RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2022 – 2023

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

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.

About the 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 43 teaching staff. All the faculty members are well qualified and possess post graduate degree with 29 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 11 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 Rs1,20,000 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

MSRIT 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 M S 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

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, create R&D environment, to be a centre of excellence and to offer post graduate programs in the emerging fields of 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)

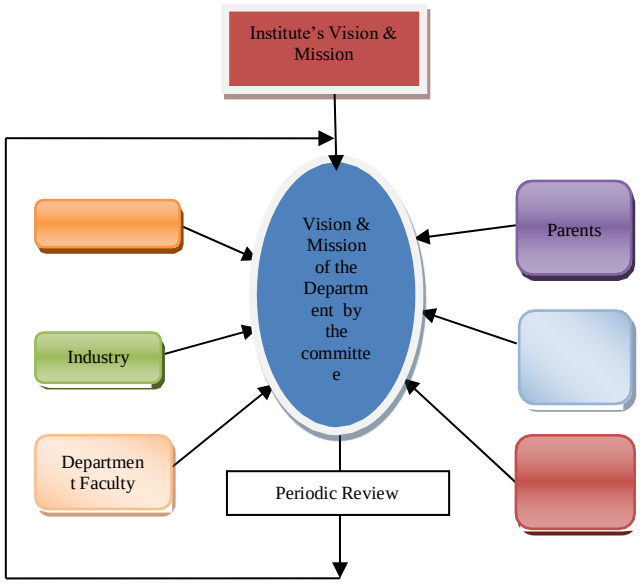

Fig1. Block Diagram – Deriving the Vision & Mission of the department

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

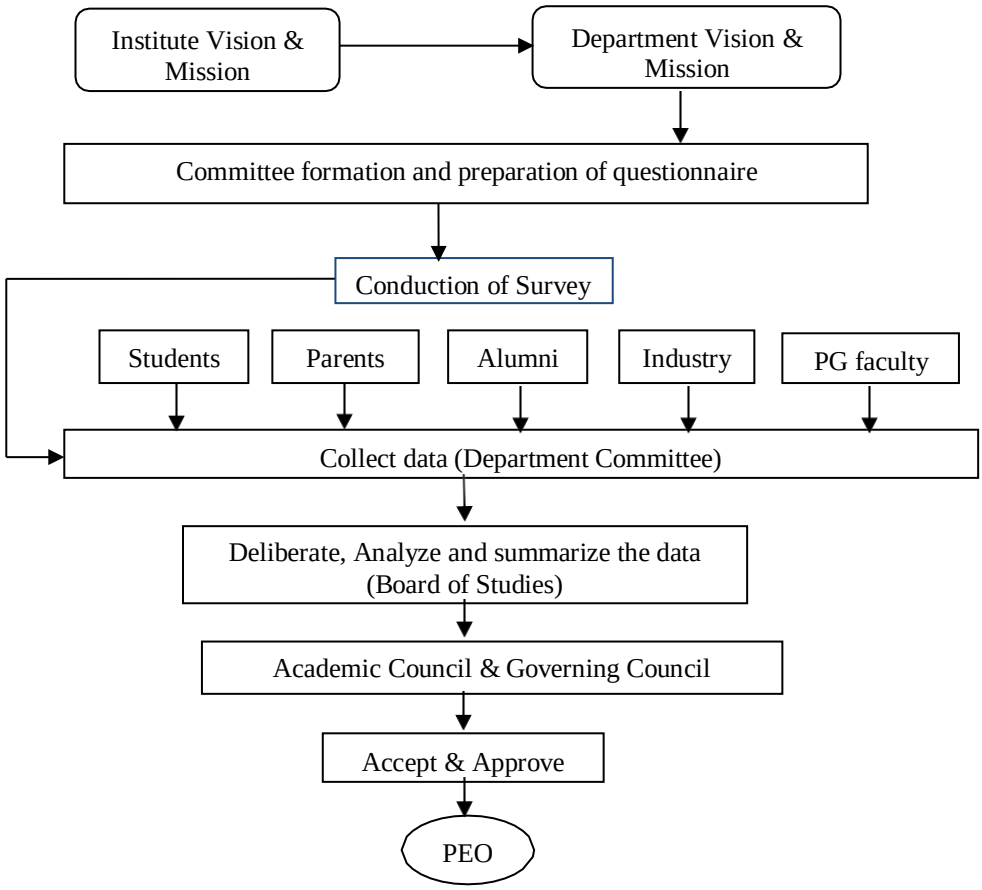

Fig 2 : Process employed for deriving the PEO's of the department

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

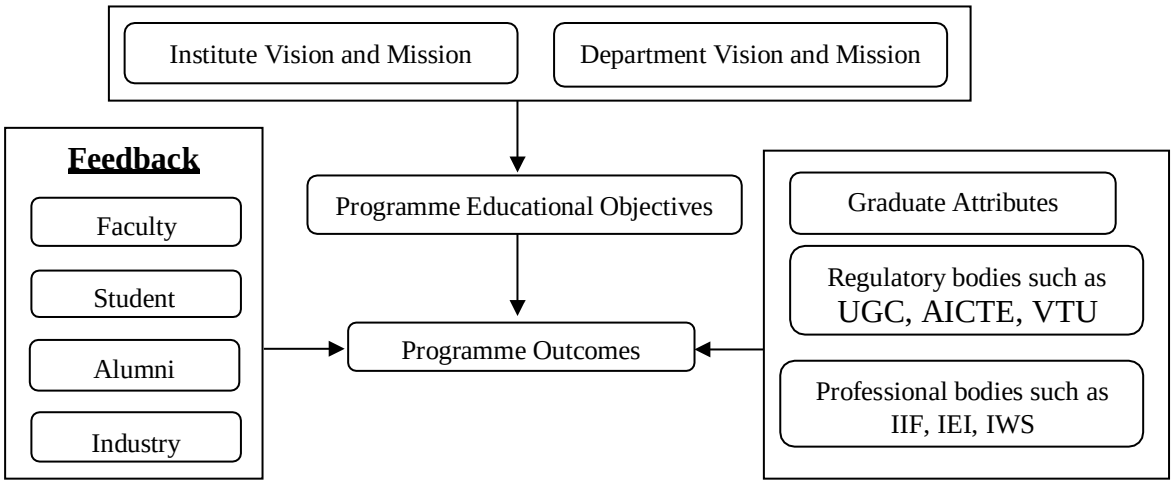

Fig 3: Process employed for deriving PO's

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	Experimental Methods and Mathematical Modelling	Mechanical Engineering	3	1	0	**4**
2	MCM 12	CNC Systems and Programming		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 L11	Design of Experiment Laboratory		0	0	1	**1**
7	MCM L12	CAD/CAM Laboratory		0	0	1	**1**
8	MCM 13	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	Automation and Production Systems	Mechanical Engineering	4	0	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 L21	Automation & Simulation Laboratory		0	0	1	**1**
7	MCM L22	Industrial Robotics Laboratory		0	0	1	**1**
8	MCM 23	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	Flexible 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.	Course Code	Course	Credits			
			L	T	P	Total
1	MCM E01	Advanced Management Techniques in Manufacturing	4	0	0	4
2	MCM E02	Advanced Material Technology	3	0	1	4
3	MCM E03	Additive Manufacturing	4	0	0	4
4	MCM E04	Simulation and Modelling of Manufacturing Systems	4	0	0	4
5	MCM E05	Industrial Process Automation	4	0	0	4
6	MCM E06	FEM For Manufacturing	3	0	1	4
7	MCM E07	Mechatronics and MEMS	3	0	1	4
8	MCM E08	Machine Learning and Python	4	0	0	4
9	MCM E09	Computer Aided Design	4	0	0	4
10	MCM E10	Supply Chain Management and Enterprise Resource Planning	4	0	0	4
11	MCM E11	Internet of Things for manufacturing	4	0	0	4
12	MCM E12	Artificial Intelligence for CIM	4	0	0	4
13	MCM E13	Reverse Engineering	4	0	0	4
14	MCM E14	Computer Aided Process Planning	4	0	0	4
15	MCM E15	Industry 4.0	4	0	0	4

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

EXPERIMENTAL METHODS AND MATHEMATICAL MODELLING

Subject Code: MCM 11 **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 Learning 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 of 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]

CNC SYSTEMS AND PROGRAMMING

Subject Code: MCM 12 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Dr LOKESHA

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 Learning Objectives:

1. To impart the basic concepts in manufacturing systems and fundamentals of NC & CNC system.
2. To create awareness in CNC system design and CNC construction features.
3. To make the students to understand the basic concepts of hardware and software component of CNC system.
4. To make the students to develop the CNC part program for turning and milling operations.
5. To impart the concepts of CNC systems in non-traditional machining process and the role of adaptive control systems in CNC systems.

UNIT I

Introduction: Introduction to CAD/CAM integration, CAM and its historical development, Fundamentals of numerical control, classification of N.C systems, CNC concepts, the digital computer, reference pulse technique, sample data technique, microprocessor in CNC systems. Advantages and limitations of CNC systems. DNC concepts. Factors to be considered for selecting machine tool.

Features of CNC Machine tools: Design consideration of CNC machine tools, guide ways, Friction, Anti friction and other types of guide ways. Elements used to convert the rotary

motion to a linear motion Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, and spindle assembly. Torque transmission elements, gears, timing belts, flexible couplings, Bearings, Spindle drives and feed drives

UNIT II

Increasing productivity with CNC machines: CNC Machine tool and machining centre, Cutting tool materials, HSS, Carbides, Ceramics, CBN, PCD, cutting tool inserts, qualified, semi qualified and preset tooling. Tool holding systems for CNC machining centers, automatic tool changers. Work holding devices for CNC machining centers, vices, pallets, indexing devices, automatic pallet changer, robots for loading jobs & material handling, hydraulic and pneumatic Fixtures, anti-vibration boring bars. Shrink Fit Adaptors for Drills and Reamers. Automatic swarf removal system.

System devices: Drives – Hydraulic system, Stepper motor, Servo motor, DC and AC motors, Feedback devices – Encoders, Resolvers, Inductosyn, Counting devices – Flip-Flops, Counters, decoder, Digital to Analog converters – Weighted resistor network, resistor ladder network. Interpolators – DDA integrator, DD hardware interpolator, CNC software interpolator, reference word CNC interpolator.

UNIT III

CNC part programming for turning: Introduction, selection of cutting tool, work holding device, process parameters. Tool offset, work offset, machine reference, tool path, Coordinate system, G and M codes, CNC part program including – facing, turning, countering, drilling, grooving, thread cutting, tapping, reaming, boring. Introduction to commercial CNC part programming software and CAD compatibility, basic steps followed to generate CNC program from a CAD file.

UNIT IV

CNC part programming for milling: Introduction, selection of cutting tool, work holding device, process parameters. Tool offset, work offset, machine reference, tool path, Coordinate system, G and M codes, CNC part program including – facing, pocket milling, countering, drilling, boring, reaming, thread cutting, tapping, sub program. Introduction to commercial CNC part programming software and CAD compatibility. Introduction to APT programming – geometric and motion statements

UNIT V

Control loop systems: Introduction, control of point to point System, control of contouring systems.

Adaptive control systems: Introduction, adaptive control with optimization Adaptive control with constraints, variable gains AC systems, adaptive control of grinding, cost analysis in machining.

CNC concepts: DNC Systems, Machining Cell, Flexible manufacturing systems, introduction to the CNC concepts in non-traditional machining process.

TEXT BOOKS:

1. Martin J. Numerical control of machine tools
2. Yoram .Koren "Computer Controls of Manufacturing Systems" McGrawHill 1983
3. James V. Valentino and Joseph Goldenberg, Introduction to Computer Numerical Control, 5th Edition, Prentice Hall, Engle wood Cliff, New Jersey, 2012.
4. David Gibbs and Thomas Crandall, CNC Machining and Programming: An Introduction, Industrial Press Inc., 2003.

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.
4. Chang, T. C., Wysk, R.A. and Wang, H.P., "Computer Aided Manufacturing", Pearson Prentice Hall, 2009.
5. Jones, B.L., "Introduction to Computer Numerical Control", Pitman, London, 1987.
6. "Mechatronics", HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

Course Outcomes (COs):

Student will be able to

1. Understand the fundamental concepts, design and features of CNC systems. [PO1, PO2, PO3, PO4 & PO5]
2. Understand the basic concepts of adaptive control systems in CNC systems. [PO1, PO2, PO3, PO4 & PO5]
3. Analyze CNC machining process and process parameters (feed, speed, depth of cut, cutting tools, work holding devices, etc.) for the given product. [PO1, PO2, PO3, PO4 & PO5]
4. Evaluate for optimal process. [PO1, PO2, PO3, PO4 & PO5]
5. Create the CNC part program involving turning and milling operations. [PO1, PO2, PO3, PO4 & PO5]

DESIGN OF EXPERIMENTS LABORATORY

Course code: MCM L11 **Credits: 0:0:1**
Prerequisites: To have completed/registered for MCM11
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 Learning 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 and B using the software.
The basic data sets shall be taken from appropriate journal papers.

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]

CAD / CAM LABORATORY

Course Code : MCM L12 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Dr R KUMAR

Course Learning 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]

TECHNICAL SEMINAR 1

Course Code : MCM 13 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Dr LOKESHA

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 Learning Objectives:

This course helps the students

1. To identify 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 two 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]

AUTOMATION AND PRODUCTION SYSTEMS

Course Code: MCM 21 **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 automation, sensors, PLCs 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 and production systems.

Course Learning Objective:

1. The aim of course is to make the student to understand the concept of automation in production system, levels and strategies of automation, concepts of production and mathematical models
2. To enable the student in understanding the basic elements of automation, sensors, actuators and other control system components for discrete data handling
3. To enable a student to develop ladder logic diagrams and PLC programming for industrial automation applications and understand the concept of material handling and transportation system.
4. To enable the student to understand the concept of storage system and its location strategies, conventional and automated storage systems and analysis of storage system.
5. To enable the student to learn and understand FMS and Automated System Assembly

UNIT I

Introduction: Production System Facilities, Manufacturing Support Systems, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles and Strategies, Ten Strategies for Automation and Production Systems, Basic Elements of Automated System, Advanced Automation Functions, Levels of Automation. Production concepts and mathematical models

UNIT II

Basic Elements of an Automated System: Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer process control Forms of Computer Process Control.

Sensors, Actuators, and Other Control System Components: Sensors, Actuators, Analog-to-Digital Conversion, Digital-to-Analog Conversion, Input / Output Devices for Discrete Data.

UNIT III

Discrete Control Using Programmable Logic Controllers and Personal Computers: Discrete Process Control, Ladder Logic Diagrams, Programmable Logic Controller, Personal Computers Using Soft Logic.

Material Handling and Transportation System: Overview Material Handling Equipment, Considerations in Material Handling System Design, Principles of Material Handling, Industrial Trucks, Automated Guided Vehicle Systems, Monorails and Other Rail Guided Vehicles, IDA Conveyors Systems, Crane and Hoists, Analysis of Material Transport Systems.

UNIT IV

Storage Systems: Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated storage systems, Engineering Analysis of Storage System.

UNIT V

FMS and Automated System Assembly: Introduction to FMS, FMS Components, FMS Applications and Benefits, FMS Planning and Implementation Issues, Quantitative Analysis of Flexible Manufacturing Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, Quantitative Analysis of Assembly Systems.

REFERENCE BOOKS

1. David J Parrish ―Flexible manufacturing, Butterworth-Heinemann Publisher, 1990 ISBN: 9780750610117
2. Mikell P Groover ―Automation, Production Systems and Computer Integrated Manufacturing‖, Prentice Hall India (P) Ltd, 2008 ISBN: 9780132393218
3. William W. Luggen ―Flexible Manufacturing Cells & Systems‖ Prentice hall, 2006, ISBN: 9780133217384
4. H.K. Shivanand, M.M. Benal, V. Koti - New Age International Publisher (2006), **ISBN- :** 978-8122418705

Course Outcomes (COs):

1. Identification, Classification of different Automation types in Production System and application of production concepts using mathematical models. [PO1, PO2, PO3, PO4 & PO5]
2. Analyze the concepts of Automation with respect to Process Industries and Discrete Manufacturing Industries. [PO1, PO2, PO3, PO4 & PO5]
3. Apply the concepts of mathematical models in material handling, Automation System and discrete control using PLCs. [PO1, PO2, PO3, PO4 & PO5]
4. Apply the concepts of mathematical models in automated storage systems. [PO1, PO2, PO3, PO4 & PO5]
5. Evaluate the techniques involved in FMS and automated assembly systems. [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 Learning 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, Definition, Classification, History, Components, DoF, Accuracy, Repeatability, Precision, Joints, Coordinates, Reference Frames, Robot Motions, Joint Notation Schemes, Workspace, Characteristics, Robot Terminologies, Robot System Integration process for Industrial Robot.

UNIT II

Physical configurations: Work volumes of an Industrial robot the wrist and its motions, Grippers and types, Robot Motion and Analysis. 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- Six Axis Robot Manipulators

UNIT III

Industrial Application of Robotics: Robots in Industry – Pick and Place, Spray Coating, Assembly, Inspection. Robots in Handling – Machine Loading and Unloading, Material Transfer, Palletizing, Welding, Robot Compliance, Assembly Applications, Applications of Cobots, Applications in Construction

Medical Applications: Da Vinci Surgical Robots, Rehabilitation Robot, Bio Robots, Telepresence Robots.

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 Steerability, Robot maneuverability.

UNIT V

Mobile Robot Planning and Navigation: Introduction, Competences for Navigation Planning and Reacting, Path Planning, Obstacle avoidance, Navigation architectures-Modularity – Modularity code reuse and sharing, Control localization, Techniques for decomposition.

Programming Languages: Introduction, Levels of Programming Languages, and Introduction to VAL, RAIL and AML languages. Example of programming by VAL II, FANUC Robot program and syntax.

TEXT BOOKS:

1. M P Groover "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.
4. Introduction to Autonomous Mobile Robots – Roland, Illah, MIT Press, ISBN – 0-262-19502 – x
5. Saeed B. Niku, "Introduction to Robotics analysis, Systems & Applications", Pearson Education Singapore P. Ltd., 2002.

REFERENCE BOOKS:

1. Robotics by Fu and Lee, Tata McGraw-Hill Education, 1987
2. Walking machines- An introduction to Legged Robots by D J Todd.

Course Outcome (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 L21 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Mr. NANDHEESH H L

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 Learning 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.

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]

INDUSTRIAL ROBOTICS LABORATORY

Course Code: MCM L22 **Credits: 0:0:1**
Prerequisites: Industrial Robotics
Course Coordinator: Dr. SUNITH BABU L

Preamble:

Robotics has been identified as one of the thrust areas of engineering and many institutes have introduced the course as an integral part of the curriculum. The skill sets related to system integration and programming of robot becomes increasingly important for a student gain better employability in the market. This lab course provides the essential part of robot programming and handling using FANUC robot.

Course Learning Objective:

1) Design and Simulate a Robot Work cell using Robot Software
2) Develop skill sets in programming and control of a Material Handling Industrial Robot
3) Manipulate Joint, World, Tool and User coordinate system of robot using Teach Pendant

PART – A
(RoboGuide - Software)

- Robot Selection and Work cell creation
- System Integration for Material Handling for Pick and Place
- Programming of robot using Teach Pendant
- Gripper Movement using Linear and Circular Path

PART – B
(Fanuc – M10iD/12 Material Handling Robot)

- Control of Robot using Teach Pendant
- Application of Vacuum Gripper
- Application of Magnetic Gripper
- Application of Two Jaw and Three Jaw Gripper for ID and OD application

Reference:

1) Help Manual of RoboGuide V9.0

Scheme of Examination – Exam Marks: 50 Duration 3 Hours
Students per Batch in Examination – FIVE ONLY

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

Course Outcomes (COs):

Student will be able to:

1. Create a Robotic Work cell using Robot Software. [PO1, PO2, PO3, PO4 & PO5]
2. Generate Robot Programs for a material handling application using Teach Pendant Robot. [PO1, PO2, PO3, PO4 & PO5]
3. Develop Path Planning Sequence of End of Arm Tooling for a given application. [PO1, PO2, PO3, PO4 & PO5]

TECHNICAL SEMINAR 2

Course Code : MCM 23 **Credits: 0:0:1**
Prerequisites : Nil
Course Coordinator: Dr. LOKESHA

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 Learning 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 two 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]

FLEXIBLE MANUFACTURING SYSTEMS

Course Code: MCM 31 **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 Learning 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. H K Shivanand,Dr M M Benal, V koti "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]

INTERNSHIP/INDUSTRIAL TRAINING

Course Code : MCM 32 **Credits: 0:0:4**
Prerequisites : Nil
Course Coordinator: Dr. SUNITH BABU L & Dr JAYACHRISTIYAN K G

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 Learning 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
Course Coordinator: Dr. SRIDHAR B S

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 Learning 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
Course Coordinator: Dr. SRIDHAR B S & Dr SUNITH BABU L

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 Learning 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
Course Coordinator: Dr. JAYACHRISTIYAN K G

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 Learning 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 COURSE

ADVANCED MANAGEMENT TECHNIQUES IN MANUFACTURING

Course Code: 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 Learning 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 tools

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 MATERIAL TECHNOLOGY

Course Code: MCM E02 **Credits: 3:0:1**
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 Learning 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, 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.

Macro mechanical analysis of lamina. Introduction, review of definitions, Hookes Law of different types of materials. Hookes law for two dimensional unidirectional lamina, Invariant form of stiffness and compliance matrices for an angular laminate.

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.

Laboratory Component:

Melting and pouring of metals, Metallographic study, Tensile test, Micro hardness test, Vickers hardness test, Airjet erosion test, Wear test, Impact test, Corrosion test, Density measurement.

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 Outcome (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,PO3,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]

ADDITIVE MANUFACTURING

Course Code: MCM E03 **Credits: 4:0:0**
Prerequisites: Nil Course
Course Coordinator: Dr. JAYACHRISTIYAN 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 Learning 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 Additive Manufacturing methods and CAD/CAM technology
2. The students will be exposed to the development of AM Technology 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 Design process parameters associated with Additive manufacturing technique
5. Selectively choose tooling techniques for a specific application

UNIT I

Additive Manufacturing, The Generic AM Process, AM Information work flow, AM – An Integral part of Time compression Engineering, The Benefits of AM, Distinction Between AM and CNC Machining.

Reverse Engineering Technology: Introduction, Reverse Engineering Hardware, Contact methods, Non contact Methods, Reverse Engineering Software.

Classification of AM Processes: Liquid Polymer Systems, Discrete Particle Systems, Molten Material Systems, Solid Sheet Systems, New AM Classification Schemes, Metal Systems, Hybrid Systems

UNIT II

Vat Photo polymerization Processes: Introduction, Vat Photo polymerization Materials, Photo polymerization Process, **Powder Bed Fusion Processes**: Introduction, Materials, Powder Fusion Mechanisms, Process Parameters and Modeling, Polymer Laser Sintering, **Extrusion-Based Systems**: Introduction, Basic Principles, Fused Deposition Modeling from Stratasys, Materials, Limitations of FDM, Bio extrusion,

Software Issues for Additive Manufacturing: Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist AM.

UNIT III

Beam Deposition Processes: Material Delivery, Process Parameters, Typical Materials, **Direct Write Technologies**: Ink-Based DW, Laser Transfer DW., Thermal Spray DW, Beam Deposition DW., Liquid-Phase Direct Deposition, Beam Tracing Approaches to Additive/Subtractive DW., Hybrid Technologies,

Design for Additive Manufacturing: Design for Manufacturing and Assembly, Core DFAM Concepts and Objectives, AM Unique Capabilities, Exploring Design Freedoms, Design Tools for AM

UNIT IV

Direct Laser Cladding of AM: Fundamentals of Direct Laser Cladding., Fundamentals of the Laser Cladding Process, Material Aspects of Laser Cladding, Future Trends for Laser Cladding., Laser-Based Joining of Metallic and Non-Metallic Materials.

Laser-Based Joining of Metallic and Non-Metallic Materials: Lasers and System Technology for Welding, Laser Welding Parameters, Laser Welding of Different Materials, Limitations of Laser Welding., Laser Welding Process Control Tools, Innovations in Laser Welding,

UNIT V

Directed Energy Deposition Processes: Introduction, Material Delivery, Powder Feeding, Wire Feeding, Laser Based Metal Deposition Processes; Electron Beam Based Metal Deposition Processes. **Laser Rapid Manufacturing:** Laser Rapid Manufacturing of Low-Cost Tools, Laser Rapid Manufacturing of Porous Materials., Laser Rapid Manufacturing of Bimetallic Components, Laser Surface Melting Treatment for Enhanced, Fundamental Aspects of Laser Material Processing., Polymer Materials, Joining with Laser Beams

TEXT BOOKS:

1. Additive Manufacturing Technologies, I. Gibson l D. W. Rosen l B. Stucker, Springer New York Heidelberg Dordrecht London, 2010.
2. Stereo lithography and other RP & M Technologies, Paul F.Jacobs: “SME, NY 1996.
3. Rapid manufacturing, Fiham D.T & Dinjoy S.S Verlog London 2001.

4. Rapid Prototyping: Principles and Application…(Hardcover) by Rafiq I. Noorani
5. Laser-Induced Materials And Processes For Rapid Prototyping, L.Lii, J. Y. H. Fuh, y.s. Wong, Kluwer Academic Pub1ishers in 2001.

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 will learn about a working principle and construction of Additive Manufacturing technologies [PO1,PO2,PO3,PO4 & PO5]
2. The students will potential to support design and manufacturing, modern development in additive manufacturing process [PO1,PO3,PO4 & PO5]
3. The student can assess and implement AM techniques for specific application leading to better ROI for the company that uses Laser AM 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 AM technology.[PO1,PO2,PO3,PO4 & PO5]

SIMULATION AND MODELING OF MANUFACTURING SYSTEMS

Course Code: MCM E04 **Credits:4:0:0**
Prerequisites: Nil
Course Coordinator: Dr. HEMAVATHY 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 Learning 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, ValidatingInput-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]

INDUSTRIAL PROCESS AUTOMATION

Course Code: MCM E05 **Credits:4:0:0**
Prerequisites: Nil
Course Coordinator: Dr. HEMAVATHY S

Preamble:

The aim of this course is provide the knowledge of automation components, tools, machine to machine communication, internet of things involved in industrial automation. Industrial process automation runs and controls the production process. One can hardly think of an industry or production line sans automation. As manufacturers face growing demands for high quality, consistency and competitive pricing, they turn increasingly towards new manufacturing techniques and the use of automation technologies. Industrial process automation enables better product quality and production rate while reducing production costs.

Course Learning Objectives

1. Recognize the need for process automation and automation strategy.
2. To impart the role of PLC in Industry automation.
3. To expose various Industrial networks employed in process automation.
4. To impart the knowledge of safety management and risk analysis
5. Formulate the Automation related business in terms of design aspects.

UNIT I

Industrial Process Automation:

Need for process automation - generic duties of an automation system, Concepts of process Automation in automotive, food/beverage, oil/gas and chemical industries.

Automation strategy: Physical architecture of an automation system- Plant wide control systems, Process control systems-Continuous and batch process-feedback control system overview.

UNIT II

Automation system control strategies & DCS

Modes of computer control, DCS- Introduction, Architecture and components, Controllers and Functional features.

SCADA: Introduction, Architecture and components, Controllers and functional features, RTU technology, Interfacing PLC to SCADA/DCS.

UNIT III

Industrial Communication Infrastructure

Serial communication standards - RS232/422/485 - ModBUS. Industrial networks - HART – Device Net - ProfiBUS and FieldBUS communication.

Operator consoles and interfaces: HMI Basics, Types, Applications of Human Machine Interface - HMI Processing -Interaction styles and general design interaction - strategies interface metaphors and conceptual models HCI and the World Wide Web HCI - security accessibility of user interfaces, evaluation HCI and socialcomputing.

UNIT IV

Functional safety and safety Instrumented systems

Introduction,Safety Functions and Safety-Related Systems, Legislation and Standards- Scope, Safety Life Cycle, Risk and Its Analysis and Reduction, Safety Integrity Level, Functional Safety Management.

Risk analysis techniques: Concepts Of Residual Risk, Risk Reduction, And Required SIL, Quantitative Risk Analysis, Risk Graph Methods, SIL Evaluation, Safety Requirement Specifications-Introduction, General Requirements.

UNIT V

Industrial and Factory Business Systems:

Automation-Related Businesses, Departments and Functions, Lean Manufacturing, Systemization, machine and system design- requirements, quoting, procurement, design and fabrication, start-up and debug, Installation, and support.

Case Studies: Case studies on applications of automation systems in different industrial processes.

TEXT BOOKS:

1. B. R. Mehta and Y. J. Reddy, Industrial Process Automation Systems Design and Implementation, Elsevier Inc. 2015.
2. Frank Lamb, Industrial Automation: Hands On, McGraw-Hill Professional, 2013.
3. S.K. Singh, "Industrial Instrumentation and control" – The McGraw Hill companies 3rd edition – 2009

REFERENCE BOOKS

1. K.L.Sharma, Overview of Industrial Process Automation, Elsevier, 2011
2. Process Automation Handbook- A Guide to Theory and Practice by Jonathan - 2007
3. Industrial Automation Technologies – edited by ChanchalDey, Sunitkumar Sen-2020
4. Introduction to Industrial Automation by StamatiosManesis, George Nikolakopoulos · 2018

Course Outcomes: (CO's)

On completion of this course, the students will be able to

1. Familiarize with various automation technologies in manufacturing and process industries. [PO1, PO2, PO3, PO5, PO5]
2. Understand various automation tools and methods in manufacturing industry. [PO1, PO2, PO3, PO5]

3. Implement and Install various communication network devices and other network hardware for field and ProfiBUS. [PO3, PO4, PO5]
4. Understand the concepts of safety function and risk factors in Industrial processes. [PO4, PO5]
5. Troubleshoot the problems and risks involved in automated related businesses. [PO4, PO5]

FEM FOR MANUFACTURING

Subject Code : MCM E06 **Credits: 3:0:1**
Prerequisites : Nil
Course Coordinator: Dr LOKESHA

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 Learning 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 element, 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.

Lab Components

1D problems: Problems on Bar – Truss – Beams – Dynamic Analysis
2D problems: problems on Plate
3D problems: CAD to CAE – Exercise on machine elements.

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]

MECHATRONICS AND MEMS

Course code: MCM E07 **Course Credits: 3:0:1**
Prerequisites: Nil
Course Coordinator: Dr. R KUMAR

Preamble:

Mechatronics, which is also called mechatronic engineering, is a multidisciplinary branch of engineering that focuses on the engineering of both electrical and mechanical systems, and also includes a combination of robotics, electronics, computer, telecommunications, systems, control, and product engineering. As technology advances over time, various subfields of engineering have succeeded in both adapting and multiplying. The intention of mechatronics is to produce a design solution that unifies each of these various subfields. Originally, the field of mechatronics was intended to be nothing more than a combination of mechanics and electronics, hence the name being a portmanteau of mechanics and electronics; however, as the complexity of technical systems continued to evolve, the definition had been broadened to include more technical areas.

Course Learning Objectives:-

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

1. Define Mechatronics systems and recognize its various elements.
2. Compile the key elements of signal conditioning circuits.
3. Express the concepts of actuation systems.
4. Express the concepts of programming logic controllers.
5. Understand the concept of MEMS

UNIT I

Mechatronics, Sensors and Transducers: Introduction to Mechatronics Systems, Measurement Systems Control Systems Microprocessor based Controllers. Sensors and Transducers: Performance, Terminology, Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light sensors selection of sensors.

UNIT II

Signal Conditioning: Introduction to signal conditioning. The operational amplifier, Protection, Filtering, wheat stone bridge, digital signals Multiplexers, data acquisition, Introduction to Digital system processing pulse modulation.

UNIT III

Actuation System: Electrical Actuation Systems - Mechanical Switches – Solid State Switches, Solenoid Construction and working principle of DC and AC Motors speed control of AC and DC drives, Stepper Motorsswitching circuitries for stepper motor – AC & DC Servo motors. Introduction to Hydraulic and Pneumatic actuation systems and their application

UNIT IV

Micro Electro Mechanical Systems (MEMS) : Introduction –MEMS, MEMS micro sensor, Mems micro actuator, manufacturing processes of MEMS, commonly used MEMS micro sensors, Advantages and applications of MEMS.

UNIT V

Programmable Logic Controllers: Programmable Logic Controllers – Basic Structure Input / Output Processing – Programming – Mnemonics Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – DataHandling Analogs Input / Output – Selection of a PLC.

Lab Component

Experiments on Home automation with the application of PLC

TEXT BOOKS:

1. Mechatronics- W. Bolton, Longman, 2nd Pearson Publications, 2007
2. Microprocessor Architecture, programming and applications with 8085.8085A- R.S. Ganokar, Wiley Eastern.

REFERENCE BOOKS:

1. Mechatronics Principles & applications by Godfrey C. Canwerbolu, Butterworth-Heinemann 2006.
2. Mechatronics- danNecsulescu, Pearson Publication, 2007
3. Introduction Mechatronics & Measurement systems, David. G. Aliciatore & Michael.B. Bihistand, tata McGraw Hill, 2000.
4. Mechatronics : Sabricentinkunt, John wiley& sons Inc. 2007

Course Outcomes (COs):

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

1. Define Mechatronics systems and recognize its various elements. [PO1,PO2,PO3,PO4 & PO5]
2. Compile the key signal conditioning circuits. [PO5]
3. Demonstrate the concepts of system models and controllers. [PO1,PO2,PO3,PO4 & PO5]
4. Understand the concepts of programming logic controllers. [PO1,PO2,PO3,PO4 & PO5]
5. Understand the concepts of MEMS. [PO1,PO2,PO3,PO4 & PO5]

MACHINE LEARNING AND PYTHON

Course Code: MCM E08 **Course Credits: 4:0:0**
Prerequisite: Probability, Statistics
Course Coordinator: Dr. JAYACHRISTIYAN K G

Preamble

Machine learning is about designing programs that can learn without being explicitly programmed. It is a branch of Artificial Intelligence in which we learn concepts/patterns/hypotheses from Data by using heuristic based algorithms. Accordingly, this field is about study and implementation of two main category of algorithms: Supervised and Unsupervised. Supervised learning algorithms make use of data with known classification, aka labeled examples whereas Unsupervised learning algorithms use data with unknown classification, aka unlabeled examples. This field has become so popular that one can find machine leaning applications in virtually all domains ranging from identifying emails as spam or legitimate to automated vehicle guided system to game playing to credit card fraud detection. As this form is unlikely to become exact science, a learning method/algorithm needs to be evaluated and estimated for its performance on unseen data or the population.

Course Learning Objectives

1. To introduce students to the Read and write simple Python programs.
2. To make students learn the basics of machine learning and apply concept learning to real time scenarios.
3. To give an introduction to working of Decision trees.
4. To understand the importance Bayesian learning algorithm and its variants, Instance based learning.
5. To learn the role of concept learning, Bayes classifier, k nearest neighbour, Regression.

UNIT I

Introduction, Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments. Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for.

UNIT II

Strings: string slices, immutability, string functions and methods, string module. Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters. Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods.

UNIT III

What is Machine Learning, Benefits, opportunities and risk for the mechanical engineering, Well-posed learning problems, Designing a learning system, Perspectives and Issues, a concept learning task, Concept learning as search, Find-S: Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm.

UNIT IV

Decision tree learning: Representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, Introduction to Linear and Non-Linear regression

UNIT V

Bayes Theorem and Concept learning, Maximum Likelihood and Least Squared Error, Maximum Likelihood hypotheses for predicting probabilities Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Instance based learning: k-nearest neighbor learning, Locally weighted regression

TEXT BOOKS:

1 Think Python: How to Think Like a Computer Scientist Allen B. Downey Shroff O'Reilly Publishers 2nd edition 2016
2 An Introduction to Python – Revised and updated for Python 3.2 Guido van Rossum and Fred L. Drake Jr Network Theory Ltd., 2011
3 Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013

REFERENCE BOOKS:

1 Introduction to Programming in Python: An Inter-disciplinary Approach Robert Sedgewick, Kevin Wayne, Robert Dondero Pearson India Education Services Pvt. Ltd 2016
2 Fundamentals of Python: First Programs Kenneth A. Lambert CENGAGE Learning 2012
3 EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Read and write by hand simple Python programs. [PO1,PO2,PO3,PO4 & PO5]
2. Outline the preliminaries of machine learning and apply concept learning to real time scenarios. [PO1,PO2,PO3,PO4 & PO5]
3. Illustrate the working of Decision trees. [PO1,PO2,PO3,PO4 & PO5]
4. Describe Bayesian learning algorithm and its variants, Instance based learning. [PO1,PO2,PO3,PO4 & PO5]
5. Investigate concept learning, Bayes classifier, k nearest neighbor, Regression. [PO1,PO2,PO3,PO4 & PO5]

COMPUTER AIDED DESIGN

Course Code : MCM E09 **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 Learning 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

Interpretation & Applications of CAD:

Curve Segmentation, Trimming, Intersection & Projection. Mechanical Assembly: Introduction, Assembly modelling – Parts modelling and Representation, Hierarchical Relationship, Mating Conditions. Inference of position from mating conditions.Versatility of Applications of CAD- Case Studies.

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 CWK Lui – Computer Aided Design and Manufacturing, Affiliated East West, India 1988.
2. Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill 1988.

COURSE OUTCOMES (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]

SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

Course Code: MCM E10 **Credits: 4:0:0**
Prerequisite: Nil
Course Coordinator: Dr. HEMAVATHY S

Preamble:

This course provides a network of supplier, manufacturing, assembly, distribution, and logistics facilities that perform the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these products to customers. Supply chain management has emerged as the new key to productivity and competitiveness of manufacturing and service enterprises. This course aims the importance of SCM by a significant spurt in research in the last five years and also proliferation of supply chain solutions and supply chain companies. All major ERP companies are now offering supply chain solutions as a major extended feature of their ERP packages.

Course Learning Objectives:

1. To understand the phases, process and cycle views of supply chain to attain the strategic fit, framework and obstacles in achieving the strategic fit.
2. To identify the factors and analyze the options for distribution networks.
3. To recognize the role of ERP and risk factors associated for its implementation.
4. To apply the ERP transition strategies for its implementation in various projects.
5. To analyze the success and failure factors in operating and maintaining the ERP system in business.

UNIT I

Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: Push/Pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

UNIT II

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

The Supply Chain IT Framework: The role of IT Supply Chain, The Supply Chain IT Framework, CRM, Internal SCM, SRM, The role of E-business in a supply chain, The E- business framework, E-business in practice, Bullwhip effect.

UNIT III

Introduction to ERP: Enterprise – an overview, brief history of ERP, common ERP myths, Role of CIO, Basic concepts of ERP, Risk factors of ERP implementation, Operation and Maintenance issues, Managing risk on ERP projects.

UNIT IV

ERP and Related Technologies: BPR, Data Warehousing, Data Mining, OLAP, PLM, SCM, CRM, GIS, Intranets, Extranets, Middleware, Computer Security, Functional Modules of ERP Software, Integration of ERP, SCM and CRM applications.

UNIT V

ERP Implementation: Why ERP, ERP Implementation Life Cycle, ERP Package Selection, ERP Transition Strategies, ERP Implementation Process, ERP Project Teams.

ERP Operation and Maintenance: Role of Consultants, Vendors and Employees, Successes and Failure factors of ERP implementation, Maximizing the ERP system, ERP and e-Business, Future Directions and Trends.

TEXT BOOKS:

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia, 2010.
2. Alexis Leon, Enterprise Resource Planning, Tata McGraw Hill, Second Edition, 2008.

REFERENCE BOOKS:

1. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2000.
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw Hill, 2007.
3. Carol A P tak, ERP: Tools, Techniques, and Applications for Integrating the Supply Chain, 2nd Edition, CRC Press, 2003.

Course Outcomes (COs):

At the end of the course, the students will be able to

1. Describe the various phases, process and cycle views of supply chain in attaining the strategic fit, framework and obstacles in achieving the strategic fit. [PO1,PO2,PO3,PO4 & PO5]
2. Evaluate and analyze the factors required for designing the supply chain network. [PO1,PO2,PO3,PO4 & PO5]
3. Identify the role of ERP and the risk factors associated for its implementation. [PO1,PO2,PO3,PO4 & PO5]
4. Execute the ERP transition strategies for its implementation in various projects. [PO1,PO2,PO3,PO4 & PO5]
5. Correlate the success and failure factors in operating and maintaining the ERP system in business. [PO1,PO2,PO3,PO4 & PO5]

INTERNET OF THINGS FOR MANUFACTURING

Course Code: MCM E11 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator:Mr. NANDEESHA H L

Preamble:

Internet of Things (IoT) has gained prominence with the ever increasing connected devices, sensor systems and capability of computing resources. Thanks to the advancement of fabrication technology which has now made IoT devices and systems integral part of our daily life. An IoT system typically comprises of smart sensor nodes to collect data either real-time or offline, data communication over a network and the back-end data management & processing to extract intelligent information. The typical use cases of IoT are wearables, smart homes, smart vehicles, traffic prediction & control, weather monitoring & forecasting, indoor location-based services, health monitoring of machines & structures, augmented/virtual reality etc. Consumers and industries are the beneficiaries of such applications

Course Learning Objectives

1. The focus of this introductory course would be "the smart sensor node" with emphasis on design, requirement, data interfacing and capabilities.
2. The course would cover engineering fundamentals, blended with good industrial practices, which lead to the first-time success of the design and development of sensor node.
3. Compare and contrast the deployment of smart objects and the technologies to connect them to network.
4. Appraise the role of IoT protocols for efficient network communication.
5. Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry**.**

UNIT I

INTRODUCTION : Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

DESIGN OF IoT : Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT II

SMART OBJECTS The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. Application Protocols for IoT

UNIT III

PROTOTYPING OF IoT : Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

UNIT IV

PREREQUISITES FOR IoT : IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

UNIT V

APPLICATION IN MANUFACTURING : Applications HCI and IoT world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

REFERENCES BOOKS:

1. Adrian McEwan and Hakim Cassimally, "Designing the internet of things", Wiley, 2013
2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.
3. Internet of Things: A Hands-On Approach by Vijay Madisetti, Arshdeep Bahga, VPT; 1st edition 2014.
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence" Elsevier
5. Meta Products -Building the Internet of Things by Wimer Hazenberg, Menno Huisman, BIS Publishers 2014.

Course Outcomes (COs):

After completing this course, students will be in

1. Position to understand various building blocks and working of state-of-the-art IoT systems. [PO1,PO2,PO3,PO4 & PO5]
2. Gain better knowledge about wireless technology and control system. [PO1,PO2,PO3,PO4 & PO5]
3. Easy management of resources for particular application by using suitable sensors and IoT from anywhere. [PO1,PO2,PO3,PO4 & PO5]
4. Students would also gain enough insights to conceive and build IoT systems on their own**.** [PO1,PO2,PO3,PO4 & PO5]
5. The typical use cases of IoT are wearables, smart homes, smart vehicles, traffic prediction & control weather monitoring & forecasting, indoor location-based services, health monitoring of machines & structures. [PO1,PO2,PO3,PO4 & PO5]

ARTIFICIAL INTELLIGENCE FOR CIM

Course code: MCM E12 **Course Credits: 4:0:0**
Prerequisites: Nil
Coordinator : Dr. R KUMAR

Preamble

AI is a branch of computing science that deals with the specification, design and implementation of information systems that have some knowledge related to the enterprise in which the information systems are situated. Furthermore, such systems are designed per se to be responsive to the needs of their end-users. Intelligent machines have replaced human capabilities in many areas. Artificial intelligence is the intelligence exhibited by machines or software. It is the branch of computer science that emphasizes on creating intelligent machines that work and react like humans.

Course Learning Objectives

1. Observe 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 system.
5. Students will understand the examples of expert system and machine learning system.

UNIT I

Introduction to AI and production systems: Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Heuristic Search Techniques.

UNIT II

Knowledge Representation Issues: Representations and Mappings, Approaches to knowledge representation. Issues in knowledge representation.

Use of Predicate Logic: Representing simple facts, Instance and ISA relationships, Computable Functions and Predicates, Resolution, Natural deduction.

UNIT III

Knowledge Representation Using Rules: Procedural Vs Declarative knowledge, Logic programming. Forward Vs Backward reasoning, matching.

Symbolic reasoning under uncertainty: Nonmonotic reasoning. Depth First Search and Breadth First Search.

UNIT IV

Statistical And Probabilistic Reasoning: Probability and Bayes' theorem, Certainity factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic and simple exercises.

Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Back propagation algorithm, factors affecting back propagation training, applications.

Fuzzy Logic And Fuzzy Sets: Fuzzy set Theory, Interval arithmetic, Operations on Fuzzy Sets, Fuzzy Logic Theory, Classical Logic Theory, Fuzzy System Modeling, Fuzzy Control Systems, Adaptive fuzzy Control.

UNIT V

Expert systems: Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

TEXT BOOKS:

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 3rd Ed., M/H 2009.
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):

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

1. Understand a AI-Problem formulation and production system concepts. [PO1,PO2,PO3,PO4 & PO5]
2. Solve the concept of knowledge representation issues and the forward, backward reasoning. [PO1,PO2,PO3,PO4 & PO5]
3. Ability to use of predicate logic to represent simple facts and Instances. [PO1,PO2,PO3,PO4 & PO5]
4. Identify a problem in statistical and probabilistic reasoning. [PO1,PO2,PO3,PO4 & PO5]
5. Demonstrate the various learning typical expert system. [PO1,PO2,PO3,PO4 & PO5]

REVERSE ENGINEERING

Course Code: MCM E13 **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 Learning 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 E14 **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 Learning 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,PO3,PO4 & PO5]
2. Classify and summarize CAPP techniques for specific applications. [PO1,PO2,PO3,PO4 & PO5]
3. Apply and administer advanced planning software. [PO1,PO2,PO3,PO4 & PO5]
4. Breakdown and appraise stages of development in CAPP technology. [PO1,PO2,PO3, PO4 & PO5]
5. Reframe and conclude concepts of practical implementation of GT and coding. [PO1,PO2,PO3,PO4 & PO5]

INDUSTRY 4.0

Course Code: MCM E15 **Credits: 4:0:0**
Prerequisites: Nil
Course Coordinator: Mr. NANDEESHA H L

Preamble

The world is at the onset of the Fourth Industrial Revolution and this revolution is very much driven by the smarts in automating decision making and processes. Advancements in IT has resulted in immense improvements in computational power across nearly all electronic devices and enhanced capabilities in connecting the dots in an increasingly networked society. Digital platforms in the Cloud provides a perfect canvas for inventing new business models and for intelligent algorithms to analyse data and derive knowledge for operationalize use by cyber physical systems. This course provides a comprehensive coverage on, among others, the role of data, manufacturing systems, various Industry 4.0 technologies, applications and case studies. In particular, we also draw input from researchers and practitioners on what are the opportunities and challenges brought about by Industry 4.0, and how organizations and knowledge workers can be better prepared to reap the benefits of this latest revolution.

Course Learning Objectives:

1. To know the introduction to Industry 4.0 (or the Industrial Internet), its applications in the business world and how smartness being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges
2. To understand the concept of IOT in modern technical perspective
3. To understand role of data analytics in manufacturing
4. To understand the role of additive manufacturing techniques and virtual manufacturing softwares in industries
5. To understand the importance of Augmented Reality in the age of Industry 4.0

UNIT I

Introduction: Industrial, Internet, Case studies, Cloud and Fog, M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.

UNIT II

The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.

UNIT III

Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing.

Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns.
Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.

UNIT IV

Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing. Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software , Limitations of the Commercial Software

UNIT V

Augmented Reality: The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance , Assembly, Collaborative Operations , Training.
Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward.
A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.

Course Outcomes (COs):

After going through this course the student will be able to:

1. Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals. [PO1,PO2,PO3,PO4 & PO5]
2. Understand the concepts of Additive manufacturing. [PO1,PO2,PO3,PO4 & PO5]
3. Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services. [PO1,PO2,PO3,PO4 & PO5]
4. Apply Hardware and software systems in Industry 4.0. [PO1,PO2,PO3,PO4 & PO5]
5. Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits. [PO1,PO2,PO3,PO4 & PO5]