RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2019 – 2020

DEPARTMENT OF MECHANICAL ENGINEERING

Computer Integrated Manufacturing (CIM)

I – IV Semester M. TECH

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Ramaiah Institute of Technology (RIT) (formerly known as M. S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah All engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with faculty student ratio of 1:15 and achieves excellent academic results. The institute is a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments are full with competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 130 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT has a strong Placement and Training department with a committed team, a fully equipped Sports department, large air-conditioned library with over 80,000 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls, all air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007.As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 45th rank in 2017 among the top 100 engineering colleges across India and occupied No. 1 position in Karnataka, among the colleges affiliated to VTU, Belagavi.

About the Department:

History of Department:

The Department of Mechanical Engineering started in the year 1962 with an intake of 40 students. The department has grown strong over the last 52 years and today has an intake of 180 students and 48 teaching staff. All the faculty members are well qualified and possess post graduate degree with 20 doctorates.

The department offers four year degree course and also offers two Master's Degree in Manufacturing Science & Engineering and Computer Integrated Manufacturing, with an intake of 18 each. The Department also offers research program which includes MSc Engineering by research and PhD degree from Visvesvaraya Technological University and at present 24 researchers are pursuing PhD. The department received software grants from Autodesk a leading Computer Aided Design multinational company and has been using them in the curriculum. The faculty members have taken up number of research projects funded by external agencies like DRDO, DST, AICTE and Visvesvaraya Technological University and received funding to the tune of 1 Crore. In view of the golden jubilee celebrations, the department has conducted a national level project exhibition and an International Conference on "Challenges and Opportunities in Mechanical Engineering, Industrial Engineering and Management Studies" – ICCOMIM. Faculty members from the department have published books on different domains of Mechanical Engineering and are recommended by Visvesvaraya Technological University Board of Studies as reference text books.

The students from the department participate both at the national and international competition throughout the year, in the year 2013 – AeRobusta – 4 member student team from the department participated in SAE Aero Design competition and stood 18th position out of 64 teams from all over the world. The team AeRobusta stood FIRST AMONG THE ASIAN COUNTRIES.

Another team from the department also participated in the "Unmanned Air Vehicle System "conducted by U.S. Navy at Maryland, USA. The team secured 5th Place in the technical session out of 36 participating teams from all over the world.
A team of two students also participated in the CAD Design Competition conducted by Autodesk, a CAD multinational company, in association with IIT Madras and secured FIRST PLACE among the teams from all over India with a cash prize of Rs 1,20,000 and also received a free Trip to Autodesk University, held at Las Vegas, USA.

Vision of the Institute

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

Mission of the Institute

RIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

Quality Policy

We at Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

The Vision of the Department

To be a centre of international repute in mechanical engineering and to create qualified human resources needed to meet the demanding challenges in different areas and emerging fields of mechanical engineering and allied sciences.

Mission of the Department

To impart quality technical education to meet the growing needs of the profession through conducive and creative learning environment to produce qualified and skilled human resources in Mechanical Engineering, offer post graduate programme in the emerging fields of Mechanical Engineering, create R & D environment to be a centre of excellence in Mechanical Engineering.

Process of deriving the vision and mission of the department

Process of deriving the vision and mission of the department is shown in block diagram below (fig1)

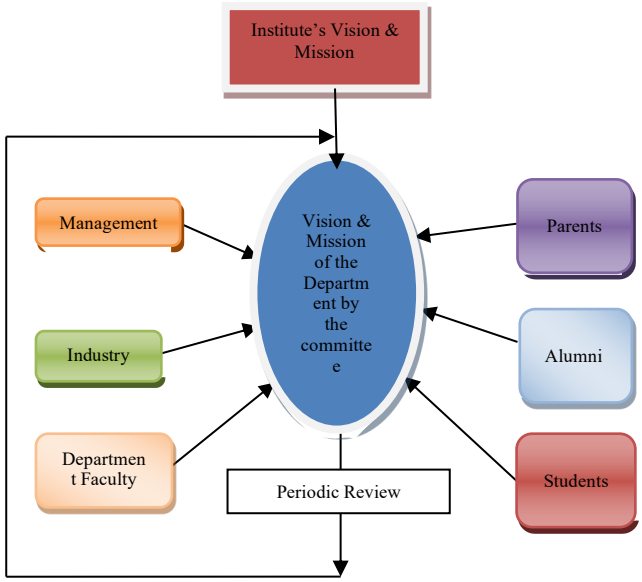

Fig1. Block Diagram – Deriving the Vision & Mission of the department

Programme Educational Objectives (PEOs)

The Mechanical Engineering Program, M.Tech-CIM is a four semester course and will provide the advanced building blocks for conceptualizing, understanding and optimizing manufacturing systems integrated with computer based applications. These building blocks will include advanced materials, traditional and non-traditional manufacturing methods, Advanced trends in manufacturing management, Robotics, Computer aided design, Flexible Manufacturing Systems, Computer control in manufacturing systems, Condition based Maintenance, Automation in manufacturing, Advanced material Technology, Rapid Prototyping, etc. the course includes an individual project work by the student to help him understand his learning and apply the principles to practical situations and would enable the student to be technically and professionally equipped and improve for taking up challenges in the industrial sector, government organization, research organizations and pursuing higher studies or for starting his or her own industry or entrepreneurship.

PEOs of the Program

PEO 1: Apply the technical skills gained to model and analyze real time projects in the field of computer integrated manufacturing.

PEO 2: Able to take up profession in R&D areas, management and teaching activity in the field of mechanical engineering.

PEO 3: Engage in industry institute interaction and lifelong learning by adhering to ethical and environmental conditions.

Process of Deriving the Programme Educational Objectives (PEOs):
Fig 2 shows the process employed for deriving the PEO's

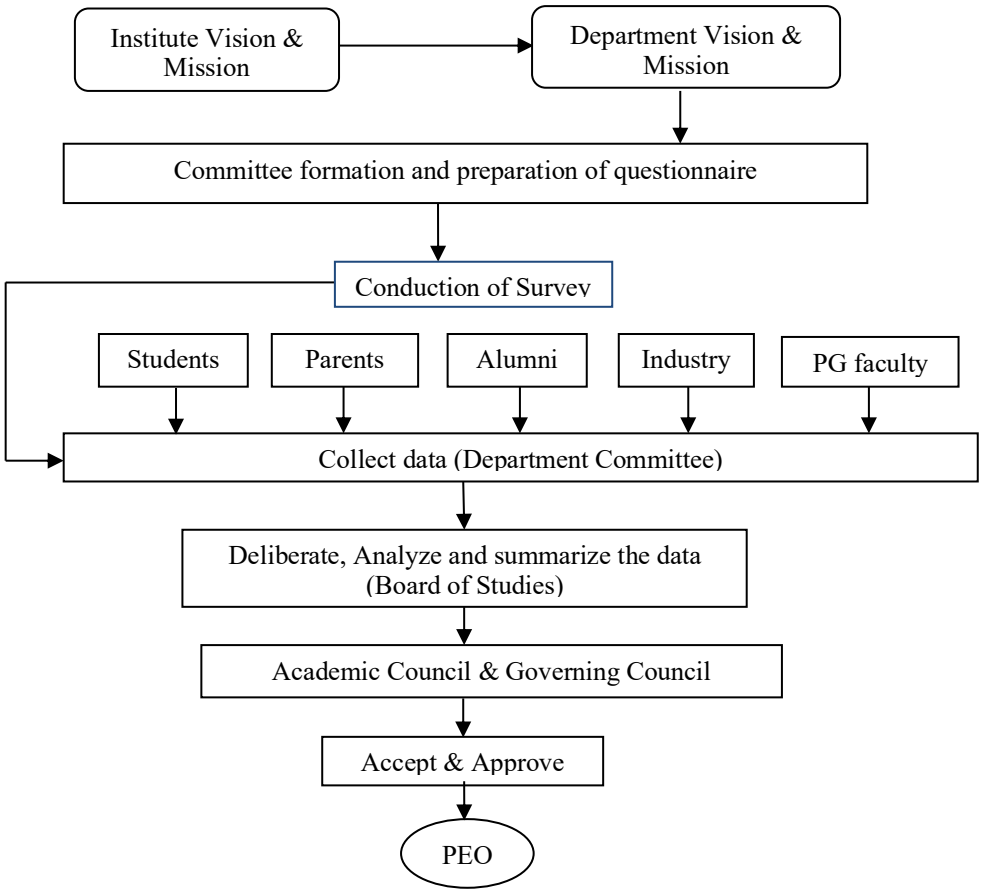

Fig 2 : Process employed for deriving the PEO's of the department

Programme Outcomes (POs):

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial Technical report/document.

PO3: Be able to demonstrate a degree of mastering over the area as per the specialization of the programme. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to identify problems, explore opportunities, propose feasible solutions and adopt latest computer-integrated manufacturing tools, to transform into an accomplished CIM engineer.

PO5: Ability to apply the learned principles to the analysis, development and implementation of the computer integrated manufacturing; to prepare oneself to work professionally in academic institutions and industries.

Process of Deriving the Programme Outcomes (POs):

Fig 3 shows the process employed for deriving the PO's

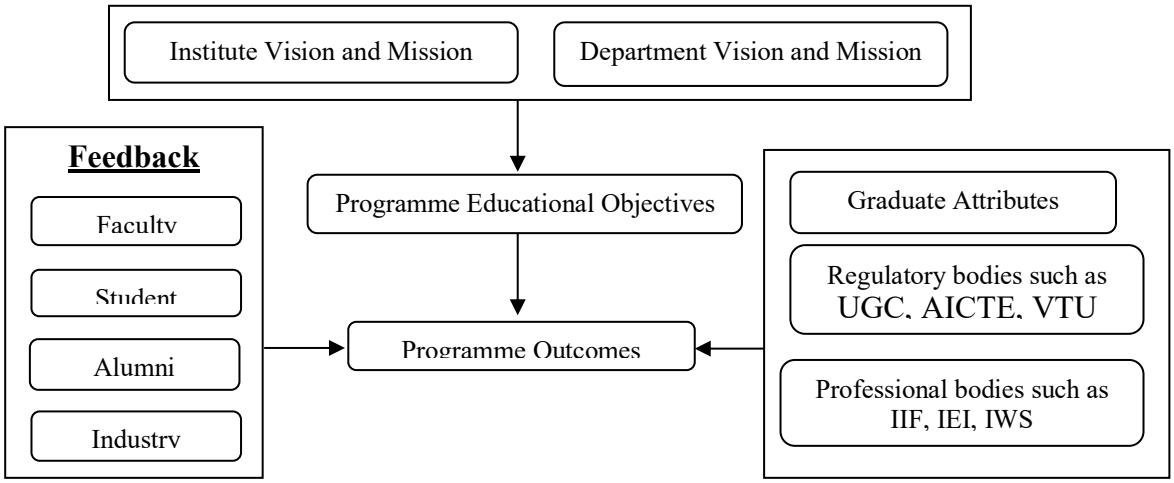

Fig 3: Process employed for deriving PO's

Mapping of PEO's and PO's

The correlation between the Programme outcomes and Program Educational objectives are mapped in the Table1 shown below.

Table 1: Correlation between the POs and the PEOs

Sl. No.	Programme Educational Objectives (PEOs)	Programme Outcomes (PO)				
		PO1	PO2	PO3	PO4	PO5
1	Apply the technical skills gained to model and analyze real time projects in the field of computer integrated manufacturing.	3	3	3	3	3
2	Able to take up profession in R&D areas, management and teaching activity in the field of mechanical engineering.	3	3	3	3	3
3	Engage in industry institute interaction and lifelong learning by adhering to ethical and environmental conditions.	3	3	3	3	3

Master of Technology (M.Tech)

In
Computer Integrated Manufacturing (CIM)

Curriculum - Course Credits Distribution

Semester / Total	Core Courses	Electives	Project Work / Dissertation Preliminaries	Laboratory	Internship /Industrial Training	Seminar	Total
I	08	12	-	02	-	01	**23**
II	08	12	-	02	-	01	**23**
III	04	04	08	-	04	-	**20**
IV	-	-	20	-	-	02	**22**
Total	**20**	**28**	**28**	**04**	**04**	**04**	**88**

FIRST SEMESTER

Sl. No.	Subject Code	Subject	Teaching Dept.	Credits			
				L	T	P	Total
1	MCM 11	Computational Numerical Methods	Mathematics	3	1	0	4
2	MCM 12	Computer Aided Design	Mechanical Engineering	4	0	0	4
3	MCM EXX	Elective – I		4	0	0	4
4	MCM EXX	Elective – II		4	0	0	4
5	MCM EXX	Elective – III		4	0	0	4
6	MCM L13	CAD –CAM Laboratory		0	0	1	1
7	MCM L14	Advanced Measurements Laboratory		0	0	1	1
8	MCM 15	Technical Seminar 1		0	0	1	1
Total				19	1	3	23

SECOND SEMESTER

Sl. No.	Subject Code	Subject	Teaching Dept.	Credits			
				L	T	P	Total
1	MCM 21	Statistical Modelling and Experimental Methods	Mechanical Engineering	3	1	0	4
2	MCM 22	Industrial Robotics		4	0	0	4
3	MCM EXX	Elective – IV		4	0	0	4
4	MCM EXX	Elective – V		4	0	0	4
5	MCM EXX	Elective – VI		4	0	0	4
6	MCM L23	Automation & Simulation Laboratory		0	0	1	1
7	MCM L24	Design of Experiments Laboratory		0	0	1	1
8	MCM 25	Technical Seminar 2		0	0	1	1
Total				20	0	3	23

THIRD SEMESTER

Sl. No.	Subject Code	Subject	Teaching Dept.	Credits			
				L	T	P	Total
1	MCM 31	Computer Control of Manufacturing Systems	Mechanical Engineering	4	0	0	4
2	MCM EXX	Elective - VII		4	0	0	4
3	MCM 32	Internship / Industrial Training		0	0	4	4
4	MCM 33	Project work / Dissertation Preliminaries		0	0	8	8
Total				8	0	12	20

IV SEMESTER

Sl. No.	Subject Code	Subject	Teaching Dept.	Credits			
				L	T	P	Total
1	MCM41	Project work / Dissertation	Mechanical Engineering	0	0	20	20
2	MCM42	Project work / Dissertation seminar		0	0	2	02
Total				0	0	22	22

L – Lecture Hours T – Tutorial Hours P – Practical/Seminar

LIST OF ELECTIVES
(Computer Integrated Manufacturing)

Sl. No.	Subject Code	Subject	Credits			
			L	T	P	Total
1	MCM E01	Advanced Management Techniques in Manufacturing	4	0	0	4
2	MCM E02	Advanced Material Technology	4	0	0	4
3	MCM E03	Condition Based Monitoring	4	0	0	4
4	MCM E04	Additive Manufacturing	4	0	0	4
5	MCM E05	Automation in Manufacturing	4	0	0	4
6	MCM E06	Tooling for Manufacturing in Automation	4	0	0	4
7	MCM E07	Simulation and Modelling of Manufacturing Systems	4	0	0	4
8	MCM E08	Ergonomics in Manufacturing	4	0	0	4
9	MCM E09	FEM for Manufacturing	4	0	0	4
10	MCM E10	Nanotechnology	4	0	0	4
11	MCM E11	Artificial Intelligence and Expert System in Manufacturing	4	0	0	4
12	MCM E12	Machine Tool Dynamics	4	0	0	4
13	MCM E13	Flexible Manufacturing System	4	0	0	4
14	MCM E14	Reverse Engineering	4	0	0	4
15	MCM E15	Computer Aided Process Planning	4	0	0	4

Students have to earn a total of 88 credits by choosing subjects from the above list of electives.

COMPUTATIONAL NUMERICAL METHODS

Course Code:MSE11/MCM11 **Course Credits: 3:1:0:0**
Prerequisite: UG Mathematics **Contact Hours:42+14**
Course Coordinator: Dr. Nancy Samuel

Course Objectives:
The student will

1. Learn the concepts of orthogonalization, QR transformation and singular value decomposition
2. Learn to solve simultaneous first order ODE and higher order ODE snumerically.
3. Understand the concept of PDE and its applications to engineering
4. Learn programming in MATLAB

UNIT -I

Linear Algebra: Eigen values, Eigen vectors – properties, orthogonal vectors and subspaces, projections, orthogonal bases and Gram Schmidt orthogonalization, QR transformation, SVD, Application to network problems.

UNIT -II

Numerical solution of ODE: Simultaneous first order ODE byTaylor's, Euler's, modified Euler's and RK method, Higher order ODE by Taylor's series and RK method. Shooting method.

UNIT -III

Finite difference method for parabolic and elliptic equations: PDE classification, Parabolic equations – explicit and implicit finite difference methods, Dirichlet and Neumann conditions, 2D parabolic equations – ADI and ADE methods.Laplace and Poisson equation in a rectangular region: five point finite difference scheme,

UNIT -IV

Finite difference method for hyperbolic equations: Hyperbolic equations – explicit and implicit finite difference methods. 2D hyperbolic equations – ADE method.
Numerical interpolation and integration: Hermite and Cubic Spline interpolation, Trapezoidal rule for double integration.

UNIT -V

MATLAB: Introduction – variables, arrays, functions, Plotting – 2-D plots, 3-D plots. Script files, user defined functions, Programming – solution for differential equations.

Text books:

1. Rudra Pratap – Getting started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University press, 7th edition, 2016.
2. David C Lay, Steven R Lay, Judi J – Linear Algebra and its applications, Pearson, 5th edition, 2014.
3. M K Jain, S R K Iyengar, R K Jain – Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 6th edition, 2012.

Reference books:

1. Amos Gilat – MATLAB:An introduction with applications, 6th edition, WILEY Publications, 2016.
2. Gilbert Strang –Linear Algebra and its applications, 4th edition, Cengage Learning, 2007.
3. Steven C Chapra – Applied Numerical Methods with MATLAB for Engineers and Scientists, 3rd edition, Tata Mcgraw Hill publications, 2012.
4. M K Jain, S R K Iyengar, R K Jain – Computational methods for partial differential equations, New Age International Publishers, 2nd edition, 2016.

Course Outcomes (COs):

At the end of the course the student will be able to

1. Obtain the singular value and QR decomposition of a given matrix. (PO1,2)
2. Solve simultaneous first order ODE, higher order ODE and boundary value problems. (PO1,2)
3. Apply finite difference method to solve heat equations and elliptic equations. (PO1,2)
4. Estimate the solution of wave equations using finite difference method and also interpolate, integrate numerically. (PO1,2)
5. Program and simulate engineering problems using MATLAB. (PO1,2)

COMPUTER AIDED DESIGN

Course Code : MCM 12 **Credits: 4:0:0**
Prerequisites : Nil
Course Coordinator: Mr BHARATH M R

Preamble:

Computer aided design is the technology concerned with the use of digital computers to perform various functions related to design and manufacturing. CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry and computer graphics (both hardware and software), drafting, simulation, analysis and manufacturing. Computer aided design technology integrates design and manufacturing, which were earlier traditionally been treated as distinct and separate functions in production firm. Experience and wisdom, have it that CAD users become very inefficient in using CAD systems unless they understand the fundamental concepts on which these systems are built. Computer aided design provides a technology base along with Computer aided manufacturing for the Computer Integrated Manufacturing or Computer integrated factory of the future.

Course Objectives:

1. To impart the basic need of product cycle, automation, production and Computer aided design
2. Knowledge enhancement in areas like computer graphics, database structure and software configuration in CAD systems
3. To enable students to choose appropriate hardware configuration for various CAD applications, which include operational principles of graphics input systems, output systems and workstation
4. To make the students to demonstrate/analyze various techniques available to solve various math based application in transformation of graphical entities
5. To enable students to utilize appropriate features in CAD application thereby enhancing productivity in design

UNIT – I

Introduction to CAD
Definition, Product cycle and CAD/CAM, Automation & CAD/CAM Computer Graphics and Database: Introduction, Software configuration of a Graphic system, Functions of graphics package, Constructing the Geometry, Database structure and Content, Wire frame features. Computer Aided Design System Hardware Introduction, Generative design, topology optimization

UNIT - II

Graphic Interface and CAD/CAM Cloud

CAD System Configuration, Computer Aided System Software: Introduction, Operating system, Graphics system. Graphics Database structure and Handling, Data Selection, Graphic transformation, Plotting, Graphic standards. Cloud Based CAD/CAM tools.

UNIT – III

Transformation System

Display, Windowing and Clipping, Two-dimensional transformations, Three-dimensional transformations, linear transformations, problems on Two-dimensional Transformations.

UNIT – IV

Geometric Modelling: Introduction

Dimensions of models, Types of models, Construction of solid models, Wire frame models, Curve representation. Parametric representation of analytic curves – Lines, Circles, Ellipse, Parabolas, Hyperbolas, Conics. Parametric representation of Synthetic Curves – Hermite Cubic Splines, Bezier Curves, B-Spline Curves, Rotational Curves. Surface Models: Introduction – Surface models, Surface Entities, Surface Representation. Parametric Representation of Analytic Surface – Plane surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Parametric representation of Synthetic surface, Bezier Surface, B- Spline surface, Coons Surface,

UNIT - V

Segmentation

Curve Segmentation, Trimming, Intersection & Projection. Mechanical Assembly: Introduction, Assembly modelling – Parts modelling and Representation, Hierarchical Relationship, Mating Conditions. Inference of position from mating conditions. Representation schemes – Graph structure Sequences – Precedence Diagram, Liaison – sequence analysis.

Text books:

1. M P Groover and Zimmer, CAD/CAM Computer Aided Design and Manufacturing, Prentice hall 2000.
2. CAD/CAM Ravindra A.S Best Publishers 2005.

Reference Books:

1. C B Besant and ewkLui – Computer Aided Design and Manufacturing, Affiliated East West, India 1988.
2. Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill 1988.

Course Outcome (COs):

1. Demonstrate basics of product cycle, CAD system software and hardware, CAD Database, graphic standards, Mechanical assembly and inferences to be drawn from an assembly.[PO1,PO2,PO4 & PO5]
2. Illustrate basics of graphic transformations and graphic representations and exhibit the knowledge of working on a CAD user interface. [PO1,PO2,PO4 & PO5]
3. Solve math based problems using graphic transformation and graphic representation. [PO1,PO2,PO3,PO4 & PO5]
4. Analyze the geometrical entities with respect to their parametric representation. [PO1,PO2,PO3,PO4 & PO5]
5. Evaluate the detailed hierarchical condition of an assembly model and represent them graphically[PO1,PO2,PO4 & PO5]

CAD –CAM LABORATORY

Course Code : MSEL13/MCM L13 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Dr R KUMAR

Course objectives

1. To develop skills and abilities for creating a three dimensional model using appropriate CAD software.
2. To be able to use a commercial CAM software for generating NC Part Program.
3. To be able to design a Pneumatics and Hydraulics Circuits and to develop Ladder Logic Diagram for Programming PLC.

Part A:

CAD: 3D modeling of simple machine elements using any CAD Package – Minimum of five components

Part B:

CAM: Simulation of machining process (Turning and Milling) using CAM PACKAGES CNC Machining: Manual Part programming for CNC Machines to perform Turning and Milling operations. - Minimum of five components

Pneumatics, Hydraulics & PLC: Four typical experiments the basis of these topics to be conducted.

Reference:

1. CAD/CAM –Ibarahim Zeid-Tata MC Graw Hill 2nd Edition
2. CAD/CAM/CIM by Radhakrishnan P

Scheme of Examination: Exam marks: 50 Duration: 3 Hours

Component	Marks
Part A	20
Part B	20
Viva	10
Total	50

Course Outcomes (COs):

Student will be able to:

1. Create 3D models of engineering components/sub assemblies/assemblies using CAD software. [PO1,PO3,PO4 & PO5]
2. Generate CNC part programming for 3D models using CAM software. [PO1,PO2,PO3,PO4 & PO5]
3. Develop Hydraulic and pneumatic circuits and Ladder Logic program for PLC. [PO1,PO2,PO3,PO4 & PO5]

ADVANCED MEASUREMENTS LABORATORY

Course Code : MSE L14 / MCM L14 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Dr JYOTHILAKSHMI R

Course Objectives:

Student will be able to

1. Demonstrate the concepts learnt in Mechanical Measurements and Metrology through experiments
2. Choose Proper measuring Instruments for measurement purpose
3. Understand and explain the concept of Calibration

Part-A

Calibration of Measuring Devices(CMM, Dial Gauge), Measurements of Model Dimensions using CMM(MCS, PCS), Thermal Property assessment for metals and alloys(Thermal Conductivity, Thermal Expansion)

Part-B

Surface Roughness Measurements. Analysis of cutting forces, Toll tip Temperature Measurements

Reference: Department Manual

Examination

Exam marks: 50 Exam time: 3 Hours

Component	Marks	Remarks
Part A	25	Group experiment
Part B	15	Individual experiment
Viva	10	
Total	50	

Course Outcomes (COs):

Student Will be able to,

1. Perform measurements precisely, analyze and interpret the results [PO1,PO2 & PO3]
2. Demonstrate the Calibration Procedure of Measuring Instruments [PO1,PO2 & PO3]
3. Solve Measurement related problems encountered in Industries [PO1,PO2 & PO3]

TECHNICAL SEMINAR 1

Course Code : MSE 15 / MCM 15 **Credits: 0:0:1**
Prerequisites : Nil

Preamble:

M. Tech. being post graduate program, the students should know the latest information in their fields. One of the ways to keep them updated is by the study of journal papers in the field. Explanation of the papers in the field will further enhance their communication skills. Teaching being one of the important careers an M. Tech student can take up, understanding and explaining these journal papers will be an added advantage. Apart from these, writing a journal paper is desirable of the program. Hence by studying the journal papers and trying to present their understanding as part of the seminar help students identify good journals, can know what journal expect from a paper, can understand the shortcomings and plus points of published papers. This will also help the students write review papers.

Course Objectives:

This course helps the students

1. To indentify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper
2. To develop overall skills for technical communication and help technical decision making
3. To understand the latest research in their field of study.

Scheme of seminars:

Students shall select published journal papers, related to their specialization, read, understand, prepare slides and present the same. Each student shall present their understanding of at least three Journal papers. All students shall attend the seminars of other students of their specialization. A copy of the full paper shall be got signed by the evaluating faculties and the same shall be maintained by the student and submitted at the end for marks finalization. The students shall select the journal paper themselves with the assistance of faculties, if required. Papers shall be selected only from peer reviewed unpaid journals.

Evaluation:

Each presentation shall be evaluated for 50 marks. Average marks obtained for three best presentations will be the student's CIE marks. No SEE.

Course Outcomes (COs):

The student will be able

1. To indentify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper[PO1,PO2,PO3,PO4 & PO5]
2. To develop overall skills for technical communication and help technical decision making [PO1,PO2,PO3,PO4 & PO5]
3. To understand the latest research in their field of study. [PO1,PO2,PO3,PO4 & PO5]

STATISTICAL MODELLING AND EXPERIMENTAL METHODS

Subject Code: MSE 21 / MCM 21 **Credits:3:1:0**
Prerequisites: Nil
Course Coordinator: Dr B P HARICHANDRA

Preamble:

Experimentation is a part of any research work. M. Tech. program requires orientation towards research, and hence requires knowledge of the various experimental and statistical methods both for project work, for understanding of literature, and for understanding requirements of improvement in the processes/products. This course aims at teaching the students some of the basic aspects of statistical tools like the regression analysis, correlation analysis. The course aims at having understanding of experiments, the various concepts of experiments, teaching how to design and analyze experiments. Various designs of experimentation and their analysis and applications are taught in the subject.

Course Objectives

1. To understand the basic aspects of experimentation, data collection, errors in experimentation and conducting uncertainty analysis.
2. To model the experimental data mathematically through regression; linear, multi and curvilinear.
3. To understand the classification of Design of Experiments and conduct ANOVA for CRD, RBD, LSD designs,
4. To understand and interpret screening experiments, multifactor experiments, fractional factorial experiments; and represent the same graphically
5. To understand the basic aspects of, Taguchi (with simple numericals) and know fundamental concepts RSM.

UNIT- I

Experimentation & handling of experimental data:
Fundamentals and principles of experimentation, basic terms and variables in experiments, experimental environment
Introduction, causes and types of experimental errors – Fixed errors, random errors, error analysis on commonsense basis, Introduction to Uncertainty Analysis in engineering measurements – simple numericals.
Handling missing data: Need for statistical approximation of missing data, introduction to various methods.
Tutorial exercises from Journal papers.

UNIT- II

Regression and correlation analysis:
Linear Regression models – Simple Linear Regression, method of least squares, estimation of regression coefficients, analysis of variance of LR, determination of correlation coefficients. Multiple regression, Curvilinear Regression – Quadratic, Logarithmic and Exponential models.
Tutorial exercises from Journal papers.

UNIT -III

Fundamental designs of experiments: Introduction, Classification DESIGN OF EXPERIMENTS , Basic principles of good design, Completely Randomized Design, Randomized Block Design, Latin Square Design, Analysis of variance in experimental design.
Tutorial exercises from Journal papers

UNIT -IV

Factorial Design: Factorial design, graphical representation of 2^2 and 2^3 designs, Fractional Factorial Design.
Tutorial exercises from Journal papers

UNIT -V

Other designs:
Taguchi design – Taguchi's definition of quality, Taguchi's Quality philosophy, Taguchi's Quality loss function, S/N ratios for static cases, for Smaller-the-better, Larger-the-better, Nominal-the-best– simple numericals on S/N ratios and ranking.
Introduction to RSM.
Tutorial exercises from Journal papers

Reference Books:

1. Richard A Johnson, "Probability and statistics for engineers", 6th Edition, Pearson education.
2. Phillip J Ross Taguchi "Techniques for quality Engineering 2nd Edition", Mc Graw- Hill 1996.
3. J. P. Holman, "Experimental methods for Engineers", McGraw-Hill International edition
4. Research Methodology, R.Pannerselvam, Prentice Hall of India, New Delhi
5. J.M. Juran, Frank M. Gryna, "Juran's Quality Control Handbook", McGraw-Hill International Edition
6. Douglas C. Montgomery, "Design and Analysis of Experiments" 5th Edition, John Wiley and Sons, Inc.

Course Outcomes (COs):

At the end of the course, a student:

1. Would have understood the basic aspects of experimentation, data collection, errors in experimentation and would know how to conduct uncertainty analysis. [PO1,PO3,PO4 & PO5]
2. Would know to model the experimental data mathematically through regression; linear (along with hypothesis testing), multi and curvilinear. [PO1,PO2,PO3,PO4 & PO5]
3. Would have understand the classification of DESIGN OF EXPERIMENTS and will be able to conduct ANOVA for CRD , RBD, LSD designs. [PO1,PO2,PO3,PO4 & PO5]
4. Would have understood two factor, multifactor, fractional factorial experiments; and will be able to represent the same graphically. [PO1,PO2,PO3,PO4 & PO5]
5. Would have understood the basic aspects Taguchi approach and do simple problems on Taguchi method and interpret the results; and would have known the fundamental aspects of RSM. [PO1,PO2,PO3,PO4 & PO5]

INDUSTRIAL ROBOTICS

Course Code : MCM 22 **Credits: 4:0:0**
Prerequisites : Nil
Course Coordinator: Dr SUNITH BABU L

Preamble

This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid-body dynamics, exposure is given to 3D graphic simulation; control design, actuators, and sensors; wireless networking, task modeling, human-machine interface, and embedded software.
Students are exposed to the concept of DH Methods, transformation matrices. A wide scope is give to the area of Applications where in students understand as to how robotics can be applied in area of welding machine loading and unloading, die casting, forging, spray painting and drilling. Various leg configuration followed by programming sequence, planning, path planning, obstacle avoidance is discussed.

Course Objectives:

1. To acquire the knowledge of robotic technology and provide solutions to implement robotics systems quickly and effectively
2. To develop skill-set in transformation and DH sequence analysis
3. Develop an ability in analyzing the possible application of robots in different fields of engineering
4. Develop skill sets in analyzing the type of leg configuration system in different application
5. Enable real – time programming and obstacle avoidance system

UNIT –I

Basic Concepts of Robotics:
Introduction to robotics, Definition of robot, Basic structure of robot, Numerical control of Machine tools, Resolution, Accuracy and Repeatability, Position representation, Performance specification: Pay load, Speed. Classifications and Structures of Robotics Systems: Point-to-point and Continuous path systems, Trajectory Planning,

UNIT –II

Physical configurations and work volumes of an Industrial robot

The wrist and its motions, Grippers and types, Kinematic Analysis and Coordinate Transformations: Direct kinematics problem in Robotics, Euler's angle representation, Basic transformations, Rotation about an arbitrary axis, Homogeneous transformation matrices, Denvit and Hertanberg Convention, Applications of D-H Method- Three axis Robot Arms, Three axis wrists, Six axis Robot Manipulators.

UNIT –III

Industrial Applications of Robots:

Welding Machine loading: Multiple Robot & Multiple Machine loading, Sequential machine loading, forging and Die Casting. Spray painting and drilling. Assembly: Engine Assembly, Electrical and Electronics machine assembly, General assembly, Unusual applications: Sheep-shearing Robots, Robot in Construction, Autonomous Mobile Robots: Introduction, Locomotion-key issues for locomotion, Legged Mobile Robots

UNIT –IV

Leg configurations and stability

Wheeled Mobile Robots, Difference between wheeled and legged mobile Robots, Mobile Robot Kinematics: Introduction, Kinematics Models and Constraints, Representing robot position, Forward kinematics models, Wheel kinematics constraints, Robot kinematics constraints. Mobile Robot Maneuverability: Degree of Mobility, Degree of Streeability, Robot maneuverability.

UNIT –V

Mobile Robot Planning and Navigation

Introduction, Competences for Navigation Planning and Reacting, Path Planning, Obstacle avoidance, NavigationArchitectures-Modularity – Modularity code reuse and sharing, Control localization, Techniques for decomposition. Programming Languages: Introduction, Levels of Programming Languages, Introduction to VAL, RAIL and AML languages. Example of programming by VAL II.

Text Books:

1. M P Grover "Industrial Robotics" MGH.
2. Yoren and Koren, "Robotics for Engineers" MGH
3. Robotics and Manufacturing Automation, by C Ray Asfahl, John Wiley and Sons, Inc, Second edition.

Reference Books:

1. Robotics by Fu and Lee
2. Robotics for Engineers by Philippe Coffet, Volume 01 to 08
3. Walking machines- An introduction to Legged Robots by D J Todd.

Course Outcomes (COs):

1. To ascertain the acquired knowledge and develop robotic solutions to meet the industry demands[PO1,PO2,PO3,PO4 & PO5]
2. Demonstrate the ability to apply the spatial transformation and obtain forward kinematics equation and DH workflow [PO1,PO2,PO3,PO4 & PO5]
3. Be proficient in quickly analyzing the possible application of robots in potential areas of engineering domain. [PO1,PO2,PO3,PO4 & PO5]
4. Formulate the potential workflow to ensure quick maneuverability of robot systems. [PO1,PO2,PO3,PO4 & PO5]
5. Validate the predicted navigation system and develop appropriate programming sequence[PO1,PO2,PO3,PO4 & PO5]

AUTOMATION AND SIMULATION LABORATORY

Course Code : MCM L23 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Mr LOKESHA K

Preamble

Simulation is the method of imitating the actual process in a virtual environment. This involves generating mathematical models to simulate the manufacturing systems. Simulation helps to reduce the experimentation cost and time and provides the user with the approximate results in optimum time. Simulation can solve a wide range of problems ranging from simple queuing to complicated problems. Ability to create Simulation Software adds on to a student's overall skill and may help him explore such job opportunities. The laboratory course aims at imparting necessary skills in a student to develop Simulation Software with a wide area of application.

Course Objectives:

1. To emulate an ability to identify various opportunities for automation on a production floor.
2. To inculcate skills to practically simulate various processes of production for optimization.

Syllabus

Part A: Queuing Simulation – Simulating common and unique scenarios in a production environment through Single & Multiple Channel Queuing Techniques on a spreadsheet platform.
Part B: Inventory & Reliability Simulation – Simulating exercises on Inventory, Assembly-Lines, Material-Handling Systems on a spreadsheet platform.

Examination

Exam Marks: 50 Exam Time: 3 Hours

Component	Marks	Remarks
Part-A	20	Simulation Table – 10 Marks + Execution – 10 Marks
Part-B	20	Simulation Table – 10 Marks + Execution – 10 Marks
Viva	10	

Course Outcomes (COs):

Students will be able to

1. Understand the vast potential of using a software for simulating production environment scenarios. [PO1,PO2,PO3,PO4 & PO5]
2. Apply the knowledge of simulation to convert manual techniques into executable algorithms. [PO1,PO2,PO3,PO4 & PO5]
3. Create Simulation Software using spreadsheets to simulate various processes such as queuing, inventory, assembly lines and material-handling for enhanced productivity. [PO1,PO2,PO3,PO4 & PO5]

DESIGN OF EXPERIMENTS LABORATORY

Course code: MSE L24 / MCM L24 **Credits: 0:0:1**
Prerequisites: To have completed/registered for MSE21/MCM21
Course Coordinator: Dr B P HARICHANDRA

Preamble:

Statistics and design of experiments is undoubtedly a course that M.Tech students, especially in the field of Mechanical Engineering should undergo. In this context two courses on the topics are introduced in I and II Semester of M.Tech. However, today with a number of computer aided facilities available for the topic, it has become almost inevitable that students use computers for computations. In this context it is very much essential for the students to know about the use of software in executing the problems on statistics and DESIGN OF EXPERIMENTS . This course is aimed at fulfilling this requirement.

Course Objectives:

1. To understand the use of appropriate software(s) for statistical analysis and Design of Experiments ; and be able to read research papers, understand the results and explain the same.
2. To select an appropriate graphical representation for a given set of data, represent the same using appropriate software(s), mathematically model and analyze the same.
3. To perform hypothesis testing. ANOVA for different experimental data involving 2 factor design, multifactor design, factorial design and Taguchi design using appropriate software(s)

Learning of appropriate software and implementation of the Parts A,B and C using the software. The basic data sets shall be taken from journals in the area of their specialization.

Part A: Regression and correlation analysis

Linear Regression, Multiple Regression, Curvilinear Regressions, correlation analysis. Hypothesis testing.

Part B: ANOVA, Optimization.

Analysis and graphical representation and interpretation of 2 factor design, multifactor design, factorial design, Taguchi design. ANCOVA. Optimization techniques & RSM, Artificial Neural Network

Examination

Exam marks: 50 Exam time: 3 Hours.

Component	Marks	Remarks*
Part A	20	Initial write up and preliminary idea of results: 05 marks, Computer work: 05 marks, Presentation of data and results: 05 marks, interpretation of results: 05 marks
Part B	20	Initial write up and preliminary idea of results: 05 marks, Analysis, presentation of data and results: 10 marks interpretation of results: 05 marks
Viva	10	

* The split up may vary depending on the questions.

Reference books:

1. J.M. Juran, Frank M. Gryna, "Juran's Quality Control Handbook" McGrawHill International Editions.
2. Douglas C. Montgomery, "Design and Analysis of Experiments"
3. Hines et. Al., "Probability and statistics in engineering", 4th Ed., John Wiley and Sons, Inc.
4. Richard A Johnson, "Probability and statistics for engineers", 6th Edition, Pearson education.
5. User manuals/Tutorials of the appropriate software used.

Course Outcomes (COs):

At the end of the course, a student will be able to:

1. Understand the use of appropriate software(s) for statistical analysis and Design of Experiments ; and be able to read research papers, understand the results and explain the same. [PO1,PO2,PO3,PO4 & PO5]
2. Select an appropriate graphical representation for a given set of data, represent the same using appropriate software(s), mathematically model and analyze the same. [PO1,PO2,PO3,PO4 & PO5]
3. Perform hypothesis testing. ANOVA for different experimental data involving 2 factor design, multifactor design, factorial design and Taguchi design using appropriate software(s) [PO1,PO2,PO3,PO4 & PO5]

TECHNICAL SEMINAR 2

Course Code : MSE 25 / MCM 25 **Credits: 0:0:1**
Prerequisites : Nil

Preamble:

M.Tech. being post graduate program, the students should know the latest information in their fields. One of the ways to keep them updated is by the study of journal papers in the field. Explanation of the papers in the field will further enhance their communication skills. Teaching being one of the important careers an M.Tech student can take up, understanding and explaining these journal papers will be an added advantage. Apart from these, writing a journal paper is desirable of the program. Hence by studying the journal papers and trying to present their understanding as part of the seminar help students identify good journals, can know what journal expect from a paper, can understand the shortcomings and plus points of published papers. This will also help the students write review papers and choose topics for their research

Course Objectives:

This course helps the students

1. To indentify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper
2. To develop overall skills for technical communication and help technical decision making
3. To understand the latest research in their field of study and try to formulate a research problem.

Scheme of seminars:

Students shall select published journal papers, related to their specialization, read, understand, prepare slides and present the same. Each student shall present their understanding of at least three Journal papers. All students shall attend the seminars of other students of their specialization. A copy of the full paper shall be got signed by the evaluating faculties and the same shall be maintained by the student and submitted at the end for marks finalization. The students shall select the journal paper themselves with the assistance of faculties, if required. Papers shall be selected only from peer reviewed unpaid journals.

Evaluation:

Each presentation shall be evaluated for 50 marks. Average marks obtained for three best presentations will be the student's CIE marks. No SEE.

Course Outcomes (COs):

The student will be able

1. To indentify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper[PO1,PO2,PO3,PO4 & PO5]
2. To develop overall skills for technical communication and help technical decision making [PO1,PO2,PO3,PO4 & PO5]
3. To understand the latest research in their field of study and try to formulate a research problem. [PO1,PO2,PO3,PO4 & PO5]

COMPUTER CONTROL OF MANUFACTURING SYSTEMS

Subject Code: MCM 31 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Mr LOKESHA K

Preamble:

The declining cost of microcomputers change the look of factory floor. Modern manufacturing systems and industrial robots are advanced automation systems that utilize computers as an integral part of their control. Computers are vital part of automation. There is increase in case of computer controlled machine tools in the production line. Numerical controlled (NC) machine tools are more accurate than conventional machine tools, which can reduce all non automating machining time, apply fast tool changing method and idle motions by increasing the rapid traverse velocities.
Numerical controlled (NC) machines and Computer Numerical controlled (CNC) machines employ control circuits, which include counters, decoders, DAC converters etc.,. Computer Control of Manufacturing Systems employs closed loop controllers that measure state of system during operation and decrease effects of load disturbances and compensate in real time for parameter variation. To improve production rate or reduce machining cost adaptive control is used to automatically set the optimal operating parameters subject to machining constraints in order to optimize the performance of overall system. The supervision of flexible manufacturing system is performed by computer integrated manufacturing (CIM) systems in which production flow from the conceptual design through the finished products will be entirely under computer control and management.

Course Objectives:

1. To impart the basic concepts in manufacturing systems and fundamentals of NC & CNC system
2. To enhance students awareness in system devices that include feedback devices, counters, DAC converters and interpolators
3. To make the students perform /analyze manual part programming , computer aided programming and APT programming
4. To impart concepts of CNC systems and utilization of microprocessors in CNC systems to replace the hardware part
5. To impart concepts of adaptive control to improve the production rate and reduce machining cost by calculation and setting of optimal operating parameters during machining

UNIT –I

Introduction

Fundamentals of numerical control, advantages limitations of N.C systems-classification of N.C systems. Features of N.C. Machine tools: design consideration of N.C machine tools 9 Hrs

UNIT –II

Increasing productivity with N.C machines

Machining centre, tooling for CNC machine. System device: device, feedback devices-counting devices digital to analog converters 9 Hrs

UNIT –III

Interpolations

DDA integrators, simple and symmetrical DD reference word CNC interpolators. N.C part programming: Introduction-punched tape-manual part programming computer aided programming, APT programming. 9 Hrs

UNIT –IV

Control loops for N C Systems

Introduction-control loops for point and contouring systems. 9 Hrs

UNIT –V

Computerized numerical control:

CNC concepts-advantage of CNC references pale techniques, Sampled data techniques microcomputers in CNC, Adaptive control systems: adaptive control with optimization Adaptive control with constraints-variable gains AC systems.

9 Hrs

Text Books:

1. Martin J. Numerical control of machine tools
2. Yoram .Koren “Computer Controls of Manufacturing Systems” McGrawHill 1983

Reference Books:

1. Y.koren&J.Benuri “Numerical control of machine tools”, Khanna Pub 2005.
2. Wilson F.M “Numerical control in manufacturing” McGraw Hill Newyor.
3. Robot Technology Fundamental by James.G.Keramas, Denmark Pub 1985.

Course Outcomes (COs):

Student will be able to

1. Understand fundamentals of NC & CNC systems. [PO1,PO3,PO4 & PO5]Implement appropriate control system for specific machine tool to increase its productivity**.**
2. Develop manual and computer aided part programming and APT programming for a given profile**.** [PO1,PO3,PO4 & PO5]
3. Acquired knowledge in concepts of CNC systems and use of microprocessors in CNC systems. [PO1,PO2,PO3,PO4 & PO5]
4. Understand the adaptive control system and its application in a machine tool. [PO1,PO2,PO3,PO4 & PO5]

INTERNSHIP/INDUSTRIAL TRAINING

Course Code : MSE 32 / MCM 32 **Credits: 0:0:4**
Prerequisites : Nil

Preamble:

Preamble: Any manufacturing engineering candidate would ultimately require ability for research or be able to solve problems in industries. Hence a candidate would be required to have a practical exposure to some typical industries. In this connection Industrial Training / Internship goes a long way in helping the candidates give an actual exposure to industrial environment. Hence this course is being introduced.

Course Objectives:

At the end of the internship / industrial training duration, a candidate

1. Would have required exposure to industry / research center.
2. Would have handled live problems in industry / research centers
3. Would have developed basic managerial skill in taking up technical research / industry related problems.

Course Outcomes (COs):

At the end of the internship / industrial training duration, a candidate would have

1. Acquired exposure to industry / research center. [PO1,PO2,PO3,PO4 & PO5]
2. Handled live problems in industry / research centers[PO1,PO2,PO3,PO4 & PO5]
3. Developed basic managerial skill for taking up technical research / industry related problems. [PO1,PO2,PO3,PO4 & PO5]

PROJECT WORK / DISSERTATION PRELIMINARIES

Course Code :MCM 33 **Credits: 0:0:8**
Prerequisites : Nil

Preamble:

The students are required to take up a project work relevant to the course, which involves literature review, problem formulation, experimentation, analysis of results and discussion. In this background the preliminary work involving literature review and problem formulation will be taken up during the III Semester. The department will provide one supervisor for each candidate, under whose supervision the entire project will be executed.

Course Objective:

1. To conduct literature review, understand well, with an aim of identifying a problem in the area relevant to the program.
2. To formulate a research problem in the area relevant to the program
3. To prepare a consolidated report of the literature survey and the problem formulation

Course Outcome (COs):

1. The candidate will be able to identify a problem in the area relevant to the program through literature survey. [PO1,PO2,PO3,PO4 & PO5]
2. The candidate would have formulated a research problem in the area relevant to the program. [PO1,PO2,PO3,PO4 & PO5]
3. The candidate would have prepared an consolidated report of the literature survey and problem formulation. [PO2,PO3,PO4 & PO5]

PROJECT WORK / DISSERTATION

Course Code : MCM 41 **Credits: 0:0:20**
Prerequisites : Nil

Preamble:

During the III Semester, through literature survey and discussion with the supervisor allotted by the department, the candidate would have formulated a research problem. During the Phase II, based on the problem formulation, experimentation will be carried out, followed by results and discussion. As a last part of the project work, in Phase III, the candidate shall prepare a project report in bound form and submit the same to the department, with due certification by the supervisor.

Course Objective:

1. The candidate should be able to apply the technical knowledge learnt to prepare a methodology to solve the problem formulated
2. The candidate should be able to conduct the experiments according the standards acceptable by the peers, understand, analyze and evaluate the results obtained.
3. The candidate should be able to prepare a comprehensive report of the project work,
4. The candidate should be able to publish a journal paper for a peer reviewed journal.

Course Outcomes (COs):

1. The candidate would have applied the technical knowledge learnt to prepare a methodology to solve the research problem formulated. [PO1,PO2,PO3,PO4 & PO5]
2. The candidate would have conducted the experiments according the standards acceptable by the peers, and will be able to demonstrate and analyze results obtained. [PO1,PO2,PO3,PO4 & PO5]
3. The candidate would have prepared a comprehensive report of the project work. (a technical article in peer reviewed journals) [PO1,PO2,PO3,PO4 & PO5]

PROJECT WORK / DISSERTATION SEMINAR

Course Code : MCM 42 **Credits: 0:0:2**
Prerequisites : Nil

Preamble:

The candidate should be able to effectively, orally present a seminar on the project work executed during the III and IV semesters. The same shall be evaluated by a panel of examiners recommended by the department.

Course Objective:

1. To prepare a suitable computer aided slides on the project work carried out
2. To present orally the details of the project work carried out.
3. To prove the ability to defend questions arising out of the project work with respect to correctness and acceptability

Course Outcomes (COs):

1. The candidate will have prepared suitable computer aided presentation on the project work carried out[PO2,PO3,PO4 & PO5]
2. The candidate will be able to present orally the details of the project work carried out. [PO2,PO3,PO4 & PO5]
3. The candidate will be able to prove the ability to defend questions arising out of the project work with respect to correctness and acceptability [PO1,PO2,PO3,PO4 & PO5]

ELECTIVE SUBJECTS

ADVANCED MANAGEMENT TECHNIQUES IN MANUFACTURING

Course Code: MSE E01 / MCM E01 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr VISHWANATH KOTI

Preamble

Advanced Topics in Manufacturing is a new domain featuring tools and techniques that help manufacturers gain productivity and enable constant monitoring mechanisms helping industry focus on reduced lead time and enhanced work rejection rates. Areas such as just in time production is discussed with use of software packages making production system move to the next level. Quality control and its methods enable companies to ensure quality products reach market and various techniques available to enhance the checking process thereby enabling the overall quality process.

Course Objectives:

1 To make a student understand the concept of JIT, types, their principles, economics and applications.
2 To know the implementation and production of different types of JIT for manufacturing systems. Also understand the process of Scheduling and Sequencing.
3 To learn about the sequential withdrawal system
4 The student is able to understand the concepts of Kanban system implemented in Toyota
5 Learn and understand the concept of production planning, production smoothing and demand fluctuation

UNIT –I

Introduction and need of CPC
What CPC can do, CPC – getting the right tool JIT – Introduction – The spread of JIT Movement, some definitions of JIT, core Japanese practices of JIT, Creating continuous Flow Manufacturing, Enabling JIT to occur, Basics elements of JIT, Benefits of JIT

UNIT –II

Just in Time
Primary purpose., profit through cost reduction, Elimination of over production, quality control, Quality Assurance, Respect for Humanity, Flexible work force, JIT, Production Adapting to changing production Quantities, purpose layout for shortened lead times, standardization of operation, Sequencing and scheduling used by suppliers – Monthly and daily information.

UNIT –III

Sequenced withdrawal systems

By sequenced schedule table problems and counter measure in applying the kanban systems to sub contractors. Toyota Production Systems – The philosophy of TPS, Basics Frames Work of TPS, kanbans. Determine the Number of Kanbans in Toyota Production systems.

A) Kanban Number under constant Quality withdrawal systems
B) Constant Cycle, Non constant Quality Withdrawal Systems
C) Constant Withdrawal Cycle System for the Supplier Kanban
D) Examples A Detailed Kanban Systems Examples

Supplier Kanban and the sequencing Scheduled for the USE by Supplier

1) Later replenishment systems by Kanban
2) Sequenced Withdrawal systems
3) Circulation of the Supplier Kanban within Toyota

Production Smoothing in TPS, Production Planning, Production Smoothing, Adaptability to Demand fluctuation, Sequencing Method for the Mixed Model Assembly Line to Realize Smoothed Production

UNIT –IV

JUST IN TIME Production

With Total Quality Control – Just in Time Concept, cutting purchase order cost the JIT cause – effect chain, scrape / Quality Improvement, Motivation effects responsibility effects, small group improvement activities withdrawal of buffer inventory The total quality control concept, The Quality Control Introduction – TQC concept, responsibility, learning from the west, TQC concepts, categorized, goals, habit of improvement, perfection, basics process control, easy to see quality control as facilitator, small lot size, house keeping. Less than full capacity scheduling, daily machine checking.

UNIT –V

Techniques and tool

Exposure to problems, fool proof devices, tools of analysis QC circles, TQC in Japanese owned US Electronics plant TQC in Japanese owned Automotive plants. Plant configuration: Introduction ultimate plant configuration Job shop fabrication frame welding forming frames parts from tubing Dedicated production lines, overlapped production, the daily schedule, forward linkage by means of kanban, physical merger of process, Adjacency, mixed models automated production lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker cranes, Automatic Quality Monitoring.

Text Books:

1. Toyota Production system – An integrated approach to just in time – by Yasuhiro Monden
2. Lean Thinking – Byjames Wornack
3. The machine that changed the world – The story of lean production – By James P WornackHarper Perennial Edition Published 1991

Reference Books:

1. Japanese Manufacturing Techniques – By Richard Schonberger
2. Just in Time Manufacturing – Kargoanker
3. Wind chill reference manual Oxford university press,2005

Course Outcomes (COs):

Student will be able to

1. Demonstrate the concept of JIT their types, principles and application through real time examples[PO1,PO2,PO3,PO4 & PO5]
2. Assess types of JIT for different manufacturing system making scheduling and sequencing an easy process[PO1,PO2,PO3,PO4 & PO5]
3. Demonstrate sequential withdrawal system through real time examples[PO1,PO2,PO3,PO4 & PO5]
4. Have awareness of how Kanban is implemented in Toyota is enlightened to all users. [PO1,PO2,PO3,PO4 & PO5]
5. Distinguish between various chain initiative production planning and demand fluctuation[PO1,PO2,PO3,PO4 & PO5]

ADVANCED MATERIALS TECHNOLOGY

Course Code: MSE E02 / MCM E02 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr C SIDDARAJU

Preamble:

In day to day life we are coming across different types of materials pertaining to engineering field. We have conventional materials whose properties are already there in the hand books. As the new inventions are taking place, the conventional materials are being replaced with new one. So there is a need for newer materials which suits to the need, with improved properties and structures. And also there is a need for the newer materials with improved mechanical, chemical, electrical and other properties. This course deals with the study of such advanced materials to serve the required purpose in the field of aerospace, space craft and other areas where light weight and high strength are of interest.

Course Objectives

1. To apply the knowledge in the field of materials and to differentiate with conventional and advanced material.
2. To assess different methods of powder production and to study different aspects related to powder metallurgy.
3. Explain the concepts of different production methods of composites.
4. To analyze micro and macro mechanics of composite material and assess various strength and stiffness parameters associated with it.
5. Characterize different types of titanium and nickel base super alloys and choose one which suits the application.

UNIT – I

Development of Newer Materials: Properties of materials, Structure property relationship, newer materials-Ceramics and Composite materials, Ceramics- Types of ceramics, structure, processing methods and properties, applications. Composite materials – Types – Metal matrix Composites (MMC) Ceramic Matrix Composites (CMC) Polymer composites Structure.

UNIT – II

Powder Metallurgy: Introduction, advantages and limitation of powder metallurgy. Characteristics of metal powders. Different methods of powder manufacturing, powder conditioning and compaction. Sintering, Finishing operations, Applications of PM components.

UNIT – III

Processing of composites: Hand Lay techniques, Autoclave molding, Bag Moulding , filament winding Pultrusion, Pulforming, Thermoforming, Injection Moulding. Resin Transfer molding.

Cutting, machining and joining, tooling, quality assurance, Types of defects, NDT methods

UNIT – IV

Micro mechanical analysis of lamina, Introduction, volume and mass fractions, density and void content, Evaluation of four elastic moduli. Ultimate strength of unidirectional lamina

Macro mechanical analysis of lamina. Introduction, review of definitions, Hookes Law of different types of materials. Hookes law for two dimensional unidirectional lamina, Hooke's law for two dimensional angular lamina. Invariant form of stiffness and compliance matrices for an angular laminate. Hydrothermal stresses and strains in a lamina.

UNIT- V

Titanium and its alloys: Production of titanium, properties, titanium alloy systems, Classification of titanium alloys, Alpha titanium alloys, Beta titanium alloys and some recent development in titanium alloys.

Nickel and cobalt alloys: Production, chemical composition, microstructure and properties of pure nickel. Nickel- copper alloys, Nickel- chromium alloys, Nickel base super alloys, Cobalt base super alloys; chemical composition, applications, microstructure, Strengthening mechanisms in single-crystal nickel base superlloys.

Reference Books:

1. Materials and Processing in Manufacturing – E Paul Degarmo, J T Black, Ronald A Kohser. Pub 2006
2. Powder Metallurgy – A K Sinha.Sapna Publication, 2009
3. Composite Materials Hand book – M M Schwartz, McGraw Hill.
4. Rober M.Jones "Mechanics of composite Materials" McGraw Hill Kogakusha Ltd
5. Autar K. Kaw " Mechanics of Composite materials" CRC Press ,1997.

Course Outcomes (COs):

Students should be able to:

1. Apply the gained Knowledge in the field of material and to differentiate properties with respect to conventional material. [PO1,PO2,PO4 & PO5]
2. Select suitable powder production methods for different materials in order to get the required components. [PO1,PO2,PO3,PO4 & PO5]
3. Select suitable production technique for composite material. [PO1,PO2,PO3,PO4 & PO5]
4. Analyze and obtain stiffness and compliance matrix and also study strength parameters of lamina. [PO1,PO2,PO3,PO4 & PO5]
5. Decide the material to be used in aerospace and other high temperature application. [PO1,PO2,PO3,PO4 & PO5]

CONDITION BASED MONITORING

Course Code: MSE E03 / MCM E03 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr C M RAMESHA

Preamble:

Condition Based Maintenance (CBM) is continually evolving its conceptual basis which can be traced back to the earliest development of machinery, and the use of human senses to monitor the state of Industrial equipment. In today's industry augmented by scientific and sophisticated instrumentation.CBM is widely employed in sophisticated instrumentation allows the quantification of the health or condition of industrial machinery and equipment, so that problems can be diagnosed early in their development and corrected by suitable maintenance, before they become serious enough to cause failure and plant breakdown.

Course Objectives:

To make a student

1. Understand the basic concept about of Maintenance and condition based maintenance, types, their principles, economics and applications.
2. Implementation of different types of monitoring techniques applicable to various manufacturing systems.
3. Understand general concept of NDT and their application and specialized techniques used in CBM and their importance in modern plants
4. Understand the monitoring technique incorporated in Bearings, concept of condition monitoring technique by case studies included in bearing failure, history of failure, Analysis of failure, faulty detection and symptoms and monitoring of cracks, misalignment and vibration monitoring.
5. To Analyze and understand trend monitoring techniques, performance parameters with appropriate case studies and examples.

UNIT -I

Condition based Maintenance: Introduction, principles, classification of maintenance, types of maintenance, Economics in maintenance.
Condition Monitoring Methods, Economics of condition monitoring, sets up a condition Monitoring Activates. Implementation of condition based Maintenance, Information Systems, selection of Monitoring Methods, Assessment of Monitoring techniques, case studies. Consequences of implementation of CBM

Non –Destructive testing and Specialized techniques: Introduction, visual testing, liquid penetrate inspection, Water washable method.. Pre-cleaning, penetrate application, Dwell time, surface drying, Developer application, Dwell time, Excess surface penetrate removal, Interpretation, Post-emulsifiable penetrates, Solvent-soluble penetrates**.**

UNIT -II

Radiographic examination: X-Ray apparatus, X-Ray generation, Tube Shielding Control console, Other X-Ray Sources, Electrostatic or VenDegraff generators, Linear accelerators. Gamma –Ray Radiography, Sources –Radium, Thallium 170, Iridium 192, cobalt 62.Isotope Projectors- geometric factors, Radiographic film, Radiograph, safety hazards and Government control

Ultra Sonic's Examination: Ultrasonic triangulation fault location acoustic emission technique (AET) – Instrumentation, Transducers, Preamplifier and filter, Main amplifier, and signal processing display unit, Signals and processing, Magnetic testing Methods, current flow magnetization, Induction Magnetic Flow method, Induction threading bar method, Induction Magnetizing coli method, Induced current flow method, Magnetic particle Inspection links, strippable Magnetic film,

UNIT -III

Vibration Monitoring and Analysis: Introduction to vibration monitoring, Machinery vibration signatures, selection of Transducers. Analysis Techniques, Machine failure Modes, Measurement location, Vibration severity criteria, Vibration frequency analysis. Permanent monitoring, case studies.

Vibration Monitoring of ball and roller bearings: Introduction, shock pulse method (SPM), SPM for testing Antifriction bearings, Manual monitoring. Continuous monitoring, the kurtosis method, Fiber optics system, Vibration signature analysis, contact resistance method, case studies. SPM and its applications

UNIT -IV

Condition Monitoring case studies & Applications: Failure of fan bearings, History of failures, Analysis of the failures, solution. High frequency vibration of gas compressor – History of trouble, Analysis of trouble, solution. Monitoring of cracks in rotors – Turbo compressor misalignment. Detection of faulty electrical components. Turbine shell distortion. Symptoms and Detections

Thermography and Performance Trend Monitoring: Eddy current apparatus, cost. Thermography- thermo graphic Equipment, application of thermography. Introduction to steam turbine performance parameters, case studies and Examples.

UNIT -V

Corrosion Monitoring and wears monitoring: Need for corrosion monitoring, fields of application, Monitoring Techniques, Resistance Techniques. Other probe techniques- Analytical technique and others. Wear process monitoring techniques – Direct debris detection methods, Debris collection methods.

Lubricant analysis: Introduction, source of contamination, significant oil contaminants, used oil contamination-time trends, changes in the carrier fluid, erratic wear debris. Lubricant sampling methods, Lubricant analysis methods, interpretation of results, indications from the amount of debris present, indication from the size distribution of debris, Application of chemical analysis of debris, wears detection using proximity monitors, case studies.

Reference Books:

1. L. F. Pau Marcel Dekker "Failure Diagnosis and Performance Monitoring".
2. Condition Monitoring and condition based maintenance "Current Literature. Update CEP ISTE New Delhi "
3. Hand Book of condition Monitoring: Techniques and Methodology: Davis.A. Chapman & Hall,Madras, NewYork, Tokyo, Mellborne.
4. Mechanical Fault Diagnosis and Condition monitoring R. A. Caollacatt , Chapman and hall 1977.
5. Hand book of condition monitoring B K N Rao . Elsevier 1st Edition 1996 .\
6. Machinery condition Monitoring , principles and Practiceses , Amiya Ranjan Mohanty- 2014, CRC Press.

Course Outcomes (COs):

At the end of the course students are able to

1. Understand the concept of Maintenance and condition based maintenance, types, their principle, economics and applications. [PO1,PO2,PO3,PO4 & PO5]
2. Identify the advanced NDT methods like Radiographic examination and Ultrasonic examination used to improve the availability, maintainability of the modern plant for optimal running condition. [PO1,PO2,PO3,PO4 & PO5]
3. Understand general concept of NDT and their application and specialized techniques used in CBM and their importance in modern plants [PO1,PO2,PO3,PO4 & PO5]
4. Understand the monitoring technique incorporated in Bearings, concept of condition monitoring technique by case studies included in bearing failure, history of failure, Analysis of failure, faulty detection and symptoms and monitoring of cracks, misalignment and vibration monitoring. [PO1,PO2,PO3,PO4 & PO5]
5. To Analyze and understand trend monitoring techniques, performance parameters with appropriate case studies and examples. [PO1,PO2,PO3,PO4 & PO5]

ADDITIVE MANUFACTURING

Course Code: MSE E04 / MCM E04 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr JAYA CHRISTIYAN K G

Preamble

The current marketplace is undergoing an accelerated pace of change that challenges companies to innovate new techniques to rapidly respond to the ever changing global environment. A country's economy is highly dependent on the development of new products that are innovative with shorter development time. Organizations now fail or succeed based upon their ability to respond quickly to changing customer demands and to utilize new innovative technologies. In this environment, the advantage goes to the firm that can offer greater varieties of new products with higher performance and greater overall appeal. At the center of this environment is a new generation of customers. These customers have forced organizations to look for new methods and techniques to improve their business processes and speed up the product development cycle. As the direct result of this, the industry is required to apply new engineering philosophy such as ***Rapid Response*** to ***Manufacturing (RRM).*** RRM concept uses the knowledge of previously designed products in support of developing new products.

Course Objective

1. The aim of the course is to provide the students, with an opportunity to conceive, design, and implement products quickly and effectively, using the latest rapid prototyping methods and CAD/CAM technology
2. The students will be exposed to the history of product development and its stages in the manufacturing arena
3. Technologies associated with material addition process are identified and its advantages are evaluated.
4. The students learn to differentiate various process parameters associated with Rapid manufacturing technique
5. Selectively choose tooling techniques for a specific application

UNIT - I

Introduction: Prototype Fundamentals, History of RP system, Fundamentals of RP, Growth of RP industry, classification of RP system.
Stereo Lithography Systems: Principle, Process parameter, Data preparation, data files and machine details, application.

UNIT - II

Selective Laser Sintering: Type of machine principle of operation, process parameters, Data preparation for SLS, application.

Fusion Deposition Modelling Principle, process parameter, path generation, application
Solid Ground Curing: Principle of operation machine details, applications, case studies.

UNIT - III

Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.
Rapid Prototyping Data Formats: STL format, STL file problems, Building valid and invalid tessellated models, STL file repair, other translators, new formats, standards for representing layered manufacturing

UNIT - IV

Rapid Manufacturing Process Optimization Factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation.
Materials for RP: Introduction, Types of materials, liquid based materials, solid based materials, powder based materials, case studies.

UNIT - V

Rapid Tooling: Indirect methods for RT, Direct methods for RT
Reverse Engineering: Measuring Devices, CAD Model construction from point cloud, data handling and reduction methods, application and trends,
Industry Perspective: Guidelines for Implementation, Operating Issues, Managing Issues, Service Bureaus, Rapid Prototyping Consortia

Text Books:

1. Stereo lithography and other RP & M Technologies, Paul F.Jacobs: "SME, NY 1996.
2. Rapid manufacturing, Fiham D.T & Dinjoy S.S Verlog London 2001.
3. Rapid Prototyping: Principles and Applications By C. K. Chua, K. F. Leong, C. S. Lim
4. Rapid Prototyping: Principles and Application…(Hardcover) by Rafiq I. Noorani

Reference Books:

1. Rapid prototyping, Terry Wohler's Report 2000" association 2000.
2. Rapid prototyping materials by Gurumurthi. IISc Bangalore.
3. Rapid automated by lament wood. Indus press New York.

Course Outcomes (COs):

1. The students can express the concept of product design stages and methods, thereby making him a better product designer[PO1,PO2,PO3,PO4 & PO5]
2. The stages of development in rapid prototyping technology will help the students to evaluate and look forward for newer techniques and processes in the future[PO1,PO3,PO4 & PO5]
3. The student can assess and implement RP techniques for specific application leading to better ROI for the company that uses RP machines [PO1,PO2,PO3,PO4 & PO5]
4. The students can enhance the production sequence of tooling process by choosing the correct material for the job[PO1,PO2,PO3,PO4 & PO5]
5. The students are in a position to incorporate the productivity sequence by choosing the right CAD[PO1,PO2,PO3,PO4 & PO5]

AUTOMATION IN MANUFACTURING

Course Code: MSE E05 / MCM E05 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr VISHWANATH KOTI

Preamble:

Automation technology such as robotics, machine tools, handling systems, controllers and computers are the basis of almost all important industries in the world and provide manufacturing industry with the means to improve quality, reduce errors, increase productivity and reduce cycle times. Manufacturing has had a long history, ranging from the initial creation of simple, hand-crafted items, to the development of large complex factories that include a host of factory-related production and fabrication techniques. The study of the systems of manufacturing and production has evolved into a complex field of research in its own right. Manufacturing and production in the contemporary world faces many challenges. This Course is designed to emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques and impart the student with knowledge of concepts and techniques, which have recently been applied in many practical situations. It gives a framework of knowledge that allows the students to develop an interdisciplinary understanding and integrated approach to overcome the challenges of automation in manufacturing.

Course Objective:

1. The aim of the course is to define the concept of Automation and Building blocks, Fundamentals of Manufacturing.
2. To enable student to understand components of automated production, methods and types of transfer mechanism deployment of storage buffers in automated production line
3. To explain the concept of partial automation, automated assembly system and line balancing
4. To enable a student to develop ladder logic diagrams and PLC programming for industrial automation applications.
5. To enable the student to understand the concept of on line computer control of industrial automated processes

UNIT –I

Automation and Building Blocks:
Automation, Reasons for Automation, Basic Elements of Automated system, advanced automation functions, Levels of automation, Automation Strategies, Production concept and Mathematical Models, Functions of Manufacturing.

UNIT –II

Detroit-type Automation:
Methods of transport, Transfer Mechanisms, Buffer storage, Automation for machining operations, Design and Fabrication considerations, Automated Flow lines, Analysis of automated Flow Lines with and without buffers

UNIT –III

Partial automation, analysis of assembly lines and line balancing
Partial automation, assembly systems, manual and automated assembly lines, analysis of multistage assembly lines, line balancing problems, methods of line balancing

UNIT –IV

Logic Diagrams:
Logic networks, Ladder Logic Diagrams, Timers, Response diagram. Programmable Logic Controllers: Introduction, PLC cycle, PLC internal features, PLC programming

UNIT –V

Application programs,
Advantages and Disadvantages of PLCs, On line Computer Control: Process control computers, Levels of implementations, Control strategies, Process interface, Interrupters, Process Computer Programming.

Text Books:

1. Performance Modeling of Automated Manufacturing Systems By Vishwanadhan. PHI.
2. Principles and applications of PLC, by Webb, McMillan 1992.
3. Automation, Production systems and CIM by Mikell P Grover, Person Education, Asia

Reference Books:

1. Robotics and Manufacturing Automation, by C Ray Asfahl, John Wiley and Sons, Inc, Second edition.
2. Principles of CIM by Vajpayee, PHI.

Course Outcomes (COs):

Student will be able to

1. Evaluate the Manufacturing Lead Time (MLT), Production Rate, Plant capacity by applying the concepts of automated production systems. [PO1,PO3,PO4 & PO5]
2. Involve in the design of transfer mechanisms and deployment of buffer storage mechanisms required for a automated manufacturing system. [PO1,PO2,PO3,PO4 & PO5]
3. Analyse and implement the line balancing concepts in manufacturing sectors. [PO1,PO2,PO3,PO4 & PO5]
4. Understand and develop PLC programming for industrial automation applications. [PO1,PO2,PO3,PO4 & PO5]
5. Implement the concept of on line computer control of industrial automated processes. [PO1,PO3,PO4 & PO5]

TOOLING FOR MANUFACTURING IN AUTOMATION

Subject Code: MSE E06 / MCM E06 **Credits:4:0:0**
Prerequisites: Nil
Course Coordinator: Mr LOKESHA K

Preamble:

Rapid developments are taking place in the field of manufacturing processes, the exotic and complicated machinery and new products are appearing in the market. Tool design is a specializes area of manufacturing engineering which comprises the analysis, planning, design, and the application of tools, methods and the procedures to increase the manufacturing productivity. For this, a tool designer has to have a working knowledge of machine shop practice, tool making procedures, machine tool design, etc. Tooling refers to the hardware necessary to produce a particular product. Tooling as viewed by the tool designer consists of a vast array of cutting tools, devices, jigs, fixtures, dies, gauges for measurement etc., used for manual production with the development of new materials, need for higher dimensional accuracy, high production rate, a need for development of individual requirements with respect to tooling arose. This has resulted in various new techniques and replacement of the conventional fixtures, clamping devices etc.

Course Objectives:

1. The students are introduced to the need for pre-design analysis, fixtures and jigs, principles for locating, positioning, clamping.
2. To evaluate and analyze the differences between the conventional technologies and NC machine tools.
3. To understand the sheet metal fabrication methods and understand the concept of simple dies, compound dies and progressive dies.
4. To understand the injection moulding methods
5. To understand the different gating systems, runner and gating design, the concept of ejection, cooling systems, types, shrink analysis and analyze the fluid flow in moulds.

UNIT-I

Design of Jigs & Fixtures: Pre-design analysis, fixture design procedure principles of locating and positioning, clamping and positioning, tooling for drilling and reaming processes. Milling fixture design, fixture for twining, boring & grinding.

UNIT-II

Tooling for Numeral Control Machine Tool: Special design considerations, modular fixture design, modular tooling system. Other NC tooling. Tooling for Flexible manufacturing systems.

UNIT-III

Design of Tools for sheet metal operations: Design of sample, compound and progressive dies, Design of strip layout. Die materials, press selection, Die design for sheet metal forming, cutting and SMED principles.

UNIT-IV

Design of Thermoplastic Injection Mould Design: Product and mould, fluid flow, machine and its influence on mould design. Two plates and Three plate moulds. Runner and gate design. Runner less and undercut moulds. Mould cooling. Ejection methods, Prototype moulds. Mould Tool materials.

UNIT-V

Part and Mould Design Optimization: Part and mould design, simulation-static, dynamic and thermal analysis of thermoplastic parts and injection moulds. Analysis of Thermo Plastic and Rubber Moulds: Cool, wrap, shrink analysis, locating of weld lines. Mould materials.

Reference books:

1. William E Boyes, “Handbook of Jig and Fixture Design”, Second Edition, SME, Michigan, 1989.
2. Cracknell P S and Dysor R W, “Handbook of Thermoplastic Injection Mould Design”, Blackie Academic & Professional, Glasgow, 1993.
3. SME, “Tool and Manufacturing Engineers Hand Book”, Vol.II-Forming Fourth Edition, 1984.
4. Nagpal, “Tool design”
5. P H Joshi, “Jigs & Fixtures”, TMH Publications.

Course Outcomes (COs):

Student will be able to

1. Understand, identify and adopt new techniques of jigs and fixture for an industrial application. [PO1,PO2,PO3,PO4 & PO5]
2. Acquire and demonstrate the need of numerical control machine tools for a manufacturing sector. [PO1,PO2,PO3,PO4 & PO5]
3. Adopt the concept and applications of dies in sheet metal fabrication. [PO1,PO2,PO3,PO4 & PO5]
4. Adopt the concept and applications of dies in injection moulding for plastic component manufacturing. [PO1,PO2,PO3,PO4 & PO5]
5. Understand the various mould defects and acquire basic knowledge on mould flow analysis. [PO1,PO2,PO3,PO4 & PO5]

SIMULATION AND MODELING OF MANUFACTURING SYSTEMS

Course Code: MSE E07 / MCM E07 **Credits:4:0:0**
Prerequisites: Nil
Course Coordinator: Ms HEMAVATHI S

Preamble:

Simulation is the method of generating the actual process in a virtual environment. This involves generating mathematical models to simulate the manufacturing systems. Simulation helps to reduce the experimentation costs and time. It provides the user with the approximate results in optimum time. Simulation can solve a wide range of problems ranging from simple queuing to complicated problems in a production environment.

Course Objectives

1. To understand the need for simulation and modeling in manufacturing sectors
2. To understand and analyze the problems related to Queuing Systems in a Production Setup
3. To understand and analyze the problems related to Reliability and Inventory Systems in a Production Setup
4. To understand and analyze different issues in Manufacturing and Material-Handling Systems
5. To gain knowledge about verification and validation of the simulation packages

UNIT -I

Introduction to Simulation:
Definition of Simulation, Types of Simulation, Difference between Simulation & Experimentation; History of Simulation
Brief Description of Monte-Carlo Simulation, Limitations of Simulation, Areas of Applications
System and Environment: Components of a System; Discrete and Continuous Systems

UNIT -II

Queuing Simulation:
Description of Discrete Event Simulation; Simulation of Single Channel Queue and Two Channel Queue – General Applications and Production Environment Applications; Simulation of Lead-Time Demand;

UNIT- III

Reliability, Inventory & Event Scheduling:
Simulation of Reliability Problems & Inventory Problems; Even Scheduling Algorithm – Single Channel Queue and Two Channel Queue; Simulation of an Activity Network

UNIT -IV

Simulation of Manufacturing and Material-Handling Systems:
Models of Manufacturing Systems; Models of Material-Handling Systems; Goals and Performance Measures; Issues in Manufacturing and Material-Handling Simulations; Assembly Line Simulation

UNIT -V

Verification and Validation of Simulation Models:
Model-Building, Verification and Validation, Verification of Simulation Models, Calibration and Validation of Models- Face Validity, Validation of Model Assumptions, Validating Input-Output Transformations;
Simulation Software: Selection of simulation software, simulation packages.

Text books:

1. Jerry Banks & John S Carson II, "Discrete Event System Simulation". Prentice Hall Inc. 1984.
2. Gordan. G. "Systems Simulation", Prentice Hall India Ltd, 1991.
3. NusingDeo, "System Simulation with Digital Computer", Prentice Hall of India 1979.

Reference Books:

1. Francis Neelamkovil, "Computer Simulation and Modeling", John Wilely& Sons,1987.
2. Rath M. Davis & Robert M O Keefe, "Simulation Modeling with Pascal'. Prentice Hall

Course Outcomes (COs):

Students will be able to

1. Remember the significance and applications of various methods of Simulation. [PO1,PO2,PO3,PO4 & PO5]
2. Understand the difference between Experimentation & Simulation and the concepts of Verification & Validation of Simulation Models. [PO1,PO2,PO3,PO4 & PO5]

3. Apply the simulation concepts of Single and Two Channel Queue Systems appropriately to various problems in a production setup. [PO3,PO4 & PO5]
4. Analyze the Inventory Scenarios and propose necessary Event Scheduling solutions. [PO3,PO4 & PO5]
5. Evaluate the Reliability of machineries and processes in a production environment. [PO3,PO4 & PO5]

ERGONOMICS IN MANUFACTURING

Course Code: MCM E08 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr SRIDHAR B S

Preamble:

With change in technology different approaches of making design in industry and its comfortness have evolved. There are continuous studies on improvement of the product life by using various techniques. There are some standard methods of preparing the design approaches. And also there is a need to improve the methods of making human life more comfort. This course deals with the study of such advanced methods of design to serve the required purpose.

Course Objectives:

1. Students are initially made to know the concept of the subject Industrial Design and its creating ability.
2. Students will have the knowledge to study various methods of industrial design.
3. To analyze different processes/ terminologies of the various Control and display and its applications.
4. To obtain brief description of visual effects of line and form and **t**he mechanics of seeing.
5. The students will have the knowledge to improve aesthetic concepts of various products**.**

UNIT –I

Introduction:
An approach to industrial design, elements of industrial design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics And Industrial Design**:** Introduction, general approach to the man machine relationship, work station design, working position.

UNIT –II

Control And Display:
Shapes and Sizes of various controls and displays, multiple displays and control situation, design of major controls in automobiles, machine tools etc, design of furniture, design of instruments. Ergonomics and Production: Ergonomics and product design, ergonomics in automated systems expert systems for ergonomics, anthropomorphic data and its applications in ergonomic design, limitations of anthropomorphic data, use of computerized database.

UNIT –III

Visual Effect Of Line And Form

The mechanics of seeing, psychology of seeing, general influences of lined and form. Colour: Colour and Light, Colour and Objects, Colour and the eye, Colour consistency, Colour terms, reaction to colour and colour continuation, colour on engineering equipments.

UNIT –IV

Aesthetic Concepts

Concept of unity, Concept of order with variety, Concept of purpose style and environment, Aesthetic expressions. Style components of style, house style, observations style in capital goods.

UNIT –V

Industrial Design In Practice

General design, specifying design equipments, rating the importance of industrial design, Industrial design in the design process.

Text books:

1. Mayall W.H.” Industrial Design for Engineers” London Hliffee Books Ltd., 1988.

Reference Books:

1. Introduction to Ergonomics, R C Bridger, McGraw-Hill, Publications.
2. Brien Shakel” Applied Ergonomics Hand Book” Butter Worth Scientific, London1988.
3. Human Factors in Engineering Design, Mccormick.

Course Outcomes (COs):

Students will be able to

1. Understand the concept of the subject Industrial Design and its creating ability[PO1,PO2,PO3,PO4 & PO5]
2. Understand the various methods of industrial design[PO1,PO2,PO3,PO4 & PO5]
3. Analyze the different processes of various Control and applications. [PO1,PO2,PO3,PO4 & PO5]
4. Obtain brief description of visual effects of line and form and the mechanics of seeing. [PO1,PO2,PO3,PO4 & PO5]
5. Understand and improve aesthetic concepts of various products. [PO1,PO2,PO3,PO4 & PO5]

FEM FOR MANUFACTURING

Subject Code : MCM E09 / MSE E09 **Credits: 4:0:0**
Prerequisites : Nil
Course Coordinator: Dr P DINESH

Preamble

Finite Element Method is proving to be a very powerful technique of solving and analyzing complex engineering problems. It is a numerical method which yields fairly accurate results for complex engineering problems and of late has emerged as a very rapidly growing area of research for applied mathematics. Its usefulness in various branches of engineering is due to the ease with which the method is made amenable to computer programming, leading to a process of iterative design.
Its uniqueness lies in the fact that complex engineering problems having no analytical solutions can be solved with ease and iterative designs can be worked out.
Of late, this technique has found a lot of applications in the area of manufacturing as newer and specialized techniques and materials are being used with changing technology. In this context it is desirable to introduce the subject of FEM in the curriculum of PG courses related to manufacturing so as to train the students for developing skills for designing and analyzing the various manufacturing processes for an optimized process. The method can also be used in the development of machine tools, newer materials and failure analysis of processes.

Course Objectives

1. To introduce fundamentals of elasticity, plasticity and mechanics of metalworking.
2. To learn the fundamental concepts of variational methods and weighted residual methods, to solve problems of beams and bars and understand fundamentals of space and planar frames. and bending of thin plates.
3. To understand the fundamentals of heat transfer and dynamic problems and solve related problems.
4. To learn and understand the fundamentals of axisymmetric elements, shell elements and bending of thin plates and non linear FEM analysis.
5. To develop competence in solving real life engineering problems using commercial FE software.

UNIT -I

Elasticity fundamentals: State of stress and strain at a point, equations of equilibrium, compatibility conditions, elastic stress strain relations
Plasticity fundamentals: Material models, yield criteria, methods of analysis of mechanics of metal working processes.

UNIT –II

Review of fundamentals of FEM, variational and weighted residual methods, 1D Problems based on Rayleigh Ritz and Galerkin's methods. Analysis of beams and trusses Fundamentals of space and planar frame elements.(elementary treatment only)

UNIT – III

Straight fin analysis using linear and quadratic elements Hamilton's principle, derivation of mass matrices of bar and beam elements, deriving Eigen values and Eigen vectors for free vibrating bars.(elementary treatment only)

UNIT – IV

Axi-symmetric formulation for axi-symmetric loading, triangular element (simple problems).
Shell elements, forces on shell elements, types of elements and solid shell elements bending behaviour of thin plates.(elementary treatment only)

UNIT – V

Non linear FEM, nonlinear problems such as material non linearity, geometric nonlinearity and material and geometric non linearity, analysis procedures.

Text books:

1. Introduction to Finite Element in Engineering, RChandrupatla and Ashok Belegundu, Prentice Hall India Pub 2006.
2. The Finite Element Methods in Engineering – S.S. Rao, Butter Worth Heinemann, Pub 2005.
3. Hybrid Modelling and Optimization of Manufacturing, Quiza R et.al, Springer – Verlag Berlin Heidelberg, Pub. 2012
4. Finite Element Analysis, S.S.BhaviKatti, New Age International Publishers, 2015

Reference Books:

1. Finite Element Analysis Theory & Programming - C S Krishnamurthy – Tata McGraw Hill, Pub 2000.
2. The Finite Element Method – Zienkiewicz, O C-Tata McGraw Hill, Pub 1979.

Course Outcomes (COs):

The student will be able to:

1. Understand basics of theory of elasticity, plasticity and mechanics of metal working. [PO1,PO2,PO3,PO4 & PO5]
2. Understanding the variational and weighted residual methods and solve problems on bar, beams, trusses and have an understanding of planar and space frames. [PO1,PO2,PO3,PO4 & PO5]

3. Demonstrate ability and skill to solve problems of heat transfer and Dynamic problems. [PO1,PO2,PO3,PO4 & PO5]
4. Develop understanding of axi-symmetric, shell and thin plate elements and non linear FEM analysis. [PO1,PO2,PO3,PO4 & PO5]
5. Demonstrate the ability to solve real life 1D, 2D and 3D problems using commercial FE software. [PO1,PO2,PO3,PO4 & PO5]

NANOTECHNOLOGY

Course Code: MCM E10 / MCM E10 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr PRAKRATHI S

Preamble

The world of materials science is witnessing a revolution in the exploration of matter at the small scale. Sub-atomic particles have been a fascination since the first half of the 20th century. The science of nanometer scale objects is nanoscience. The resulting technology is called nanotechnology. Nanotechnology involves achieving the capability to manipulate matter in a desired fashion, atom by atom. At this scale, the constituents of matter do functions, which are different from those of the constituents or bulk materials. The course introduces the fundamental concepts, principles, fabrication, characterization and application of nanomaterials

Course Objective

At the end of this course, the student would be able to understand

1. The Physics & Chemistry of Nano Science
2. The Semiconductor Nanostructures
3. The method of Fabrications and characterization of Nanostructures
4. Nano Tribology
5. Nanomechanical properties

UNIT - I

Introduction: Overview of Nanoscience and Nanotechnology, Classification of nanostructures, Nanoscale Architecture, Scaling and miniaturization laws

Electronics Properties Of Atoms and Solids: The isolated atom - Bonding between atoms - LCAOs. - Van der Waals forces- Dispersion interaction - Orientation interaction _ Induction interaction, Stating Schrodinger's wave equation and its importance - Physical Significance of wave function - Eigen values and Eigen functions. The Free electron (particle) model and energy bands- particle in 1¬ D potential well of infinite height (discussion on energy values, wave functions - normalization and probability densities), Particle in 1- D potential well of finite height - Concept of tunneling- Heisenberg's uncertainty principle- Derivations of Density of states for 3D, 2D, I D and OD, and graphical representations.

Effects of Nanometer Length Scale: Changes to the system total energy, Changes to the system structure, Effect of nanoscale dimensions on properties- structural, thermal, Chemical, mechanical, magnetic, optical and electrical.

Inorganic Semiconductor Nanostructures: semiconductor, Doping, concept of effective mass, Carrier transport, mobility and electrical conductivity, Optical property of semiconductors, The P-N junction, Phonons, Types of semiconductors

Quantum Confinement in Semiconductor Nanostructures: Quantum confinement in one dimension- quantum well; Quantum confinement in two dimensions- quantum wires; Quantum confinement in three dimensions- quantum dots, Super lattices, Band offsets.

UNIT - II

Fullerenes: structure and synthesis, chemical reactivity-Chemistry of higher fullerenes-applications.
Nanotubes: carbon forms structured by energetic species-amorphous nanotubes and crystalline forms, Carbon- an ideal model system to study structuring by energetic species, structuring of amorphous carbon forms, structuring of ordered Sp2 forms, structuring carbon forms. Synthesis and purification of multiwalled and single walled carbon nanotubes: Electric arc (arc evaporation) technique, laser ablation, catalytic decomposition of hydrocarbons purification. Structure and properties of carbon nanotubes, Inorganic nanotubes- structure, synthesis and properties. Electron transport in nanotubes, Ballistic, Spintronics, Coulomb blockade and Nano wires, Organic semiconductors, Organic light emitting diodes.
Self-Organization: Phase behavior of Nano particle suspensions, hard sphere Behavior, soft repulsions, and weakly attractive suspensions.
Catalysis: Nano crystalline zeollites- Hydrothermal synthesis of nanocrystallinezeollites-application in environmental catalysis, selective partial oxidation reactions of hydrocarbons and photo catalytic decomposition of organic contaminations using nanocrystallinezeollites.
Nanoclusters- Properties and applications in catalysis.
Surface and Interface Chemistry: Colloid systems - Colloids theory of coagulation, micells, nanocrystals and their super lattices. Background of the measurement of surface forces and interface forces. Optical, thermal and magnetic properties of nanomaterials: Applications- Biosensors, Optical tweezers, Paints Laser materials, Membranes and mesoporous materials, Water Purification. Molecular motors, Nanospring, Nanobalance. Atomic manipulation - Quantum corrals, Quantum mirage.

UNIT - III

Fabrications of Nanostructures: Top-Down Processes-Milling; Silicon VLSI fabrication processes - Doping, Oxidation / Deposition, Etching; Lithographic processes - Photo, e-beam, Focused ion beam, X¬-ray: Soft Lithography; Machining - Micromachining, Micromachining, and LlGA. (MEMS processes); Applications- Nano- and Micro-machines (NEMS and MEMS) Nanotube FET, Interconnects and Electron emitters
Bottom - Up Processes: Vapor deposition methods - MBE, OMVPE; Hetrostructures, Quantum Wells, Multiple Quantum Wells; Quantum Wires and Quantum Dots; Modulation doping devices, Resonant Tunneling Devices;
QWIP, Quantum Well lasers, photonic crystals, Nano computing; Liquid Phase methods - molecular and biological computing; Colloidal methods; Sol-gel methods; Electrodeposition; Self-assembly and self-organization processes

UNIT - IV

Basics Of Scattering Physics Related to Characterization:
X-rays and their interaction with matter,Electron and their interaction with matter, Phonon scattering, Plasmon scattering, Single-electron excitation, Direct radiation losses, Neutrons and their interaction with matter, Ions and their interaction with matter. Elastic scattering and diffraction.

Technology of Characterization:
Profilometry, Optical microscope, SEM, TEM, FIB, STM, AFM, Surface Raman Scattering, Wettability (contact angle) measurements, Small angle X-ray diffraction and electron diffraction

UNIT - V

Nanotribology: Composition and structure of surfaces natural condition: oxide and hydrocarbon films surface segregation and reaction with environments, thermodynamics structure of surfaces, atomistic simulations methods to study composition and structure of surfaces composition -Auger electron spectroscopy, X - ray photoelectron spectroscopy
Structure-LEED,STM/AFM,XRD,HRE, Chemical interactions on surfaces, adsorption and deposition on surfaces (physisorption and chemisorption); Langmuir adsorption isothenn, desorption from surfaces: Electronic properties and surface reactions relevant to tribology, density functional studies analysis structure sensitivity lubricant degradation.
Nanomechanical properties: Determination of surface mechanical Properties (AFM/ nanoindentation), simple friction theories -effects of surface composition and structure: on friction environmental and temperature effects, relationship with surface chemistry, mixed and boundary lubrication, failure mechanisms.

Reference Books:

1. Handbook of Nanoscience Engineering and Technology, Ed. William A. Goddard III, Donald W.Brenner, Sergey EdwartLyschevski and Gerald J.Iafrate, CRC Press, New York (2003).
2. Microlithography Fundamentals in Semiconductor Devices and Fabrication Technology, by Ueno T., Ito T. and Nonogaki S., Marcel Dekker (1998).
3. Semiconductor Lithography: Principles, Practices and Materials, by William Moreau, Plenum Press (1988).
4. Sub-Half Micron Lithography for ULSI, Ed. by Matsui S., Ochiai Y., and Suzuki, K., Cambridge University Press (1999).
5. Nanolithography: A Borderland between STM, EB, IB and X-ray Lithographies, Ed. by Gentili M., Giovannella c., and Se1ci S., NA TO Asi Series E: Applied Sciences, vol. 264, Kluwer Academic Publishers (1994).
6. Solid State Physics, by G.I. Epifanov, Mir Publishers (1979).
7. Semiconductor Devices - Physics and Technology, by S.M. Sze, John Wiley & Sons (2003).
8. Introduction to Semiconductor Devices, by Kevin F. Brennan, Cambridge

University Press (2005).
9. The MEMS Handbook, by M.Gad-EI-Hak.
10. Nanoscale Science and Technology, Ed. by Robert Kelsall, lam Hamley and Mark Geoghegan, John Wiley & Sons (2005).
11. Fundamental of Machine Elements, by Hamrock, Jacobson and Schmid.
12. Tribology, Principles and Design Applications, by Amell et al.
13. Tribology Handbook, by B.Bhushan.
14. Principles and Applications ofTribology, by B. Bhushan. Fluid Film Lubrication, by Hamrock

Course Outcomes (COs):

At the end of this course, the student will have

1. The ability to appreciate the current trends in nanotechnology and critical evaluation of the technological potential of inorganic nanostructure materials. [PO2,PO3,PO4 & PO5]
2. Able to understand the physics and chemistry of Nanoscience [PO1,PO2,PO3,PO4 & PO5]
3. Gain knowledge of various fabrication processes and classification techniques for preparing nanostructures. [PO1,PO2,PO4 & PO5]
4. Gain knowledge of various nanoscale characterization tools and their use to characterize nanostructured materials. [PO1,PO2,PO3,PO4 & PO5]
5. To understand Nanotribology and Nano mechanical properties [PO1,PO2,PO3,PO4 & PO5]

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS IN MANUFACTURING

Subject Code: MCM E11 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr R KUMAR

Course Objective

1. Examine the different ways of approaching AI & example systems that use AI
2. Students should be able to understand and implement the forward & backward chaining reasoning algorithm
3. Students should understand the representing predicate logic and syntax and semantics for prepositional logic
4. Students should learn about different aspects of a statistics and probabilistic reasoning and expert systems.
5. Students will understand the examples of expert system and machine learning systems

UNIT -I

Artificial Intelligence: Introduction, definition, underlying assumption, importance of AI & AI related fields.
Space Representation: Defining a problem. Production systems and its characteristics, Search and Control strategies – Generate and Test, Hill Climbing, Best – first Search, Problem reduction, Constraint Satisfaction, Means – Ends Analysis.

UNIT -II

Knowledge Representation Issues: Representations and Mappings, Types of knowledge – Procedural Vs Declarative, Logic programming. Forward Vs Backward reasoning, matching.

UNIT -III

Use of Predicate Logic: Representing simple facts, Instance and Isa relationships, Syntax and Semantics for Prepositional logic, FOPL and properties of Wffs, Conversion to Clausal form, Resolution, Natural deduction.

UNIT -IV

Statistical And Probabilistic Reasoning: Symbolic reasoning under uncertainty, Probability and Bayes' theorem, Certainity factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic.

Expert Systems: Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition learning classification patterns, recognizing and understanding speech.Introduction to knowledge Acquisition, Types of Learning.

UNIT -V

Typical Expert Systems: MYCIN, Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF, ETC.
Introduction To Machine Learning: Perceptrons, Checker Playing Examples, Learning Automata, Genetic Algorithms, Intelligent Editors.

Text Books:

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 3rd Ed., M/H 1983.
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 1999.

Reference Books:

1. Principles of Artificial Intelligence, Springer Verlag, Berlin, 1981.
2. Artificial Intelligence in business, Science & Industry, Wendy B. Ranch 179
3. A guide to expert systems, Waterman, D.A., Addison – Wesley inc. 1986
4. Building expert systems, Hayes, Roth, Waterman, D.A. Addison – Wesley, 1983

Course Outcomes (COs):

Student will be able to

1. Understand the basics of artificial intelligence and its related fields. [PO1,PO2,PO3,PO4 & PO5]
2. Lear to apply the logics and knowledge for implementing the artificial intelligence. [PO1,PO2,PO3,PO4 & PO5]
3. Learn the various logics used and conversion to clausal form. [PO1,PO2,PO3,PO4 & PO5]
4. Understand the pattern recognition and learning classification of patterns. [PO1,PO2,PO3,PO4 & PO5]
5. Learn about different aspects of a learning system, concept of mycin, variants of mycin and prospector. [PO1,PO2,PO3,PO4 & PO5]

MACHINE TOOL DYNAMICS

Course Code: MCM E12 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr P DINESH

Preamble

Machine tools are essential elements of manufacturing activity. Engineers are always in quest of developing machine tools which result in products of highest accuracy and best surface finish. In this context it is desirable for engineers to have an understanding of principles of machine tool design and machine tool dynamics for the objectives of developing machine tools for producing components of high accuracy and surface finish. The need for such a subject in the curriculum of CIM is very apt and will give the students an opportunity to understand the principles behind the development of better machine tools.

Course Objectives:

1. To make student understand the principles of design of machine tool, speed and feed boxes.
2. To make student know the concepts associated with design of machine tool structure , materials used and design of structures based on strength and stiffness.
3. To make student understand the design of beds, columns, housings, bases and tables and materials used for the same.
4. To understand the principles of spindle design and air lubricated bearings.
5. To learn the principles of machine tool dynamics, effect of vibrations of machine tool and avoidance of chatter.

UNIT -I

Requirements for machine tool design, design process and layout, design of speed and feed boxes, hydraulic, mechanical and electrical step less regulation of speed and feeds (one example each)

UNIT -II

Design of machine tool structures, materials, dynamic and static stiffness, design of structures based on strength and stiffness.

UNIT -III

Design of beds, columns, housings, bases and tables, model techniques in design of structures, design of slideways - materials and design criteria.

UNIT -IV

Functions of spindle unit, requirements of spindle unit and materials for spindles, effect of compliance on accuracy, deflection of spindle axis due to spindle supports, spacing between spindle supports , air lubricated bearings for spindles.

UNIT -V

Machine tool vibrations, static stiffness, dynamic rigidity and stability, vibration types, causes of self excited vibrations, analysis of self excited vibration-cutting, vibratory and coupling of cutting and vibratory systems, instability analysis – limiting width of cut, avoidance of chatter and vibration, stick slip motion.

Text Books:

1. Machine Tool Design, N.K.Mehta,Tata McGraw Hill Pub. Co. Ltd, New Delhi,2009
2. Fundamentals of Metal cutting and Machine Tools, B.L.Junejaet., al., New Age International Pub. 2009.

Reference Books:

1. Principles of Machine Tools, Bhattacharya and Sen, New Central Book Agency, 2009.
2. Machine Tool Structures, Koenisberger and Tlusty, Pergamon Press, 1970.

Course Outcomes (COs):

1. Student will understand the principles of design of machine tool, speed and feed boxes. [PO1,PO2,PO3,PO4 & PO5]
2. Student will be able to apply the concepts associated with design of machine tool structure, materials used and design of structures based on strength and stiffness. [PO1,PO2,PO3,PO4 & PO5]
3. Student will have the skill to design beds, columns, housings, bases and tables of machine tools and learn about the materials used for the same. [PO1,PO2,PO3,PO4 & PO5]
4. Student will understand the principles of spindle design and air lubricated bearings. [PO1,PO2,PO3,PO4 & PO5]
5. Student will apply the principles of machine tool dynamics to study effect of vibrations of machine tool and chatter and their avoidance. [PO1,PO2,PO3,PO4 & PO5]

FLEXIBLE MANUFACTURING SYSTEMS

Course Code: MCM E13 **Credits: 4:0:0**
Prerequisites : Nil
Course Coordinator: Dr SRIDHAR B S

Preamble:

This subject helps the student to learn about the importance of Flexible Manufacturing system its configurations and different types of FMS layouts available for different industries. It also helps the student to learn multi-disciplinary concepts like, JIT, KANBAN, GT, DNC, Material handling systems, Retrieval systems, Sequencing, schedule and loading of the FMS systems. Finally the subject helps to understand and interpret technically and economically the use of FMS.

Course Objectives:

1. To know the differences between conventional and flexible manufacturing systems in manufacturing industries.
2. To learn the different types of automated material handling systems, design of conveyor and AGV and AS/RS systems.
3. To be able to understand the concepts of JIT, KANBAN and GT in a FMS system.
4. To learn the different types of scheduling and loading methods.
5. To know the tool management, economical and technological justification for FMS.

UNIT –I

FMS-An overview : Definition of FMS- Types and configurations concepts – types of flexibility and performance measures. Function of FMS host computer – FMS host and area controller function distribution, Development and implementation of an FMS: Planning phase – integration – system configuration – FMS layouts – Simulation – FMS project development steps.

UNIT –II

Automated material handling and storage systems: Functions – types – analysis of material handling equipments, design of conveyor and AGV systems, Problems, Automated storages: Storage system performance, AS/RS Carousel storage system. WIP storage system interfacing handling storage with manufacturing

UNIT –III

JIT, KANBAN and GT System: Introduction, Definition, JIT Concept, Goals of JIT, Quality and Quantity Principles of JIT, JIT Implementation. Kanban/Card System, Push vs. Pull System, Types of Kanban. Group Technology, Introduction, Reasons for Adopting Group Technology, Benefits, Obstacles to Application of GT.

UNIT –IV

Scheduling and loading of FMS: Introduction - Scheduling rules, Scheduling of operations on a single machine, 2 machine flow shop scheduling, 2 machine job shop scheduling, 3 machine flow shop scheduling, scheduling 'n' operations on 'm' machines, problems on loading of FMS.

Distributed Numerical Control (DNC): DNC system, general configuration and components of DNC system, different modes of DNC communication, Hierarchical processing of data in DNC

UNIT –V

Tool management of FMS: Tool management, tool strategies, Tool Preset, Identification and Data Transfer, Tool Monitoring and Fault Detection, Experimental Setup and Data Collection, Relational, economical and technological justification of FMS, typical case studies of FMS implementation.

Text books:

1. Parrish D J, Flexible manufacturing, Butterworth – Heinemann, Ltd Oxford, 1993
2. Groover M P, Automation, production system and computer integrated manufacturing, PHI, 1989
3. Kusiak A, Intelligent Manufacturing systems, prentice hall, Englewood Clitts, NJ, 1990
4. William W Luggen – Flexible Manufacturing Cells and systems, PH, NJ

Reference Books:

1. Considine D M and Considine G D, Standard handbook of industrial automation, Chupman and Hall, London, 1986
2. Vishwanatham N and Narahari Y, peroformance modeling of automated manufacturing Systems, PHI, 1992
3. Ranky P G, The design and operation of FMS, IFS publication, UK, 1988
4. Dr. H K Shivanand, "Flexible Manufacturing System" – Dhanpat Rai Publication, New Delhi.

Course Outcomes (COs):

The student will be able to;

1. Understand the concept of FMS and automation in conventional manufacturing system. [PO1,PO2,PO3,PO4 & PO5]
2. Synchronize the machineries with material handling and retrieval systems. [PO1,PO2,PO3,PO4 & PO5]

3. Able to apply concepts of JIT, KANBAN and GT in a FMS system. [PO1,PO2,PO3,PO4 & PO5]
4. Able to perform different types of scheduling and loading techniques in production system. [PO1,PO2,PO3,PO4 & PO5]
5. They will be finally able to economically and technically justify the application of FMS and tool management. [PO1,PO2,PO3,PO4 & PO5]

REVERSE ENGINEERING

Course Code: MCM E14 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr JAYACHRISTIYAN K G

Preamble:

With change in technology different approaches of making Re design of the products whose dimensions are unknown. There are continuous studies on improvement of the various methods for determining the dimensions with various scanning techniques, light imaging technique. There are some standard Benchmark systems for preparing the dimensions such as rapid prototyping. And also there is a need to improve the methods of making human life more comfort. This course deals with the study of such advanced methods of reverse engineering to serve the required purpose.

Course Objectives

1. The fundamental Theory behind RE.
2. Study the theory of RE hardware and software.
3. Study the industrial standards of RE & RP.
4. Understand the legal aspect of RE.
5. Application of the RE in Engineering & Medical field.

UNIT - I

Introduction: Fundamentals of RE, Generic Process, Phase - 1: Scanning, contact scanner and non contact scanner, Phase- 2: Point Processing, Phase - 3: Application of Geometric Model Development, Technique for RE: Potential use of 3D laser scanner, Computer Aided Reverse Engineering, Computer Aided Forward Engineering, Comparisons. Coordinate measuring machine, Active Illumination 3-D Stereo, Benefits and Drawbacks. Reinvention of Engineering Marvels from Nature , Reverse Engineering in Modern Industries , Reverse Engineering vs. Machine Design, Analysis and Verification **Structure Light Range Imaging:** Source Illumination Categories, sheet- of - light Range Imaging, Scanner pipe line - Data collection, Mesh Reconstruction, Surface Fitting.

UNIT - II

RE Hardware and Software: RE Hardware- Contact, Non Contact & Destructive Methods, RE Software - Classification, different Phase & Engineering Equipment.
RE Selection System: Selection Process, team formation, Business and technical requirements, vendor assessment, benchmarking perform commercial evaluation. Capture devices, contact device, touch trigger continuous analogue scanning probe. Triangulation approach, time of flight, structured - light and stereoscopic Imaging system, Light based approach. Tracking and Internal Measurement System: Accuracy issues, post processing captured data, handling point, curve and surface creation,

inspection application, Surface and Solid Model Reconstruction, Dimensional Measurement.

UNIT -III

Additive Prototyping Technologies, Subtractive Prototyping Processes, Rapid Injection Molding, Steps of Geometric Modeling.
RE vs RP : Modelling cloud data in reverse engineering, data processing in rapid prototyping, integrating RE and RP in layer based model generation, adaptive slicing approach for cloud data modeling. curve construction process, adaptive layer thickness

UNIT -IV

Legal Aspects of RE, Copyright Law, Resent Case Law, Fair use Statutory defense**,** Legality of Reverse Engineering, Legal Definition of Reverse Engineering, Legal Precedents on Reverse Engineering, Patent, Copyrights, Copyright Codes, Legal Precedents on Copyrights, Trade Secret, Case Study of Reverse Engineering a Trade Secret , Third-Party Materials **Barriers to adopt RE,** The research model, Research methodology, Factor analysis Approach
Reconstruction approach, Experimental reconstruction of environmental point data, Dimensional tolerancing in reverse engineering, Geometrical tolerancing in reverse engineering, Cost - effective RE-tolerance assignment, Shape engineering, Engineering software evaluations, Parametric solid modeling. Solid model export, Design for manufacturing and assembly by RE, Integration of RE with DFMA,

UNIT -V

Application : RE in Automotive Industry, work flow for Automotive body design, RE in Aerospace Industry, Reducing the cost of hard Tooling, Digitizing NASA Space Vehicle, RE in Medical Device Industry, Reverse engineering transcriptional regulatory modules, case Studies, RE of Hearing instruments, dentistry, knee replacement technique, orthodontics etc..

Text Books:

1. Reverse Engineering: An Industrial Perspective by Vinesh Raja, Kiran J. Fernandes, Springer: 1 Edition (December 2007).
2. Reverse Engineering – Recent Advances And Applications, Alexandru C. Telea, Danijela Duric 2012.

Reference Books:

1. Reverse Engineering Technology Of Reinvention by WEGO WANG, CRC Press Taylor & Francis Group, 2010.
2. Paul F. Jacobs: "Stereo Lithography and other RP&M Technology" SME, NY, 1996.
3. CAD/CAM principles and applications by P.N. Rao, Tata MC Graw Hill 2002

Course Outcomes (COs):

The student should be able to

1. Understanding the concept of Reverse Engineering. [PO1,PO2,PO3,PO4 & PO5]
2. Learn the theory behind the hardware and software of Reverse Engineering. [PO1,PO2,PO3,PO4 & PO5]
3. Learn the process of additive manufacturing and its implementation in RE[PO1,PO2,PO3,PO4 & PO5]
4. Understand the legal aspects of RE[PO1,PO2,PO3,PO4 & PO5]
5. Apply the knowledge of RE in Engineering and Medical disciplines. [PO1,PO2,PO3,PO4 & PO5]

COMPUTER AIDED PROCESS PLANNING

Course Code: MCM E15 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Mr BHARATH M R

Preamble:

Process Planning has been a major part of decision making in all the industries for continuous growth. Over the years process planning has evolved into computer aided process planning which helps in reducing overall lead time of the system. It provides the system with a systematic planning strategy for getting optimal outcomes.

Course Objective:

1. The aim of the course is to provide the students, with an opportunity to conceive, design, and implement products quickly and effectively, using the latest techniques involved in planning
2. It will help in bridging the gap between CAD/CAM and Concurrent Engineering.
3. The students will be exposed to skill of quick decision making.
4. The subject helps the students to be familiar with the GT coding concepts.
5. The students learn various concepts of part design representation and tolerance and Students will be exposed to various advanced planning software's being used in the industries.

UNIT – I

Introduction: Process Planning,
Approaches to process planning - Study of a typical process planning - role of process planning in CAD / CAM Integration-Concurrent Engineering, Part design Representation: Tolerance concepts - Geometric Tolerance

UNIT – II

Drafting Practices in Dimensioning and Tolerancing
Geometric Transformation - Data Structure - GT coding, DCLASS, OPITZ system, MICLASS system

UNIT – III

Process Planning:
Decision tables and Decision Trees - Process Planning, Variant Process Planning, Generative Process planning – AI, Geometric modelling for Process Planning - Process Capability Analysis

UNIT – IV

Computer Aided Process Planning Systems:
Logical Design of Process Planning - Manufacturing System component, Production Volume, Production families - CAM I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP, Genetic Algorithm and Integrated Process Planning systems

UNIT – V

Genetic algorithm in CAPP
Practical use of CAPP in real Manufacturing area, Expert systems, Fuzzy Logic in Process Planning, totally integrated process planning and Case study

Text Books:

1. Rao, 'Computer Aided Manufacturing', Tata McGraw Hill Publishing Company, 2000
2. Nanua Singh, 'Systems approach to Computer Integrated Design and Manufacturing', John Wiley & sons, 1996

Reference Books:

1. Gideon Halevi and Roland. D. Weill, 'Principles of Process Planning, A logical approach', Chapman & Hall 1995
2. Tien - Chien Chang, Richard. A. Wysk, 'An introduction to Automated process planning system', Prentice Hall, 1985.

Course Outcomes (COs):

The student should be able to

1. Recognize and reproduce the concepts of CAPP. [PO1,PO2,PO4 & PO5]
2. Classify and summarize CAPP techniques for specific applications. [PO1,PO2,PO4 & PO5]
3. Apply and administer advanced planning software. [PO1,PO2,PO4 & PO5]
4. Breakdown and appraise stages of development in CAPP technology. [PO1,PO2,PO4 & PO5]
5. Reframe and conclude concepts of practical implementation of GT and coding. [PO1,PO2,PO4 & PO5]