process parameters, Analysis of machining, Response characteristics, Applications of the Electro-Discharge Machining, Laser Beam Machining, Plasma Arc Machining.

UNIT –D

Rapid prototyping: Introduction, Steps in RPT, Major RP Technologies, Rapid Manufacturing, Applications of RPT, Future Developments, Limitations and Challenges.

References:

1. Pandey P.C and Shan H.S, *Modern Machining Processes*, Tata McGraw Hill education Pvt. Ltd.
2. Jain V.K., *Advanced Machining Processes*, Allied Publishers pvt. Ltd. New Delhi
3. Kalpakjian S., *Manufacturing Engineering & Technology*, Pearson Education Asia.
4. Ghosh & Mallick. , *Manufacturing Science*, New Age Publishers pvt. Ltd. New Delhi
5. Mishra, P.K., *Non -Conventional Machining*, Narosa Publishing House, New Delhi.
6. Benedict G.F., *Non Traditional machining* by G.F Benedict, Marcel Deekker.

Course Title: Programming in Matlab
Paper Code: MEC 731

L	T	P	Credits
4	-	-	4

Objective:

- The main objective of this course is to provide the students with the opportunity to improve their Programming Skills using the MATLAB environment to implement algorithms and to teach the use of MATLAB as a tool in solving problems in engineering.
- Upon completion of this course, the students can able to use the MATLAB applications in engineering problem solving.

UNIT-A

Introduction to Basics of MAT Lab: Introduction, Arithmetic Operations, Display Formats, Elementary Math Built-in Functions, Variable Names, Predefined Variables, Commands for Managing Variables, General Commands, Arrays, Operations with Arrays, Element-by-Element Operations, Random Numbers Generation, Polynomials, System of Linear Equations, Script Files, Relational and Logical Operations, Order of Precedence, Built-In Logical Functions, Conditional Statements, Nested if Statements, Else And Else if Clauses, Matlab While Structures, Basic 2D Plots, Specialized 2D Plots, 3D Plots, Saving and Printing Graphs, Input/output in Matlab, Symbolic Mathematics.

UNIT –B

Engineering Mechanics: Introduction, Newtonian Mechanics, Newton's Laws of Motion, Resultants of Coplanar Force Systems, Resultants of Non-coplanar Force Systems, Equilibrium of Coplanar Force Systems, Equilibrium of Non-coplanar Force System, Trusses, Analysis of Beams, Friction, First Moments and Centroids, Virtual Work, Kinematics of a Particle, D'Alembert's Principle, Kinematics of a Rigid Body in Plane Motion, Moments of Inertia, Dynamics of a Rigid Body in Plane Motion, Work and Energy, Impulse and Momentum, Three-dimensional Mechanics.

UNIT –C

Mechanical Vibrations: Introduction, Classification of Vibrations, Elementary Parts of Vibrating Systems, Discrete and Continuous Systems, Vibration Analysis, Components of Vibrating Systems, Free Vibration of Single Degree of Freedom Systems, Forced Vibration of Single-degree of Freedom Systems, Harmonic Functions, Two-degrees of Freedom Systems, Multi-degree of Freedom Systems, Free Vibration of Damped Systems, Proportional Damping, General Viscous Damping, Harmonic Excitations, Modal Analysis for Un-damped Systems, Lagrange's Equation, Principle of Virtual Work, D'Alembert's Principle, Lagrange's Equations of Motion, Vibrational Principles, Hamilton's Principle.

UNIT –D

Direct Numerical Integration Method: Introduction, Single Degree of Freedom System: Finite Difference Method, Central Difference Method, Runge Kutta Method; Multi degree of freedom, Explicit schemes: Two Cycle iteration with trapezoidal rule, Fourth Order Runge Kutta Method; Implicit scheme.

References:

1. Dukkipati, R. V. *Matlab for Mechanical Engineers*. New Age international Private Limited Ltd.2008.Print
2. Esfandiari, R. S. *Numerical Methods for Engineers and Scientists using Matlab*. CRC Press Taylor & Francis Group.2013.Print.
3. Bansal, R.K, Goel, A. K, and Sharma, M.K. *Matlab and its Application in Engineering.* Pearson Education. First Edition. (2008). Print.
4. Kwon, Y.W. and Bang, H. *The Finite Element Method using Matlab*. Second edition, CRC Press.2000.Print.

Course Title: Computational Fluid Dynamics
Paper Code: MEC 722

L	T	P	Credits
4	-	-	4

Objective: This course aims to

- Introduce Numerical Modeling and its role in the field of Heat and Fluid Flow.
- It will enable the students to understand the various Discritization Methods and solving Methodologies and to create confidence to solve complex problems in the field of Heat Transfer and Fluid Dynamics.

UNIT-A

Mathematical description of fluid flow: Conservation Equations for Mass, Momentum and Energy. Classification of various types of Equation: Parabolic, Elliptic and Hyperbolic, Boundary and Initial conditions. Finite difference methods: Different means for formulating finite difference equation: Taylor series expansion, Integration over element.

UNIT –B

Finite volume methods: Different types of finite volume Grids; Approximation of surface and volume integrals; Interpolation methods; Central, upwind and hybrid formulations and comparison for convection-diffusion problem. Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; Interpolation Functions.

UNIT –C

Solution of Systems of Linear Algebraic Equations: Elimination, Iteration and Gradient Search method, Elimination method: Forward elimination and backward substitution, Tridiagonal matrix algorithm (TDMA). Iteration methods: Jacobi's method and Gauss Siedel method, Generalized analysis of the iterative methods, Sufficient condition for convergence, Rate of convergence, Illustrative examples of Jacobi's method and Gauss-Siedel method, Relaxation methods, Preferential characteristics of iterative methods, Line by line TDMA, ADI (Alternating direction implicit) method.

UNIT –D

Discritization of Convection-Diffusion Equations, A Finite Volume Approach: Finite volume Discritization of convection-diffusion problem: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume Discritization of two-dimensional convection-diffusion problem, The concept of false diffusion, QUICK scheme.

Discritization of the Navier stroke equation; Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm, Unstructured Grid Formulation.

References:

1. S V Patankar, *Numerical Heat Transfer and Fluid Flow*, McGraw Hill, NY, (2005).
2. John Anderson, *Computational Fluid Dynamics*, McGraw-Hill Publication, First edition (February 1, 1995).
3. W M Kays and M E Crawford, *Convective Heat and Mass Transfer*, Mc-Graw Hill, New York (1993)

Course Title: Computer Aided Production Planning
Paper Code: MEC 723

L	T	P	Credits
4	-	-	4

Objective: The aim of this course is to provide the student with an understanding of the importance of process planning role in manufacturing and the application of Computer Aided Process Planning tool in the present manufacturing scenario.

UNIT-A

Process Planning: Traditional process planning, process planning elements, product design evaluation; Selection of tooling and process parameters; Operation sequence evaluation**.**

Computer Aided Forecasting: Nature and use of forecast, Sources of data, Demand Patterns, Forecasting Models, Selection of Forecasting Technique, Measurement of forecast Accuracy, Computerized Relative Allocation of Facility Technique, Automated Layout design program and Computerized Relationship layout planning for facility location and layout.

UNIT –B

Group Technology: Introduction, objectives part families, Algorithms and models for G.T. - Rank order clustering, Bond energy, Mathematical model for machine – component cell formation. Design and Manufacturing attributes. Parts classification and coding, concept of composite job machine group, Cell group tooling, Design rationalization, CAD/CAM and GT benefits.

UNIT –C

Production Systems at Operation Level : Manufacturing support systems and concepts at the level of production processes; Computer generated time standards; Machinability data system; Cutting condition optimization.

Production Systems at Plant Level: Communication oriented production information and control system (COPICS); material requirements planning_ capacity planning; shop floor control and operation scheduling.

UNIT –D

MRP: Introduction, Objective, Input, Computational procedure, Information provided by the system. Detailed capacity planning, Manufacturing resources planning

ERP: Introduction, main features, generic model of ERP system, selection of ERP, proof of concept approach, analytic hierarchy approach, ERP implementation.

References:

1. Tien-Chien-Chang, Richard A. Wysk, *An Introduction to automated process planning systems*, Prentice Hall, 1985, Print.
2. Groover & Zimmers, *Computer Aided Design & Manufacturing*. Prentice Hall, 2010, Print.

3. Burbidge John L., *Group technology in the engineering industry*, Mechanical Engineering Publications, 1979.
4. Colin Crompton Gallagher & Winston Anthony Knight, *Group technology production methods in manufacture*, E. Horwood, 1986.
5. Arn, E.A., *Group Technology-An Integrated Planning and Implementation Concept for Small and Medium Batch Production*, Springer, 1975, Print.
6. Orlicky J. & Plossl G., *Material Requirements Planning*, McGraw Hill Professional, 1994, Print.
7. Mahapatra P.B., *Computer Aided production management*, Prentice-Hall, 2004, Print.
8. Group Technology; *Prod. Method in Manufacturing* Gallagher & Knight Ellis Hosewood.
9. Gideon Halevi and Roland D. Weill, *Principle of process planning*, Alogical approach, Chapman & Hall, 1995.
10. Chang. T.C., *An Expert Process Planning System*, Prentice Hall, 1985, Print.
11. Nanua Singh, *Systems Approach to Computer Integrated Design and Manufacturing*, John Wiley & Sons, 1996, Print.
12. Rao, *Computer Aided Manufacturing*, Tata McGraw Hill Publishing Co., 2000, Print.

Course Title: Instrumentation and Control Engineering
Paper Code: MEC 790

L	T	P	Credits
4	-	-	4

Course Objectives: Students will learn about; the basic concepts of control engineering, instrumentation control system, Sensors signal transmission, Transfer functions of mechanical, electrical, pneumatic and hydraulic systems.

UNIT-A

Introduction: Review of basic principles of measurement & process control systems; Elements of instrumentations.
Instrumentation system elements: Introduction, displacement sensors, speed sensors, fluid pressure sensors, fluid flow, liquid level, temperature sensors, sensor selection, signal transmission.

UNIT-B

Measurement: Principles of Dynamic Measurement; Transducers, Amplifiers and Recording systems; Measurement of Physical Variables, i.e. Motion, Strain, Force, Torque, Temperature, Pressure and Flow etc. Principles of optical, Eddy Current based and Ultrasonic based Measurement Devices for Metrological Applications; Interferometers; Principles of Holography; Calibration its importance and General principles.

UNIT-C

Control systems: Concepts, Controller characteristics, Transfer functions of Mechanical, Electrical, Pneumatic and Hydraulic Systems; Transients and frequency response; Types of control action. Cascade control, Feed Forward Control, Digital Control System, Control Networks.
Process controllers: Introduction, On-off control, Proportional Control, Derivative Control, Integral control.

UNIT-D

Stability: Concept, criterion and determination by analytical and graphical methods Routh, Hurwitz, Bode and Niquist, Relative stability.

References:

1. Bolton, W. *Instrumentation and control system*, second edition.UK. Published 2015.
2. Doebelin. *Measurement Systems*. New Delhi. McGraw Hill, (Pub. at Singapore).
3. Jain R.K. *Mechanical and Industrial Measurements*. Khanna Publishers, 2002.
4. Nagoorkani. A. *Control System*. RBA publication. First edition ninth reprint 2002.
5. Baskar S. *Instrumentation control system measurements and control*. Anuradha agencies publishers. 2004.
6. Nagrath M. and Gopal I.J. *Control system engineering*. Wiley eatern Ltd. 2001.

Course Title: Non Destructive Testing
Paper Code: MEC 725

L	T	P	Credits
4	-	-	4

Objective: To study and understand the various Non-Destructive Evaluation and Testing Methods, Theory and their Industrial Applications. Upon completion of this course, the students can able to use the various Non-Destructive Testing and Testing methods understand for Defects and Characterization of Industrial Component.

UNIT-A

Introduction: Non-destructive versus destructive testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, various physical characteristics of materials and their applications in NDT.

Visual Inspection: Introduction, basic terms associated with visual inspection, equipment and accessories used for visual inspection, Visual Detection of Discontinuities, Evaluation of test results, application, advantage and limitations.

UNIT –B

Liquid Penetration Testing: Introduction, principle, Equipment, Characteristics of Penetrates and their types, Developer, Hazards Precautions, Evaluation of Test Results, Application, Advantage and Limitations.

Radiographic Testing: X-ray radiography principle, Equipment & Methodology-Type of Industrial Sources and Application –Radiographic exposure factor and Technique-gamma ray and X-Ray equipment-Radiographic procedure, Interpretation, Image quality, Radiographic Testing Procedures for Weld. Precautions against radiation Hazards, Application, Advantage and Limitations.

UNIT –C

Magnetic Particle Testing: Principle of magnetic particle testing, Basic terms associated with magnetic particle testing, Different methods to generate fields, Magnetic particle testing equipment, Magnetic particle testing procedures, Method of de-magnetization, Magnetic particle medium, Evaluation of indication, Application, Advantage and Limitations.

Ultrasonic Testing: Introduction, Principle of operation, Basic terms associated with Ultrasonic Testing, Type of Ultrasonic Propagation and Probes, Type of Transducers, Data Representation, A-Scan, B-scan, C-scan, and Method for Evaluating Discontinuities, Ultrasonic Testing Procedures for different component, Application, Advantage and Limitations.

UNIT –D

Eddy Current Testing: Introduction, Principle of operation, Basic terms associated with eddy current testing, Factor effecting eddy current-defect-frequency-geometry-conductivity-Proximity (Lift off & Fill Factor),eddy current flow characteristics, Test

Equipment, Types of probes, Eddy current application and signal display, Advantage and Limitations.

References:

1. Prasad, J and Nair, C. G. K. *Non-Destructive Testing and Evaluation of materials*. Tata McGraw Hill Education Private Limited 2011 Print.
2. Hellier, C. *Handbook of Non-Destructive Evaluation*. Tata McGraw Hill Education Private Limited 2003 Print.
3. Prakash, R. *Non-Destructive Testing Techniques*. 1st revised edition. New Age International Publishers. 2010 Print.
4. Mix, P. E. *Introduction to nondestructive testing.* Second Edition. A John Wiley & Sons, Inc., Publication.2005 Print.
5. ASM Metals Handbook. *Non-Destructive Evaluation and Quality Control*. American Society of Metals, Metals Park, Ohio, USA, 200. Volume-17.1990, 2007 Print.

Course Title: Advance Tool Design
Paper Code: MEC 726

L	T	P	Credits
4	-	-	4

Objective: After successful completion of the course, student will be able to

- To explore various design aspects of machine tools elements like Transmissions, Structures, Materials, Kinematics, Dynamics and Construction of Machine Tools etc.
- To understand concepts related to Design of Die and Punch.

UNIT-A

Introduction: Tool design practice, procedure of tool design, process planning and tool design .

Mechanics of Machining: Place of machine in production , Classification of material removal processes, Orthogonal and Oblique Cutting, Merchant's circle diagram-force and velocity relationship, Types of cutting tool mechanics, their characteristics and selection criteria, Mechanics of metal cutting- effect of tool-geometry and other cutting parameters, Mechanisms of formation of chips-types of chips formed, Concept of specific cutting pressure , Types of tool wear, Factors causing wear, Tool life, Variables affecting tool life, Economical cutting speed, Mach inability of metals, Economics of Machining.

UNIT –B

Thermal Aspects in Machining: Sources of heat generation in machining and its effects, temperature measurement techniques in machining, types of cutting fluids, Functions of cutting fluid, Characteristics of cutting fluid, Application of cutting fluids.

Design of Single Point Cutting Tools: Tool geometry for single point cutting tool, tool signature , Design of single point cutting tools such as solid tools , tipped tools, coated tipped tools, throw away type tools and diamond tools.

Design of Multipoint Tools: Design of milling cutters, gear milling cutters, hobs gear shaping tools, broaches, drills, reamers, taps & dies for thread cutting, boring tools, flat form tools, circular form tools. Standard tool holders & standard tooling and their design for turrets and automates.

UNIT –C

Cutting Tool Materials: Types of cutting tool materials, their selection and applications.

Design of Press Tools: Introduction to press tools and related terminology, Effect of clearances, Theory of deformation, Stages of cutting operation, Centre of pressure, Strap strip layout , Die and Punch design, Design of simple, Compound and progressive dies, methods of mounting punches and dies, design of drawing dies, Bend allowances, Bending and forming dies, Dies for die-casting and forging operations.

UNIT –D

Jigs and Fixture: Essential requirements of jigs & fixtures, Economics of Jigs and Fixtures, Principles of location and clamping, Location and Clamping devices, Types of Drill Bushes, Types of Jigs and Fixtures, Standardization in Jigs and Fixtures, Principle of work holders and its types.

Gauges and Gauge Design: Introduction, Plain gauges, Design of limit gauges, Manufacturing of limits gauges, Choice of limits gauges, Thread or screw gauges, Advantages and limitation of limit gauges, Care of gauges, other types of gauges.

References:

1. Sharma P.C. *A Text Book of Production Engineering* S Chand & Co. , Print 2014
2. Pandey P.C. & Singh C.K., *Production Engineering Sciences,* Standard Publishers. Revised 2011.
3. Donaldson, *Tool Design* Tata McGraw Hill, Revised Edition 2017.
4. Nagpal G.R. *Tool Engineering and Design* Khanna Publishers, Revised Edition 2014
5. Ghosh & Mallik *Manufacturing Science* East West Press, New Delhi, Revised Edition 2010
6. Kalpakjian S, *Manufacturing Processes for Engineering Materials* Pearson Publication, Print 2010
7. Boothroyd Geoffrey *Fundamental of Metal Machining and Machine Tools*, CRC Press, 2005.
8. JOSHIP.H. *Jig & Fixtures* Tata McGraw Hill, 3rd Edition, 2010
9. Grant, *Jigs & Fixtures* Tata McGraw Hill, 1971

Course Title: Design of Hydraulic and Pneumatic Systems.
Paper Code: MEC 727

L	T	P	Credits
4	-	-	4

Objective:

- To impart students on the science, use and application of Hydraulics and Pneumatics as Fluid Power in Industry.
- To impart knowledge on the methodology of basic and advanced design of Pneumatics and Hydraulics Systems.
- It helps students to get knowledge on the need, use and application of Fluid Power and make them familiar to industrial design that lead to automation.

UNIT-A

Introduction: Introduction to Hydraulics and Pneumatics, their structure, Advantages and Limitations. Properties of Fluids, Fluids for Hydraulic systems, Governing laws. Distribution of fluid power, ISO symbols, Energy losses in Hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performance curves and parameters.
Hydraulic actuators, Types and constructional details, lever systems, control elements – direction, Pressure and Flow Control Valves. Valve configurations, General valve analysis, Valve Lap, Flow Forces and Lateral Forces on spool Valves. Series and Parallel Pressure Compensation Flow Control Valves. Flapper valve Analysis and Design.

UNIT –B

Hydraulic Circuits: Regenerative circuit, Circuit for speed control - meter in - meter out Bleed of, Different types of Circuit employed in Hydraulic press, Pumps, Pump unloading Circuit, Sequencing Circuit, Automatic reciprocation, Cylinder Synchronizing Circuit, Locked cylinder using pilot check valves, Hydraulic Motor Breaking System, Hydrostatic Transmission, Safety & Emergency Mandrels, Low cost Automation. Accumulators: Accumulator types& its circuits Pressure Boosters, Advantages of pressure boosters.

UNIT –C

Hydraulic and Pneumatic Design: Electrical controls for fluid power Circuits, Design of Hydraulic & Pneumatic circuit for specific application - Cascading - Ladder diagram (Electrical controls), Microprocessor controlled design of Circuits, Circuits for Copying Lathe, Broaching Machines & Milling Machines.
Fluid Logic Controls Systems: Principles of Fluid Logic Control, Basic Fluidic Devices Fluidic Sensors, Fluidic Logic Circuits.

UNIT –D

Pneumatic Systems: Pneumatic, Fundamentals, Merits & Demerits over Hydraulic systems, Pneumatic Conditioners - Filters - Regulators - Lubricators - Mufflers - Air dryers, Types of Air Compressors, Pneumatic Actuators, Design of Pneumatic Circuits.

Fluid Circuit Failures: Common causes of failure dirt - Heat - Misapplication -Improper fluids – Faulty Installation - Improperly designed Circuits.
Maintenance: Maintenance of Hydraulic & Pneumatic Circuits.

References:

1. S.R. Majumdar. *Pneumatic Systems: Principles and Maintenance*. New Delhi: McGraw Hill Education, 2015 Print.
2. Antony Espossito. *Fluid Power with Applications.* Prentice Hall, 1980 Print.
3. Harry L. Stewart. *Pneumatics & Hydraulics.* Bombay: D.B. Taraporevala sons & co Pvt Ltd.1996 Print.
4. Andrew Parr. *Hydraulics and Pneumatics.* Jaico Publishing House, 1999Print.
5. John Pippenger, Tyler Hicks. *Industrial Hydraulics.* New Delhi: McGraw Hill International Edition.1987Print.
6. Hehn Anton, H., *Fluid Power Trouble Shooting,* Marcel Dekker Inc., New York, 1984Print.
7. Thomson, *Introduction to Fluid power*, Prentice Hall, 2004Print.
8. Herbert E. Merritt: *Hydraulic control systems,* John Wiley and Sons Inc. 1991Print.
9. K. Shanmuga Sundaram, *Hydraulic and Pneumatic Controls: Understanding made Easy*. New Delhi: S. Chand & Co Book publishers, 2006 print.

Course Title: Micro Electro Mechanical Systems
Paper Code: MEC 728

L	T	P	Credits
4	-	-	4

Objective: The aim of this course is to teach the fundamentals of modelling and analysis of MEMS with a specialized focus on Electro- Mechanical actuated systems.

UNIT-A

Introduction: Introduction, MEMS Definition, History, Applications and Technology development Market.
Micro Fabrication: Materials -substrates, Additive Materials. Fabrication Techniques-Bulk Micro machining, Surface Micromachining, Non-conventional Micro Machining, Deposition, Lithography, Etching, Surface Micro Machining, Thick film, Screen-printing and Electroplating.

UNIT –B

Micro Mechanics and Structures: Basic Mechanic, Axial Stress and Strain, Shear Stress, Poisson's ratio, Commonly used Deflection Equations, Beam and Torsion Equations etc.
Mechanical Transduction Techniques: Piezo resistivity, Piezoelectricity, Capacitive Techniques, Optical Techniques, Resonant Techniques. Actuation Techniques, Smart Sensors. MEMS Simulation and Design tools Behavioural model ling simulation tools and Finite element simulation tools.

UNIT –C

Pressure Sensors: Introduction, Techniques for Sensing, Physics of Pressure Sensing-Pressure Sensor Specifications, Dynamic Pressure Sensing. Pressure Sensor Types, MEMS Technology Pressure Sensors-Micro Machined Silicon Diaphragms.
Force, Torque and Inertial Sensors: Introduction-Silicon based devises-Optical devises-capacitive devises-Magnetic devices-Atomic force microscope and scanning probes- micro machined accelerometer-Micro machined Gyroscope, Future inertial micro machined sensors.

UNIT –D

MICROFLIDICS: Fluid Dynamics at Micro Scale, Surface Tension Driven Transport, Micro Pumps, Valves and Mixers, Lab on chip applications.
Mechanical Sensor Packaging: Introduction, Standard IC packages-ceramic, Plastic and Metal packages. Packaging process-Electrical interconnects, Methods of Die attachment, Sealing Techniques. MEMS Mechanical sensor packaging, Process integration.

References:

1. Graham Ensell, Michael Kraft and Neil White, *MEMS Mechanical sensors' Stephen Bee*, Artech House, Inc. Boston. Print 2003.
2. Mahalik, *MEMS,* Tata McGraw Hill. Print 2007.
3. Nadim Maluf and Kirt, *An introduction to Micro electro mechanical System Engineering*, Williams, Artech House, Inc. Boston. Print 2003
4. GAD-el-Hak. M, *MEMS: Design and Fabrication*, CRC Tayler & Francis, Boca Raton, Florida Print 2006.
5. Michael Koch, & Alan Evans, *Microfluidic Technology and Applications*, Arthur Brunnschweler, Print 2000.

Course Title: Optimization Techniques
Paper Code: MEC 788

L	T	P	Credits
4	-	-	4

Objective: After successful completion of the course, student will be able to

- understand importance of optimization of industrial process management
- apply basic concepts of mathematics to formulate an optimization problem
- analyses and appreciate variety of performance measures for various optimization problems

UNIT-A

Introduction to optimization techniques: Operation Research approach, scientific methods, introduction to models and modelling techniques, methodology and advantages of optimization techniques.
Duality in linear programming, Integer linear programming: Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two Phase Method.
Sequencing: Introduction, Processing N jobs through two Machines, Processing N jobs through three Machines, Processing N jobs through m Machines.

UNIT –B

Inventory Model: Introduction to inventory control, Deterministic Inventory Model, EOQ model with Quantity Discount.
Network Analysis: Network definition and Network Diagram, Probability in PERT Analysis, Project time cost trade off, Introduction to resource smoothing and allocation.

UNIT –C

Queuing Models: Concepts relating to queuing systems, Basic Elements of Queuing Model, Role of Poison & Exponential Distribution, Concepts of Birth and Death Process.
Replacement & Maintenance Models: Replacement of items, Subject to deterioration of items subject to random failure group vs. individual replacement policies.
Non Linear Programming: One and Multi Variable Unconstrained Optimization, Kuhn-Tucker Conditions for Constrained Optimization, Quadratic Programming, Separable Programming Convex programming. Non Convex Programming.

UNIT –D

Simulation: Introduction & steps of simulation method, Distribution Functions and random number generation.
Introduction to various evolutionary optimization techniques: i.e. Generic algorithm, NSGA, NSGA-II, Neural Network, Ant colony optimization, Particle swarm optimization etc.

References:

1. Gupta P.K. andHira. D.S. *Operations Research*. Sultan Chand & Sons New Delhi, 2001.
2. H.A. Taha, *Operations Research -An Introduction* (8thedition). New York: Macmillan Publishing Co. 2006.
3. Hadly, G. *Non-Linear and Dynamic Programming*. New Delhi: Addision Wesley, Reading Mass. 1967.
4. Rao, S.S. *Optimization theoryand Applications* (4thedition).New Delhi: Wiley Eastern Ltd. 2009.
5. Hagan. T. Howard B. *Neural Network Design*2nd Edition, Print 2014.
6. Kalyanmoy D. *Multi-Objective Optimization Using Evolutionary Algorithms,* 1st Edition, Wiley publication, Print 2001.

Course Title: Quality Control and Reliability
Course Code: MEC 729

L	T	P	Credits
4	-	-	4

Course Objectives:

- To impart the knowledge about concepts of quality control.
- To make students learn various control charts used for quality control.
- To learn the concepts of acceptance sampling.
- To learn about reliability and it's testing.

UNIT – A

Introduction : Concept of quality, Need, Factor influencing quality, Types of quality, Quality control, Cost of quality control, Quality assurance, Benefits, Modern concept, Inspection and quality control, Quality characteristics, Quality circles with case study, Quality function deployment, Benchmarking and performance evaluation, Tools for continuous quality improvement, Philosophies of quality gurus and their impact on quality.

UNIT– B

Statistical Concepts Control Charts and Acceptance Sampling: Review of fundamental statistical concept, Frequency distribution, Central tendency, Measures of dispersion, Probability distributions, statistical quality control, Theory of control charts, Control charts for variables and attributes ($\bar{x}$, R, P, np, u and C chart), their advantages and disadvantages, Applications, Multi variate control charts, Process Capability Analysis, process capability indices. Analysis procedures, analysis for non normal distributions.

Introduction to acceptance sampling, Advantages and Disadvantages, Operating Characteristics curve and its characteristics, Producer's and consumer's risk, Quality indices for acceptance sampling plans, Types of sampling Plans-single double sequential sampling plan, Sampling plan for variables, continuous sampling plans, Skip lot sampling plans, Chain sampling plan. Average outgoing quality.

UNIT– C

Reliability: Introduction, Factors effecting Reliability, Failure and its types, Failure curve, reliability and its management, MTBF, MTTF, Relationship b/w reliability failure rate and MTBF, and its characteristics, reliability predictions and analysis, Life-cycle curve and Probability distributions in Modeling reliability.

UNIT – D

Reliability Testing: System reliability analysis considering systems in series, parallel and stand by configurations, Product testing, Reliability life testing, Test time calculations, Burn-in testing, Acceptance testing, Accelerated life testing, Experimental Design, Reliability growth testing.

References:

1. Mitra, Amitava**.** *Fundamental of Quality Control and Improvement*. Wiley. Print, 2016.
2. Harrism and Wadsworth, M. *Modern Methods for Quality Control and Improvement.* Print. 2002
3. Grant, E. and Leavenworth R. *Statistical quality control*, New Delhi: Tata McGraw Hill. Print. 2007
4. Ebling, *Reliability Engineering***.** New Delhi: Tata McGraw Hill. Print. 2000
5. Mahajan, *Statistical Quality Control*, New Delhi: Dhanpat Rai and Co. (P) Ltd. Print 2016
6. Sharma, D.D. *Total Quality Control.* New Delhi: Tata McGraw Hill. Print. 2014
7. Raju, N.V.S. *Industrial Engineering and Management*. Cengage Learning. Print 2013

Course Title: Dissertation Phase-I
Course Code: MEC 795

L	T	P	Credits
0	0	12	6

As per policy document of DAV University wide reference no. **DAVU/ Regr/2016/2613**

Course Title: Dissertation Phase-II
Course Code: MEC 796

L	T	P	Credits
0	0	24	12

As per policy document of DAV University wide reference no. **DAVU/ Regr/2016/2613**