ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M. Tech.
AUTOMATION

(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 fulfil 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.

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

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

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 automation 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 automation and manufacturing technology related 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 involving automation 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. (AUTOMATION):

Degree:	**M.Tech.**	Specialization:	**Automation**
Duration:	**2 Years (4 semesters)**	Details:	**2 semesters – Course work** **2 semesters – Project**
Mode:	**Full-time**	Year of starting:	**2011**
Intake:	**18**	Regulations:	**R15**

- **Overview of the programme:**

  Automation is a technique, method or system concerned with the use of automatic machines, electronic devices etc. to operate or control a process so that the human intervention is reduced to a minimum. Automation profession includes "everyone involved in the creation and application of technology to monitor and control the production and delivery of products and services. This two year (four semesters) programme is designed to address the challenges in automation of manufacturing systems. Automation crosses all functions within industry from installation, integration, and maintenance to design, procurement, and management. Automation even reaches into the marketing and sales functions of these industries. The programme has been running for the last 02 years and is regularly updated in line with the subject developments and industrial practices. It involves a very broad range of technologies including robotics and expert systems, telemetry and communications, electro-optics, process measurement and control, sensors, wireless applications, systems integration, test measurement etc.

- **Objectives:**
  - To provide a comprehensive foundation of the basics of automation in manufacturing systems.
  - To understanding of specific advanced and emerging manufacturing technologies.
  - 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 design and implement advanced control systems, intelligent instrumentation, and automation solutions for industrial systems
  - to perform testing, analysis and evaluation of the automated systems.

- **Opportunities:**

  The spectrum of Automation programme is broad, ranging from Product development, Aircraft modeling, Instrumentation, Active damping controls, Network management, Thermo-Structural Testing on Aerospace Vehicle, Satellite altitude control, Safety for Automatic Transmission Vehicles, Machine learning and data mining, Remote monitoring of solar plants. Students will have ample opportunities to work in these areas in designing, research and development and product manufacture.

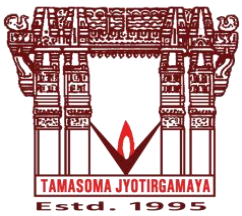
VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

M. Tech. (AUTOMATION)

(R15 Regulation)

I YEAR I SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	P	Credit
AMS01	Core	Automation in Manufacturing	3	1	4
AUT01		Modern Control Engineering	3	1	4
AMS03		Precision Engineering	3	1	4
AUT11	Elective – I & Elective – II Basket	Concurrent Engineering & Product Life Cycle Management	3	0	3+3
AUT12		Micro-Electro Mechanical Systems	3	0	
AMS13		Design for Manufacturing & Assembly	3	0	
AUT13		Experimental Techniques & Data Analysis	3	0	
AMS12		Materials Technology	3	0	
AMS15		Mechatronics	3	0	
AUT31 AUT32 AMS32	Open Elective – I	Industrial Automation Design and Manufacturing of MEMS and Micro Systems Quality and Reliability Engineering	3	0	3
AMS51	Lab	Manufacturing Simulation & Precision Engineering lab	0	3	2
AUT61		Mini Project - I	0	0	4
Total			**18**	**3**	**27**



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M. Tech. (AUTOMATION)

(R15 Regulation)

I YEAR II SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	P	Credit
AUT02	Core	Fluid Power Systems	3	1	4
AUT03		Intelligent Instrumentation & Manufacturing	3	1	4
AUT04		Industrial Robot Technology	3	1	4
AUT21	Elective – III & Elective – IV Basket	Microprocessor & Applications	3	0	3+3
AUT22		Neural Network & Fuzzy Systems	3	0	
AMS21		Quality Engineering in Manufacturing	3	0	
AUT23		Stress Analysis and Vibrations	3	0	
AUT24		Smart Materials & Structures	3	0	
AUT25		Optimization Techniques and Applications	3	0	
AMS41 AUT41 AUT42	Open Elective – II	Industrial Safety Management Plastics & Composites Artificial Intelligence & Expert Systems	3	0	3
AUT52	Lab	Automation & Robotics Lab	0	3	2
AUT62		Mini Project - II	0	0	4
Total			**18**	**3**	**27**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY HYDERABAD

M.Tech. (AUTOMATION)

(R15 Regulation)

II YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
AUT63		Comprehensive Viva Voce	0	0	4
AUT71		Internship / Dissertation Phase – I	0	0	8
Total			**0**	**0**	**12**

II YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
AUT72		Dissertation Phase – II	0	0	18
Total			**0**	**0**	**18**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

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 assemble 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. (Automation)	**L**	**P**	**C**
	3	**1**	**4**

(AUT01) MODERN CONTROL ENGINEERING

Course Prerequisites: Electrical and Mechanical Engineering, Physics.

Course Objectives:

- Understand mathematical modeling of control systems.
- Understand frequency time response of first and higher order systems.
- Understand concepts of stability of linear and non linear systems.

Course Outcomes:

Students will be able to:

- Apply fundamental knowledge of mathematics for mathematical modeling of control systems using differential equations and transfer function.
- Identify areas requiring frequency time response control systems in designing them.
- Stabilize linear and non-linear systems & stabilize the control systems.

UNIT I:

Introduction to open loop and closed loop system

Mathematical modeling of mechanical systems, Transient response of first and second order systems, Root locus and Bode plots (only construction) compensators introduction.

UNIT II:

State variables, Transition Matrix, Transformation of variables, Diagonalization of matrix, Canonical form.

UNIT III:

State Variable feed back systems, Closed loop pole zero assignment, Observability and controllability.

UNIT IV:

Introduction to non linear systems, Phase plane method.

UNIT V:

Stability analysis, Routh – Hurwitz Criterion, Nyquist method, Lyapunov method of stability analysis.

Text Books & References:

1. Gopal M, Control Systems Principles and Design, Tata McGraw Hill Company, 1998.
2. Francis Raven H., Automatic Control Engineering, 5th Edition, Tata Mc Graw Hill Company, 1995.
3. Franklin G.F. and Powell J.D., Digital Control of Dynamic Systems, Addison – Wesley, 1980.

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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 Datums - 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. (Automation)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AUT11) CONCURRENT ENGINEERING AND PRODUCT LIFECYCLE MANAGEMENT

Course Prerequisites: Basic Mechanical Engineering, Industrial Engineering background.

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 study the concepts of product life cycle management in under relation to its need, components and role of human resource.

Course Outcomes:

Student would be able to:

- Identify the trends, techniques of concurrent engineering.
- Apply the use of IT in concurrent engineering.
- Analyze and identify the various components of product life cycle.

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:

Need for PLM: Importance of PLM, Implementing of PLM, Responsibility for PLM, Benefits to different managers, Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize.

UNIT V:

Components of PLM: Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards.

Text Books & References:

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
5.	Product Lifecycle Management	John Stark	Springer-Verlag, UK
6.	Product Lifecycle Management	Michael Grieves	McGraw Hill
7.	Concurrent Engineering: Automation tools and Technology	Andrew Kusiak	Wiley Eastern

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

(AUT12) MICRO-ELECTRO MECHANICAL SYSTEMS

Course Prerequisites: Mathematics, Physics, Robotics.

Course Objectives:

- Understand MEMS devices and their applications.
- Understand the principle laws of physics and chemistry that apply in fabricating a MEMS device and various fabrication techniques.
- Understand the electronic interface and software design tools for MEMS devices.

Course Outcomes:

Student would be able to:

- Apply fundamental knowledge of mathematics, physics and chemistry to analyze practical micro-systems.
- Experiment or simulate MEMS design using a software.
- Design MEMS for a given application.

UNIT I:

Mechatronics in Products-Semi conductor Sensors and micro electro mechanical Devices – Actuators Hydraulics Actuators – pneumatic Actuators. Programmable Ligic Controllers (PLC) – basic structure – input/output processing-programming – Mnemonics Timers – relays and counters – data handling – selection of PLC. Control architecture – Analog – Digital – Examples of Mechatronic systems from Robotics. Manufacturing, Machine Diagnosis.

UNIT II:

Miniaturization and application – Micro electro mechanical devices and trends in developing them – Miniactuators, Microsensors, and Micromotors – Priniciples of Operations. Introduction, Absolute and Relative Tolerance in Manufacturing , Human Manufacturing , Top-Down Manufacturing Methods, Bottom-Up Approaches.

UNIT III:

Dry Etching – Definitions – Plasmas or Discharges – Ion Etching or Sputtering and Ion – Beam Milling – Plasma etching (Radical Etching) – Physical Etching.

Wet Isotropic And Anisotropic Etching – Alignment Patterns – Chemical Etching Models - Etching with Bias And/Or Illumination Of The Semiconductor – Etch – Stop Techniques – Problems.

UNIT IV:

Physical and Chemical Vapor Deposition – Silk – Screening – Printing – Sol-Gel Deposition Technique, Doctors' Blade or Tape Casting, Plasma Spraying – Deposition and Arraying Methods of Organic Layers in BIOMEMS – Thin versus Thick Film Deposition – Selection Criteria for Deposition Method.

UNIT V:

Surface Micromachining Processes, Poly-Si and Non-Poly-Si Surface Micromachining Modifications, Surface Micromachining Modifications – LIGA – Background , LIGA and LIGA – Like Process Steps.

Introduction and exposure to Nanotechnology – Application –Basics of nanofabrication, nano machining, nano assembly.

Text Books & References:

1. David G.Alciatore and Micheal.B.Histand - Introduction of Mechatronics and Measurement Systems, McGraw Hill International Edition, 1999.
2. HMT - Mechatronics, Tata McGraw Hill Publishing Company Ltd., 1998.
3. Lawrence J.Kamm - Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics, Prentice Hall, 2000
4. Marc Madou - Fundamentals of Micro fabrication, CRC Press, 1997.
5. W.Trimmer (ED.) - Micromechanics and MEMS, IEEE Press, 1997.
6. M.Elwenspoek - Silicon Micromachining, Cambridge Press, 1998.
7. R.C.Jaeger - Introduction to Microelectronic Fabrication, Wiley, 1989.
8. Bharat Bhushan(Ed.) - Handbook of Nanotechnology, Springer, 2004.

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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. (Automation)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AUT13) EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS

Course Prerequisites: Measurements, knowledge of cutting forces, metallurgy, statistical techniques

Course Objectives:

- Understand various measurement techniques used for measuring cutting forces.
- Understand the concepts and techniques involved in microscopy, metallurgical studies and surface measurements.
- Understand the statistical and taguchi methods used in experimentation.

Course Outcomes:

Students will be able to

- Measure strain displacement ,flow temperature and cutting forces
- Perform microscopic studies for knowing surface morphology and topography
- Utilize the Taguchi methods in conducting the experiments and draw conclusions based on data obtained.

UNIT I:

Measurement of Cutting Forces : Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and strain measurements by photoelasticity. Holography, interferometer, Moir techniques, strain gauge rosettes.

UNIT II:

Temperature Measurement: Circuits and instrumentation for different transducers viz, bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers.

Flow Measurement : Transducers for flow measurements of Non-compressible and compressible fluids. Obstruction and drag methods, Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques shadow graphs. Schlieren photography. Interferometer.

UNIT III:

Metallurgical Studies: Optical and electron microscopy, X-Ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses. Electron spectroscopy, electron microprobe.

Surface Measurements: Micro hardness, roughness, accuracy of dimensions and forms. 3-D co-ordinate measuring machines.

UNIT IV:

Experiment design & data analysis : Statistical methods, Randomized block design, Latin and orthogonal squares, factorial design. Replication and randomization.

Data Analysis: Deterministic and random data, uncertainly analysis, tests for significance : Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

UNIT V:

Taguchi Methods: Experiment design and planning with Orthogonal arrays and line graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors. Performance evaluation and Optimization by signal - noise ratios. Concept of loss function and its application.

Text Books & References:

1. Holman, J.P.: Environmental Methods for Engineers, McGraw Hill Int., New York.
2. Venkatesh, V.C., and Chandrasekharan, Experimental Methods in Metal Cutting Prentice Hall of India, Delhi.
3. Davis, O.V.; The Design and Analysis of Industrial Experiments, Longman London.
4. Box and Jenkins; Time Series analysis, Forecasting and control, Holden Day, San Francisco.
5. Dove and Adams, Experimental stress analysis and motion measurement Prentice Hall of India Delhi.
6. Tapan P.Bagchi, Taguchi Methods Explained, Prentice Hall of India, Delhi.

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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 Heiremann.
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**

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

(AUT31) INDUSTRIAL AUTOMATION

Course Prerequisites:

Course Objectives:

- Explain the General function of Industrial Automation
- Identify Safety in Industrial Automation
- Identify Practical Programmable Logic Controller Applications

Course Outcomes:

Students will be able to:

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

UNIT I:

Introduction: Automation in Production System, Principles and Strategies of Automation, BasicElements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines)

UNIT II:

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. **Quality Control Systems:** Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

UNIT III:

Control Technologies in Automation: Industrial Control Systems, Process Industries Versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. (SLE: Sensors, Actuators and other Control System Components).

UNIT IV:

Computer Based Industrial Control: Introduction & Automatic Process Control
Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU.
Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems. (SLE: Display Systems in Process Control Environment.)

UNIT V:

Modeling and Simulation for Plant Automation: Introduction, need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. **Industrial Control Applications:** Cement, Thermal, Water Treatment & Steel Plants. (SLE: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications)

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th edition, 2009.

References:

1. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
2. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk
3. Performance Modeling of Automated Manufacturing Systems,- Viswanandham, PHI, 1st edition,2009.

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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. (Advanced Manufacturing Systems & Automation)	**L**	**P**	**C**
	0	**3**	**2**

(AMS51) MANUFACTUIRNG 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. (Automation)	L	T/P/D	C
	0	0	4

(AUT61) MINI PROJECT - I

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

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	3	**1**	**4**

(AUT02) FLUID POWER SYSTEMS

Course Prerequisites: Fluid Mechanics, Thermodynamics, Engineering Mechanics, Mathematics

Curse Objectives:

- Understand about the components used and their functioning in hydraulic systems
- Understand about the hydraulic Control system component
- Understand the feed-back systems used in fluid power circuits

Course Outcomes:

- The student can apply the fundamental knowledge of hydraulic components in mechanical systems.
- Able to design hydraulic circuits for different applications
- Apply the knowledge of hydraulics and develop feed-back systems for positional, force and velocity controls.

UNIT I:
Fluid Power Fundamentals – Advantages & dis-advantages of hydraulic systems, Graphical Symbols of hydraulic components, properties of hydraulic fluids, requirements of hydraulic fluids, filters, particulate contamination and its control.

UNIT II:
Power Generating Components – Positive displacement pumps and their types, Constructional details – Gear pumps, vane pumps, piston pumps, balancing of pumps, pressure compensated pumps, pressure and flow fluctuations and their control, Capacities & power

UNIT III:
Control Valves- Pressure control valves - relief valves and their variants, remote control, constructional and functional aspects of pressure control valves. Directional Control valves – spool type valves, different modes of operation of DC valves, Different centre configurations, pressure drops in DC valves. 4/3, 4/2 DC valves. Flow control valves, types, check valves, unidirectional, pilot operated, pressure compensated flow control valves, Metering in, metering out valves.

UNIT IV:
Linear Actuators - Cylinders, Single acting, double acting, constructional features, Cushioning, Force and velocity calculations.
Rotary Actuators - Types of hydro-motors, Gear, vane, piston types, limited rotation vane motors. Design features, Torque and speed calculations.
Hydraulic Circuits – Manual, automatic, regenerative, Application in press tools, Machine tools, Circuits with Hydraulic accumulators.

UNIT V:
Feed-back systems – Feed-back elements, Transducers, Copying valves, EH Servo Valves & systems, Transmission systems, Applications

Text Books & References:

1. Oil hydraulic systems – Principles and Maintenance, S. R. MAJUMDAR, McGraw Hill
2. Introduction To Fluid Power, JAMES L. JOHNSON, Thomson Learning
3. Fluid Power with Applications, Anthony Esposito, Pearson Education

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	3	**1**	**4**

(AUT03) INTELLIGENT INSTRUMENTATION AND MANUFACTURING

Course Prerequisites: Micro controllers, PLC s.

Course Objectives:

- Understand the working principle of advance controllers used in manufacturing industries.
- Understand PLC programming of PLC s.
- Understand SCADA and its programming.

Course Outcomes:

Students will be able to:

- Apply fundamental knowledge of basic controllers & develop programs.
- Mini project & major project upon PLC, DCS.
- Develop SCADA & PLC programming for a given application.

UNIT I:
Introduction: Introduction of intelligent instrumentation, Historical Perspective, Current status, software based instruments.
Virtual Instrumentation: Introduction to graphical programming, data flow & graphical programming techniques, advantage of VI techniques, VIs and sub VIs loops and charts, arrays, clusters and graphs, case and sequence structure, formula nodes, string and file I/O Code Interface Nodes and DLL links.

UNIT II:
Data Acquisition Method: Analog and Digital IO, Counters, Timers, Basic ADC design, interfacing methods of DAQ hardware, software structure, use of simple and intermediate Vis. Use of Data Sockets for Networked communication and controls.

UNIT III:
PC Hardware Review and Instrumentation Buses: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, PCMCIA Buses. IEEE488.1 & 488.2 serial Interfacing –RS 232C, RS422, RS423, RS485, USB, VXI, SCXI, PXI.

UNIT IV:
Analysis Techniques: DSP software, Measurement, filters and wavelets, windows, curve fitting probability & statistics.
Communication: Basis networking methods and their applications in instrumentation, use of Data sockets for distributed control.

UNIT V:
Components of knowledge based systems: Basic components of knowledge based system, knowledge Representation, comparison of knowledge Representation Schemes, Interference Engine, knowledge acquisition Machine Learning – concept of Artificial intelligence, conceptual learning, Artificial Neural Networks – Biological Neuron, Artificial Neuron, types of Neural Networks, applications in manufacturing.

Text Books:

1. G.C. Barney/Intelligent Instrumentation/Prentice Hall, 1995ce:
2. Lisa, K.Wells & Jeffery Travis/Lab VIEW For every one Prentice Hall, 1997

References:

1. A.S. Morris/Principles of measurement and Instrumentation/Prentice Hall, 1993
2. S.Gupta/P.C.Interfacing for data Acquisition & Process Control, 2nd Edition/Instrument Society of America, 1994
3. Gray Johnson/Lab VIEW Graphical Programming 2nd Edition/Tata Mc Graw Hill, 1997.
4. Bitter, Mohiuddin, Nawrocki/Advanced Cal VIEW Programming Techniques.

I Year – II Sem. M.Tech. (Automation)	L	P	C
	3	1	4

(AUT04) INDUSTRIAL ROBOT TECHNOLOGY

Course Prerequisites: Basics of automation, assembly and manufacturing operations

Course Objectives:

- Understand about the classification, components, functions and specifications of robots
- Understand different robot programming methods.
- Understand the applications of robots in different areas.

Course Outcomes:

Students will be able to:

- Know the usage of robots in different industries.
- Know how the programming is done for the robot to do a task.
- Get clear idea about optical and non-optical position sensors.

UNIT I:
Robotics and Automation – Robot Definition, Classification of Robots, Robot System components, functions of Robot System, Specification of Robot System, Robot Drives and Power transmission systems, Remote centered Compliance devices.

UNIT II:
Robotic Sensory Devices, Non optical Position sensors, Optical position sensors, velocity sensors, Accelerometers, Proximity sensors, touch and Slip sensors, Force and Torque sensors – Robot vision system.

UNIT III:
Methods of Robot programming – Lead though programming methods – capabilities and limitations, Textual Robot languages – robot language structure – motion commands, end effectors and sensor commands, Robot programming functions, robot pr9ogramming environment, On-Line and Off Line programming Langauges.

UNIT IV:
Robot cell layouts – multiple Robots and machine interface, consideration in work cell design, interlocks, error detection and recovery, Robot cycle time analysis, simulation of Robot work cells.

UNIT V:
Application of robots in material transfer, machine loading and unloading, welding, assembly and inspection, safety, training, maintenance and quality aspects, Economics and social aspects of robotics.

Text Books & References:

1. Richard D. Klafter - Robotic engineering – An Integrated approach, Prentice Hall of India Pvt Ltd, 2002
2. Mikell P. Groover, Weiss, Roger - Industrial Robotics – Technology, Programming and Applications, McGraw Hill International Edition, 1996.
3. Shimon Y.Nof Hand Book of Robotics, John Wiley sons, 1985.
4. Spong and Vidhyasagar, Robot Dynamics and Control, John Wiley and Sons
5. Fu. K.S., Gonzalez, R.C, Lee. C.S.G, Robotics, Control, Sensing, Vision and Intelligence, McGraw Hill International, 1987

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Elective – III & IV	**3**	**0**	**3**

(AUT21) MICROPROCESSOR AND APPLICATIONS

Course Prerequisites: Switching theory and logic design

Course Objectives:

- Understand the operation of microprocessor, assembly language programming interfacing techniques.
- Understand the application of 8086 micro processor, interfacing it with different peripherals.
- Understand the design and implement processes of micro controlled based system in both hardware and software.

Course Outcomes:

Students will be able to:

- Write various assembly language programs for 8086 based on various algorithms for software and hardware applications.
- Designing the micro processor based systems by applying the knowledge of internal operations.
- Applying the above knowledge in advanced processor architecture.

UNIT I:

8086 Architecture CPU Architecture, Internal Operations, Addressing modes, Machine Language Instructions. Instruction formats, Instruction execution Timing. Assembly Instruction Format : Data transfer instructions Arithmetic Instructions : Binary arithmetic packed BCD arithmetic, Unpacked BDC arithmetic. Branch Instructions: Conditional Branch Instructions, Unconditional Branch Instructions, Loop instructions. NOP and HLT instructions, Flag Manipulation Instructions, Logical Instructions. Shift and Rotate Instructions, Directives and Operators. Assembly Process, Translation and Assembly Instruction.

UNIT II:

Linking and Relocation, Stacks, procedures, Interrupts and Interrupt Routines, Macros, Program Design Byte and string manipulation, I/O programming.

UNIT III:

I/O Interface Serial Communication Interfaces, 8251 programmable communication interface, A/D and D/A example. Programmable Timers and Event counters, 8254 programmable Interval Timer, interval Application to A/D. DMA Controller (8237).

UNIT IV:

Peripheral Devices Keyboard and Display keyboard Design, LED Display Design, Keyboard/Display Controller (8279), CRT Controller and Interface (8275), Floppy Disk Controller (8272).

UNIT V:

Advanced processor Architecture 80386, 80486 and Pentiums' Register structure, Instruction set, Memory management protected and virtual modes, memory paging mechanism.

Text Books & References::

1. Liu yu-Cheng, Gibson GA, Microcomputer Systems: the 8086/8088 Family Architecture, programming and Design (2nd Edition), PHI, 1995.
2. Barry B.Brey The Intel Microprocessors, PHI, 1995.

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Elective – III & IV	**3**	**0**	**3**

(AUT22) 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.

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

UNIT III:
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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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 – I Sem. M.Tech. (Automation)	**L**	**P**	**C**
Elective – III & IV	**3**	**0**	**3**

(AUT23) STRESS ANALYSIS AND VIBRATIONS

Course Prerequisites: Mathematics, fundamentals of vibrations and stress analysis.

Course Objectives:

- Understand elastic theory and Plane stress concept.
- Understand application of Torsion concept on noncircular, prismatic, rectangular, axisymmetric components.
- Identify the causes and effects of Vibration of Single and Multi degree freedom systems.
- Investigate free & forced vibrations of strings bars and beams.

Course Outcomes:

Students will be able to:

- Apply the concept of elastic theory on component under plane stresses.
- Apply fundamentals to identify causes and effects of vibrations.
- Find out intensity of vibrations in a given system.
- Solve the free and forced vibrations of continuous system

.

UNIT I:
Two dimensional elasticity theory in Cartesian coordinates, Polar coordinates-Thick cylinders, Rotating discs -problems.

UNIT II:
Torsion of non-circular prismatic sections, rectangular and axisymmetric, Circular plates, Introduction to shell theory – geometry of shells of revolutions-thin axisymmetric.

UNIT III:
Single degree freedom, Two degree freedom system without and with damping – Free and forced vibrations, Transient vibrations- response to input, step input, ramp input.

UNIT IV:
Transient vibrations of single degree freedom system, Continuous systems- lateral vibrations of a spring, longitudinal vibration of rods or bars, torsional vibrations of uniform shafts or rods.

UNIT V:
Multi degree freedom system-exact analysis- natural frequencies and mode shapes, matrix iteration methods. Principle of orthogonality, Classical methods-Rayleigh method, Dunkerley's equation, Rayleigh-Ritz Method, Holzer method, Stodola's method.

Text Books & References:

1. Theory of elasticity, Timoshenko and Goodier
2. Advanced strength of materials, Den Hartog J.P
3. Mechanical Vibrations, Den Hartog J.P., Dover Publications
4. Theory of Vibrations with Applications, Thomson W.T., CBS Publishing
5. Mechanical Vibrations, Thammaiah Gowda, Jagadeesha T, D V Girish

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

(AUT24) SMART MATERIALS AND STRUCTURES

Course Prerequisites: Instrumentation, material science, basic electrical and electronics

Course Objectives:

- Understand type of smart material and structures and their usage
- Understand smart material application in automation .
- Understand smart materials application in instrumentation and control system .

Course Outcomes:

Students will be able to:

- Identify the types of materials and classify them based upon their properties .
- Decide on the type of materials for a given application in automation .
- Decide on materials for smart structures .

UNIT I:
Overview of Smart Materials, Structures and Products Technologies.

UNIT II:
Smart materials (Physical Properties): Piezoelectric Materials, Elctrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids Electroheological Fluids, Shape Memory Materials, Fiber-Optic Sensors.

UNIT III:
Smart Sensor, Actuator and Transducer Technologies: Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Impact Hammers; MEMS Sensors; Sensor Arrays Smart Actuators; Displacement Actuators; Force Actuators; Power Actuators; Vibration Dampers; Shakers; Fluidic Pumps; Motors Smart Transducers: Ultrasonic Transducers; Sonic Transducers.

UNIT IV:
Measurement, Signal Processing, Drive and control Techniques: Quasi – Static and Dynamic Measurement Methods; Signal Conditioning devices;; Constant Voltage, Constant Current and Pulse Drive Methods; Calibration Methods; Structural Dynamics and Identification Techniques; Passive, Semi-Active and Active Control; Feedback and Feed forward Control Strategies.

UNIT V:
Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products: Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products. Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, as well as medical and dental tools and equipment.

Text Books:

1. M.V.Gandhi and B.So Thompson, Smart Materials and Structures, Chapman & Hall, London; New York, 1992
2. B.Cui Shaw, Smart Structures and Materials, Artech House, Boston, 1996

References:

1. A.V.Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001
2. A.J.Moulson and J.M.Herbert, Electroceramics: Materials, Properties, Applications, 2nd Edition, John Wiley & Sons, 2003
3. G. Gautschi, Piezoelectric Sensories: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York,2002
4. K.Uchino, Piezoelectric Actuators and Wtrasonic Motors, Kluwer Academic Publishers, Boston, 1997
5. G.Engdahl, Handbook of Giant Magnetostrictive Materials, Academic Press, San Diego, Calif.; London, 2000
6. K.Otsuka and C.M.Waymana, Shape Memory Materials, Cambridge University Press, Cambridge; New York, 1998
7. Eric Udd, Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley & Sons, New York, 1991

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

(AUT25) OPTIMIZATION TECHNIQUES AND APPLICATIONS

Course Prerequisites: Design of Machine Elements, Vibrations.

Course Objectives:

- Understand principles of optimization for various mechanical elements.
- Understand techniques for minimization of unconstraint and methods to solve it by developing algorithms.
- Understand optimization applications in mechanical vibrations.

Course Outcomes:

Students will be able to:

- Develop an optimizing technique to solve an engineering problem.
- Apply concepts developing algorithms to solve a problem.
- Apply various applications of design optimization techniques on bodies.

UNIT I:
General Characteristics of mechanical elements, Adequate and optimum design, Principles of optimization, Formulation of objective function, Design constraints, Classification of optimization problems, Single and multivariable optimization techniques

UNIT II:
Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, Interpolation methods, Equality and inequality constraints.

UNIT III:
Direct methods and indirect methods using penalty function, Lagrange multipliers, Geometric programming and stochastic programming, Genetic algorithms.

UNIT IV:
Engineering applications, Structural-design application axial and transverse loaded members for minimum cost, Maximum weight. Design of shafts and torsion members, Design optimization of springs.

UNIT V:
Dynamics applications for two degree freedom system, Vibration absorbers. Application in mechanisms.

Text Books:

1. Engineering Optimization -Theory and Practice, Singerusu S. Rao, New Age.
2. Optimum Design of Mechanical elements, Johnson Ray C, Wiley, John & Sons

References:

1. Genetic Algorithms in search, Optimization and Machine, Goldberg D. E., Addison-Wesley-NewYork.
2. Optimization for Engineering Design Algorithms and Examples, Kalyanamoy Deb, Prentice Hall of India.

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

(AMS41) INDUSTRIAL SAFETY MANAGEMENT

Course Prerequisites: 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:

- 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 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 to safety – pressure vessel act- Indian boiler 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.

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

(AUT41) PLASTICS AND COMPOSITES

Course Prerequisites: Material Technology, Chemistry.

Course Objectives:

- The ability to learn the basic structure of plastic.
- Understand the properties and the manufacturing of plastics.
- Learn about the concept of machinability and joining of plastics.
- The type of reinforcement and manufacturing technique of composites.

Course outcomes:

- Understand the structure-processing-property relationship of polymers.
- Understand and apply various processing and manufacturing techniques.
- Identify the steps involved in machining and joining of plastics.
- Understand the preparation, application and type of reinforcement.
- Understand the composite manufacturing processes.

UNIT I:
Chemistry and classification of polymers – properties of thermos plastics –properties of thermosetting plastics – applications – merits and disadvantages. Various plastic materials and their applications.

UNIT II:
Study of molding processes and mold design for:
Extrusion – blow molding – casting - thermos forming – rotomolding.

UNIT III:
Study of molding processes and mold design for:
Compression and transfer molding – injection molding.

UNIT IV:
General machining properties of plastics – machining parameters and their effect – joining of plastics – mechanical fasteners – thermal bonding – press fitting.

UNIT V:
Fibers – glass, boron, carbon, organic, ceramic and metallic fibers – matrix materials – polymers, metals and ceramics.
Open mold processes, bag molding, compression molding with BMC and SMC – filament winding – pultrusion – centrifugal casting – injection molding – application of PMC's.

Text Books & References:

1. Harold belofsky, plastics, "product design and process engineering", hanser publishers, 1995.
2. Bera, E and Moet, A, "high performance polymers", hanser publishers, 1991.
3. Hensen, F, "plastics extrusion technology", hanser publishers, 1988.
4. Rauwendaal, C, "polymer extrusion", hanser publishers, 1990.
5. John dalmonte, "plastics moulding", john wiley.
6. Akira kobyashi, "machining of plastics", Mc-Graw hill.
7. Krishna K.chawla, "composite materials science and engineering", springer-verlag, 1987.
8. Agarwal. D. and Broutman L.J., "analysis and performance of fiber composites", wiley, 1990.
9. Mallick, P.K. and Newman, S, "composite materials technology", hanser publishers, 1990.

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

(AUT42) ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Course Prerequisites: Mathematical foundations of Computer Science, Basic Mechanical Engineering

Course Objectives:

- Understand artificial intelligence ,search problem solving ,heunistic methods
- Concepts and aspects of expert and intelligent tutoring systems.
- Theory of state space learning ,game playing ,knowledge representative uncertainty.

Course Outcomes:

Students should be able to:

- Describe search strategies and solve problems by applying a suitable search method.
- Describe the key aspects of expert systems
- Describe and apply knowledge representation

UNIT I:

Artificial Intelligence: Introduction, definition, underlying assumption, important of AI,AI & related fields State space representations, defining a problem, production systems and its characteristic, search and control strategies – Introduction, preliminary concepts, examples of Search problems.

UNIT II:

Uniformed or Preliminary Concepts: Examples of search problems, Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques – Generate and Test, Hill climbing, best first search, problem reduction, constraint satisfaction, Means – Ends Analysis.

Knowledge Representation Issues: Representations and Mapping, Approaches, Issues in Kr, Types of Knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.

UNIT III:

Use of Predicate Logic: Representing Simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution Natural deduction

Statistical and Probabilistic Reasoning: Symbolic reasoning under uncertainly, Probability and Bayes' theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster – Shafer Theory, Fuzzy Logic.

UNIT IV:

Expert Systems: Introduction, Structure and uses, Representing and using domain knowledge, Expert System shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.

UNIT V:

Introduction to Knowledge Acquisition: Types of learning, General Learning model, and performance measures.

Typical Expert Systems: MYCIN**,** Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF etc.

Introduction to Machine Learning: Perceptions, Checker Playing examples, Learning, Automata, Genetic Algorithms, Intelligent Editors**.**

Text Books & References:

1. Artificial intelligence – Elaine Rich & Kevin Knight, M/H 1983.
2. Artificial intelligence in business, Science & Industry – Wendry B.Ranch, Vol II application, Ph 1985.
3. A guide to expert systems – waterman, D.A., Addison – Wesley inc.1986.
4. Building expert systems – Hayes, Roth, Waterman, D.A(ed), AW 1983.
5. Designing expert systems – weis, S.M. and Kulliknowske, London champion Hull 1984.

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

(AUT52) AUTOMATION & ROBOTICS LABORATORY

Course Prerequisites: Manufacturing processes, fluid and electric controllers, robot programming, mathematics.

Course Objectives:

- To conduct the experiments for understanding the working of hydraulic, pneumatic, electric and electronic controls used in automation.
- To understand the concepts of PLC's, microcontrollers and automated transfer devices in automation by conducting experiments.
- To demonstrate the robotics manipulator motions using the robotic programming and languages.

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Course Outcomes:

Students will be able to:

- Design hydraulic and pneumatic controls.
- Program PLC, microcontrollers, transfer devices.
- Use robotic programming for robotic manipulation.

Experiments to demonstrate:

1. Pneumatic, hydraulic, electrical systems in automation
2. Microprocessor applications in automated systems.
3. Robotics Systems and Programming
4. Automated transfer devices.
5. Training on Programmable Logic Controllers

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I Year – II Sem M.Tech. (Automation)	**L**	**T/P/D**	**C**
	0	**0**	**4**

(AUT62) MINI PROJECT - II

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

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II Year – II Sem M.Tech. (Automation)	**L**	**T/P/D**	**C**
	0	**0**	**4**

(AUT63) COMPREHENSIVE VIVA-VOCE

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II Year – II Sem M.Tech. (Automation)	**L**	**T/P/D**	**C**
	0	**0**	**8**

(AUT71) DISSERTATION PHASE – I

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II Year – II Sem M.Tech. (Automation)	**L**	**T/P/D**	**C**
	0	**0**	**18**

(AUT72) DISSERTATION PHASE – II