# ACADEMIC REGULATIONS
# COURSE STRUCTURE
# AND
# DETAILED SYLLABUS

## M. Tech.
## AUTOMATION - ME

***(Applicable for the batches admitted from 2011-2012)***


***VNR VIGNANA JYOTHI***
***INSTITUTE OF ENGINEERING & TECHNOLOGY***
***(AFFILIATED TO JNTUH)***
***An Autonomous Institute under JNTUH***

**Bachupally, Nizampet (S.O), Hyderabad –500090**
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**Academic Regulations 2011 For M.Tech. Degree Course**
**(Effective for the students admitted into first year from the academic year 2011-2012)**

## 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 2011-12, for the students admitted into two year post graduate programme offered by the college leading to Master Of Technology (M. Tech.) degree in the disciplines viz., Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering, Electronics and Communication Engineering, Computer science and Engineering, Information Technology, Electronics and Instrumentation Engineering and Automobile Engineering.

The M.Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the program 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, qualifications and specialization prescribed by the University from time to time. Admissions shall be made on the basis of GATE Rank and merit rank obtained by the qualifying candidate at an Entrance Test conducted by the University, subject to reservations prescribed by the university/ State Government from time to time.

## 2. Courses of Study

The following specializations are offered at present for the M.Tech. Course of study.

1. Advanced Manufacturing Systems
2. Highway Engineering
3. Structural Engineering
4. Power Electronics
5. Software Engineering
6. VLSI System Design
7. Embedded Systems
8. Geotechnical Engineering
9. Electronic Instrumentation
10. Automation

and any other course as approved by the Academic Council of the Institute and the authorities of the University from time to time.

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**2.1 Departments offering M.Tech. Programmes with specializations are mentioned below:**

| | |
|---|---|
| ME | 1.Advanced Manufacturing Systems<br>2. Automation |
| CE | 1. Highway Engineering<br>2.Structural Engineering<br>3 Geotechnical Engineering |
| EEE | Power Electronics |
| CSE | Software Engineering |
| ECE | 1.VLSI System Design<br>2.Embedded Systems |
| EIE | Electronic Instrumentation |

**3. Attendance**

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

**3.1** A candidate shall be deemed to have eligibility to write end semester examinations in a subject if he has put in at least 75% of attendance in that subject.

**3.2** Shortage of attendance up to 10% in any subject (i.e. 65% and above and below 75%) may be condoned by the College Academic Committee on genuine and valid reasons on application by the candidate with supporting evidence.

**3.3** A candidate shall get minimum required attendance at least in three (3) 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 candidate 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 candidate secures less than the required attendance in any subject(s), he shall not be permitted to appear for the End Examination in that subject(s). He shall re-register the subject when next offered.

**4. Evaluation**

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

**4.1** For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination, 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the better of the marks secured in the two Mid Term-Examinations conducted one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for duration of 2 Hours with 4 questions to be answered out of 6 questions.

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**4.2** For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations, 40 marks shall be awarded based on the day-to-day performance as Internal Marks.

**4.3** There shall be two seminar presentations during the I year, one in each semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department, supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

**4.4** There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva- Voce will 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. course of study. The Comprehensive Viva-Voce is valued for 100 marks by the Committee. There are no internal marks for the Comprehensive viva-Voce.

**4.5** A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

**4.6** A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and he has failed in the end examination. In such a case candidate 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 that 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 with prior permission.

**4.7** 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 from the same dept.

**5.** Evaluation of Project / Dissertation Work.

**5.1** Registration of Project Work: A candidate is 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 Department, project supervisor and one senior faculty member of same specialization.

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**5.3** After satisfying 5.1, a candidate has to submit, in consultation with the project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for its approval. Only after obtaining the approval of Departmental Academic Committee, the student can initiate the Project work.

**5.4** If a candidate wishes to change his supervisor or topic of the project he can do so with the approval of Departmental Academic Committee. However, the Departmental Committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, his date of registration for the project work starts from 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 II year by the committee consisting of Head of the Department, project supervisor ,PG coordinator of the Department and senior faculty member of the Department. belonging to same specialization. A candidate shall submit status 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 candidate is permitted to submit Project Thesis 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 candidate shall submit the daft copy of thesis to the Head of the Department (Through project supervisor/PG coordinator) and shall make an oral presentation before the PRC.

**5.7** After approval of PRC, every student has to submit three copies of the Project Thesis certified by the supervisor to the Department.

**5.8** The thesis 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 candidate shall revise and resubmit the Thesis, within the time frame as described by PRC. If the report of the examiner is unfavourable again, the thesis 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 supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report candidates 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 candidate has to secure any one of the grades as Excellent, Good or Satisfactory on his thesis/dissertation and viva-voce. If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he has to reregister the project work as in clause 5.1. However, the candidate may select a new guide and new topic with the approval of the PRC and submit the project report with a minimum of 240 days from the date of re-registration. Of course this shall not prejudice the clause 6.1 below. The candidate can be permitted to change the topic/guide only once.

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**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 completes 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** After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree shall be placed in one of the following four classes:

| Class Awarded | % of marks to be secured |
|---|---|
| First Class with Distinction | 70% and above |
| First Class | Below 70% but not less than 60% |
| Second Class | Below 60% but not less than 50% |

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

**7. Withholding of Results**

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

**8. Transitory Regulations**

Candidate who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered without precluding clauses Nos.6.0 and 6.1

**9. General**

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

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

**9.3** 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.

**9.4** Wherever the words he, him or his occur, they will also include she, her and hers.

**10. Supplementary Examination**

Supplementary examinations will be conducted along with regular semester end examinations. Supplementary examinations will be conducted to a maximum number of four continuous times subsequent to the revision of the syllabus. Supplementary examinations will be conducted in the equivalent courses as approved by the Institute Academic Committee.

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**VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY HYDERABAD**

**M.Tech. – AUTOMATION - ME**

**I YEAR I SEMESTER** **COURSE STRUCTURE**

| Subject Code | Group | Subject Name | L | P | Credit |
|---|---|---|---|---|---|
| R11AMS2101 | | Automation in Manufacturing | 3 | 0 | 3 |
| R11AMS2103 | | Precision Engineering | 3 | 0 | 3 |
| R11AUT2101 | | Modern Control Engineering | 3 | 0 | 3 |
| R11AMS2111 | | Simulation Modeling of Manufacturing Systems | 3 | 0 | 3 |
| R11AUT2102 | **Elective - I** | Concurrent Engineering & Product Life Cycle | 3 | 0 | 3 |
| R11AUT2103 | | Micro-Electro Mechanical Systems | | | |
| R11AUT2104 | | Artificial Intelligence & Expert Systems | | | |
| R11AMS2102 | **Elective - II** | Materials Technology | 3 | 0 | 3 |
| R11AUT2105 | | Experimental Techniques & Data Analysis | | | |
| R11AMS2109 | | Mechatronics | | | |
| R11AMS2201 | **Lab** | Manufacturing Simulation & Precision Engineering lab | 0 | 3 | 2 |
| R11AUT2301 | | Seminar | 0 | 0 | 2 |
| | | **Total Credits (6 Theory + 1 Lab.)** | **18** | **3** | **22** |

**I YEAR II SEMESTER** **COURSE STRUCTURE**

| Subject Code | Group | Subject Name | L | P | Credit |
|---|---|---|---|---|---|
| R11AUT2106 | | Fluid Power Systems | 3 | 0 | 3 |
| R11AUT2107 | | Microprocessor & Applications | 3 | 0 | 3 |
| R11AUT2108 | | Intelligent Instrumentation & Manufacturing | 3 | 0 | 3 |
| R11AUT2109 | | Industrial Robot Technology | 3 | 0 | 3 |
| R11AUT2110 | **Elective - III** | Optimization Technique & Applications | 3 | 0 | 3 |
| R11AUT2111 | | Neural Network & Fuzzy Systems | | | |
| R11AMS2112 | | Quality Engineering in Manufacturing | | | |
| R11AUT2112 | **Elective - IV** | Smart Materials & Structures | 3 | 0 | 3 |
| R11AUT2113 | | Vibration Analysis & Condition Monitoring | | | |
| R11AMS2104 | | Design for Manufacturing & Assembly | | | |
| R11AUT2201 | **Lab** | Automation & Robotics Lab | 0 | 3 | 2 |
| R11AUT2301 | | Seminar | 0 | 0 | 2 |
| | | **Total Credits (6 Theory + 1 Lab.)** | **18** | **3** | **22** |

* L/P: Lectures/Practical

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**M.Tech. – AUTOMATION - ME**

**II YEAR I SEMESTER** **COURSE STRUCTURE**

| Subject Code | Group | Subject Name | L | P | Credit |
|---|---|---|---|---|---|
| R11AUT2302 | | Comprehensive Viva | 0 | 0 | 2 |
| R11AUT2303 | | Project Seminar - I | 0 | 3 | 2 |
| R11AUT2304 | | Project Work | 0 | 0 | 18 |
| | | **Total Credits** | **0** | **0** | **22** |

**II YEAR II SEMESTER** **COURSE STRUCTURE**

| Subject Code | Group | Subject Name | L | P | Credit |
|---|---|---|---|---|---|
| R11AUT2305 | | Project Work | 0 | 0 | 20 |
| R11AUT2306 | | Project Seminar – II | 0 | 0 | 2 |
| | | **Total Credits** | **0** | **0** | **22** |

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| I Year – I Sem. M.Tech. (Automation) | L | P | C |
|---|---|---|---|
| | 3 | 0 | 3 |

## (R11AMS2101) AUTOMATION IN MANUFACTURING

**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 implementing 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. Transfer lines, Design for Automated Assembly, Partial Automation, Communication Systems in Manufacturing

**Text Books:**

(1) Mikell P. Grower, "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,"Svstem 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** | **0** | **3** |

## (R11AMS2103) PRECISION ENGINEERING

**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.

| I Year – I Sem. M.Tech. (Automation) | L | P | C |
|---|---|---|---|
| | 3 | 0 | 3 |

## (R11AUT2101) MODERN CONTROL ENGINEERING

**UNIT I:**
Mathematical modeling of dynamic systems, Transient response of second and higher order systems, Root locus and Bode plots, Lead, lag and lead lag circuits.

**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.

**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. (Automation)** | **L** | **P** | **C** |
|---|---|---|---|
| | **3** | **0** | **3** |

## (R11AMS2111) SIMULATION MODELING OF MANUFACTURING SYSTEMS

**UNIT I:**

**Introduction:** System - Ways to analyze the system - Model - Types of models - Simulation - Definition - Types of simulation models - Steps involved in simulation - Advantages & Disadvantages.

**Parameter estimation**: Estimator – Properties – Estimate - Point estimate - Confidence interval estimates - Independent - dependent — Hypothesis - Types of hypothesis – Steps in Hypothesis – Type I & II errors - Strong law of large numbers.

**UNIT II:**

**Building of Simulation model validation:** Verification – Credibility - their timing - Principles of valid simulation modeling - Techniques for verification - Statistical procedures for developing credible model - Modeling of stochastic input elements – Importance - Various procedures - Theoretical distribution - continuous - Discrete their suitability in modeling.

**UNIT III:**

**Generation of random variates**: Factors for selection - Methods - Inverse transform - Composition - Convolution - Acceptance Rejection - Generation of random variables - Exponential - Uniform - Weibull – Normal - Bernoullie - Binomial - Uniform - Poisson

**Simulation languages:** Comparison of simulation languages with general purpose languages Simulation languages vs Simulators - Software features - Statistical capabilities - G P S S - SIMAN - SIMSCRIPT —Simulation of WMJI queue — Comparison of simulation languages.

**UNIT IV:**

**Output data analysis:** Types of Simulation w.r.t output data analysis — Warmup period- Welch algorithm — Approaches for Steady State Analysis — Replication & Batch means methods.

**UNIT V:**

**Applications of Simulation:** Flow shop system — Job shop system — M/M/1 queues with infinite and finite capacities — Simple fixed period inventory system — Newboy paper problem.

**Text books:**


1. Simulation Modelling and Analysis / Law, A.M.& Kelton / McGraw Hill, Edition, New York,1991.
2. Discrete Event System Simulation / Banks J. & Carson J.S., PH/Englewood Cliffs, NJ, 1984.
3. Simulation of Manufacturing Systems/Carrie A. /Wiley, NY, 1990.
4. A Course in Simulation /Ross, S.M., McMillan, NY, 1990.
5. Simulation Modelling and SlMNET/TahaHA./PH,Englewood Cliffs, NJ, 1987

| I Year – I Sem. M.Tech. (Automation) | L | P | C |
|---|---|---|---|
| Elective – I | 3 | 0 | 3 |

## (R11AUT2102) CONCURRENT ENGINEERING AND PRODUCT LIFECYCLE MANAGEMENT

**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 support, 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.

**Textbooks:**


| | | | |
|---|---|---|---|
| 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** | **3** | **0** | **3** |

## (R11AUT2103) MICRO-ELECTRO MECHANICAL SYSTEMS

**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.

**Reference Books:**


1. David G.Alciatore and Mecheal.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. (Automation)** | **L** | **P** | **C** |
|---|---|---|---|
| **Elective – I** | **3** | **0** | **3** |

## (R11AUT2104) ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

**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 Acuqistion:** 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, Genertic, Algorithms, Intelligent Editors**.**

**Text Books:**


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 – I Sem. M.Tech. (Automation) | L | P | C |
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## (R11AMS2102) MATERIALS TECHNOLOGY

**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. Dicter/McGraw Hill, 1998.

**Reference:**

"Selection and use of Engineering Materials", 3e/Charles J.A/Butterworth Heiremann.

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## (R11AUT2105) EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS

**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 tansducers 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. Vortes 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, Randomised 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.

**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 Sanfrancisco.
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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## (R11AMS2109) MECHATRONICS

**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.

**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. I. C.W. De Silva, “Control sensors and actuators”, 2 Edition, Prentice Hall.

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## (R11AMS2201) MANUFACTURING SIMULATION & PRECISION ENGINEERING LABORATORY

### 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, Centreless 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.
9. Study and programming of Robots.

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## (R11AUT2106) FLUID POWER SYSTEMS

**UNIT- I:**
Fluid power components: Pump relief valve, non-return valve, pilot-operated relief valve, series and parallel compensator of flow control valve. Pressure compensated pump, motor, actuators. Compressibility and Inertia loading, hydraulic stiffness, stiffness of a pneumatic system.

**UNIT- II:**
Transmission system: component effectiveness, breakage, compressibility, linearity constant torque load, constant power load. Inertia load, viscous damping.

**UNIT- III:**
Valve controlled systems: Flow through a single speed control valve, series pressure compensation, parallel pressure compensation, combined directional and flow rate control valve. Steady reaction force. Transient reaction force. Advanced pneumatics circuits for controlling multi cylinders (inoperable circuits), Electro pneumatics with relay logic, Pneumatics System with PID controllers Application of fluids a non-moving part logic

**UNIT-IV:**
Analysis of accumulator systems: Accumulator system dynamics. Thermodynamics consideration. Accumulator as observed of pressure shocks.

**UNIT-V**
Feed back systems: Pressure control, position control, pump/motor systems, control with variable capacity pumps, pump stroke mechanisms, position control using metering valve, double acting actuator, speed control, inertia load position control system. Programmable sequential control using pneumatic modular elements, stepper controls.

**References:**
1. A.B Goodnain, Fluid Power systems, Mc Millian Press Ltd, 1976
2. McCloy and Martin H.R., The Control of Fluid Power, Longman Publications. 1973

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**I Year – II Sem. M.Tech. (Automation)**

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## (R11AUT2107) MICROPROCESSOR AND APPLICATIONS

**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.

**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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## (R11AUT2108) INTELLIGENT INSTRUMENTATION AND MANUFACTURING

**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 Schems, 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.

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**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

**Reference books:**

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.

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## (R11AUT2109) INDUSTRIAL ROBOT TECHNOLOGY

**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.

**Reference books:**

1. Richard D. Klafter, - Robotic engineering – An Integrated - Thomas a. Chemielewski approach, Prentice Hall of India Pvt Ltd, and Michael Negin 2002
2. Mikell P. Groover, Weiss, Roger - Industrial Robotics – Technology, Programming and Applications, McGraw Hill Internationl 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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## (R11AUT2110) OPTIMIZATION TECHNIQUES AND APPLICATIONS

**UNIT –I:**

**Single variable non-linear unconstrained optimization:** One dimensional Optimization methods: Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods-quadratic & cubic interpolation methods.

**Multi variable non-linear unconstrained optimization:** Direct search method-Univariant method-pattern search methods-Powell's Hook – Jeeves, Rosenbrock search methods-gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

**UNIT-II:**

**Geometric programming:** Polynomials – arithmetic – geometric inequality – unconstrained G.P - constrained G.P

**UNIT-III:**

**Dynamic Programming:** Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory, allocation, scheduling replacement.

**UNIT-IV:**

**Linear programming**: Formulation – sensitivity analysis. Change in the constraints, cost coefficient, coefficients of the constraints, addition and deletion of variable, constraints.
Simulation – introduction- types steps application- inventory- queuing- thermal system

**UNIT-V:**

**Integer Programming:** Introduction- formulation- gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

**Stochastic Programming:** Basic concepts of probability theory, random variables-distributions mean, variance, correlation, covariance, joint probability distribution- stochastic linear, dynamic programming.

**Text books:**

1. Optimization theory & Applications/S.S.Rao/New Age International.
2. Introductory to operation Research/Kasan & Kumar/ Springar
3. Optimization Techniques theory and practice /M.C.Josi, K.M.Moudgalya/ Norsa Publications

**Reference Books:**

1. S.D.Sharma/Operations Research
2. Operations Research/H.A.Taha/TMH
3. Optimization in Operations Research/R.L.Rardin
4. Optimization Techniques/Benugundu & Chandraputla/Pearson Asia

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## (R11AUT2111) NEURAL NETWORK AND FUZZY 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.

**Reference Books:**


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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## (R11AMS2112) QUALITY ENGINEERING IN MANUFACTURING

**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 Books:**

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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## (R11AUT2112) SMART MATERIALS AND 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 (ISBN: 0412370107).
2. B.Cui Shaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN:0890066817)


**Reference books:**

1. A.V.Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).
2. A.J.Moulson and J.M.Herbert, Electroceramics: Materials, Properties, Applications, 2nd Edition, John Wiley & Sons, Chichester, West Susses; New York, 2003 (ISBN: 0471497479).
3. G. Gautschi, Piezoelectric Sensories: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York,2002 (ISBN:3540422595)
4. K.Uchino, Piezoelectric Actuators and Wtrasonic Motors, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
5. G.Engdahl, Handbook of Giant Magnetostrictive Materials, Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)
6. K.Otsuka and C.M.Waymana, Shape Memory Materials, Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
7. Eric Udd, Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley & Sons, New York, 1991 (ISBN: 0471830070).


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## (R11AUT2113) VIBRATION ANALYSIS AND CONDITION MONITORING

**UNIT-I:**
Causes and effects of vibration, Vibration of single Degree and Multi Degree of freedom systems. Steady state and transient charecterstics of vibration.

**UNIT-II:**
Introduction to Condition Monitoring, Filure types, investigation and occurrences. Causes of failure, Characterstics of vibration –SHM, Periodic motion, Displacement, Velocity and acceleration. Peak to peak & RMS, linear and logarithmic scales and phase angle.

**UNIT-III:**
Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers.

**UNIT-IV:**
Condition monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques.

**UNIT-V:**
Special vibration measuring techniques – Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, shaft –orbit & position analysis..

**References:**


1. Collacott. R.A., Mechanical Fault Diagnosis and Condition Monitoring, Chapman & Hall, London, 1982.
2. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma,1993.
3. Nakra.B.C .Yadava, G.S. and Thuested .L., Vibration Measurement and Analysis, National Productivity Council, New Delhi, 1989.
4. Pox and Zenkins, Time Series Analysis.
5. A.H. Search, Vibration and Time Series Analysis.


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| **I Year – II Sem. M.Tech. (Automation)** | **L** | **P** | **C** |
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## (R11AMS2104) DESIGN FOR MANUFACTURING AND ASSEMBLY

**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 - General design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts.

**Metal Casting:** Appraisal of various casting processes, Selection of casting process - General design considerations for casting - Casting tolerances - Use of solidification simulation in casting design – Product design rules for sand casting.

**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 - Design of brazed joints.

**Forging:** Design factors for Forging - Closed die forging design - Parting lines of die drop forging die design - General design recommendations.

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


**Reference Books:**


1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekker, N.Y. 1990.
2. A. Delchambre "Computer Aided Assembly Planning”, Springer London, 1992.
3. Product Design and Manufacture – Chitale & Gupta, PHI 2008.


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| **I Year – II Sem. M.Tech. (Automation)** | **L** | **P** | **C** |
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## (R11AUT2201) AUTOMATION AND ROBOTICS LABORATORY

Experiments To Demonstrate

i). Principles of automation
ii). Limit stops and CAM control devices
iii). Pneumatic, hydraulic, electrical systems in automation
iv). Microprocessor applications in automated systems.
v). CNC machines and programming.
vi). Robotics Systems and Programming
vii). Automated transfer devices.
viii). Training on Programmable Logic Controllers

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