Department of Mechanical Engineering

CURRICULUM

Master of Technology (M.Tech)

In

Computer Integrated Manufacturing (CIM)

Academic Year: 2020 – 2021

I TO IV SEMESTER

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
BANGALORE – 560054
About the Institute

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

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

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

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

Another team from the department also participated in the “Unmanned Air Vehicle System “conducted by U.S. Navy at Maryland, USA. The team secured 5th Place in the technical session out of 36 participating teams from all over the world.

A team of two students also participated in the CAD Design Competition conducted by Autodesk, a CAD multinational company, in association with IIT Madras and secured FIRST PLACE among the teams from all over India with a cash prize of Rs 1,20,000 and also received a free Trip to Autodesk University, held at Las Vegas, USA.
Vision of the Institute
To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

Mission of the Institute
RIT shall meet the global socio-economic needs through

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

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

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

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

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

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

Programme Educational Objectives (PEOs)

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

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

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

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

Process of Deriving the Programme Educational Objectives (PEOs):

Fig 2 shows the process employed for deriving the PEO’s

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

![Diagram showing the process of deriving POs](image)

**Mapping of PEO’s and PO’s**

The correlation between the Programme outcomes and Program Educational objectives are mapped in the Table 1 shown below.

**Table 1: Correlation between the POs and the PEOs**

<table>
<thead>
<tr>
<th>Institute Vision and Mission</th>
<th>Department Vision and Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty</td>
<td>Program Educational Objectives</td>
</tr>
<tr>
<td>Student</td>
<td>Professional bodies such as IIF, IEI, IWS</td>
</tr>
<tr>
<td>Alumni</td>
<td>Regulatory bodies such as UGC, AICTE, VTU</td>
</tr>
<tr>
<td>Industry</td>
<td>Graduate Attributes</td>
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</tbody>
</table>

Fig 3: Process employed for deriving PO’s
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Programme Educational Objectives (PEOs)</th>
<th>Programme Outcomes (PO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Apply the technical skills gained to model and analyze real time projects in the field of computer integrated manufacturing.</td>
<td>PO1: 3 PO2: 3 PO3: 3 PO4: 3 PO5: 3</td>
</tr>
<tr>
<td>2</td>
<td>Able to take up profession in R&amp;D areas, management and teaching activity in the field of mechanical engineering.</td>
<td>PO1: 3 PO2: 3 PO3: 3 PO4: 3 PO5: 3</td>
</tr>
<tr>
<td>3</td>
<td>Engage in industry institute interaction and lifelong learning by adhering to ethical and environmental conditions.</td>
<td>PO1: 3 PO2: 3 PO3: 3 PO4: 3 PO5: 3</td>
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</table>
**Master of Technology (M.Tech)**

**In**

**Computer Integrated Manufacturing (CIM)**

**Curriculum - Course Credits Distribution**

<table>
<thead>
<tr>
<th>Semester / Total</th>
<th>Core Courses</th>
<th>Electives</th>
<th>Project Work / Dissertation Preliminaries</th>
<th>Laboratory</th>
<th>Internship / Industrial Training</th>
<th>Seminar</th>
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**FIRST SEMESTER**

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<tr>
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<td>MCM 11</td>
<td>Experimental Methods and Mathematical Models</td>
<td>Mechanical Engineering</td>
<td>3 1 0 4</td>
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<tr>
<td>2</td>
<td>MCM 12</td>
<td>CNC Systems and Programming</td>
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<td>3</td>
<td>MCM EXX</td>
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### SECOND SEMESTER

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<td>Automation and Production Systems</td>
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<td>MCM 22</td>
<td>Industrial Robotics</td>
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<td>3</td>
<td>MCM EXX</td>
<td>Elective – IV</td>
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### THIRD SEMESTER

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L – Lecture Hours    T – Tutorial Hours    P – Practical/Seminar
### LIST OF ELECTIVES
(Computer Integrated Manufacturing)

<table>
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<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
<th>Credits</th>
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<td>MCM E01</td>
<td>Advanced Management Techniques in Manufacturing</td>
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<td>Simulation and Modelling of Manufacturing Systems</td>
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<td>Artificial Intelligence for CIM</td>
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Students have to earn a total of 88 credits by choosing subjects from the above list of electives.
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:
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:**
Introduction to RSM.
Tutorial exercises from Journal papers

REFERENCE BOOKS:
4. Research Methodology, R. Pannerselvam, Prentice Hall of India, New Delhi

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


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
REFERENCES BOOKS:

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]
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, B and C using the software. The basic data sets shall be taken from journals in the area of their specialization.

Part A: Regression and correlation analysis
Linear Regression, Multiple Regression, Curvilinear Regressions, correlation analysis.
Hypothesis testing.

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

Exam marks: 50

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<th>Component</th>
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<tr>
<td>Part A</td>
<td>20</td>
<td>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</td>
</tr>
<tr>
<td>Part B</td>
<td>20</td>
<td>Initial write up and preliminary idea of results: 05 marks, Analysis, presentation of data and results: 10 marks, interpretation of results: 05 marks</td>
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* The split up may vary depending on the questions.

REFERENCE BOOKS:

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]
Course Code: MCM L12  
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:
2. CAD/CAM/CIM by Radhakrishnan P

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

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<th>Component</th>
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<td>Part A</td>
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<td>Viva</td>
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<td>Total</td>
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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
Prerequisites: Nil
Course Coordinator: Dr. SUNITH BABUL

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

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

Evaluation:
Each presentation shall be evaluated for 50 marks. Average marks obtained for three best presentations will be the student’s CIE marks. No SEE.
Course Outcomes (COs):

The student will be able

1. To identify 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 the 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


UNIT II


UNIT III

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

Course Outcomes:
After going through this course the student will be able to:
1. Identify and Classify different Automation types in Production System and application of production concepts using mathematical models
2. Analyze the concepts of Automation with respect to Process Industries and Discrete Manufacturing Industries
3. Apply the concepts of mathematical models in material handling, Automation System and discrete control using PLCs
4. Apply the concepts of mathematical models in automated storage systems
5. Evaluate the techniques involved in FMS

REFERENCE BOOKS
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. [PO1, PO2, PO3, PO4 & PO5]
INDUSTRIAL ROBOTICS

Course Code : MCM 22
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 given to the area of Applications where in students understand as to how robotics can be applied in areas 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


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, Denavit and Hertanberg Convention, Applications of D-H Method- Six Axis Robot Manipulators

UNIT III

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

Mobile Robot Maneuverability: Degree of Mobility, Degree of Steerability, Robot maneuverability.

UNIT V

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

TEXT BOOKS:
1. M P Groover “Industrial Robotics” MGH.
2. Yoren and Koren, “Robotics for Engineers” MGH

REFERENCE BOOKS:

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]
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.


Examination

Exam Marks: 50
Exam Time: 3 Hours

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<td>Part-A</td>
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<td>Simulation Table – 10 Marks + Execution – 10 Marks</td>
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<tr>
<td>Part-B</td>
<td>20</td>
<td>Simulation Table – 10 Marks + Execution – 10 Marks</td>
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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]
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:

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

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

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

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

Course Outcomes (COs):
The student will be able
1. To identify 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]
ADVANCED MANUFACTURING TECHNOLOGY

Course Code: MCM 31
Prerequisites: Nil
Course Coordinator: Dr. N D PRASANNA

Preamble:
Advanced manufacturing is the use of innovative technology to improve products or processes, with the relevant technology being described as "advanced," "innovative," or "cutting edge." Advanced manufacturing industries "increasingly integrate new innovative technologies in both products and processes. The rate of technology adoption and the ability to use that technology to remain competitive and add value to define the advanced manufacturing sector. This course addresses recent manufacturing principles, variety and its concept, scope of advanced manufacturing and areas of application.

Course Learning Objectives:
1. To analyze and determine material fabrication processes.
2. To use laboratory instrument doing routine metrological measurements.
3. To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
4. To recognize engine machine tool requirements and be selective in the choice of tools.
5. To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.

UNIT I
Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT II

UNIT III
UNIT IV
Processing of ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, drying, sintering, Hot compaction, Area of application, finishing of ceramics.

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT V
Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics.

E-Manufacturing, nanotechnology, and micromachining. High speed Machining

TEXT BOOKS:

Course Outcome (COs):
1. At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes. [PO1,PO2,PO3,PO4 & PO5]
2. Able to understand different types of composite material characteristics, types of micro & macro machining processes. [PO1,PO2,PO3,PO4 & PO5]
3. Understand the e-manufacturing & nano materials. [PO1,PO2,PO3,PO4 & PO5]
4. Identify with numerical control machining and computer programming. [PO1,PO2,PO3,PO4 & PO5]
5. Determine costs and establish basic programs in machine shop economics. [PO1,PO2,PO3,PO4 & PO5]
Course Code: MCM 32  
Credits: 0:0:4

Prerequisites: Nil

Course Coordinator: Dr. P DINESH

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]
Course Code : MCM 33
Prerequisites : Nil
Course Coordinator: Dr. P DINESH

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]
Course Code: MCM 41
Prerequisites: Nil
Course Coordinator: Dr. P DINESH

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
Prerequisites : Nil
Course Coordinator: Dr. P DINESH

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

TEXT BOOKS:

1. Toyota Production system – An integrated approach to just in time – by Yasuhiro Monden
2. Lean Thinking – By James Wornack

REFERENCE BOOKS:

2. Just in Time Manufacturing – Kargoanker
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]
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

UNIT II

UNIT III

UNIT IV
Micro mechanical analysis of lamina, Introduction, volume and mass fractions, density and void content, Evaluation of four elastic moduli.

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.


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:

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
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

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

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


UNIT V

TEXT BOOKS:
4. Rapid Prototyping: Principles and Application…(Hardcover) by Rafiq I. Noorani

REFERENCE BOOKS:
2. Rapid prototyping materials by Gurumurthi. IISc Bangalore.
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
Prerequisites: Nil
Course Coordinator: Dr. HEMAVATHI S

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

Course 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:
UNIT V

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

TEXT BOOKS:

REFERENCE BOOKS:

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]
FLEXIBLE MANUFACTURING SYSTEMS

Course Code: MCM E05  
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

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

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:
2. Groover M P, Automation, production system and computer integrated manufacturing, PHI, 1989

REFERENCE BOOKS:

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]
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, bending of thin plates.
3. To understand the fundamentals of heat transfer and dynamic problems and solve related problems.
4. To learn and understand the fundamentals of axisymmetric elements, shell elements and bending of thin plates and non-linear FEM analysis.
5. To develop competence in solving real life engineering problems using commercial FE software.

UNIT I

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

UNIT II

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

UNIT III

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

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

UNIT V

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

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:

REFERENCE BOOKS:

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
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

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, Numerical problems

UNIT III

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

Programmable Logic Controllers:
Experiments on Home automation with the application of PLC.

Lab Component
Experiments on Home automation with the application of PLC

TEXT BOOKS:

REFERENCE BOOKS:
   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]
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/algorith 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:
2. An Introduction to Python – Revised and updated for Python 3.2 Guido van Rossum and Fred L. Drake Jr Network Theory Ltd., 2011

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

Course Outcomes (COs):
At the end of the course, students will be able to
1. Read and write by hand simple Python programs. [P01,P02,P03,P04 & P05]
2. Outline the preliminaries of machine learning and apply concept learning to real time scenarios. [P01,P02,P03,P04 & P05]
3. Illustrate the working of Decision trees. [P01,P02,P03,P04 & P05]
4. Describe Bayesian learning algorithm and its variants, Instance based learning. [P01,P02,P03,P04 & P05]
5. Investigate concept learning, Bayes classifier, k nearest neighbor, Regression. [P01,P02,P03,P04 & P05]
COMPUTER AIDED DESIGN

Course Code : MCM E09
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

UNIT II

Graphic Interface and CAD/CAM Cloud
CAD System Configuration, Computer Aided System Software: Introduction, Operating system, Graphics system. The overlay system, Graphics Database structure and Handling, operating features, Symbols, Macros, Editing facilities, Data Selection, Graphic transformation, Plotting, Graphic standards- GKS and CORE, GKS-3D and PHIGS, IGES and other 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 Transformations.

UNIT IV

Geometric Modelling: Introduction

UNIT V

Segmentation

TEXT BOOKS:

REFERENCE BOOKS:

Course Outcome (COs):
1. Students explain basics of product cycle, automation, production systems and Computer aided design [PO1,PO2,PO4 & PO5]
2. Student applies the knowledge of computer graphics , database structure in configuring CAD related software applications for specific industrial needs [PO1,PO2,PO4 & PO5]
3. Students implement appropriate hardware for specific CAD projects leading to effective project solving capabilities in industry related projects [PO1,PO2,PO3,PO4 & PO5]
4. Acquires knowledge related to various techniques to solve math based application in transformation of graphical entities[PO1,PO2,PO3,PO4 & PO5]
5. Implement methods of utilization of appropriate features in CAD application thereby enhancing productivity in design[PO1,PO2,PO4 & PO5]
SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

Course Code: MCM E10  
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


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

UNIT II


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:**

**REFERENCE BOOKS:**

**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. [P01,P02,P03,P04 & P05]
2. Evaluate and analyze the factors required for designing the supply chain network. [P01,P02,P03,P04 & P05]
3. Identify the role of ERP and the risk factors associated for its implementation. [P01,P02,P03,P04 & P05]
4. Execute the ERP transition strategies for its implementation in various projects. [P01,P02,P03,P04 & P05]
5. Correlate the success and failure factors in operating and maintaining the ERP system in business. [P01,P02,P03,P04 & P05]
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

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

UNIT III

UNIT III
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:


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]
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: No monotonic reasoning. Implementation Depth First Search and Breadth First Search.

UNIT IV

**UNIT V**


**TEXT BOOKS:**
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 1999.

**REFERENCE BOOKS:**

**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
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

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
**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:**


**REFERENCE BOOKS:**

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:

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:


REFERENCE BOOKS:


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]
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 analyze 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

UNIT III

UNIT IV

UNIT V

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]