ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M. Tech.
ADVANCED MANUFACTURING SYSTEMS

(Applicable for the batches admitted from 2015-2016)

VALLURUPALLI NAGESWARA RAO VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institute, Accredited by NAAC with 'A' Grade
NBA Accreditation for CE, EEE, ME, ECE, CSE, EIE, IT B.Tech. Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH
Recognized as "College with Potential for Excellence" by UGC
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VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
HYDERABAD
An Autonomous Institute

Academic Regulations - M.Tech. Programme
(Applicable for the batches admitted from the academic year 2015-2016)

1. Introduction

Academic programmes of the institute are governed by rules and regulations as approved by the Academic Council of the institute.

These academic rules and regulations are effective from the academic year 2015-16, for the students admitted into two year post graduate programme offered by the college leading to Master of Technology (M. Tech.) degree in different specializations offered by the departments of Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering, Electronics and Communication Engineering, Computer Science and Engineering, Information Technology and Electronics and Instrumentation Engineering.

The M.Tech. degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on students who are admitted to the programme after fulfilling all the requirements for the award of the degree.

1.1 Eligibility for Admissions

Admission to the above program shall be made subject to the eligibility and qualifications prescribed from time to time. Admissions shall be made on the basis of GATE Rank and merit rank obtained at an Entrance Test conducted by the TSSCHE or as decided by TSSCHE subject to reservations prescribed by the university/ State Government from time to time.

2. Programmes of study

The following two year M.Tech. degree programmes of study are offered by the departments at VNR VJIET.

Department	Specializations
ME	1. Advanced Manufacturing Systems 2. Automation 3. CAD/CAM
CE	1. Highway Engineering 2. Structural Engineering 3 Geotechnical Engineering
EEE	1. Power Electronics 2. Power Systems
CSE	1. Software Engineering 2. Computer Science and Engineering
ECE	1. VLSI System Design 2. Embedded Systems
EIE	Electronics and Instrumentation
IT	Computer Networks and Information Security

- **'ENGLISH'** language is used as the medium of instruction in all the above programmes.

3. Attendance requirements

Each academic year shall be divided into two semesters, each of 90 Instructions days, excluding examination, evaluation, declaration of results etc.

3.1 A student shall be eligible to appear for the semester end examinations in subject if he / she acquire a **minimum of 75% of attendance in that subject.**

3.2 Shortage of attendance up to 10% in any subject (i.e., attendance of 65% and above and below 75%) in a semester may be condoned by the Institute Academic Committee based on the rules prescribed by the Academic Council of the Institute from time to time.

3.3 A student shall get **minimum required attendance in at least three (03) theory subjects** in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech. degree, the student shall complete all the academic requirements of the subjects, as per the course structure.

3.4 Shortage of **attendance below 65% shall in NO case be condoned**.

3.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

3.6 In case the student secures less than the required attendance in any subject(s), he shall not be permitted to appear for the semester end examination in that subject(s). He shall re-register for the subject when offered next.

4. Evaluation

i. The performance of a student in each semester shall be evaluated subject–wise with a maximum of **100 marks for theory** and **100 marks for practical subjects**. In addition, **mini-project** and **comprehensive viva-voce** shall be evaluated for **100 marks** respectively.

ii. For theory subjects, the distribution shall be **40 marks for mid-term evaluation** and **60 marks for the semester end examination**.

❖ **Mid-Term Evaluation (40 M):**

Mid-term evaluation consists of **mid-term examination (30 M)** and **assignment/objective test/ case study/course project (10 M).**

➢ **Mid-term examination (30 M):**

- For theory subjects, two mid-term examinations shall be conducted in each semester as per the academic calendar. Each mid-term examination shall be evaluated for 30 marks.
- Pattern of Mid-term examination:
  3 X 10M = 30 M (three internal choice questions one from each UNIT shall be given, the student has to answer ONE question from each UNIT)
- There shall be TWO mid-term examinations for each subject and the average of two mid-term examinations shall be considered for calculating final mid-term examination marks in that subject.

➢ **Assignment/objective exam/ case study/course project (10 M):**

- Two assignment/objective exam/ case study/course project shall be given to the students covering the syllabus of first mid-term and second mid-term examinations respectively and evaluated for 10 marks each.
- The first assignment/objective exam/ case study/course project shall be submitted before first mid-term examination and the second one shall be submitted before second mid-term examination.
- The average of 2 assignments shall be taken as final assignment marks.

iii. For practical subjects, there shall be a **continuous evaluation during the semester for 40 marks and 60 marks for semester end examination**. Out of the 40 marks, **day-to-day work in the laboratory shall be evaluated for 10 marks**, and **15 marks for practical examination** and **15 marks for laboratory record.**

❖ **Semester End Examination (60 M):**

(a) Theory Courses

Question paper pattern for semester end examination (60 Marks)

- Paper shall consist of 05 questions of 10 marks each. (05X12M = 60 M)
- There shall be 01 question from each unit with internal choice.

(b) Practical Courses

Each laboratory course shall be evaluated for 60 marks. The semester end examination shall be conducted by two examiners, one Internal and other external concerned with the subject of the same / other department / Industry. The evaluation shall be as per the standard format.

4.1. **Evaluation of Mini-Project:** There shall be two presentations during the first year, one in each semester. For mini-project 1 and mini-project 2, a student under the supervision of a faculty member, shall collect the literature on a topic, critically review the literature, carry out the mini-project, submit it to the department in a report form and shall make an oral presentation before the departmental Project Review Committee (PRC). The Departmental PRC consists of Head of the Department, supervisor and one senior faculty member of the department. For each mini-project there shall be only internal evaluation of 100 marks. A student has to secure a minimum of 50% to be declared successful.

4.2. There shall be a comprehensive viva-voce in II year I semester. The comprehensive viva-Voce shall be conducted by a committee consisting of Head of the Department and two senior faculty members of the department. The comprehensive viva-voce is aimed to assess the students' understanding in various subjects studied during the M.Tech. programme of study. The comprehensive viva-voce shall be evaluated for 100 marks by the committee. There are no internal marks for the comprehensive viva-voce. A student must secure a minimum of 50% to be declared successful.

4.3. A student shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the semester end examination and a minimum aggregate of 50% of the total marks in the semester end examination and mid-term evaluation taken together.

4.4. A student shall be given one chance to re-register, after completion of the course work, for each subject, provided the internal marks secured by a student are less than 50% and he has failed in the semester end examination. In such a case student may re-register for the subject(s) and secure required minimum attendance. Attendance in the re-registered subject(s) has to be calculated separately to become eligible to write the end examination in the re-registered subject(s). Re-registration for the subjects is allowed only if those particular re-registration subjects are the hindrance for the award of Degree. Re-registration is allowed in this case provided the student doesn't have any subject(s) yet to pass other than the re-registration subjects where the internal marks are less than 50% with prior permission.

4.5. Laboratory examination for M.Tech. courses must be conducted with two examiners, one of them being laboratory class teacher and second examiner shall be a teacher of same specialization either external or a teacher from the same department other than the teacher who conducted laboratory classes for that batch.

5. Evaluation of Project / Dissertation Work.

5.1 Registration of Project Work: A student shall be permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects).

5.2 A Project Review Committee (PRC) shall be constituted with at least four members namely HOD, PG coordinator of the M.Tech. programme, project supervisor and one senior faculty member of same specialization.

5.3 After getting permission as per 5.1, a student has to submit, in consultation with the project supervisor, the title, objective and plan of action of his project work to the Departmental PRC for its approval. Only after obtaining the approval of PRC, the student can initiate the project work.

5.4 If a student wishes to change his supervisor or topic of the project he can do so with the approval of PRC. However, the committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, the date of registration for the project work shall be the date of change of supervisor or topic as the case may be.

5.5 Internal evaluation of the project shall be on the basis of the seminars (Project reviews) conducted during the second year by the PRC. A student shall submit draft report in a spiral bound copy form.

5.6 The work on the project shall be initiated in the beginning of the second year and the duration of project is for two semesters. A student is permitted to submit Project work only after successful completion of theory and practical course with the approval of PRC not earlier than 240 days from the date of registration of the project work. For the approval of PRC the student shall submit the draft copy of thesis to the Head of the Department (Through project supervisor and PG coordinator) and shall make an oral presentation before the PRC.

The student is eligible to submit project work if he has published at least one paper covering 70% of the project work and presented his project work in Show and Tell activity.

5.7 After approval of PRC, every student has to submit three copies of the project dissertation certified by the supervisor to the Department.

5.8 The dissertation shall be adjudicated by one examiner selected by the Chief Superintendent. For this, HOD shall submit a panel of 3/ 5 examiners, who are eminent in that field with the help of the concerned guide.

5.9 If the report of the examiner is not favourable, the student shall revise and resubmit the Dissertation, within the time frame as prescribed by PRC. If the report of the examiner is unfavourable again, the dissertation shall be summarily rejected.

5.10 If the report of the examiner is favorable, viva-voce examination shall be conducted by a board consisting of the project supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The Board shall jointly report students work as:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. The student has to secure any one of the grades as Excellent, Good or Satisfactory on his dissertation and viva-voce. If the report of the viva-voce is unsatisfactory, the student shall retake the viva-voce examination after three months, making modifications as suggested. If he fails to get a satisfactory report at the second viva-voce examination, he has to re-register for the project work as mentioned in clause 5.1. However, the student may select a new guide or new topic or both with the approval of the PRC and submit the project dissertation with a minimum of 240 days from the date of re-registration. Of course, this shall not prejudice the clause 6.1 below.

6. Award of Degree and Class

A student shall be declared eligible for the award of the M.Tech. degree, if he pursues a course of study and complete it successfully for **not less than two academic years** and **not more than four academic years**.

6.1 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his admission, for any reason whatsoever, shall forfeit his seat in M.Tech. Course.

6.2 A student shall register and put up **minimum academic requirement in all 84 credits** and earn **84 credits.** Marks obtained in all 86 credits shall be considered for the calculation of Cumulative Grade Point Average (CGPA).

6.3 CGPA System:

Method of awarding absolute grades and grade points in two year M.Tech. degree programme is as follows:

- Absolute Grading Method is followed, based on the total marks obtained in mid-term evaluation and semester end examinations.

- Grades and Grade points are assigned as given below.

Marks Obtained	Grade	Description of Grade	Grade Points(GP) Value Per Credit
>=90	O	Outstanding	10.00
>=80 and <89.99	A	Excellent	9.00
>=70 and <79.99	B	Very Good	8.00
>=60 and <69.99	C	Good	7.00
>=50 and <59.99	D	Pass	6.00
<50	F	Fail	
Not Appeared the Exam(s)	N	Absent	

The student is eligible for the award of the M.Tech degree with the class as mentioned in the following table.

CGPA	Class
>= 8.0	First Class with Distinction
>= 7.0 and <8.0	First Class
>= 6.0 and < 7.0	Second Class

➢ **Calculation of Semester Grade Points Average (SGPA):**

- The performance of each student at the end of the each semester shall be indicated in terms of SGPA. The SGPA shall be calculated as below:

$$\text{SGPA} = \frac{\text{Total earned weighted grade points in a semester}}{\text{Total credits in a semester}}$$

$$\text{SGPA} = \frac{\sum_{i=1}^{p} C_i * G_i}{\sum_{i=1}^{p} C_i}$$

Where Ci = Number of credits allotted to a particular subject 'i'

Gi = Grade point corresponding to the letter grade awarded to the subject 'i'

i = 1,2,…..p represent the number of subjects in a particular semester

Note: SGPA is calculated and awarded for the students who pass all the courses in a semester.

➢ **Calculation of Cumulative Grade Point Average (CGPA):**

The CGPA of a student for the entire programme shall be calculated as given below:

- Assessment of the overall performance of a student shall be obtained by calculating Cumulative Grade Point Average (CGPA), which is weighted average of the grade points obtained in all subjects during the course of study.

$$\text{CGPA} = \frac{\text{Total earned weighted grade points for the entire programme}}{\text{Total credits for the entire programme}}$$

$$\text{CGPA} = \frac{\sum_{j=1}^{m} C_j * G_j}{\sum_{j=1}^{m} C_j}$$

Where Cj = Number of credits allotted to a particular subject 'j'

Gj = Grade Point corresponding to the letter grade awarded to that subject 'j'

j = 1,2,….m represent the number of subjects of the entire program.

- Grade lower than D in any subject shall not be considered for CGPA calculation. The CGPA shall be awarded only when the student acquires the required number of credits prescribed for the program.

➢ **Grade Card**

The grade card issued shall contain the following:

a) The credits for each subject offered in that semester

b) The letter grade and grade point awarded in each subject

c) The SGPA/CGPA

d) Total number of credits earned by the student up to the end of that semester.

7. Withholding of Results

If the student has not paid dues to the Institute, or if any case of indiscipline is pending against him, the result of the student may be withheld and he shall not be allowed into the next higher semester. The award or issue of the provisional certificate and the degree may also be withheld in such cases. This delay shall not prejudice clauses Nos.6.0 and 6.1.

8. Transitory Regulations

Students who have discontinued or have been detained for want of attendance or any other academic requirements, may be considered for readmission as and when they become eligible. They have to take up Equivalent subjects, as substitute subjects in place of repeated subjects as decided by the Chairman of the BoS of the respective departments. He/She shall be admitted under the regulation of the batch in which he/she is readmitted.

9. Minimum Instruction Days

The minimum instruction days for each semester shall be **90 instruction days.**

10. General

10.1 The academic regulations should be read as a whole for purpose of any interpretation.

10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

10.3 The Institute may change or amend the academic regulations and syllabi at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the Institute.

10.4 Wherever the words he, him or his occur, they shall also include she, her and hers.

11. Supplementary Examination

Supplementary examinations shall be conducted along with regular semester end examinations. (During even semester regular examinations, supplementary examinations of odd Semester and during odd semester regular examinations, supplementary examinations of even semester shall be conducted).

Vision

To develop into a Centre of Excellence in Education and Research in the field of Mechanical Engineering, consistent with the contemporary and future needs of the country

Mission

- To impart **high quality education** by using **modern pedagogical tools** so as to make the students **technically competent** in their chosen fields and **socially responsible**
- To inculcate **quality research** by developing **linkages with Industry** and **R & D organizations** in India & abroad

M.TECH. PROGRAMME OBJECTIVES:

- To prepare students for successful careers in their domain that meets the need of Indian and global/multinational organizations.
- To provide a strong foundation in the chosen specialization that enables students to visualize, analyze and solve domain specific mechanical engineering problems.
- To inculcate in students a zeal and attitude for comprehending state of the art advancements and undertake further work in the chosen specialization.
- To prepare students for undertaking research in the chosen specialization and to function effectively in teams/groups.
- To provide students with an academic environment that fosters excellence leadership, ethical codes and guidelines and develops for life-long learning for a successful professional career.

M.TECH. PROGRAMME OUTCOMES:

- **Engineering Knowledge:** Graduates will demonstrate in-depth knowledge of manufacturing technologies and systems, mathematics, sciences, essential computational techniques/procedures that help in problem solving. Graduates will be able to assimilate the emerging developments in the field and enhance their understanding.
- **Problem Analysis:** Graduates will be able to demonstrate ability to identify, critically analyze, conceptualize, formulate and solve manufacturing technology problems in the specific area with due consideration for safety, environmental, cultural and societal concerns.
- **Design and Development of solutions:** Graduates will demonstrate ability to design a component, a process or a system in manufacturing or inter/multi-disciplinary region by following research methodology while arriving at a solution working in engineering and science laboratories as teams, involving review of literature, prepare a model, conduct experiments, analyze and interpret data.
- **Modern tool usage:** Graduates will demonstrate skills to use modern engineering tools, equipments, processes, state-of-the-art software tools for modeling and analysis while solving problems and drawing inferences in the specialized areas with due regard to their limitations and applicability.
- **Individual and Team Work:** Graduates will demonstrate ability to work as an individual as well as a team member/lead and play his role appropriately in the group with a proper understanding of group dynamics, contribute positively to collaborative multidisciplinary scientific research with positive attitude, open mindedness and objectivity for furtherance of individuals and groups' learning.
- **Ethics:** Graduates will demonstrate knowledge, understanding and application of Professional and Ethical responsibilities, intellectual integrity and human values in all the dealings.
- **Communication:** Graduates will demonstrate ability to communicate in both verbal and written form and present complex engineering activities confidently and effectively.
- **Project Management and Finance:** Graduates will demonstrate ability to administer and regulate projects with emphasis on time management, financial management and personnel management to both individuals own work and the teams collective work.
- **The engineer and society:** Graduates will demonstrate a broad understanding of impact of engineering solutions on economy, environment and society while arriving at solutions so as to avoid ill-effects and are sustainable.
- **Life Long Learning:** Graduates will demonstrate recognition of the need and engage in life-long learning, keep abreast with regard to nuances in the chosen field to improve knowledge, proficiency and competence on a continuous basis.
- **Self and Reflective Learning:** Graduates will demonstrate ability to learn, observe, reflect and evaluate ones' own activities for identifying, critically examining and rectifying the mistakes without outside help and thus self-learn.

M.TECH. (ADVANCED MANUFACTURING SYSTEMS):

Degree:	**M.Tech.**	Specialization:	**Advanced Manufacturing Systems**
Duration:	**2 Years (4 semesters)**	Details:	**2 semesters – Course work 2 semesters – Project**
Mode:	**Full-time**	Year of starting:	**2003**
Intake:	**18**	Regulations:	**R15**

- **Overview of the programme:**

  Advanced Manufacturing Systems is concerned with the effective utilization of innovative technology, management and integration to achieve superior performance and improve the products and processes. In order to achieve world class manufacturing performance, it is important to have knowledge of all the manufacturing systems and its key components. This two year (four semesters) programme is designed to address the challenges of modern manufacturing and enterprise systems. The programme has been running for the last 10 years and is regularly updated in line with the subject developments and industrial practices. It covers a wide range of subjects- both compulsory and electives - that enable to understand and deal with complexities of modern industrial environments.

- **Objectives:**
  - To provide a thorough knowledge and understanding of specific advanced and emerging manufacturing technologies.
  - To provide a comprehensive foundation required to exploit the potential of advanced manufacturing systems.
  - To encourage work on real industrial problems, giving confidence in the ideas underlying manufacturing and the practicalities of implementing these ideas.

- **Outcomes:**

  To enable the students
  - to engage in design, development and research involving manufacturing technology
  - to analyse and investigate practical problems and
  - work in the management of manufacturing systems

- **Opportunities:**

  The passed out students of this programmes have been well received by the manufacturing industry as design engineers, manufacturing engineers, production engineers, engineering managers, systems engineers, or research and development engineers. They are placed in various companies like Tata Consultancy Services, Mahindra Satyam, GE, Hindustan Aeronautics Limited, Bharat Dynamics Limited, HBL Nife, Denison Hydraulics-Veljan etc.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

M. Tech. (ADVANCED MANUFACTURING SYSTEMS)

(R15 Regulation)

I YEAR I SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	T/P	Credit
AMS01	Core	Automation in Manufacturing	3	1	4
AMS02		Special Manufacturing Processes	3	1	4
AMS03		Precision Engineering	3	1	4
AMS 11	Elective – I & Elective – II Basket	Product Data Management	3	0	3 + 3
AMS 12		Materials Technology	3	0	
AMS 13		Design for Manufacturing & Assembly	3	0	
AMS 14		Additive Manufacturing Processes	3	0	
AMS 15		Mechatronics	3	0	
AMS 16		Theory of Elasticity & Plasticity	3	0	
AUT32 AMS32 AMS33	Open Elective – I	Design and Manufacturing of MEMS and Micro Systems Quality and Reliability Engineering Neural Network & Fuzzy Systems	3	0	3
AMS51	Lab	Manufacturing Simulation & Precision Engineering lab	0	3	2
AMS61		Mini Project - I	0	0	4
Total			**18**	**6**	**27**

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M. Tech. (ADVANCED MANUFACTURING SYSTEMS)

(R15 Regulation)

I YEAR II SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	T/P	Credit
CAD02	Core	Computer Aided Manufacturing	3	1	4
CAD03		Rapid Prototyping	3	1	4
AMS04		Product Design & Development Strategies	3	1	4
AMS 21	Elective – III & Elective – IV Basket	Quality Engineering in Manufacturing	3	0	3 + 3
AMS 22		Tool Design	3	0	
AMS 23		Theory of Metal Cutting	3	0	
AMS 24		Intelligent Manufacturing Systems	3	0	
AMS 25		Finite Element Method	3	0	
AMS 26		Industrial Robotics	3	0	
AMS41 CAD41 AMS42	Open Elective – II	Industrial Safety Management Concurrent Engineering Design of experiments	3	0	3
AMS52	Lab	CAD/CAM Lab	0	3	2
AMS62		Mini Project - II	0	0	4
Total			**18**	**6**	**27**

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M. Tech. (ADVANCED MANUFACTURING SYSTEMS)

(R15 Regulation)

II YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
AMS63		Comprehensive Viva Voce	0	0	4
AMS71		Internship/Dissertation Phase – I	0	0	8
Total					**12**

II YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
AMS72		Dissertation Phase – II	0	0	18
Total					**18**

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I Year – I Sem. M. Tech. (AMS, Automation & CAD/CAM)

L	P	C
3	1	4

(AMS01) AUTOMATION IN MANUFACTURING

Course Prerequisites: Industrial engineering and Manufacturing technology concepts.

Course Objectives:

- Understand the basic principles of automation and tool transfer, implementation of automated flow line.
- Understand design aspects and analysis of material handling system.
- Understand ways of improving line balance and solving line balancing problems.

Course Outcomes:

Students will be able to:

- Implement concepts of a productive system in automation.
- Apply the concepts of automated flow lines and design technologies.
- Apply it in material handling systems for balancing assembly lines.

UNIT I:

Fundamentals of Manufacturing Automation: Basic Principles of automation, Types of automated systems, Degrees of automation, Automation - reasons, Production operations and automation strategies, Plant Layout, Production concepts and mathematical models, Design the parts for automation, Automatic loading Systems.

UNIT II:

High Volume Production Systems: Automated flow lines, Methods of work flow, Transport transfer mechanisms, buffer storage, Control functions, Automation for machining operations, Design and fabrication considerations.

UNIT III:

Analysis of Automated Flow Lines: Analysis of transfer lines without storage, Partial automation, Automated flow lines with storage buffers, Implementation of automatic flow lines, Line balancing problems, Considerations in assembly line design.

UNIT IV:

Assembly Systems and Line Balance: Manual assembly lines, Line balancing problem, Methods of line balancing, Ways to improve line balancing, Flexible manual assembly lines, Automated assembly systems, Analysis of multi station assembly. Manufacturing Cells, Automated Cells, Analysis of Single Station Cells.

UNIT V:

Automated Material Handling: Types of equipment and functions, Design and analysis of material handling system, Conveyor system, Automated guided vehicle system, Components operation, Types, Design of automated guided vehicles and applications, Automated storage and Retrieval systems - Types, Basic components and Applications, Design for Automated Assembly, Communication Systems in Manufacturing.

Text Books & References:

1. Mikell P. Groover, "Automation, Production Systems and CIM", PHI Pvt., Ltd., 1998
2. P. Radha Krishnan & S. Subrahamanyarn and Raju, "CAD/CAM/CIM", New Age International Publishers, 2003.
3. Singh, "System Approach to Computer Integrated Design and Manufacturing", John Wiley 1996.

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I Year – I Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
	3	**1**	**4**

(AMS02) SPECIAL MANUFACTURING PROCESS

Course Prerequisites: Manufacturing technology, Non conventional machining processes.

Course Objectives:

- Integrate Modern manufacturing operations, including their capabilities, limitations and how to design for lower cost.
- Understand the relationship between customer desires, functional requirements, product materials, product design and manufacturing process selection.
- Understand manufacturing of circuit boards and rapid prototyping.
- Grade Micro and Nanofabrication processes.

Course Outcomes:

Students will be able to:

- Identify the requirement of special manufacturing technique and use the suitable one.
- Appreciate special manufacturing techniques and suggest them for suitable applications. considering desires and functional requirements.
- Apply Micro and Nanofabrication processes.
- Demonstrate the Fused Deposition Method.

UNIT I:

Surface Treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, Economics of coating. Electro forming, Physical Vapor Deposition, Chemical Vapor Deposition, Thermal Spraying, Ion Implantation, Diffusion coating, Diamond coating and Cladding.

UNIT II:

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 III:

Processing of Integrated Circuits: Overview of IC Processing - Processing Sequence, Clean Rooms, Silicon Processing- Production of Electronic Grade Silicon, Crystal Growing, Shaping of Silicon into Wafers, Lithography- Photolithography, Other Lithography Techniques.
Micro Fabrication Processes - Silicon Layer Processes, LIGA Process, Other Micro fabrication Processes
Nano Fabrication Processes - Top-Down Processing Approaches, Bottom-Up Processing Approaches

UNIT IV:

Advanced Manufacturing: E-Manufacturing, High Speed Machining, Micromachining, Nanomachining and Additive manufacturing.

UNIT V:

Prototyping: Need of Prototyping, Process of Prototyping and its Advantages, Rapid Prototyping and its working principles, Methods, Stereo-Lithography, Laser Smiting, Fused Deposition Method, Applications and Limitations.

Text Books & References:

1. Manufacturing Engineering and Technology, I Kalpak Jian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.
3. Fundamentals of modern manufacturing, 4th ed/ Mikell P. Groover,/ John Wiley & Sons, Inc
4. Advanced Machining Processes / V.K.Jain / Allied Publications.
5. Introduction to Manufacturing Processes / John A Schey / McGraw Hill.

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I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(AMS03) PRECISION ENGINEERING

Course Prerequisites: Accuracy and tolerances, geometric dimensioning, machine drawing and production engineering.

Course Objectives:

- Asses the machine tool accuracy and types of errors, datum features, tolerance zone conversion, process capability and surface finish.
- understand the tolerance charting techniques.
- Explain the fundamentals of nanotechnology and nanometer accuracy.
- Understand measuring system processing – Mechanical and optical measuring systems.

Course Outcomes:

Students will be able to:

- Apply fundamental knowledge of machine tool accuracy and geometric dimensioning for Components.
- Apply the concept of process capability while choosing the machine.
- Decide on measuring system for inspection components.
- Apply nanotechnology and nanometer accuracy

UNIT I:

Concepts of Accuracy: Introduction - Concept of Accuracy of Machine Tools - Spindle and Displacement Accuracies - Accuracy of Numerical Control Systems - Errors due to Numerical Interpolation, Displacement Measurement System and Velocity tags

Geometric Dimensioning and Tolerancing: Tolerance Zone Conversions - Surfaces, features, Features of Size, Datum Features - Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's - Datum Feature of Representation - Form controls, Orientation Controls - Logical Approach Tolerancing.

UNIT II:

Datum Systems: Design of freedom, Grouped Datum System - different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue - slot pair - Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT III:

Tolerance Analysis: Process Capability, Mean, Variance, Skewness, kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT IV:

Tolerance Charting Techniques: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum features - functional and manufacturing Components design - Machining Considerations, Redesign for manufactured, Examples.

UNIT V:

Fundamentals of Nanotechnology: Systems of nanometer accuracies, Mechanism of metal Processing, Nano physical processing of atomic bit units, Nanotechnology and Electrochemical atomic bit processing.

Measuring Systems Processing: In processing or in-situ measurement of position of processing point, Post process and on-machine measurement of dimensional features and surface, Mechanical and optical measuring systems.

Text Books:

1. Precision Engineering in Manufacturing/Murthy R.L/New Age International (P) Limited, 1996
2. Geometric Dimensioning and Tolerancing/ James D. Meadows / Marcel Dekker Inc. 1995

References:

1. Nano Technology / Norio Taniguchi / Oxford University Press, 1996.
2. Engineering Design - A systematic Approach / Matousek / Blackie & Son Ltd., London.

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I Year – I Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS11) PRODUCT DATA MANAGEMENT

Course Prerequisites: Production process, CAD, CAM.

Course Objectives:

- Understand process management, plan, and product development.
- Understand about Robust design and Integration of CAE, CAD and CAM tools along with the principles of rapid prototype.
- Understand Product Development Management process.

Course Outcomes:

Student would be able to:

- Develop a sequence for developing a product in a company.
- Understand the concepts of robust design, Rapid prototyping.
- Understand the concept of Product development.

UNIT I:

Introduction: Need for IPPD, Strategic importance of product development, Integration of customer designer material supplier and process planner, Competitor and Customer, Behavior analysis, Understanding customer, Promoting customer understanding, Involve customer in development and managing requirements, Organization – Process management and improvement, Plan and establish product specification.

UNIT II:

Concept Generation and Selection: Task, Structured approaches, Clarification, Search, Extemally and internally, Explore systematically, Reflect on the solutions and process, Concept selection, Methodology, Benefits

Product Architecture: Implications, Product change, Variety, Component standardization, Product performance, Manufacturability.

UNIT III:

Product Development Management: Establishing the architecture, Creation, Clustering, Geometric layout development, Fundamental and incidental interactions related system level design issues, Secondary systems, Architecture of the chunks, Creating detailed interface specifications.

Industrial Design: Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools - simulating product performance and manufacturing 'processing electronically - Need for industrial design - impact - design process.

UNIT IV:

Investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V:

Design for Manufacturing and Product Development: Definition - Estimation of manufacturing cost - reducing the component/costs and assembly costs- Minimize system complexity. Prototype basics - Principles of Rapid prototyping - planning for prototypes – Economic analysis - Understanding and representing tasks - baseline project planning - accelerating the project execution.

Text Books & References:

1. Product Design and Development / Kari T. Ulrich and Steven D. Eppinger / McGraw Mill International Edns.1999.
2. Concurrent Engg/integrated Product development / Kemnneth Crow / DRM Associates.
3. Effective Product Design and Development / Stephen Rosenthal / Business One Orwin, Homewood, 1992.
4. Tool Design - Integrated Methods for Successful Product Engineering / Staurt Pugh / Addison Wesley Publishing, NY, 1991.

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I Year – I Sem. M.Tech. (AMS & Automation)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS12) MATERIALS TECHNOLOGY

Course Prerequisites: Maths, Physics, Chemistry, Metallurgy and Material science

Course Objectives:

- Understand strengthening mechanisms of materials and their properties and relationship between them.
- Understand the principles of material science applied to material technology.
- Understand how to choose a material for a given application.

Course Outcomes:

Students should be able to:

- Apply fundamental knowledge of mathematics to modeling and analysis of materials.
- Apply strengthening mechanisms to analyze problems by making good assumptions.
- Apply fundamental principles to manufacture different types of components.

UNIT I:

Elasticity in metals and polymers, mechanism of plastic deformation , Role of dislocations, Yield stress, Shear strength of perfect and real crystals, Strengthening mechanism, Work hardening, Solid solution, Grain boundary strengthening, Poly phase mixture, Precipitation, Particle Fiber and dispersion strengthening; Effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material

UNIT II:

Griffith's Theory, Stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson - Miller parameter, Deformation and Fracture mechanism maps.

UNIT III:

Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Pari's Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT IV:

Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT V:

Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

Nonmetallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesive and Coatings, structure, Properties and Applications of Engineering, polymers, Advanced Structural Ceramics WC, TiC, TiG, A 12 O3, SiC, Si3 N4, CBN and Diamond - properties, Processing and applications.

Text Books:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ 2nd Edition, McGraw Hill, 2000
2. Mechanical Metallurgy/George E. Dieter/McGraw Hill, 1998.

References:

1. Selection and use of Engineering Materials, 3e/Charles J.A/Butterworth Heinemann.
2. Material Science & Metallurgy by Kodgire.

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I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS13) DESIGN FOR MANUFACTURING AND ASSEMBLY

Course Prerequisites: Production technology, Machine Tools, Material Technology

Course Objectives:

- Impart the knowledge on steps involved in design process and material selection
- Understand about the design rules involved in machining and casting
- Understand about the design rules involved in metal joining, forging, extrusion and sheet metal work
- Understand about the design principles involved in manual and automatic assembly transfer systems

Course Outcomes:

Student will be able to:

- Apply the knowledge on steps involved in design process and material selection
- Apply the knowledge on design rules involved in machining and casting
- Analyze the design rules involved in metal joining, forging, extrusion and sheet metal work
- Design and analyze the principles involved in manual and automatic assembly transfer systems

UNIT I:

Introduction: Design philosophy, Steps in Design process, General Design rules for manufacturability, Basic principles of designing for economical production, Creativity in design.

Materials: Selection of Materials for design, Developments in Material technology, Criteria for material selection, Material selection, Interrelationship with process selection, Process Selection charts.

UNIT II:

Machining Process: Overview of various machining processes, Design rules for machining, Redesigning of components for machining ease with suitable examples

Metal Casting: Appraisal of various casting processes, General design considerations for casting, Overview of solidification simulation in casting design, Product design rules for sand casting, Casting Defects.

UNIT III:

Metal Joining: Appraisal of various welding processes, Factors in design of weldments, General design guidelines, Pre and post treatment of welds, Effects of thermal stresses in weld joints, Welding Defects, Design of brazed joints.

Forging: Design factors for Forging, Closed die forging design, Parting lines of die drop forging die design

Extrusion & Sheet Metal Work: Design guidelines for extruded sections, Design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram, Die Design for Blanking.

UNIT-IV:

Assembly Advantages: Development of the assembly process, Choice of assembly method, Assembly advantages, Social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, Intermittent transfer, Indexing mechanisms and operator paced free transfer machine.

UNIT-V:

Design of Manual Assembly: Design for assembly fits in the design process, General design guidelines for manual assembly, Development of the systematic DFA methodology, Assembly efficiency, Classification system for manual handling, Classification system for manual insertion and fastening, Effect of part symmetry on handling time, Effect of part thickness and size on handling time, Effect of weight on handling time, Parts requiring two hands for manipulation, Effects of combinations of factors, Effect of symmetry, Effect of chamfer design on insertion operations, Estimation of insertion time.

Text Books:

1. Geoffrey Boothroyd, “Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Engineering Design – Material & Processing Approach – George E. Dieter, McGraw Hill Intl. 2nd Ed. 2000.

References:

1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekker, N.Y. 1990.
2. A. Delchambre "Computer Aided Assembly Planning”, Springer London, 1992.

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I Year – I Sem. M.Tech. (AMS, CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS14) ADDITIVE MANUFACTURING PROCESSES

Course Prerequisites: Manufacturing Technology, CAD/CAM.

Course Objectives:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effect of the additive manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in additive manufacturing.
- Realize the potential implications of AM technologies on product development and identify needs for new technologies to accelerate the advancement and impact of AM.

Course Outcomes:

Student will be able to:

- Upon completion of this course, the student can able to complete different methods to discuss the effects of the additive manufacturing technologies and analyse the characteristics of the different materials in additive manufacturing.
- Select a suitable material for Additive Manufacturing.
- Analyze different Methods for post-processing of additive manufacturing parts.
- Understand the applications of Additive Manufacturing.
-

UNIT I:

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM,

AM Process Chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.

UNIT II:

Classification of AM Processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

UNIT III:

Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

UNIT IV:

Guidelines for Process Selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries

UNIT V:

Post Processing of AM Parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM: Introduction, new types of products and employment and digiproneurship.

Text Books & References:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
2. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
3. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001
5. Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Hanser Publishers, 2013.

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I Year – I Sem. M.Tech. (AMS, Automation& CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS15) MECHATRONICS

Course Prerequisites: Basic electronics, manufacturing, intelligence systems.

Course Objectives:

- To understand mechatronics principles and applications.
- To explore architecture of intelligence machines
- Understand machine design principles for similar applications

Course Outcomes:

Students will be able to

- Develop motion control algorithm
- Effectively choose /select proper sensor actuator to a given application
- Develop an intelligent automated system and manufacturing data base system

UNIT I:

Introduction: Definition of Mechatronics products, Design Considerations and Tradeoffs, Overview of Mechatronic products. Intelligent Machine vs Automatic. Machine Economic and social justification.

Actuators and Motion Control: Characteristics of Mechanical, electrical, Hydraulic and pneumatic actuators and their limitations. Control parameters and system objectives. Mechanical configurations. Popular control system configurations. S-curve, Motor/Load inertia matching, design with linear slides.

UNIT II:

Motion Control Algorithms: significance of feed forward control loops, shortfalls, Fundamental concepts of adaptive and fuzzy control. Fuzzy logic compensatory control of transformation and deformation non-Z linearities.

UNIT III:

Architecture of Intelligent Machines: Introduction to Microprocessor and programmable logic controllers and identification of system, System design Classification. Motion control aspects in Design.

UNIT IV:

Manufacturing Data Bases: Data Base management system, CAD/CAM Data bases, Graphic Data Base, Introduction to object oriented concepts, objects oriented model language interface, procedures and methods in creation, edition and manipulation of data.

UNIT V:

Sensor Interfacing: Analog and Digital Sensors for Motion Measurement, Digital Transducers, Human — Machine and Machine — Machine Interfacing devices and strategy.

Machine Vision: Feature and Pattern Recognition methods, concepts of perception and cognition in decision making.

Text Books & References:

1. Control sensors and actuators, “Designing Intelligent Machines”, Open University, London
2. Michel B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems” Tata McGraw Hill.
3. C.W. De Silva, “Control sensors and actuators”, 2 Edition, Prentice Hall.

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I Year – I Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS16) THEORY OF ELASTICITY AND PLASTICITY

Course Prerequisites: Mathematics, Physics, Mechanics, Strength of materials.

Course Objectives:

- Understand the mechanisms of stress, strain and their relationships for ductile metals.
- Understand bending of bars with different mountings and cross sections.
- Understand elastic and plastic deformations in engineering materials.

Course outcomes:

Student would be able to:

- Identify the components under plane stresses and plane strains.
- Analyze engineering components subjected to various loads and comment on their design and suggest a new design.
- Design components for a given application considering elastic and plastic deformation.

UNIT I:
Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.

UNIT II:
Problem in Rectangular Coordinates: Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.
Problems in Polar Coordinates: General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT III:
Analysis of Stress and Strain in Three Dimensions: Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General Theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT IV:
Bending of Prismatic Bars: Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.
Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT V:
Methods of Solving Practical Problems: The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

Text Books & References:

1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N.
2. An Engineering Theory of Plasticity by E.P. Unksov.
3. Applied Elasticity by W.T. Wang.
4. Theory of Plasticity by Hoffman and Sacks.

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I Year – II Sem. M.Tech. (AMS & Automation)	**L**	**P**	**C**
Open Elective - I	**3**	**0**	**3**

(AUT32) DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS

Course Prerequisites: Electrical and Mechanical Engineering, Physics.

Course Objectives:

- Understand the need, general principles and mechanisms of the various components of MEMS.
- Understand the study of atomic structures, ions, molecular theory, doping of semiconductors, quantum physics.
- Understand the engineering mechanics analysis on the design of the micro systems and the study of different materials used for their fabrication processes.

Course Outcomes:

Students will be able to:

- Apply the basics of MEMS and the Microsystems.
- Apply knowledge of engineering science, mechanics, fluid systems, thermal engineering and material science while designing of systems.
- Design and fabricate a simple MEMS device.

UNIT I:

Overview and Working Principles of MEMS and Microsystems: MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics.

UNIT II:

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Force, Doping of Semiconductors, The diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT III:

Engineering Mechanics for Microsystems Design: Static Bending of thin plates, Mechanical Vibration, Thermo Mechanics, Fracture Mechanics, Thin film Mechanics, Overview of Finite Element Stress Analysis.

UNIT IV:

Thermo Fluid Engineering & Microsystems Design: Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations in Continuum Fluid dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid Flow in Sub micrometer and Nanoscale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in submicrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT V:

Materials for MEMS & Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process

Text Book:

1. Tai-Ran Hsu, MEMs & Microsystems: Design & Manufacture, Tata McGraw Hill, ed., 2002

References:

1. Maluf, M. "An Introduction to Microelectromechanical Systems Engineering", Artech House, Boston, 2000.
2. Trimmer, W.S.N. "Micro robots and Micromechanical Systems", Sensors & Actuators, Vol. 9, 1989.
3. Trim, D.W. "Applied Partial Differential Equations" VPWS-Kent Publishing, Boston 1990.
4. Madou, M. "Fundamentals of Micro fabrication", CRC Press, Boca Raton, 1997.
5. Hsu, T.R. "The Finite Element Method in Thermomechanics", Alien & Unwin, London.

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I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
Open Elective I	**3**	**0**	**3**

(AMS32) QUALITY AND RELIABILITY ENGINEERING

Course Prerequisites: Mathematics, Statistics, Quality Control and Industrial Engineering

Course Objectives:

- To understand the approaches and techniques to assess and improve process or product quality and reliability.
- To understand the robust design methodology in solving practical engineering problems
- To understand the types of factors and principles of Quality Loss Function and to Comprehend various quality control tools.
- To understand the tools and techniques that can be used early in the design phase to effectively influence a design from the perspective of system reliability, maintainability, and availability.

Course Outcomes:

Student will be able to:

- Select and use the proper orthogonal arrays in designing, conducting and analyzing the experiments.
- Utilize the analytical techniques to find out the variation in the data and obtain optimal results in the process of achieving robust design.
- Identify, formulate, and solve Quality and reliability engineering related problems
- Develop an ability to design a system component or process to meet desired quality within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

UNIT I:

Quality Engineering: Concepts of Quality Engineering, Taguchi's Approach to Quality, On-line and Offline Quality Control, Difference from Classical Approach, Quality Loss Function, System Design, Parameter Design, Tolerance Design, Causes of Variation, Classification of Parameters, Parameter Design Strategy

UNIT II:

Steps in Robust Design, Quality Characteristics and Objective Functions, Control Factors and their Levels, Noise Factors and Testing Conditions, Planning and Conducting the Experiment Response Surface Methodology – First- order and Second-order Models Crossed Array Experiments, Signal-to-Noise Ratios

UNIT III:

Reliability Engineering: The Reliability Function, Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics, Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models – Constant-hazard, Linear-hazard, Nonlinear-hazard and Gamma Models

UNIT IV:

System Reliability, Two-state Modeling, Series Models, Parallel Models, Series-parallel and Parallel-series Models, *k-out-of-m* Models, Standby Models, Non-series-parallel Models, Fault-tree Approach to System Modeling

UNIT V:

Maintained Systems, Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance

Text Books & References:

1. Antony J (2003). Design and Experiments for Engineers and Scientists, Butterworth- Heinmann.
2. Cochran W and Cox G (2000). Experimental Designs, 2nd edition, John Wiley and Sons Inc.
3. Dean A and Voss D (2006). Design and Analysis of Experiments, Springer.
4. Jeff Wu C and Hamada M (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley and Sons Inc.
5. Montgomery D (2001). Design and Analysis of Experiments, 5th edition, Wiley.
6. Phadke, M (1989). Quality Engineering using Robust Design, Prentice Hall.
7. Ross, P (1996). Taguchi Techniques for Quality Engineering, 2nd edition, McGraw Hill.
8. Balgurusamy E (2003). Reliability Engineering, Tata McGraw Hill.
9. Birolini A (2004). Reliability Engineering: Theory and Practice, 4th edition, Springer.
10. Crowder M, Kimber A, Smith R and Sweeting T (1991). Statistical Analysis of Reliability Data, Chapman and Hall.
11. Kumamoto H and Henley E (1996). Probabilistic Risk Assessment and Management for Engineers and Scientists, IEEE Press.

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I Year – I Sem. M.Tech. (AMS & Automation)	**L**	**P**	**C**
Open Elective I	**3**	**0**	**3**

(AMS33) NEURAL NETWORK AND FUZZY SYSTEMS

Course Prerequisites: Mathematics, Concept of human logic, reasoning and operations.

Course Objectives:

- Understand the fundamentals of fuzzy logic, its relative principles.
- Learn the concepts of neural networks, hybrid intelligence.
- Identifying the real time applications.

Course Outcomes:

Students will be able to:

- Identify the potential areas of application of fuzzy logic.
- Design fuzzy logic and genetic algorithm.
- Apply the concepts of fuzzy control to real time systems.

UNIT I:
Knowledge Representation and processing – Knowledge and Intelligence – logic – Frames – production systems. Fundamentals of Fuzzy logic – Fuzzy sets – Fuzzy Relation – composition and Inference.

UNITII:
Membership Function estimation – Importance – Fuzzy to crisp conversion – methods – Fuzzy extension principle – Fuzzy tautologies – Implication operation Composition operation.

UNITIII:
Basics of Fuzzy Control – Architecture of Fuzzy Control – examples of Fuzzy Control system Design – Robotic Control system – Industrial applications.

UNIT IV:
Hybrid Intelligence – Basic concepts of neural network – Inference and learning – Classification Models – Association models, Optimization models – Neural Network learning.

UNIT V:
Rule Based Neural Networks – Network Training – Application of Neural Network in Mathematical Modeling – knowledge based approaches – applications in Mechanical Engineering – Fuzzy – Neural, examples, Neuro – Fuzzy examples – Intelligence in Automation.

Text Books & References:

1. Clarence W.de Silva - Intelligent Control Fuzzy Logic Applications, CRS Press, 1995
2. Timothy J. Ross - Fuzzy Logic with engineering Applications, McGraw Hill Inc., 1995.
3. Limin Fu - Neural Networks in Computer Intelligence, Tata McGraw Hill Publishing Company Ltd., 2003
4. Stamations and V. Kartalopoulos - Understanding Neural Networks and Fuzzy Logic, Basic concepts Applications, IEE Neural Networks Council Prentice Hall of India Pvt., Ltd., 2001.
5. James A. Freeman and David M. Skapura - Neural Networks Algorithms, Applications & Programming Techniques, Pearson Education Asia, 2001.
6. Yegnarayane.B - Artificial Neural Networks, Prentice Hall – 2001.

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I Year – I Sem. M.Tech. (AMS & Automation)	**L**	**P**	**C**
	0	**3**	**2**

(AMS51) MANUFACTURING SIMULATION & PRECISION ENGINEERING LAB

Course Prerequisites: Mathematics, FMS, machine Tools, Process Planning, Metrology, Plant Layout, Automation.

Course Objectives:

- Understand and learn simulation packages of discrete time systems for Queuing systems, Job shop systems and Inventory systems.
- Appreciate the various manufacturing processes, understand the chip morphology and cutting forces involved.
- Learn the concepts of PLC and microcontrollers.

Course Outcomes:

Students will be able to:

- Simulate and develop inventory, planning and scheduling systems.
- Simulate and develop appropriate production systems for a plant.
- Determine cutting forces, measuring parameters and dimensions of precision parts.
- Use hydraulic and pneumatic circuits and PLC in part manufacture.

MANUFACTURING SIMULATION LABORATORY

1. Simulation of Continuous Time Systems and Discrete Time Systems.
2. Simulation of Queuing Systems
3. Simulation of Inventory Systems.
4. Simulation of Flexible Manufacturing Systems.
5. Simulation of Job Shop Production Systems.

(Problems may include AGV Planning, ASRS Simulation, JIT System, Kanban flow, MRP, Shop Floor scheduling, Material Handling Systems)

Packages: *Use of* ***Flexsim, AutoMOD, PROMOD, SLAM-H, CAFINS*** *Software etc*

PRECISION ENGINEERING LABORATORY

1. Study of Chip formation in Turning Process.
2. Determination of Cutting forces in Turning.
3. Study of operation of Tool & Cutter grinder, Cylindrical grinder.
4. Inspection of parts using Toolmakers Microscope, Roughness and Form tester
5. Hydraulic and Pneumatic Circuits.
6. Closed Loop Control Systems.
7. Studies in Programming Logic Controllers (PLC) programming.
8. Studies of Micro Controllers.

I Year- I Sem. M.Tech. (Advanced Manufacturing Systems)	L	T/P/D	C
	0	0	4

(AMS61) MINI PROJECT – I

A mini project work shall be carried out on any topic of Advanced Manufacturing and a seminar should be given on the same along with a brief report.

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD02) COMPUTER AIDED MANUFACTURING

Course Prerequisites: CAD/CAM, Manufacturing & Production Technology.

Course Objectives:

- Understand the NC Systems, NC part programming fundamentals
- Understand the CNC systems, APT language and develop the APT program for geometric shapes
- Understand the concepts of CNC Tooling, DNC, Adoptive control ,CAD/CAM software implementation, Postprocessor
- Understand the concept of Computer aided process planning & hybrid CAPP, and Artificial Neural Network in CAD.

Course Outcomes:

Students will be able to:

- Apply knowledge and work the NC Machines and able to program
- Develop an optimal APT program for a given component.
- Apply Tooling, DNC & Adoptive control, CAD/ CAM software, Post processor knowledge
- Work with models of CAPP, CAI & QC

UNIT I:

Computer Aided Programming [1] : General information

NC Systems [2] **:** NC Coordinate systems, elements of NC systems, Classification of NC Systems, Advantages & Disadvantages of NC Systems

NC Part Programming [2]**:** Manual Part Programming fundamentals(word address format, Preparatory function , Feed, Speed, Tool Change functions, Dimensional words, Canned Cycles, Tool Offset, Tool Length Compensation, Tool nose radius compensation)

UNIT II:

CNC Systems [2]**:** What is CNC, functions of CNC, Features of CNC, Advantages of CNC

APT programming [1&2]**:** Computer Assisted Part Programming, Computer Assisted NC Part programming Languages, APT Language & Programming (statements & Programming), Examples of APT programming problems (2D machining- Milling & Drilling only)

UNIT III:

Tooling for CNC Machines [-]**:** Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, Quick change tooling system, automatic head changers/ ATC, Modular fixturing

DNC Systems[2] **:** DNC Concepts, Objectives of DNC, Components of DNC, Types of DNC, advantages and disadvantages of DNC

Adaptive Control [1] **:** Adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, Grinding

UNIT IV:

Introduction to CAD/CAM software [2]**:** NC programming using CAD/CAM, Tool path generation using CAD/CAM, Technology of CAM, How Computer assisted programming systems work

Post Processors for CNC [3]**:** Introduction to Post Processors, The necessity of a Post Processor, the general, structure of a Post Processor, the functions of a Post Processor

UNIT V :

Computer Aided Process Planning [2]**:** CAPP system- Retrieval type CAPP System, Generative type CAPP system, Hybrid CAAP System

Computer Aided Inspection and Quality Control [2] **:** CMM Construction, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods

Text Books:

1. Computer Control of Manufacturing Systems- Yoram Koren- McGraw Hill
2. Computer Aided Design Manufacturing - K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI
3. Numerical Control Machine Programming and Software Design- C H Chang, M A Melkanoff, Prentice Hall

References:

1. CAD/CAM Computer Aided Design And Manufacturing- Mikell P. Groover, E W Zimmers Jr
2. CAD/CAM Principles and Applications- P.N.Rao, McGraw Hill
3. Computer Aided Manufacturing- TC Chang, Wysk, HP Wang, Pearson/ Prentice Hall International
4. Mastering CAD/CAM - Ibrahim Zeid

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD03) RAPID PROTOTYPING

Course Prerequisites: Manufacturing Technology, Materials Technology, CAD/CAM

Course Objectives:

- An understanding of the various rapid prototyping and rapid tooling technologies;
- The knowledge to select appropriate technologies for product development purposes.
- The rapid prototyping process will be illustrated by the actual design and fabrication of a part.

Course Outcomes:

Students will be able to:

- Describe the differences and of the application of a range of additive manufacturing processes.
- Select and use correct CAD formats in the manufacture of a 3D printed part.
- Set up and fabricate a 3D part using an additive manufacturing machine.
- Select the appropriate fabrication technology, or technologies, for a given prototyping task.

UNIT I:
Introduction: Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP. RP Process chain, 3D modeling, data conversion and transmission, checking and preparing, building, post processing.

UNIT II:
Liquid Based RP System: 3D systems' SLA, Cubital's SGC, Sony's SCS, Other similar commercial RP systems, micro fabrication.

UNIT III:
Solid Based RP System: Helisys LOM, Stratasys FDM, 3D systems MJM, Other similar commercial RP systems.

UNIT IV:
Powder Based RP Systems: DTM's selective laser sintering (SLS), MIT's 3D printing (3DP), BPM Technology's ballistic particle manufacturing (BPM)

UNIT V:
Rapid Prototyping Data formats: STL format, STL file problem, Consequences of building a valid and invalid tessellated model, STL file repair, newly proposed formats.

Text Books:
1. Rapid Prototyping: Principles and Applications - Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, World Scientific Pub Co.
2. Rapid Manufacturing – D.T. Pham and S. S. Dimov, Springer Publication.

References:
1. Rapid Prototyping : Theory and Practice - Ali Kamrani, Emad Abouel Nasr (Editors), Springer Publication
2. Rapid Prototyping: Principles and Applications- Rafiq I. Noorani, Wiley.
3. Rapid Prototyping -- Andreas Gebhardt, Hanser Gardner Publications

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I Year – II Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
	3	**1**	**4**

(AMS04) PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Course Prerequisites: Engineering Drawing, Engineering Design, Manufacturing

Course Objectives:

- Introduce the basic concepts of product design and product development process
- Create awareness about concept generation and the role of multiple functions in creating a new product
- Knowledge about the product features and its architecture so as to incorporate them suitably in product
- Learn about the economics of product development and intellectual property issues

Course Outcomes:

Student will be able to:

- Understand the product design and development process and the integration of customer requirements in product design
- Apply structural approach to concept generation, selection and testing
- Demonstrate the skills in creation of a product by considering various aspects like product architecture, industrial design and design for manufacture
- Evaluate the economics of product design and development and apply for intellectual property

UNIT I:

Introduction: Introduction to product design and development, Characteristics of successful product development, Composition of product development team, Challenges of product development, Generic product development process and its adaptation, Process flows for various product developments, Product development organizations

UNIT II:

Customer Needs: Raw data collection, Its interpretation in terms of customer needs, Organizing the needs into hierarchy, Establishing the relative importance of needs and its reflection on the results.

Product Specifications: Definitions, When to establish specifications, Establishing target specifications, Setting final specifications

UNIT III:

Concept Generation, Selection & Testing: Activity of concept generation, Five step method, Introduction to concept selection, Benefits of structured method, Concept screening, Concept scoring, Concept testing methodology

UNIT IV:

Product Architecture: Introduction, Its implications, Establishing the architecture, Platform planning, Design issues

Industrial Design: Industrial design process – Need, Impact, Management and Assessment

Design for Manufacturing & Prototyping: DFM defined, DFM process, Introduction to prototyping - Principles Technologies, Planning for prototypes

UNIT V:

Economics of Product Development: Elements, Economic analysis process, Factors for success of project, Qualitative analysis

Intellectual Property: Introduction, Overview of patents, Invention disclosure process

Text Books:

1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, Tata McGraw-Hill
2. Kevin Otto and Kristin Wood, Product Design, Pearson Education

References:

1. George E. Dieter, Linda C. Schmidt, Engineering Design, McGraw-Hill International Edition
2. Yousef Haik, T. M. M. Shahin, Engineering Design Process, Cengage Learning
3. Clive L. Dym, Patrick Little, Engineering Design: A Project-based Introduction, John Wiley & Sons

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I Year – II Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS21) QUALITY ENGINEERING IN MANUFACTURING

Course Prerequisites: Statistics, Statistical Quality Control.

Course Objectives:

- Understand the types of factors and principles of Quality Loss Function.
- Understand the robust design methodology in solving practical engineering problems.
- Comprehend the various quality control tools.

Course Outcomes:

Students will be able to:

- Value the concept of quality, use quality tools and obtain the quality loss.
- Utilize the analytical techniques to find out the variation in the data and obtain optimal results.
- Select and use the proper orthogonal arrays in designing, conducting and analyzing the experiments.

UNIT I:

Quality Value and Engineering: An overall quality system, Quality engineering in product design, Quality engineering in design of production processes, Quality engineering in production.

Loss Function and Quality Level: Derivation and use of Quality Loss Function (QLF), Economic consequences of tightening tolerances as a means to improve quality, Evaluations and types tolerances - N-type, S-type and L-type.

UNIT II:

Analysis of Variance (ANOVA): NO - way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT III:

Orthogonal Arrays: Introduction to OA, Degrees of Freedom, Structure of OA, Linear Graphs & Interaction tables, Strategies in Experimentation - Typical test strategies, Better test strategies & Efficient test strategies, Steps in designing, conducting and analyzing an experiment.

Interpolation of Experimental Results: Interpretation methods, Percent contribution, Estimating the mean.

UNIT IV:

Tolerance Design and Tolerancing: Functional limits, Tolerance design for N-type, L-type and S-type characteristics, Tolerance allocation for multiple components.

Parameter and Tolerance Design: Introduction to parameter design, Signal to noise ratios, Parameter design strategy, Some of the case studies on parameter and tolerance designs.

UNIT V:

Quality Tools: ISO-9000 Quality System, Business Process Re-engineering (BPRE), Six-sigma, Bench making, Quality circles, Brain Storming, Fishbone diagram.

Text Book:

1. Taguchi Techniques for Quality Engineering /Phillip J. Ross/ McGraw Hill, Intl. II Edition, 1995.

References:

1. Quality Engineering in Production systems / G. Taguchi, A- Elsayed et al / McGraw Hill Intl. Edition, 1989.
2. Taguchi Methods explained: Practical steps to Robust Resign / Tapan P. Bagchi /Prentice Hall Ind Pvt. Ltd., New Delhi.

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I Year – II Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS22) TOOL DESIGN

Course Prerequisites: Design principles, machine tools, process engineering.

Course Objectives:

- Analyze the properties of tool materials such as ferrous, non ferrous, non metallic materials and their heat treatment .
- Design single and multi point cutting tools for various applications.
- Create Jigs and Fixtures design.
- Analyze the design of sheet metal tools for blanking, piercing, bending, forming and drawing etc.

Course Outcomes:

Students should be able to:

- Evaluate the single and multi point cutting tools for various methods.
- Analyze the design of jigs and fixtures for several components depending on quantity requirement.
- Analyze the sheet metal tools for blanking, piercing, bending, forming and drawing.
- Apply an appropriate heat treatment for the tools.

UNIT I:

Tool Materials: Properties of materials- Tools steels, Cast Iron, Mild or low carbon steels, Non metallic and nonferrous materials and its Heat treatment.

UNIT II:

Design of Cutting Tools: Single Point cutting tools: Milling cutters, Drills, Selection of carbide steels - Determination of shank size for single point carbide tools, determining the insert thickness for carbide tools

UNIT III:

Design of Jigs And Fixtures: Basic principles of location and clamping: Locating methods and devices, Jigs-Definition Types, General considerations in the design of Drill jigs, Drill bushing, Methods of Construction. Fixtures- Vice fixtures, Milling, Boring, Lathe and grinding fixtures.

UNIT IV:

Design of Sheet Metal Blanking and Piercing Dies: Fundamentals of Die cutting operation, Power press types, General press information, Materials Handling equipment. Cutting action in Punch and die operations. Die clearance, Types of Die construction. Die design fundamentals-Blanking and piercing die construction, pilots, stripper and pressure pads presswork material, Strip layout, Short run tooling for piercing.

UNIT V:

Design of Sheet Metal Bending, Forming and Drawing Dies: Bending dies, drawing dies, forming dies, drawing operations, Variables that effect metal flow during drawing. Determination of blank size, Drawing force, Single and double action draw dies.

Texts Books:

1. Donaldson "Tool Design", Tata McGraw Hill
2. George F Dieter "Mechanical Metallurgy" Tata McGraw Hill

References:

1. Taylour Altm, Sool Ik-Oh and Harold L. Gegel - "American Society for Metals", 1983.
2. Kurt Lange, "Hand Book of Metal forming", McGraw-Hill, 1987.

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I Year – II Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS23) THEORY OF METAL CUTTING

Course Prerequisites: Production technology, Machine tools

Course Objectives:

- Understand the theory of metal cutting, cutting tools geometry and their areas of application based on principles of metal cutting.
- Understand cutting forces, cutting temperature and their measurement.
- Understand tool wear, replacement strategy, tool materials and their properties.
- Understand the economics of machining.

Course Outcomes:

Students will be able to

- Analyze the theory of metal cutting, cutting tool and its geometry.
- Select a cutting tool material and appropriate material to be cut.
- Know the methods of measuring the cutting forces, temperature and their significance
- Select a cutting tool with optimal tool life to maximize material removal rate.

UNIT I:

Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut – Types of chips chip breakers. Formation of built-up edge and its effect, Orthogonal and Oblique cutting processes – definition, Forces and energy calculations (Merchant's Analysis) – Power consumed.

UNIT II:

Measurement of Cutting Forces : Reasons for measuring cutting forces, Classification of cutting force dynamometers – mechanical, piezoelectric, and strain gage type dynamometers, Dynamometers for lathe, drilling, and milling, Calibration of dynamometers.

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation.

UNIT III:

Cutting tool materials: Historical developments, essential properties of cutting tool materials, types, composition and application of various cutting tool materials, selection of cutting tool materials.

Tool Life and Tool Wear: Theories of tool wear – adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index. Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting, effect of process parameters on tool life.

UNIT IV:

Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions, Temperature distribution, zones, and experimental techniques. Use of tool- work thermocouple for determination of temperature. Temperature distribution in Metal Cutting.

Cutting Fluids: Functions of cutting fluids, types of cutting fluids, properties, selection of cutting fluids.

UNIT V:

Economics of Machining:

Introduction, elements of total production cost, optimum cutting speed and tool life for minimum cost, optimum cutting speed and tool life for maximum production, problems.

Text books:

1. Principles of Metal Cutting by G. C. Sen and A. Bhattacharya; Publisher: New Central Book Agency.
2. Metal Cutting Principles by M C Shaw; Publisher: Oxford and IBH Publications.

References:

1. Fundamentals of Machining by Boothroyd; Publisher: Edward Amold
2. Fundamentals of Metal Cutting and Machine tools by B. L. Juneja, G. S. Sekhom & Nitin Seth; Publisher: New Age International
3. Principles of Metal Cutting by G. Kuppuswamy; Publisher: Universities Press

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS24) INTELLIGENT MANUFACTURING SYSTEMS

Course Prerequisites: Mathematics, Machine Tools, Process Planning, Plant Layout, Material Handling.

Course Objectives:

- Understand components, structures, function of CIM, computer system Architecture and data requirements.
- Understand components of knowledge based systems, machine learning, Artificial Intelligence and Neural Networks and their applications in manufacturing.
- Understand process planning and its automation, equipment selection and modeling and manufacturing system design.

Course Outcomes:

Students will be able to:

- Design and develop CIM system.
- Apply concepts of neural networks in areas of manufacturing.
- Apply Group Technology models and algorithms for automated manufacturing cells.

UNIT I:

Computer Integrated Manufacturing: Systems, Structure and functional areas of CIM system – CAD, CAPP, CAM, CAQC, ASRS- Advantages of CIM, CIM Models, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information, Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT II:

Components of Knowledge Based Systems: Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition

UNIT III:

Machine Learning: Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV:

Automated Process Planning: Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT V:

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation — Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

Text Books & References:

1. Intelligent Manufacturing Systems by Andre Kusaic.
2. Artificial Neural Networks by Yagna Narayana
3. Automation, Production Systems and CIM by Groover M.P.
4. Neural Networks by Wassarman.

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I Year – II Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS25) FINITE ELEMENT METHOD

Course Prerequisites: Numerical Methods, Engineering Mechanics, Solid Mechanics.

Course Objectives:

- Understand the concept of Finite Element Method, Identify the areas of application of FEM and study the procedure.
- Understand different methods of solving linear problems and differentiate them.
- Understand the concept of FEM to solve basic non linear problems.

Course Outcomes:

Students will be able to:

- Apply the concepts of FEM to linear 1D, 2D and 3D problems.
- Solve simple non linear problems numerically.
- Perform analysis on a given problem using ANSYS.

UNITI:

Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods, Variational approach, Galerkin methods.

Co-ordinates, Basic element shapes, Interpolation function. Virtual energy principle, Rayleigh - Ritz method, Properties of stiffness matrix, Treatment of boundary conditions, Solution of system of equations, Shape functions and characteristics, Basic equations of elasticity, Strain displacement relations.

UNIT II:

1-D structural problems, Axial bar element, Stiffness matrix load vector, Temperature effects, Quadratic shape function, Analysis of Trusses, Plane Truss and Space Truss elements, Axis symmetric solid subjected to axisymmetric loading.

Analysis of beams: Hermite shape functions, Stiffness matrix, Load vector, Problems.

2-D problems: CST, LST, Force terms, Stiffness matrix and load vector, Boundary conditions.

UNIT III:

Isoparametric element, Quadrilateral element, Shape functions, Numerical Integration, sub parametric and super parametric elements.

3-D problems: Tetrahedron element, Jacobian matrix, Stiffness matrix.

Scalar field problems: 1-D Heat conduction, 1-D fin element, 2-D heat conduction, Problems, Introduction to Torsional problems.

UNIT IV:

Dynamic considerations, Dynamic equations, Consistent mass matrix, Eigen Values, Eigen Vector, Natural frequencies, Mode shapes, Modal analysis.

UNIT V:

Non linearity, Introduction, Non-linear problems, Geometric non-linearity, Non-linear dynamic problems, Analytical problems.

Text Books & References:

1. Introduction to finite elements in engineering, Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. Concepts and applications of finite element analysis, Robert Cook
3. The finite element methods in Engineering, S.S. Rao, Pergamon, New York
4. An Introduction to Finite Element Methods, J. N. Reddy, McGraw Hill
5. The Finite element method in engineering science, O.C. Zienkowitz, McGraw Hill.
6. Finite Element Procedures in Engineering analysis, K. J Bathe
7. Hutton: Fundamentals of Finite Element Analysis, Hutton D. V
8. Lagan: A First course in the of Finite Element method, Dary L. lagan.

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AMS26) INDUSTRIAL ROBOTICS

Course Prerequisites: Matrices, Signals and linear systems, Mathematics.

Course Objectives:

- Understand the robot anatomy, the different control systems and components to control the robot manipulator.
- Analyze the forces acting on the joints in robots and develop a general configuration of the controller.
- Understand robot programming and its physical design for proper coordination and control of robots.

Course Outcomes:

Students will be able to:

- Configure a simple robot for a given application.
- Apply knowledge of matrices and vectors to find the movements of the robot manipulator.
- Write a program to control a robot.

UNIT I:

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: Basic concept and models, Controllers, Control system analysis, Robot activation and feedback components, Positions sensors, Velocity sensors, Actuators sensors, Power transmission system.

UNIT II:

Motion Analysis and Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control; robot dynamics, configuration of robot controller,

UNIT III:

End Effectors: Grippers - Types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. Sensors; Desirable features, tactile, proximity and range sensors, uses sensors in robotics'

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage; Image processing and Analysis-image data reduction, Segmentation feature extraction.

UNIT IV:

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements in function.

UNIT V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot dell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work eel 1 controller.

Robot Application: Material transfer, Machine loading/unloading, Processing operation, Assembly Inspection, Feature Application.

Text Books & References:

1. Industrial robotics, Mikell P. Groover/McGraw Hill.
2. Robotics, K.S. Fu / McGraw Hill.

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Open Elective - II	**3**	**0**	**3**

(AMS41) INDUSTRIAL SAFETY MANAGEMENT

Course Pre Requisites: Elements of Mechanical, Civil, Electrical and Industrial Engineering

Course Objectives:

- To achieve an understanding of principles, various functions and activities of safety management.
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk.
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

Course Outcomes:

Students will be able to:

- Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.
- Communicate effectively on health and safety matters among the employees and with society at large.
- Demonstrate the use of state of the art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations.
- Interpret and apply legislative / legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces.

UNIT I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation – employee participation in safety and productivity.

UNIT II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop-Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines

UNIT III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety – highway and urban safety – Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Fire fighting devices – Accident reporting investigation.

UNIT V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety– pressure vessel act- Indian boilers act- The environmental protection act – Electricity act - Explosive act.

Text Books:

1. John V. Grimaldi and Rollin H. Simonds, " Safety Management" , All India Travellers bookseller, New Delhi – 1989
2. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, 1996,

References:

1. Occupational safety manual BHEL.
2. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum
3. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety security and risk management by U.K. Singh & J.M. Dewan, A.P.H. Publishing Company, New Delhi, 1996.

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I Year – I Sem. M.Tech. (Advanced Manufacturing Systems & CAD/CAM)	**L**	**P**	**C**
Open Elective - II	**3**	**0**	**3**

(CAD41) CONCURRENT ENGINEERING

Course Prerequisites: Industrial Engineering, Product development, Manufacturing Engineering.

Course Objectives:

- Understand the concepts of concurrent engineering with respect to its trends, methodologies and design aspects.
- To study the role of computers in implementing concurrent engineering.
- To achieve the objectives of reduced cost, better quality, and improved delivery performance.
- Design and develop the product, the associated manufacturing equipment and processes.

Course Outcomes:

Student would be able to:

- Identify the trends, techniques of concurrent engineering.
- Apply the use of IT in concurrent engineering.
- Analyze concurrent function deployment, metrics and measures.
- Understand Framework and architecture of concurrent engineering.

UNIT I:

Introduction : Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, organizing for CE, CE tool box, Collaborative product development.

UNIT II:

Use of Information Technology: IT supports, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence, expert systems, Software hardware component design.

UNIT III:

Design Stage: Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, Automated analysis Idealization control, CE in optimal structural design, Real time constraints.

UNIT IV:

Concurrent Function Deployment: Components of CFD, limitations concurrent product development, concurrent function development, CFD methodology application

CE Metrics and Measures: Metrics of measurement, life cycle measurement, simulation and analysis, design for X-ability assessment Product quality assessment.

UNIT V:

Total Value Management: TQM, Total value management, methodology for TVM, major elements of TVM, TVM in product development process.

Framework and Architecture: Product information management, CE architecture.

Text Books:

1.	Integrated Product Development	M. M. Anderson and L Hein	IFS Publications
2.	Design for Concurrent Engineering	J. Cleetus	CE Research Centre, Morgantown
3.	Concurrent Engineering Fundamentals: Integrated Product Development	Prasad	Prentice hall India
4.	Concurrent Engineering in Product Design and Development	I. Moustapha	New Age International

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I Year – I Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
Open Elective - II	**3**	**0**	**3**

(AMS42) DESIGN OF EXPERIMENTS

Course Prerequisites: Statistical Methods

Course Objective:

- To prepare the orientation of the student towards planning and to understand the techniques in design of research and experimentation.

Course Outcomes:

Students will be able to:

- Understand how to design the experiments
- Perform single factor and two factor factorial designs
- Implement the Taguchi technique using parameter design

UNIT I:

Design of Experiments (DOE): Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE

Simple Comparative Experiments-Basic statistical concepts, random variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample *t*-test, *P*-value, Confidence Intervals, Paired comparison.

UNIT II:

Single Factor Experiment: Analysis of Variance (ANOVA) for fixed effect model; Total, treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors.

UNIT III:

Two factor Factorial Design: Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two-factor factorial design; Models- Effects, means and regression

UNIT IV:

Taguchi Techniques for Experimental Design: Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting- methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects

UNIT V:

Parameter Design- Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design

Text Books & References:

1. Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1
2. Montgomery, Douglas C. & Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN: 978-81- 265-1424-3
3. Ranjit Kumar, (2006), Research Methodology- A Step-By-Step Guide for Beginners, (Pearson Education, Delhi) ISBN: 81-317-04963
4. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN: 81-7722-372-0
5. Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (New Age International, New Delhi)
6. Ross, Philip J. (1996), 2/e, Taguchi Techniques for Quality Engineering, (McGraw Hill, New York)
7. Besterfield, Dale H. (2005), 3/e, Total Quality Management, (Pearson Education, New Delhi)

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

I Year – II Sem. M.Tech. (Advanced Manufacturing Systems)	**L**	**P**	**C**
	0	**3**	**2**

(AMS52) CAD/CAM LAB

Course Prerequisites: CAD, CAM and Strength of materials.

Course Objectives:

- Understand the ways in which 2D, 3D, part drawings and assembly drawings are made using appropriate CAD packages.
- Understand the part programming techniques in turning, milling and drilling operations.
- Understand the determination of stresses and strains in systems like trusses and beams.

Course Outcomes:

Students will be able to:

- Produce part and assembly drawings using CAD packages.
- Produce component with different features using CNC machines and machining centers.
- Determine the elastic properties in components of the structures.

12 exercises from the following syllabus:

1. CAD:

i) 2D Drawing using Sketcher workbench	–	1 exercise containing atleast 3 drawings
ii) 3D modeling using 3D features	–	1 exercise containing atleast 3 models
iii) Assembly and drafting	–	1 exercise containing 1 assembly
iv) Surface Modeling	–	1 exercise
v) Sheet Metal Working	–	1 exercise

Softwares: ***AutoCAD, IronCAD, CATIA, CREO***

2. CAM:

i) Part programming for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning operations.
ii) Part programming for Point to point motions, Linear motions, Circular interpolation, Contour motion, Pocket milling - Circular, Rectangular and Mirror commands.
iii) Part Programming using Fixed or Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning, Thread cutting.
iv) Generation of tool path, NC part program and its simulation.
v) Machining of small components using CNC Lathe, CNC Mill and CNC Turning center.

Softwares: ***CNC Offline Simulation, EdgeCAM***

3. CAE:

a) Determination of deflection and stresses in 2D and 3D trusses and beams.
b) Determination Principal/ Von-mises stresses and deflections, in plane stress/ plane strain/ axisymmetric models.
c) Determination of stresses in 3D and shell structures.

Softwares: ***Ansys, CATIA***

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	0	**0**	**4**

(AMS62) MINI PROJECT – II

A mini project work shall be carried out on any topic of Advanced Manufacturing and a seminar should be given on the same along with a brief report.

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	0	**0**	**4**

(AMS63) COMPREHENSIVE VIVA-VOCE

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L	**T/P/D**	**C**
0	**0**	**8**

(AMS71) INTERNSHIP / DISSERTATION PHASE- I

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	0	**0**	**18**

(AMS72) DISSERTATION PHASE - II