**ACADEMIC REGULATIONS**

**COURSE STRUCTURE**

**AND**

**DETAILED SYLLABUS**

**MECHANICAL ENGINEERING**

***For***

**5 YEAR INTEGRATED**

**DUAL DEGREE PROGRAM (I.D.P)**

**Leading to**

**(B.TECH. & M.Tech. / MBA )**

 ***(Applicable for the batches admitted from 2015-2016)***



**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

***(Autonomous)***

Kukatpally, Hyderabad – 500085

Telangana State, India

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

(Applicable from the batch admitted during 2015-16 and onwards)

**I YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | BS | Mathematics - I | 3 | 1 | 0 | 4 |
| 2 | BS | Engineering Physics | 3 | 0 | 0 | 3 |
| 3 | BS | Applied Chemistry | 3 | 0 | 0 | 3 |
| 4 | EAS | Computer Programming & Data Structures | 3 | 1 | 0 | 4 |
| 5 | EAS | Classical Engineering Mechanics | 4 | 0 | 0 | 4 |
| 6 | BS | Engineering Physics Lab | 0 | 0 | 3 | 2 |
| 7 | BS | Applied Chemistry Lab | 0 | 0 | 3 | 2 |
| 8 | EAS | Computer Programming & Data Structures Lab | 0 | 0 | 3 | 2 |
|  |  | NSS / NCC/NSO |  |  |  |  |
|  |  | **Total Credits** |  |  |  | **24** |

**I YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | BS | Mathematics – II | 3 | 1 | 0 | 3 |
| 2 | EAS | Fundamentals of Electrical & Electronics Engineering | 3 | 1 | 0 | 3 |
| 3 | HSS | English | 3 | 0 | 0 | 3 |
| 4 | EAS | Engineering Graphics | 3 | 0 | 3 | 4 |
| 5 | HSS | Environmental Science | 3 | 0 | 0 | 3 |
| 6 | BS | Computational Mathematics | 2 | 0 | 0 | 2 |
| 7 | EAS | Engineering Workshop | 0 | 0 | 3 | 2 |
| 8 | HSS | English Language Communication Skills Lab | 0 | 0 | 3 | 2 |
| 9 | BS | Computational Mathematics Lab | 0 | 0 | 3 | 2 |
|  |  | NSS/NCC/NSO |  |  |  |  |
|  |  | **Total Credits** |  |  |  | **24** |

**\*1 NSS/ NCC Participation Certificate is Mandatory for each semester (to be issued by relevant authorities).**

**\*2 shall include AutoCAD contents for about 1 UNIT (preferably last unit) and Practical contact shall be for 4**

 **Periods.**

**\*3 IT workshop shall be treated as a ‘trade’ in Engineering Workshop, and shall contain only hardware related IT experiments (such as hardware identification and connectivity, assembling and disassembling etc.) and this workshop shall be handled by Mechanical Engineering Department.**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

I**I YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | BS | Mathematics -III | 4 | 1 | 0 | 4 |
| 2 | DC | Metallurgy & Material Science | 3 | 0 | 0 | 3 |
| 3 | DC | Mechanics of Solids | 3 | 1 | 0 | 3 |
| 4 | DC | Thermodynamics | 3 | 1 | 0 | 3 |
| 5 | DC | Kinematics of Machines | 3 | 1 | 0 | 3 |
| 6 | DC | Machine Drawing practice | 2 | 0 | 3 | 3 |
| 7 | DC | Mechanics of Solids &Metallurgy Lab | 0 | 0 | 3 | 1 |
| 8 | DC | Fuels & lubricants Lab | 0 | 0 | 3 | 2 |
| 9 | Theory | Human Values and Professional Ethics | 2 | 0 | 0 | 2 |
|  |  | **Total Credits** |  |  |  | **24** |

**II YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | DC | Fluid Mechanics &Hydraulic Machinery | 4 | 1 | 0 | 4 |
| 2 | DC | Thermal Engineering-I | 4 | 1 | 0 | 4 |
| 3 | DC | Dynamics of Machines | 4 | 1 | 0 | 4 |
| 4 | DC | Production Technology | 3 | 0 | 0 | 3 |
| 5 | DC | Instrumentation & ControlSystems | 3 | 0 | 0 | 3 |
| 6 | DC | Fluid Mechanics &Hydraulic Machinery Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Instrumentation & control system Lab | 0 | 0 | 3 | 2 |
| 8 | DC | Production Technology Lab | 0 | 0 | 3 | 2 |
| 9 | HSS | Gender Sensitization Lab | - | - | - | - |
|  |  | **Total Credits** |  |  |  | **24** |

**\*1 NSS/ NCC Participation Certificate is Mandatory for each semester (to be issued by relevant authorities).**

**\*2 shall include AutoCAD contents for about 1 UNIT (preferably last unit) and Practical contact shall be for 4**

 **Periods.**

**\*3 IT workshop shall be treated as a ‘trade’ in Engineering Workshop, and shall contain only hardware related IT experiments (such as hardware identification and connectivity, assembling and disassembling etc.) and this workshop shall be handled by Mechanical Engineering Department.**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

**III YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | OE-I | Open Elective-I | 3 | 0 | 0 | 3 |
| 2 | HSS | Managerial Economics andFinancial Analysis | 4 | 0 | 0 | 4 |
| 3 | DC | Design of MachineMembers-I | 4 | 1 | 0 | 4 |
| 4 | DC | Thermal Engineering -II | 3 | 1 | 0 | 3 |
| 5 | DC |  Machine tools and Metrology | 4 | 0 | 0 | 4 |
| 6 | DC | Thermal Engineering Lab | 0 | 0 | 3 | 2 |
| 7 | DC |  Machine tools and Metrology Lab | 0 | 0 | 3 | 2 |
| 8 | HSS | Advanced English Language Communication Skills Lab | 0 | 0 | 3 | 2 |
|  |  | **Total Credits** |  |  |  | **24** |

**III YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | OE-II | Open Elective-II | 3 | 0 | 0 | 3 |
| 2 | DE | Departmental Elective-I | 4 | 0 | 0 | 4 |
| 3 | DE | Departmental Elective – II | 4 | 0 | 0 | 4 |
| 4 | DC | Design of MachineMembers-II | 3 | 1 | 0 | 3 |
| 5 | DC | Heat Transfer | 4 | 1 | 0 | 4 |
| 6 | DC | Kinematics & Dynamics Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Heat Transfer Lab | 0 | 0 | 3 | 2 |
| 8 | DC | Advanced Thermodynamics Lab | 0 | 0 | 3 | 2 |
|  |  | **Total Credits** |  |  |  | **24** |

**Summer Between III & IV Year : Industry Oriented Mini Project**

**Open Elective-I**

1. Operations Research
2. Basics of Thermodynamics
3. Fabrication Processes

**Open Elective-II**

1. Jet propulsion and Rocket Engineering

2. Ergonomics

3. Mechatronics

**Departmental Elective-I**

1. Automobile Engineering

2. Computer Graphics

3. Unconventional Machining Process

4. Industrial Engineering Practices

**Departmental Elective-II**

1. Operations Research

2. Tribology

3. Power Plant Engineering

4. Fluid Power Systems

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**(AUTONOMOUS)**

**IDP 5 Year (10 semesters) Regular Programme**

**Revised COURSE STRUCTURE**

(Applicable from the batch admitted from the Academic Year 2015-16 and onwards)

**IV YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | DC (UG) | CAD/CAM | 4 |  |  | 4 |
| 2 | DE-III (UG) | Departmental Elective-III | 4 |  |  | 4 |
| 3 | PGC-I | Advanced Manufacturing processes | 4 |  |  | 4 |
| 4 | PGE-I |  Elective-I | 4 |  |  | 4 |
| 5 | PGE-II |  Elective-II | 4 |  |  | 4 |
| 6 | PGE-III |  Elective-III | 4 |  |  | 4 |
| 7 | DC (UG) Lab | CAD/CAM Lab  | 0 |  |  | 2 |
| 8 | PGC Lab | Advanced Manufacturing Processes and Systems Lab | 0 | 0 | 4 | 2 |
| 9 | EAC (UG) | Industrial Training / Mini Project Evaluation (Summer Program) |  |  |  | 2 |
|  |  | **Total Credits** |  |  |  | **30** |

**DEPARTMENT ELECTIVE-III (UG)**

1. Unconventional Machining Processes
2. Advance IC Engines
3. Refrigeration & Air Conditioning

**Elective -I**

1. Advanced Metal Forming
2. Vibration Analysis and Condition Monitoring
3. Design For Manufacturing Of MEMS

**Elective -II**

1. Theory Of Metal Cutting And Tool Design
2. Precision Engineering
3. Mechatronics

**Elective-III**

1. Product Design and Development
2. Value Engineering and Total Quality Management
3. Manufacturing Systems : Simulation Modeling & Analysis

**IV YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | HSS (UG) | Management Science | 4 |  |  | 4 |
| 2 | PGC-II |  Optimization Techniques & Applications | 4 |  |  | 4 |
| 3 | PGE-IV |  Elective-IV | 4 |  |  | 4 |
| 4 | PGC Lab | Advanced CAD & Analysis Lab | 0 | 0 | 4 | 2 |
| 5 | DC (UG) | Major Project  |  |  |  | 14 |
|  |  | **Total Credits**  |  |  |  | **28** |

**Elective-IV**

1. Advanced Finite Element & Boundary Methods
2. Quality Engineering in Manufacturing
3. Additive Manufacturing

**V YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | PGC-III | Automation in Manufacturing | 4 |  |  | 4 |
| 2 | PGE-V |  Elective-V | 4 |  |  | 4 |
| 3 | PGE-VI |  Elective-VI | 4 |  |  | 4 |
| 4 | PGE-VII |  Elective-VII | 4 |  |  | 4 |
| 5 | PG | Project Stage – I |  |  |  | 12 |
| 6 | PG | Seminar  | 0 | 0 | 3 | 2 |
|  |  | **Total Credits**  |  |  |  | **30** |

**Elective -V**

1. Design For Manufacturing And Assembly
2. Production And Operations Management
3. Flexible Manufacturing Systems

**Elective –VI**

1. Advanced Casting And Welding Technology
2. Materials Technology

3. Industrial Robotics

**Elective-VII**

1. Nano Technology
2. Neural Networks and Fuzzy Logics
3. Scaling Laws and Micro Manufacturing

**V YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Group** | **Subject** | **L** | **T** | **P** | **Credits** |
| 1 | PG | PG Project Stage-II |  |  |  | 18 |
| 2 | PG | Comprehensive Viva  |  |  |  | 4 |
|  |  | **Total Credits**  |  |  |  | **22** |

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **3 1 0 4**

**MATHEMATICS-I**

**(Common to all branches)**

**Pre Requisites**: No Pre Requisites. Foundation Course.

**Objectives:**

* To train the students thoroughly in mathematical concepts of ordinary differential equations and their applications.
* To prepare students for lifelong learning and successful careers using mathematical Concepts of differential and integral calculus, ordinary differential equations and vector calculus.
* To develop the skill pertinent to the practice of the mathematical concepts including the students abilities to formulate and modeling the problems, to think creatively and to synthesize information.

**Outcomes:**

* The students become familiar with the application of differential and integral calculus, ordinary differential equations and vector calculus to engineering problems.
* The students attain the abilities to use mathematical knowledge to analyze, formulate and solve problems in engineering applications.

**UNIT–I: Differential calculus** **(12 lectures)**

Rolle’s Mean value Theorem – Lagrange’s Mean Value Theorem – Cauchy’s mean value Theorem – (all theorems without proof but with geometrical interpretations), verification of the Theorems and testing the applicability of these theorem to the given function.

Curve tracing – Equations given in Cartesian, polar and parametric forms.

Functions of several variables – Functional dependence- Jacobian- Maxima and Minima of functions of two variables with constraints and without constraints-Method of Lagrange multipliers.

**UNIT–II:** **Improper Integrals, Multiple Integration** **(12 lectures)**

Gamma and Beta Functions –Relation between them, their properties – evaluation of improper integrals using Gamma / Beta functions

Multiple integrals – double and triple integrals – change of order of integration- change of variables (polar, cylindrical and spherical) . Finding the area of a region using Double integration and volume of a region in space using triple integration.

**UNIT–III: Vector Calculus (12 lectures)**

 Vector Calculus: Scalar point function and vector point function, Gradient- Divergence- Curl and their related properties, - Laplacian operator, Line integral – Work done – Surface integrals –Volume integral. Green’s Theorem, Stoke’s theorem and Gauss’s Divergence Theorems (Statement & their Verification). Solenoidal and irrotational vectors, Finding potential function.

**UNIT–IV: First Order Ordinary Differential Equations (10 lectures)**

Linear and exact differential equations

Applications of first order differential equations – Newton’s Law of cooling, Law of natural growth and decay, orthogonal trajectories and electrical circuits

**UNIT-V: Higher Order Ordinary Differential Equations**  **(10 lectures)**

Linear, homogeneous and non- homogeneous differential equations of second and higher order with constant coefficients. Non-homogeneous term of the type e, Sin ax, Cos ax, and xn, eV(x), xV(x). Method of variation of parameters. Applications: Bending of beams, Electrical circuits and simple harmonic motion.

**Text books:**

1. HIGHER ENGINEERING MATHEMATICS BY B S GREWAL, KHANNA PUBLICATIONS.
2. ENGINEERING MATHEMATICS BY ERWIN KREYSZIG, WIELY PUBLICATIONS
3. VECTER ANALYSIS BY GHOSG & MAITY, NEW CENTRAL BOOK AGENCY

**References:**

1. ENGINEERING MATHEMATICS BY SRIMANTAPAL & SUBODH C. BHUNIA, OXFORD UNIVERSITY PRESS.
2. ADVANCED ENGINEERING MATHEMATICS BY PETER V O’NEIL, CENGAGE LEARNING

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**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **3 0 0 3**

**Engineering Physics**

**To be colleted from the physics dept**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **3 0 0 3**

**Applied chemistry**

**To be colleted from the chemistry dept**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **3 1 0 4**

**COMPUTER PROGRAMMING AND DATA STRUCTURES**

**Pre Requisites: none**

**Objectives:**

* To understand the various steps in Program development.
* To understand the basic concepts in C Programming Language.
* To learn how to write modular and readable C Programs
* To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
* To understand the notations used to analyze the Performance of algorithms.
* To understand the behavior of data structures such as stacks, queues,
* To understand and analyze various searching and sorting algorithms.
* To write programs in C to solve problems using data structures such as arrays , linked lists.

**Out come**s: should be able to develop logic,code in C with apropirate data base for solving given a problem

**UNIT - I**

**Introduction to Computers** – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development Method, Algorithms, Pseudo code, flow charts, applying the software development method.

**Introduction to C Language** – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output, Operators. Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Bit wise operators, Statements, Simple C Programming examples.

**Selection Statements** – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Simple C Programming examples.

**UNIT - II**

**Designing Structured Programs**- Functions, basics, user defined functions, inter function communication,

**Standard functions**-Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Preprocessor commands, example C programs

**Arrays** – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays, C program examples.

**UNIT - III**

**Pointers** – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions, command –line arguments.

**Strings** – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

**UNIT - IV**

**Derived types** – Structures – Declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit fields, enumerated types, C programming examples.

**Input and Output** – Concept of a file, streams, standard input / output functions, formatted input / output functions, text files and binary files, file input / output operations, file status functions (error handling), C program examples.

**UNIT – V**

**Sorting**- selection sort, bubble sort, insertion sort,

**Searching**-linear and binary search methods.

**Data Structures** – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

**TEXT BOOKS:**

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson

 Education.

1. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

**REFERENCES:**

1. C& Data structures – P. Padmanabham, Third Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press
3. Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion.
4. C for Engineers and Scientists, H.Cheng, Mc.Graw-Hill International Edition
5. Data Structures using C – A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson
6. Education / PHI
7. C Programming & Data Structures,E.Balagurusamy,TMH.
8. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
9. C& Data structures – E V Prasad and N B Venkateswarlu, S.Chand&Co.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **4 0 0 4**

**CLASSICAL ENGINEERING MECHANICS**

**Pre Requisites: none**

**Objectives:**

* + - To understand the resolving forces and moments for a given force system
		- To analyze the types of friction for moving bodies and problems related to friction.
		- To determine the centroid and second moment of area

**Outcomes:**

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and written reports:

1. An ability to construct free-body diagrams and to calculate the reactions necessary to ensure static equilibrium.
2. An understanding of the analysis of distributed loads.
3. A knowledge of internal forces and moments in members.
4. An ability to calculate centroids and moments of inertia.
5. A knowledge of kinematic and kinetic analyses and energy and momentum methods for particles and systems of particles.
6. A knowledge of kinematic and kinetic analyses and energy and momentum methods for rigid bodies.
7. **Introduction to Mechanics** : Basic Concepts, system of Forces Coplanar Concurrent Forces -Components in Space -Resultant -Moment of Forces and its Application - Couples and Resultant of Force Systems. Equilibrium of system of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.
8. **Friction**: Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions -Motion of Bodies -Wedge Screw, Screw-jack and differential screw –jack
9. **Centroid and Center of Gravity**: Introduction – Centroids of lines – Centroids of area - Centroids of Composite figures - Theorem of Pappus -Centre of Gravity of Bodies – Centroids of Volumes – Center of gravity of composite bodies.
10. **Area moments of Inertia**: Introduction – Definition of Moment of Inertia -Polar Moment of Inertia – Radius of gyration - Transfer Theorem for moment of inertia – Moments of inertia by integration - Moments of Inertia of Composite Figures, Product of Inertia, Transfer Formula for Product of Inertia.
11. **Mass Moment of Inertia**: Introduction - Moment of Inertia of Masses – Radius of gyration - Transfer Formula for Mass Moments of Inertia – Mass moments of inertia by integration - Mass moment of inertia of composite bodies.

**TEXT BOOKS :**

1. Singer’s Engineering Mechanics Statics and Dynamics , K. Vijaya Kumar Reddy, J. Suresh Kumar, BS Publications, 3rd Edition(SI Units)Fifth impression 2013

2. Engg. Mechanics / Timoshenko & Young

**REFERENCES :**

1. Engg. Mechanics/ Irving Shames, G. Krishna Mohan Rao, Prentice Hall
2. Engg. Mechanics Umesh Regl / Tayal.
3. A text of Engineering Mechanics /YVD Rao/ K. Govinda Rajulu/ M. Manzoor Hussain, Academic Publishing Company
4. Text Book in Applied Mechanics / Malhotra, Subramanian, Gahlot and Rathore / New Age.
5. Engg. Mechanics / KL Kumar / Tata McGraw Hill.
6. Engg. Mechanics / M.V. Seshagiri Rao & D Rama Durgaiah.
7. Engg. Mechanics / S.S. Bhavikati & K.G. Rajasekharappa

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **0 0 3 2**

**ENGINEERING PHYSICS LAB**

**TO BE COLLECTED FROM THE PHY DEPT**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **0 0 3 2**

**APPLIED CHEMISTRY LAB**

**TO BE COLLECTED FROM THE CHEMISTRY DEPT**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem L T P C**

 **0 0 3 2**

**COMPUTER PROGRAMMING AND DATA STRUCTURES LAB**

**Objectives:**

* To understand the various steps in Program development.
* To understand the basic concepts in C Programming Language.
* To learn how to write modular and readable C Programs
* To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
* To understand the notations used to analyze the Performance of algorithms.
* To understand the behavior of data structures such as stacks, queues,
* To understand and analyze various searching and sorting algorithms.
* To write programs in C to solve problems using data structures such as arrays, linked lists,

**Outcomes:**

To be able to write a C program for any desired application.

**1.** Write a C program to find the sum of individual digits of a positive integer.

**2.** Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1.

 Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

**3.** Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

**4.** Write a C program to find the roots of a quadratic equation.

**6**. Write a C program to find the factorial of a given integer.

**7**. Write a C program to find the GCD (greatest common divisor) of two given integers.

**8**. Write a C program to solve Towers of Hanoi problem.

**9.** Write a C program, which takes two integer operands and one operator from the user, performs the

 operation and then prints the result. (Consider the operators +,-,\*, /, % and use Switch Statement)

**10.** Write a C program to find both the largest and smallest number in a list of integers.

**11.** Write a C program that uses functions to perform the following:

 i) Addition of Two Matrices

 ii) Multiplication of Two Matrices

**12.** Write a C program that uses functions to perform the following operations:

i) To insert a sub-string in to a given main string from a given position.

 ii) To delete n Characters from a given position in a given string.

**13**. Write a C program to determine if the given string is a palindrome or not

**14.** Write a C program that displays the position or index in the string S where the string T begins, or – 1

 if S doesn’t contain T.

**15.**  Write a C program to count the lines, words and characters in a given text.

**16.**  Write a C program to generate Pascal’s triangle.

**17.**  Write a C program to construct a pyramid of numbers.

**18**. Write a C program that uses functions to perform the following operations:

 i) Reading a complex number

 ii) Writing a complex number

 iii) Addition of two complex numbers

 iv) Multiplication of two complex numbers

 (Note: represent complex number using a structure.)

**19.** i) Write a C program which copies one file to another.

 ii) Write a C program to reverse the first n characters in a file.

 (Note: The file name and n are specified on the command line.)

**20.** i)Write a C program to display the contents of a file.

**ii)** Write a C program to merge two files into a third file ( i.e., the contents of the first file followed by those of the second are put in the third file)

**21**. Write a C program that uses functions to perform the following operations on singly linked list.

 i) Creation ii) Insertion iii) Deletion iv) Traversal

**22**. Write C programs that implement stack (its operations) using

 i) Arrays ii) Pointers

**23**. Write C programs that implement Queue (its operations) using

 i) Arrays ii) Pointers

**24**. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order

 i) Bubble sort

 ii) Selection sort

**25**. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:

 i) Linear search ii) Binary search

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. II-Sem L T P C**

 **3 1 0 3**

**MATHEMATICS-II**

**(Common to all branches)**

**Pre Requisites**: No Pre Requisites, Foundation Courses.

**Objectives:**

* Our emphasis will be more on conceptual understanding and application of Fourier series, Fourier, Z and Laplace transforms and solution of partial differential equations.

**Outcomes:**

* The student gains the knowledge to tackle the engineering problems using the concepts of Fourier series, various transforms and partial differential equations.

**UNIT–I: Linear ODE with variable coefficients and series solutions (8 lectures)**

Equations reducible to constant coefficients-Cauchy’s and Legendre’s differential equations. Motivation for series solutions, Ordinary point and Regular singular point of a differential equation, Transformation of non-zero singular point to zero singular point. Series solutions to differential equations around zero, Frobenius Method about zero.

**Unit-II: Special Functions (8 lectures)**

Bessel’s Differential equation, Bessel functions properties: – Recurrence relations, Orthogonality, Generating function, Trigonometric expansions involving Bessel functions.

**UNIT–III: Laplace Transform (8 lectures)**

 Definition of Integral transform. Domain of the function and Kernel for the Laplace transforms, Laplace transform of standard functions, first shifting Theorem, Laplace transform of functions when they are multiplied or divided by “t”. Laplace transforms of derivatives and integrals of functions. – Unit step function – second shifting theorem – Dirac’s delta function, Periodic function – Inverse Laplace transform by Partial fractions( Heaviside method) Inverse Laplace transforms of functions when they are multiplied or divided by ”s”, Inverse Laplace Transforms of derivatives and integrals of functions, Convolution theorem-solving differential equations by Laplace transforms

**UNIT – IV: Fourier series and Fourier Transforms (8 lectures)**

 Definition of periodic function. Fourier expansion of periodic functions in a given interval of length,, Determination of Fourier coefficients – Fourier series of even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

**UNIT-V: Partial Differential Equations (10 lectures)**

Introduction and Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equation and non-linear equations (Charpit’s method).

Method of separation of variables for second order equations.Applications of Partial differential equations- one dimensional wave equation., Heat equation.

**Text books:**

1. HIGHER ENGINEERING MATHEMATICS BY B S GREWAL, KHANNA PUBLICATIONS.
2. ENGINEERING MATHEMATICS BY ERWIN KREYSZIG, WIELY PUBLICATIONS

**References:**

1. ENGINEERING MATHEMATICS BY SRIMANTAPAL & SUBODH C. BHUNIA, OXFORD UNIVERSITY PRESS.
2. ADVANCED ENGINEERING MATHEMATICS BY PETER V O’NEIL, CENGAGE LEARNING

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**FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING**

**To be collected from EEE dept.**

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**ENGLISH**

**To be collected from English dept**

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**ENGINEERING GRAPHICS**

Pre-requisites: Nil

Course objectives:

* To provide basic concepts in engineering drawing.
* To impart knowledge about standard principles of orthographic projection of objects.
* To draw sectional views and pictorial views of solids.

Outcomes:

* Preparing working drawings to communicate the ideas and information.
* Read, understand and interpret engineering drawings.

**UNIT – I**

**INTRODUCTION TO ENGINEERING DRAWING :**

Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid,

Involute. Scales – Plain, Diagonal and Vernier Scales.

**UNIT- II**

**ORTHOGRAPHIC PROJECTIONS:**

Principles of Orthographic Projections – Conventions – Projections of Points and Lines

Projections of Plane regular geometric figures.—Auxiliary Planes.

**UNIT – III**

Projections of Regular Solids – Auxiliary Views.

**UNIT – IV**

Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere.

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone

**UNIT – V**

**ISOMETRIC PROJECTIONS :**

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts.

Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

Auto CAD: Basic principles only

**TEXT BOOKS :**

1. Engineering Drawing N.D. Bhatt / Charotar

2. Engineering Drawing and Graphics Rane and Shah/ Pearson Edu.

**REFERENCE BOOKS**:

1. A Text Book of Engineering Drawing / Dhawan R K / S. Chand

2. Engineering Graphics With Auto CAD / James D Bethune / Pearson Edu.

3. Engineering Graphics / K R Mohan / Dhanpat Rai.

4. Text book on Engineering Drawing / KL Narayana/ P Kannaih /

Scitech

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**ENVIRONMENTAL SCIENCE**

**Note: To be collected from Civil Dept.**

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**COMPUTATIONAL MATHEMATICS**

**Pre Requisites**: No Pre Requisites, Foundation Courses.

**Objectives:**

* This course aims at providing the student with the concepts of matrices, numerical techniques and curve fitting.

**Outcomes:**

* The student will be able to analyze engineering problems using the concepts of Matrices and Numerical Methods.

**UNIT-I: Matrices and Linear Transformations: (8 lectures)**

Real matrices – Symmetric, skew – symmetric, orthogonal. Complex matrices: Hermitian, Skew-Hermitian and Unitary Matrices. Idempotent matrix,

Finding rank of a matrix by reducing to Echelon and Normal forms . Consistency of system of linear equations (homogeneous and non- homogeneous) using the rank of a matrix.

Cayley-Hamilton Theorem (without Proof) – Verification. Finding inverse of a matrix and powers of a matrix by Cayley-Hamilton theorem, Linear dependence and Independence of Vectors. Linear Transformation – Orthogonal Transformation. Eigen values and Eigen vectors of a matrix. Properties of Eigen values and Eigen vectors of matrices. Diagonolization of matrix – Quadratic forms upto three variables- Reduction of quadratic form to canonical form, Rank – Positive definite, negative definite – semi definite – index – signature of quadratic form.

**UNIT–II: Interpolation and Curve fitting (5 lectures)**

**Interpolation:** Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations and separation of symbols- Difference Equations – Differences of a polynomial-Newton’s formulae for interpolation –Interpolation with unevenly spaced points-Lagrange’s Interpolation formula. **Curve fitting**: Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares.

**UNIT–III: Numerical techniques. (5 lectures)**

Solution of Algebraic and Transcendental Equations and Linear system of equations.

Introduction – Graphical interpretation of solution of equations .The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method .

Solving system of non-homogeneous equations by L-U Decomposition method (Crout’s Method) Jacobi’s and Gauss-Seidel Iteration method

**UNIT- IV: Numerical Differentiation, Integration: (5 lectures)**

Numerical differentiation, Numerical integration – Trapezoidal rule, Simpson’s 1/3rd and 3/8 Rule , Generalized Quadrature.

**UNIT – V: Numerical solutions of First order differential equations (5 lectures)**

Numerical solution of Ordinary Differential equations: Solution by Taylor’s series method –Picard’s Method of successive Approximation- single step methods-Euler’s Method-Euler’s modified method, Runge-Kutta Methods.

**Text Books:**

1. INTRODUCTORY METHODS OF NUMERICAL ANALYSIS BY SS SASTRY
2. Numerical and statistical methods with programming in C by Sujatha sinha and subhabrada dinda, Scitec publishers.
3. NUMERICAL METHODS, PRINCIPLES, ANALYSIS AND ALGORITHMS BY SRIMANTAPAL & SUBODH C. BHUNIA, OXFORD UNIVERSITY PRESS.

**References:**

1. ADVANCED ENGINEERING MATHEMATICS BY ALAN JEFFERY
2. APPLIED NUMERICAL METHODS USING MATLAB BY RAO.V.DUKKIPATI,NEW AGE PUBLISHERS
3. NUMERICAL METHODS IN SCIENCE AND ENGINEERING –Apractical approach by S.Rajasekharan, S.Chand publications

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**ENGINEERING WORKSHOP**

Pre-requisites: Practical skill

Objective:

* To Study of different hand operated power tools, uses and their demonstration.
* To gain a good basic working knowledge required for the production of various engineering products.
* To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
* To develop a right attitude, team working, precision and safety at work place.
* It explains the construction, function, use and application of different working tools, equipment and machines.
* To study commonly used carpentry joints.
* To have practical exposure to various welding and joining processes.
* Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.
* To understanding the computer hardware and practice the Assembly of computer parts.
* To practice the process of Installation of operating system windows.

 Outcomes: At the end of the course, the student will be able to:

* Better understanding the process of assembly of computer parts and installation of different software’s.
* Study and practice on machine tools and their operations
* Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
* Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
* Apply basic electrical engineering knowledge for house wiring practice.
1. TRADES FOR EXERCISES :

(Any **six** trades from the following with minimum of **two** exercises in each trade)

1. Carpentry
2. Fitting
3. Tin-Smithy
4. Black Smithy
5. House-wiring
6. Foundry
7. Plumbing
8. Trades for Demonstration & Exposure
9. Demonstration of power tools & wiring
10. Welding
11. Machine Shop
12. **IT Workshop I:** Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, simple diagnostic exercises.

**IT Workshop II:** Installation of operating system windows and linux simple diagnostic exercises.

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**ENGLISH LANGUAGE COMMUNICATION SKILLS LAB**

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

**Objectives**

* To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
* To sensitise the students to the nuances of English speech sounds, word accent, intonation and rhythm
* To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking
* To improve the fluency in spoken English and neutralize mother tongue influence
* To train students to use language appropriately for interviews, group discussion and public speaking

**Learning Outcomes**

* Better Understanding of nuances of language through audio- visual experience and group activities
* Neutralization of accent for intelligibility
* Speaking with clarity and confidence thereby enhancing employability skills of the students

**Syllabus: English Language Communication Skills Lab** **shall have two parts:**

1. **Computer Assisted Language Learning (CALL) Lab**
2. **Interactive Communication Skills (ICS) Lab**

The following course content is prescribed for the **English Language Communication Skills Lab**

**Exercise – I**

**CALL Lab**: Introduction to Phonetics – Speech Sounds – Vowels and Consonants

**ICS Lab**: Ice-Breaking activity and JAM session

Articles, Prepositions, Word formation- Prefixes & Suffixes, Synonyms & Antonyms

**Exercise – II**

**CALL Lab**: Structure of Syllables - Past Tense Marker and Plural Marker – Weak Forms and Strong Forms - Consonant Clusters.

**ICS Lab**: Situational Dialogues – Role-Play- Expressions in Various Situations – Self-introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette - Telephone Etiquette.

Concord (Subject in agreement with verb) and Words often misspelt- confused/misused

**Exercise - III**

**CALL Lab:** Minimal Pairs- Word accent and Stress Shifts- Listening Comprehension.

**ICS Lab**: Descriptions- Narrations- Giving Directions and guidelines.

Sequence of Tenses, Question Tags and One word substitutes.

**Exercise – IV**

**CALL Lab**: Intonation and Common errors in Pronunciation.

**ICS Lab**: Extempore- Public Speaking

Active and Passive Voice, –Common Errors in English, Idioms and Phrases

**Exercise – V**

**CALL Lab:** Neutralization of Mother Tongue Influence and Conversation Practice

**ICS Lab**: Information Transfer- Oral Presentation Skills

Reading Comprehension and Job Application with Resume preparation.

**Minimum Requirement of infrastructural facilities for ELCS Lab:**

1. **Computer Assisted Language Learning (CALL) Lab:**

**The Computer aided Language Lab** for 40 students with 40 systems, one master console, LAN facility and English language software for self- study by learners.

**System Requirement (Hardware component):**

*Computer network with Lan with minimum 60 multimedia systems with the following specifications:*

1. P – IV Processor
	1. Speed – 2.8 GHZ
	2. RAM – 512 MB Minimum
	3. Hard Disk – 80 GB
2. Headphones of High quality
3. **Interactive Communication Skills (ICS) Lab :**

**The Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V., a digital stereo –audio & video system and camcorder etc.

**Suggested Software:**

* **Cambridge Advanced Learners’ English Dictionary with CD.**
* **Grammar Made Easy by Darling Kindersley**
* **Punctuation Made Easy by Darling Kindersley**
* Clarity Pronunciation Power – Part I
* Clarity Pronunciation Power – part II
* **Oxford Advanced Learner’s Compass, 8th Edition**
* ***DELTA’s key to the Next Generation TOEFL Test: Advanced Skill Practice.***
* Lingua TOEFL CBT Insider, by Dreamtech
* TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
* **English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge**
* **English Pronunciation in Use** (Elementary, Intermediate, Advanced) Cambridge University Press
* Raman, M & Sharma, S. 2011. Technical Communication, OUP
* Sanjay Kumar & Pushp Lata. 2011. Communication Skills, OUP

**SUGGESTED READING:**

1. Rama Krishna Rao, A. *et al. English Language Communication Skills – A Reader cum Lab Manual Course Content and Practice.* Chennai: Anuradha Publishers
2. Suresh Kumar, E. & Sreehari, P. 2009. *A Handbook for English Language Laboratories.* New Delhi: Foundation
3. *Speaking English Effectively* 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
4. Sasi Kumar, V & Dhamija, P.V. *How to Prepare for Group Discussion and Interviews.* Tata McGraw Hill
5. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad.
6. *English Pronunciation in Use. (Elementary, Intermediate & Advance).* Cambridge: CUP
7. [Chris Redston](http://www.cambridge.org/us/cambridgeenglish/authors/chris-redston), [Gillie Cunningham](http://www.cambridge.org/us/cambridgeenglish/authors/gillie-cunningham), Jan Bell. *Face to Face* (2nd Edition). Cambridge University Press
8. Nambiar, K.C. 2011. *Speaking Accurately. A Course in International Communication.* New Delhi : Foundation
9. Soundararaj, Francis. 2012. *Basics of Communication in English. New Delhi: Macmillan*
10. A textbook of English Phonetics for Indian Students by T. Balasubramanian (Macmillan)

**DISTRIBUTION AND WEIGHTAGE OF MARKS**

***English Language Laboratory Practical Examination:***

1. The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.

2. For the Language lab sessions, there shall be a continuous evaluation during the year for 30 sessional marks and 70 semester-end Examination marks. Of the 30 marks, 20 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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**COMPUTATIONAL MATHEMATICS LAB**

**Pre Requisites**: No Pre Requisites, Foundation Course.

**Objectives:**

* The aim of this lab is to develop programming skills in C for the numerical methods and allied problems. More emphasis will be on writing programs with minimum possible code.

**Outcomes:**

* After completion of this lab course, student will be well acquainted with the programming skills in C and able to write the codes for the problems they come across in engineering courses

**UNIT- 1: Interpolation:**

**Programming Tasks**:

1. A) Write a program to determine y for a given x, if two arrays of x and y of same

 size are given.(using Newton’s interpolation both forward and backward)

B) Write a program to determine y for a given x, if two arrays of x and y of same size

 are given.(using Lagrange ’s interpolation)

C) Write a program to determine y for a given x, if two arrays of x and y of same size

 are given.(using Gauss interpolation)

 (Selection criteria of the interpolation formula are important.)

**UNIT- 1I: Curve fitting**:

**Programming Tasks:**

1. A) Write a program to find a line of best fit from the given two arrays of x and y

 of same size.

1. Write a program to find a curve of the form from the given two arrays of x and y of same size.
2. Write a program to find a curve of the form from the given two arrays of x and y of same size.
3. Write a program to find a curve of the form from the given two arrays of x and y of same size.

**UNIT- 1II: Solution of Algebraic and Transcendental Equations**

**Programming Tasks:**

1. A) Write a program to find the root of a given equation using bisection method.

 (Write this program such that the initial values given to the system are not usable, then the system should ask us to give new set of initial values)

1. Write a program to find the root of a given equation using method of false position(regula false position)
2. Write a program to find the root of a given equation using iteration method
3. Write a program to find the root of a given equation using Newton Rophson method

**UNIT- 1V: Linear system of equations**

**Programming Tasks:**

1. A) Write a program to find the solution of given system of linear equations using L-

 U decomposition method

1. Write a program to find the solution of given system of linear equations using jacobi’s method
2. Write a program to find the solution of given system of equations using Gauss sidel iteration method
3. Write a program to find the solution of given system of equations using Gauss Jordan elimination method

**UNIT- V: Numerical Differentiation, Integration, and Numerical solutions of First order differential**

 **equations:**

**Programming Tasks:**

1. A) Write a program to evaluate definite integral using trapezoidal rule, Simpson’s

 1/3rd rule and 3/8th rule.

1. Write a program to solve a given differential equation using Taylor’s series
2. Write a program to solve a given differential equation Euler’s and modified Eulers method
3. Write a program to solve a given differential equation using Ruge-Kutta method.

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**MATHEMATICS – III**

**Pre Requisites:** No Pre Requisites, Foundation Course.

**Objectives:** To enable the students to understand the concepts of probability distributions, statistical Inferences, and testing of hypothesis.To enable the students to understand the key concepts of Complex functions and the calculus of complex functions.

**Outcomes:** The student achieves the knowledge to testing the hypothesis and form the probability

distributions to make inferences. The students can study some problems of engineering using the concepts of residue theorem, Laurent series of functions of complex variables.

**UNIT-I: Single Random variables and probability distributions. (12 lectures)**

Random variables – Discrete and continuous. Probability distributions, mass function/ density function of a probability distribution . Mathematical Expectation, Moment about origin, Central moments Moment generating function of probability distribution.

Binomial , Poisson & normal distributions and their properties . Moment generating functions of the above three distributions. and hence finding the mean and variance.

**UNIT-II: Multiple Random variables, Correlation & Regression (10 lectures)**

 Covariance of two random variables, Correlation -Coefficient of correlation, The rank correlation. Regression- Regression Coefficient, The lines of regression.

**UNIT-III: Sampling Distributions and Testing of Hypothesis (10 lectures)**

**Sampling:** Definitions of population, sampling, statistic, parameter. Types of sampling, Expected values of Sample mean and varience, sampling distribution, Standard error, Sampling distribution of means and sampling distribution of varience.

**Testing of hypothesis**: Null hypothesis, Alternate hypothesis, type I, & type II errors – critical region, confidence interval, Level of significance. One sided test, Two sided test,

**Large sample tests:**

1. Test of Equality of means of two samples equality of sample mean and population mean (cases of known varience & unknown varience, equal and unequal variances)
2. Tests of significance of difference between sample S.D and population S.D.
3. Tests of significance difference between sample proportion and population proportion & difference between two sample proportions.

**Small sample tests:**

1. Student t-distribution, its properties; Test of significance difference between sample mean and population mean; difference between means of two small samples
2. Chi-square distribution , it’s properties, Chi-square test of goodness of fit .

**UNIT-IV: Functions of Complex Variables (12 lectures)**

Complex functions and its representation on Argand plane, Concepts of limit Continuity, Differentiability, Analyticity, Cauchy-Riemann conditions, Harmonic functions – Milne – Thompson method.

 Line integral – Evaluation along a path and by indefinite integration – Cauchy’s integral theorem – Cauchy’s integral formula – Generalized integral formula.

Radius of convergence– Expansion in Taylor’s series, Maclaurin’s series and Laurent series. Singular point–Isolated singular point– pole of order m– essential singularity.

**UNIT – V:** C**ontour Integration (12 lectures)**

Residue – Evaluation of residue by formula and by Laurent series – Residue theorem.

Evaluation of integrals of the type

(a) Improper real integrals  (b) 

 **Conformal mapping.**

Transformation of z-plane to w-plane by a function, Conformal transformation. Standard transformations- Translation; Magnification and rotation; inversion and reflection, Transformations like, log z, z2, and Bilinear transformation. Properties of Bilinear transformation, determination of bilinear transformation when mappings of 3 points are given .

**Text Books:**

1. FUNDAMENTALS OF MATHEMATICAL STATISTICS BY S C GUPTA AND V.K.KAPOOR
2. PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS BY SHELDON M.ROSS,ACADEMIC PRESS
3. HIGHER ENGINEERING MATHEMATICS BY B S GREWAL.
4. ADVANCED ENGINEERING MATHEMATICS BY PETER V O’NEIL, CENGAGE LEARNING
5. ENGINEERING MATHEMATICS BY ERWIN KREYSZIG,10TH EDITION WIELY PUBLICATIONS

**References:**

1. ENGINEERING MATHEMATICS BY SRIMANTAPAL & SUBODH C. BHUNIA, OXFORD UNIVERSITY PRESS.
2. ADVANCED ENGINEERING MATHEMATICS BY PETER V O’NEIL, CENGAGE LEARNING.
3. PROBABILITY AND STATISTICS FOR ENGINEERING AND THE SCIENCEC BY JAY L.DEVORE.

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**METALLURGY AND MATERIAL SCIENCE**

**Prerequisites:** Basic idea of bonding nature in solids and different properties of elements

**Objectives:** Understand the crystal structure and classification of materials and determining mechanical properties and their suitability for applications. Classify cast irons and study their applications. Interpret the phase diagrams of materials. Select suitable heat-treatment process to achieve desired properties of metals and alloys. Understand the ceramics and composite materials and their properties.

**Course outcomes**: The student an able to understand basic idea of the the different material properties and heat treatment process of ferrous and non ferrous alloys with respect to phase diagrams.

 **UNIT – I**

Structure of Metals : Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution of Alloys : Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

**UNIT -II**

Equilibrium of Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cu-Sn and Fe-Fe3C.

**UNIT -III**

Cast Irons and Steels : Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plan carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

**UNIT – IV**

Heat treatment of Alloys : Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, Hardening, TTT diagrams, tempering , Hardenability surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

Non-ferrous Metals and Alloys : Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

**UNIT – V**

Ceramic materials : Crystalline ceramics, glasses, cermaets, abrasive materials, nonomaterials – definition, properties and applications of the above.

Composite materials : Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites.

**TEXT BOOKS :**

1. Introduction to Physical Metallurgy / Sidney H. Avener.
2. Material science & Metallurgy / Kodgire

**REFERENCE BOOKS :**

1. Science of Engineering Materials / Agarwal
2. Materials Science / Vijendra Singh
3. Elements of Material science / V. Rahghavan
4. An introduction to material science / W.g.vinas & HL Mancini
5. Material science & material / C.D.Yesudian & harris Samuel
6. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.

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**MECHANICS OF SOLIDS**

**Pre-requisites:** Basics of Engineering Mechanics

Course Objcetives: Course Objcetives: To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior. To provide students with exposure to the systematic methods for solving engineering problems in solid mechanics. To discuss the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading. To build the necessary theoretical background for further structural analysis and design courses.

**Course Outcomes:** Understand simple stress and strains of problems. Determine the resistance and deformation in member’s subjected to axial, flexural and torsional loads. Evaluate the forces in pin joint – plane frames. Determine the deflections of beams using different methods. Analyze and design thin, thick cylinders and springs

**UNIT-I**

**SIMPLE STRESSES AND STRAINS :** Elasticity and plasticity – Types of stresses and strains – Hooke’s law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

**Unit-II**

**SHEAR FORCE AND BENDING MOMENT :** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilver, simply supported and overhanging beams subjected to point loads , u.d.l, uniformly varying loads and combination of these loads – Point of contraflexure – Relation between S.F., B.M and rate of loading at a section of a beam.

**UNIT-III**

**FLEXURAL STRESSES :**

Theory of simple bending – Assumptions Derivation of bending equation : M/I=f/y=E/R Neutral axis – Determination bending stresses – section modules of rectangular and circular sections (Solid and Hollow), I,T,Angle and Channel sections – Design of simple beam sections.

Shear Stresses : Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

**UNIT-IV**

**ANALYSIS OF PIN-JOINTED PLANE FRAMES :** Determination of Forces in members of plane, pin-joined, perfect trusses by (i) method of joints and (ii) method of sections. Analysis of various types of cantilever and simply – supported trusses – by method of joints, method of sections and tension coefficient methods.

**DEFLECTION OF BEAMS :** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay’s methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L. uniformly varying load. Mohr’s theorems – Moment area method – application to simple cases including overhanging beams.

**Unit-V**

**THIN CYLINDERS :** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

**Thick Cylinders** – lame’s equation – cylinders subjected to inside and out side pressures – compound cylinders.

**TEXT BOOKS :**

1. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman
2. Strength of Materials by Jondar : Galgotia Publications

**REFERENCES :**

1. Strength of Materials by Bansal, Lakshmi Publications
2. Strenght of Mateirals by S. Tumoshenko
3. Strength of Materials by R.S. Khurmi; S. Chand & Co. 2005

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 **3 1 0 3**

**THERMODYNAMICS**

**Pre-requisite**: Engineering Chemistry and Physics

**Course Objective**: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

**Course Outcomes**: At the end of the course, the student should be able to Understand and differentiate between different thermodynamic systems and processes. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

**Tables/Codes: Steam Tables and Mollier Chart, Refrigeration Tables**

**UNIT – I**

**Introduction: Basic Concepts:**

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

**UNIT II**

PMM I - Joule’s Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot’s principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

**UNIT – III**

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

**UNIT IV**

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton’s Law of partial pressure, Avogadro’s Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier’s Equation – Psychrometric chart.

**UNIT - V**

**Power Cycles :** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

**Refrigeration Cycles:**

Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

**TEXT BOOKS :**

1. Engineering Thermodynamics / PK Nag /TMH, III Edition
2. Thermodynamics / C.P.Arora.

**REFERENCE BOOKS:**

1. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
2. Fundamentals of Classical Thermodynamics – G. Van Wylan & R.E. Sonntag – John Wiley Pub.
3. Thermodynamics – J.P.Holman / McGrawHill
4. Engineering Thermodynamics – Jones & Dugan
5. An introduction to Thermodynamics / YVC Rao / New Age
6. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.
7. Thermodynamics – Achutan – PHI.
8. Thermodynamics – G.C. Gupta – Pearson Publications.

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 **3 1 0 3**

**KINEMATICS OF MACHINES**

**Prerequisites:** Basic principles of mechanics

**Course Objectives:** The objective is to study the relative motion, velocity and accelerations of the various elements in a mechanism. In mechanical Engineering we come across number of mechanisms such as four bar/slider crank/double slider crank/straight line motion mechanism etc. Mechanism deals with only relative motions. Once we make a study considering for us also there it is called kinetics. The first course deals with mechanisms, their inversions straight line motion mechanisms steering mechanisms etc. Also study of cams/gears& gear trains & belts is also introduced.

**Course out Comes:** The main purpose is to give an idea about the relative motions obtained in all the above type of components used in mechanical Engineering.

**UNIT – I**

**Mechanisms :** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained .

**Mechanism and Machines** – Mobility of Mechanisms : Grubler’s criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

**UNIT – II**

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

**Plane motion of body:** Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

**UNIT – III**

**Straight-line motion mechanisms:** Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff’s and Robert Mechanism - Pantographs

**Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman’s steering gear.

**Hooke’s Joint:** Single and double Hooke’s joint –velocity ratio – application – problems.

**UNIT – IV**

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

**UNIT – V**

**Higher pair:** Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

**Gear Trains:** Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile

**TEXT BOOKS:**

1. Theory of Machines /S.S.Rattan – Tata McGraw Hill Publishers.
2. Kinematics & Dynamics Of machinery/Norton/TMH

**REFERENCE BOOKS:**

1. Theory of Machines / Thomas Bevan/CBS
2. Theory of Machines / Sadhu Singh / Pearson.
3. Theory of Machines / Shigley / Oxford
4. Mechanism and Machine Theory / JS Rao and RV Duggipati / New Age
5. Theory of Machines by / R.K. Bansal (Lakshmi Publications).

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 **2 0 3 3**

**MACHINE DRAWING PRACTICE**

**Question Paper Pattern:** Question paper has two parts. Part one has five questions out of which answer three (each 10 marks). Part two has one question (assembly with three views) and it is to be answered compulsorily( it carries 50 marks)

**Pre-requisites:** Engineering graphics

**Course objectives:** To familiarize with the standard conventions for different materials and machine parts in working drawings. To make part drawings including sectional views for various machine elements. To prepare assembly drawings given the details of part drawings.

**Course Outcomes**: Preparation of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components.

**Question Paper Pattern:** Question paper has two parts. Part one has five questions out of which answer three (each 10 marks). Part two has one question (assembly with three views) and it is to be answered compulsorily ( it carries 50 marks)

1. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

2. Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.

3. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.

4. Title boxes, their size, location and details - common abbreviations and their liberal usage

5. Types of Drawings – working drawings for machine parts.

**Drawing of Machine Elements and simple parts**

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

6. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.

7. Keys, cottered joints and knuckle joint.

8. Rivetted joints for plates

9. Shaft coupling, spigot and socket pipe joint.

10. Journal, pivot and collar and foot step bearings.

**Assembly Drawings:**

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

11. Steam engine parts – stuffing boxes, cross heads, Eccentrics.

12. Machine tool parts: Tail stock, Tool Post, Machine Vices.

13. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block

14. Simple designs of steam stop valve, spring loaded safety valve, feed check valve and air cock.

**NOTE :** First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

**TEXT BOOK :**

1. Machine Drawing –K.L.Narayana/ Wiley Eastern.

**REFERENCE BOOKS :**

1. Machine Drawing – P.S.Gill.

2. Machine Drawing – Junnarkar N.D./ Pearson Edu.

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**II Year B.Tech. Mech. Engg. I-Sem L T P C**

 **0 0 3 1**

**MECHANICS OF SOLIDS AND METALLURGY LAB**

**Pre-requisites:** Chemistry & Physics

**Pre-requisites:** Chemistry & Physics

Course Objectives: To understand the concepts of strength of materials and conduct different tests to find the strength of materials.

**Course Outcomes:** At the end of the course, the student will be able to Conduct tension test on steel, aluminium, copper and brass. Perform compression tests on spring and wood.Determine elastic constants using flexural and torsion tests. Determine hardness of metals

**MECHANICS OF SOLIDS LAB**

**List of Experiments:**

1. To study the stress -strain characteristics of (a) Mild Steel and (b) Tor steel by conducting tension test on U.T.M
2. To study the stress - strain characteristics of (a) Copper and (b) Aluminium by conducting tension test on Hounsfield Tensometer
3. To find the Compressive strength of wood and punching shear strength of G.I. sheet by conducting relevent tests on Housfield Tensometer
4. To find the Brinnell’s and Vicker’s hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper by conducting hardness test.
5. To determine the Modulus of rigidity by conducting Torsion test on (a) Solid shaft (b) Hollow shaft
6. To find the Modulus of rigidity of the material of a spring by conducting Compression test.
7. To determine the Young’s modulus of the material by conducting deflection test on a simply supported beam.
8. To determine the Modulus of elasticity of the material by conducting deflection test on a Propped Cantilever beam.
9. To determine the Modulus of elasticity of the material by conducting deflection test on a continuous beam
10. Ductility test for steel
11. Shear test on Mild Steel rods

**METALLURGY LAB**

1. Preparation and study of Crystal models.

2. Study of: Specimen cutting machine Specimen mounting press Grinding and polishing equipment

3. Study of various Metallurgical Microscopes and use of leveling press

4. Metallographic preparation of ferrous specimen for Microscopic examination

5. Preparation of non-ferrous specimen for Metallographic examination

6. Preparation and Metallographic study of pure metals like Iron, Copper and Aluminium.

7. Measurement of lattice parameters of various crystal structures and calculation of packing factors

 and size of vacancies.

8. Identification of Microstructures of steels.

9. Estimation of Carbon content of steels using metallurgical microscope and Spark test.Thermal

 analysis.

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 **0 0 3 2**

**FUELS AND LUBRICANTS LAB**

**Prerequisite:** Chemistry

**Objectives:** To Understand the fuel and lubricants properties

1. Determination of Flash and Fire points of Liquid fuels/Lubricants.
2. Carbon residue test: Liquid fuels.
3. Determination of Viscosity: Liquid lubricants.
4. Determination of Calorific value: Solid/Liquid/Gaseous fuels.
5. Greese penetration test.
6. Viscosity determination by Redwood & Saybolt methods.
7. Bomb/ Junkers Gas Calorimeter.

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 **2 0 0 2**

**HUMAN VALUES AND PROFESSIONAL ETHICS**

Course Objectives:

1.Identify the core values that shape the ethical behavior of an engineer

2.To create an awareness on professional ethics and Human Values•

 3.To appreciate the rights of others

**Course Outcomes**

After completion of he course students will be able to identify the core values that shape the ethical behavior of an engineer ,be aware of professional ethics and Human Values, appreciate the rights of others.

**Unit I**

 **Human Values:** Morals, values, ethics – integrity – work ethics –service learning –civic virtue – respect for others- living peacefully - Caring –sharing –honesty – courage –valuing time – cooperation – commitment –empathy – self-confidence –spirituality – character- Mini-Cases

**Unit II**

 **Professional Ethics:** Profession- and professionalism - Two models of professionalism –Professional etiquette -Three types of Ethics or morality Responsibility in Engineering – Engineering standards –Engineering Ethics – Positive and Negative Faces. Professional Codes and Code of conduct (as given by ASME, ASCE, IEEE, IETE, Institute of Engineers as Guidelines for ethical conduct). Mini-cases.

**Unit III**

**Professional Responsibilities:** Ethical standards Vs Professional Conduct – Zero Tolerance for Culpable Mistakes – Hazards and Risks-Risk benefit analysis– congeniality, collegiality and loyalty. Respect for authority – conflicts of interest – occupational crime ––Mini-Cases.

**Unit IV**

 **Professional Rights:** professional rights and employee rights communicating risk and public policy – Whistle blowing - collective bargaining. Professionals /engineers as managers, advisors, experts, witnesses and consultants – moral leadership- Regulatory compliances, Monitoring and control- Mini-Cases

**Unit V**

 **Ethics in global context:** Global issues in MNCs- Problems of bribery, extortion, and grease payments – Problem of nepotism, excessive gifts – paternalism – different business practices – negotiating taxes. Mini-Cases.

**Mini-projects**

**Project 1:** The student of this course should invariably attend (or watch on internet/any TV channel/youtube/social media) two speeches of 30 minutes duration each dealing with spiritual discourse and submit a report on the contents of the lecture proceedings.

**Project 2:**  Visit any organization (including shops/ hotels or shopping malls in your region) of your choice and observe how the professionals perform the given job with a focus on professional ethics and human values.

**References**

1. Aryasri, *Human Values and Professional Ethics*, Maruthi Publications.
2. S B George, *Human Values and Professional Ethics,* Vikas Publishing.
3. KR Govindan & Saenthil Kumar:Professional *Ethics and Human Values*, Anuradha Publications.
4. S K Chakraborthy & D.Chakraborthy: *Human Values and Ethics*, Himalaya.
5. M. Govindarajan, S. Natarajan, & V.S. Senthilkumar: *Engineering Ethics(Includes Human Values),* HI Learning Pvt. Ltd., New Delhi – 110001

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**II Year B.Tech. Mech. Engg. II-Sem L T P C**

 **4 1 0 4**

**FLUID MECHANICS & HYDRAULIC MACHINERY**

**Pre-requisites:** None

Course Objectives

To prepare students to demonstrate basic knowledge in mathematics, science and engineering.

To prepare students to excel their the ability to identify, formulate and solve mechanical engineering   problems.

To prepare students should be capable of self-education and clearly understand the value of life-long   learning.

To prepare students, will be broadly educated and will have an understanding of the impact of engineering   on society and demonstrate awareness of contemporary issues.

To train students  will be familiar in applying software methods to analyze mechanical engineering   problems.

To inculcate in students, the ability to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and   techniques to estimate time, resources to complete a project.

**Course Outcomes:** Understand thebasic static, kinematic and dynamic principles and conservation laws to fluid flow problems in engineering applications. Design experimental procedure for physical model studies. Design the working proportions of hydraulic machines. Compute drag and lift coefficients using the theory of boundary layer flows. Analyze of free surface and pipe flows. Formulate and solve one dimensional compressible fluid flow problems. Study of different types of pumps and turbines.

**UNIT I**

**Fluid Statics**: Dimensions and Units: physical properties of fluids-specific gravity, viscosity, surface tension- vapour pressure and their influence on fluid motion-atmospheric, gauge and vaccum pressure- measurement of pressure- piezometer, U-Tube and Differential Manometers.

**UNIT II**

**Fluid kinematics:** stream line, path line and steak line and stream line, classification of flows steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three dimensional flow.

**Fluid dynamics:** Surface & body forces Euler’s & Bernouli’s equations for flow along a stream line, moment equation and its applications on force on pipe bend. Measurement of flow: pitot tube, venture meter and orifice meter, flow nozzle.

**UNIT III**

**Closed conduit flow:** Reynold’s experiment-Darcy Weisbach equation-minor losses in pipes-pipes in series and pipes in parallel-total energy line-hydraulic gradient line.

**Boundary layer concepts:** Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivations) boundary layer in transition, separation of boundary layers submerged objects-drag and lift .

**UNIT IV**

**Basics and hydraulic turbine turbo machinery:** Hydro dynamic force on jets on stationary and moving plate, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency , flow over radial vanes.

Classification of turbines, heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine, and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube theory-functions and efficiency.

**UNIT V**

**Performance of hydraulic turbines and pumps:** Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbines, cavitation, surge tank, water hammer.

**Centrifugal pumps:** Classification, working, work done-barometric head-losses and efficiencies specific speed-performance characteristic curves, NPSH.

**Reciprocating pumps:** Working, discharge, slip, indicator diagrams.

**TEXT BOOKS:**

1. Hydraulics, Fluid mechanics and hydraulic machinery by MODI and SETH
2. Fluid mechanics and hydraulic machines by Rajput

**REFERENCES:**

1. Fluid mechanics and fluid power engineering by D.S.Kunar, Kotaria and sons.
2. Fluid mechanics and machinery by D. Rama Durgaiah, New age international.
3. Hydraulic machines by Banga and Sharma, Khanna publishers

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 **4 1 0 4**

**THERMAL ENGINEERING – I**

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the laws of Thermodynamics to analyse air standard cycles and to understand and evaluate the perform analysis of the major components and systems of IC engines, refrigeration cycles and their applications.

**Course Outcomes**: At the end of the course, the student should be able to Evaluate the performance of IC engines and compressors under the given operating conditions.Apply the laws of Thermodynamics to evaluate the performance of Refrigeration and air-conditioning cycles.Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance

**UNIT – I**

**I.C. Engines:**

Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

**UNIT – II**

Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types of SI engines.

Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

**UNIT III**

**Testing and Performance:**

Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart

Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.

**Reciprocating Compressors:** Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

**UNIT – IV**

**Rotary Compressor(Positive displacement type):** Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

**Dynamic Compressors:** Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

**Axial Flow Compressors:** Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytropic efficiency.

**UNIT – V**

**REFRIGERATION :** Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, details and principle of operation – applications of air refrigeration, Vapour compression refrigeration systems – calculation of COP – effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants- Vapour absorption system – mechanical details – working principle, Use of p-h charts for calculations

**Air-Conditioning:** Concepts of Psychrometry – Properties of moist air – Usage of Psychrometric Chart – Calculation of moist air properties.

Types of air –conditioning systems – Requirements –– schematic layout of a typical plant.

**TEXT BOOKS:**

1. I.C. Engines / V. Ganesan- TMH
2. Thermal Engineering / Rajput / Lakshmi Publications.
3. Thermal Engineering / P.K.Nag

**REFERENCE BOOKS:**

1. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons.
2. Engineering fundamentals of IC Engines – Pulkrabek / Pearson /PHI
3. Thermal Engineering / Rudramoorthy - TMH
4. Thermodynamics & Heat Engines / B. Yadav/ Central Book Depot., Allahabad
5. I.C. Engines / Heywood /McGrawHIll.
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand

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 **4 1 0 4**

**DYNAMICS OF MACHINES**

**Pre-requisite:** Kinematics of machines

**Course Objectives:** The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

**Course Out Come:** the study of KOM& DOM are necessary to have an idea while designing the various machine members like shafts, bearings, gears, belts & chains and various I.C. Engine Components & Machine tool parts.

**UNIT – I**

**Precession:** Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

**Static and Dynamic Force Analysis:** Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D’Alembert’s principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

**UNIT – II**

**Turning Moment Diagram And Flywheels:** Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.-.

**UNIT – III**

**Friction:** pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches.

**Brakes And Dynamometers:** Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**UNIT – IV**

**Governors:** Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting **–** stability – effort and power of the governors.

 **Balancing :** Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples.

 Examination of “V” and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

**UNIT – V**

**Vibrations:** Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly’s method – Raleigh’s method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

**TEXT BOOKS:**

1. Theory of Machines, S.S.Rattan.
2. Theory of Machines, R.S.Khurmi

**REFERENCE BOOKS:**

1. Theory of Machines, Shigley, Mc Graw Hill Publishers
2. Theory of Machines, Thomas Bevan, CBS Publishers
3. Theory of Machines, R.K.Bansal (Lakshmi publications)
4. Mechanism and Machine Theory, JS Rao and RV Duggipati, New Age

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 **3 0 0 3**

**PRODUCTION TECHNOLOGY**

**Pre-requisites:** Basic Mechanical Engineering, Engineering Graphics

Course Objectives; Understand and appreciate the importance of basic principles of Production Engineering.

Understand the application of those principles in practice

**Course Outcomes**: Understand the idea for selecting materials for patterns. Types and allowances of patterns used in casting and analyze the components of moulds. Design core, core print and gating system in metal casting processes Understand arc, gas, solid state and resistance welding processes. Develop process-maps for metal forming processes using plasticity principles.Identify the effect of process variables to manufacture defect free products.

**UNIT – I**

**Casting :** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

Solidification of casting – Solidification of pure metal – Nucleation and grain growth, casting design considerations

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

**UNIT – III**

Inert Gas Welding \_ TIG Welding, MIG welding, Friction welding, induction welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – IV**

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth.

Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements

Stamping, forming and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning.

Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – V**

**Extrusion of Metals :** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**Forging Processes :** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS :**

1. Manufacturing Technology / P.N. Rao/TMH

**REFERENCE BOOKS :**

1. Production Technology / R.K. Jain
2. Metal Casting / T.V Ramana Rao / New Age
3. Principles of Metal Castings / Rosenthal.
4. Welding Process / Parmar /
5. Production Technology /Sarma P C /
6. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

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 **3 0 0 3**

**INSTRUMENTATION AND CONTROL SYSTEMS**

**Prerequisite:** Mathematics-I, Thermodynamics, Basic of Electrical and electronic Engineering.

**Course Objectives:** Understanding the basic characteristic of a typical instrument. Identifying errors and

their types that would occur in a instrument. Identifying properties used for evaluating the thermal systems. The concept of transducer and Various types and their characters.

**Course Outcome:** To identify various elements and their purpose in typical instruments, to identify various errors that would occur in instruments. Analysis of errors so as to determine correction factors for each an instrument. To understand static and dynamic characteristics of instrument and should be able to determine loading response time. For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.

**UNIT – I**

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics – sources of errors, Classification and elimination of errors.

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

**UNIT – II**

**Measurement of Temperature:** Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals.

**Measurement of Pressure:** Different principles used- Classification: Manometers, Dead weight pressure gauge. Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, Mcleod pressure gauge.

**UNIT – III**

**Measurement of Level:** Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators – Bubbler level indicators.

**Flow measurement:**  Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

**Measurement of Speed :**  Mechanical Tachometers, Electrical tachometers, Non- contact type-Stroboscope

**Measurement of Acceleration and Vibration :** Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

**UNIT – IV**

**Stress-Strain measurements :** Various types of stress and strain measurements –Selection and installation of metallic strain gauges- electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

**Measurement of Humidity:** Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter.

**Measurement of Force, Torque and Power-** Elastic force meters, load cells, Torsion meters, Dynamometers.

**UNIT – V**

**Elements of Control Systems:**

Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

**TEXT BOOKS:**

1. Principles of Industrial Instrumentation & Control Systems, Alavala, Cengage Learning
2. Instrumentation, Measurement & Analysis, B.C.Nakra & K.K.Choudhary, TMH
3. Mechanical Measurements & Controls by D.S. Kumar

**REFERENCE BOOKS:**

1. Measurement Systems: Applications & design, E.O.Doebelin, TMH
2. Experimental Methods for Engineers / Holman
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Mechanical Measurements / Sirohi and Radhakrishna / New Age International

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 **0 0 3 2**

**FLUID MECHANICS & HYDRAULIC MACHINERY LAB**

**Pre-requisites:** None

Course Objectives: Understand thebasic static, kinematic and dynamic principles and conservation laws to fluid flow problems in engineering applications. Design experimental procedure for physical model studies. Design the working proportions of hydraulic machines. Compute drag and lift coefficients using the theory of boundary layer flows. Analyze of free surface and pipe flows. Formulate and solve one dimensional compressible fluid flow problems. Study of different types of pumps and turbines

**Course Outcomes:** Develop procedure for standardization of experiments. Calibrate flow discharge measuring device used in pipes channels and tanks. Determine fluid and flow properties. Characterize laminar and turbulent flows. Compute drag coefficients. Test the performance of pumps and turbines.

1. Calibration of Venturimeter & Orifice meter
2. Determination of Coefficient of discharge for a small orifice by a constant head method.
3. Determination of Coefficient of discharge for an external mouth piece by variable head method.
4. Calibration of contracted Rectangular Notch and /or Triangular Notch
5. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
6. Verification of Bernoulli’s equation.
7. Performance test on single stage centrifugal pump
8. Performance test on reciprocating pump
9. Impact of jet on vanes
10. Performance and Specific speed test on Pelton wheel (or Turbo Wheel)
11. Performance and specific speed test on Francis Turbine
12. Performance and specific speed test on Kaplan Turbine
13. Performance test on multi stage pump
14. Suitability test on centrifugal pump
15. Drag and Lift Coefficients of an Aerofoil model.

 Any ten of the above experiments are to be covered.

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### INSTRUMENTATION & CONTROLSYSTEMS LAB

**Pre-requisites:** Basic principles of Instrumentation and control systems

**Course Outcomes**: At the end of the course, the student will be able to Characterize and calibrate measuring devices. Identify and analyze errors in measurement. Analyze measured data using regression analysis. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

1. Calibration of transducer for temperature measurement.
2. Study and calibration of LVDT transducer for displacement measurement.
3. Calibration of strain gauge for temperature measurement.
4. Calibration of thermocouple for temperature measurement.
5. Calibration of capacitive transducer for angular displacement.
6. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
7. Calibration of resistance temperature detector for temperature measurement.
8. Study and calibration of a rotometer for flow measurement.
9. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
10. Study and calibration of McLeod gauge for low pressure.

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 **0 0 3 2**

**PRODUCTION TECHNOLOGY LAB**

**Pre-requisites:** Manufacturing Technology

**Course Outcomes:** Understanding the properties of moulding sands and pattern making.Fabricate joints using gas welding and arc welding. Evaluate the quality of welded joints. Basic idea of press working tools and perform moulding studies on plastics.

**Metals Casting Lab :**

1. Moulding - 2 Exercises

2. Melting & Casting - Demonstration

3. Pattern Marking - - 1 Exercise

**Welding Lab:**

1) Arc Welding:

a) Effect of polarity on welds strength & Heat affected zone

b) Effect of current on weld strength and Heat affected zone

2) Spot Welding – Effect of current on weld strength.

3) Gas welding and brazing exercises.

**Mechanical Press Working:**

1) Blanking & Piercing operation & Study of simple Compound and progressive press tools.

2) Hydraulic Press: Deep Drawing and Extrusion Operations.

3) Bending and other operations.

**Processing of Plastics:**

1) Injection Moulding

2) Blow Moulding

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 **3 0 0 3**

**OPERATIONS RESEARCH**

**OPEN ELECTIVE- I**

**Objectives:** Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

**Prerequisites:** None

**Outcome:** Understanding the problem, identifying variables & constants, formulas of optimization model and applying appropriate optimization Tech

**UNIT – I**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**ALLOCATION:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II**

**TRANSPORTATION PROBLEM** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT – III**

**SEQUENCING** – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines-graphical model

**REPLACEMENT:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

**UNIT – IV**

**THEORY OF GAMES:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**INVENTORY:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT – V**

**WAITING LINES:** Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**DYNAMIC PROGRAMMING:**

Introduction – Terminology- Bellman’s Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

**TEXT BOOK :**

1. Operation Research /J.K.Sharma/ MacMilan.
2. Operations Research/A.C.S.Kumar/Yesdee

**REFERENCE BOOKS :**

1. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
2. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
3. Operations Research / Wagner/ PHI Publications.

4. Introduction to O.R/Hillier & Libermann (TMH).

5. Introduction to O.R /Taha/PHI

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**BASICS OF THERMODYNAMICS**

**OPEN ELECTIVE- I**

**Pre-requisite**: Engineering Chemistry and Physics

**Course Objective**: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

**Course Outcomes**: At the end of the course, the student should be able to

* Understand and differentiate between different thermodynamic systems and processes
* Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes
* Understand and analyze the Thermodynamic cycles

**UNIT – I**

**Introduction: Basic Concepts:**

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility

**UNIT II**

Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

**UNIT – III**

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (cp and cv), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

**UNIT IV**

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton’s Law of partial pressure, Avogadro’s Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const.

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, , Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation ,Psychrometric chart.

**UNIT - V**

**Power Cycles :** Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

**Refrigeration Cycles:**

Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

**TEXT BOOKS :**

1. Engineering Thermodynamics / PK Nag /TMH, III Edition
2. Thermodynamics / C.P.Arora.

**REFERENCE BOOKS:**

1. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
2. Fundamentals of Classical Thermodynamics – G. Van Wylan & R.E. Sonntag – John Wiley Pub.
3. Thermodynamics – J.P.Holman / McGrawHill
4. Engineering Thermodynamics – Jones & Dugan
5. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.

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**FABRICATION PROCESSES**

**OPEN ELECTIVE- I**

Prerequisites: Nil

Objectives:

Understand the philosphipies of various Manufacturing process.

Outcomes.

For given product,one should be able identify the manufacturing process.

**UNIT – I**

**Casting :** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding \_ TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth.

Stamping, forming and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning.

Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – IV**

**Extrusion of Metals :** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes :** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS :**

1. Manufacturing Technology / P.N. Rao/TMH

**REFERENCE BOOKS :**

1. Production Technology / R.K. Jain
2. Metal Casting / T.V Ramana Rao / New Age
3. Principles of Metal Castings / Rosenthal.
4. Welding Process / Parmar /
5. Production Technology /Sarma P C /
6. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

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 **4 0 0 4**

**MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS**

Prerequisites: Economics

Objectives :

1. To enable the student to understand the importance of the business operations like demand and supply, production function, cost analysis, markets.

2 .To understand the importance of certain basic issues like forms of business organizations, capital budgeting , financial accounting and financial analysis.

Outcome :

At the end of the course, the student will,

* Understand the market dynamics namely, demand and supply, demand forecasting, elasticity of demand and supply, pricing methods and pricing in different market structures.
* Gain an insight into how production function is carried out to achieve least cost combination of inputs and cost analysis.
* Develop an understanding of
* Analyse how capital budgeting decisions are carried out.
* Understanding the framework for both manual and computerised accounting process
* Know how to analyse and interpret the financial statements through ratio analysis.

**Unit I Introduction & Demand Analysis:**Definition, Nature and Scope of Managerial Economics. Demand Analysis: Demand Determinants, Law of Demand and its exceptions. *Elasticity of Demand*: Definition, Types, Measurement and Significance of Elasticity of Demand. *Demand Forecasting,* Factors governing demand forecasting, methods of demand forecasting.

**Unit II Production & Cost Analysis:** *Production Function* – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. *Cost Analysis***:** Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

**Unit III Markets & New Economic Environment:** Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. *Pricing*: Objectives and Policies of Pricing. Methods of Pricing. *Business:*Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types,*New Economic Environment*: Changing Business Environment in Post-liberalization scenario.

**Unit IV Capital Budgeting**: Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital Trading Forecast Capital Budget, Cost Budget. Capital Budgeting: features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems).

**Unit V Introduction to Financial Accounting & Financial Analysis:** Accounting concepts and Conventions Introduction IFRS Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).*Financial Analysis***:** Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability ratios. Du Pont Chart.

**TEXT BOOKS:**

1. Aryasri: Managerial Economics and Financial Analysis, TMH, 2012.
2. Vijay Kumar & Appa Rao Managerial Ecoconomics & Financial Analysis, Cengage 2011.
3. J. V. Prabhakar Rao & P.V. Rao Managerial Ecoconomics & Financial Analysis, Maruthi Publishers, 2011.

**REFERENCES:**

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.2012.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, Pearson, 2012.
3. Lipsey & Chrystel, Economics, Oxford University Press, 2009
4. Domnick Salvatore: Managerial Economics In a Global Economy, Thomson, 2012.
5. Narayanaswamy: Financial Accounting—A Managerial Perspective, PHI, 2012.
6. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas, 2012.
7. Truet and Truet: Managerial Economics: Analysis, Problems and Cases, Wiley, 2012.
8. Dwivedi: Managerial Economics, Vikas, 2012.
9. Kasi Reddy Sraswathi, MEFA PHI Learning, 2012.
10. Shailaja & Usha : MEFA, University Press, 2012.

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 **4 1 0 4**

**DESIGN OF MACHINE MEMBERS - I**

**NOTE :** Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

**Pre**- requisites: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgy and material science.

**Course objectives:**

* To understand the general design procedures and principles in the design of machine elements.
* To study different materials of construction and their properties and factors determining the selection of material for various applications.
* To determine stresses under different loading conditions.
* To learn the design procedure of different fasteners, joints, shafts and couplings.

**Outcomes:**

* The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria of failure.
* Understands the concepts of principal stresses, stress concentration in machine members and fatigue loading.
* Design on the basis of strength and rigidity and analyze the stresses and strains induced in a machine element.

**UNIT – I**

**INTRODUCTION:** General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

**DESIGN FOR STATIC STRENGTH:** Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

**UNIT – II**

**DESIGN FOR FATIGUE STRENGTH:** Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber’s curve– Modified Goodman’s line– Soderberg’s line.

**UNIT – III**

**RIVETED, WELDED AND BOLTED JOINTS:**

Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

**UNIT – IV**

**KEYS, COTTERS AND KNUCKLE JOINTS:** Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

**UNIT – V**

**SHAFTS:** Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. Use of internal and external circlips, Gaskets and seals (stationary & rotary)

**SHAFT COUPLINGS :** Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

**TEXT BOOKS:**

1. Machine design by Khurmi
2. Machine design/pandya & shah
3. Machine Design/ V. Bhandari/ TMH Publishers

**REFERENCE BOOKS:**

1. Design of Machine Elements/V.M. Faires
2. Machine design/ Schaum Series.
3. Mechanical Engineering Design/JE Shigley

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**THERMAL ENGINEERING - II**

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the laws of Thermodynamics to analyse steam and gas turbine cycles and to perform analysis of the major components of steam and gas turbine plants and their applications.

**Course Outcomes**: At the end of the course, the student should be able to

* Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants
* Apply the laws of Thermodynamics to analyze thermodynamic cycles
* Differentiate between vapour power cycles and gas power cycles
* Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants
* Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components

**UNIT – I**

**Steam Power Plant:** Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

**Boilers** – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

**UNIT – II**

**Steam Nozzles :** Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

**UNIT – III**

**Steam Turbines:** Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

**Reaction Turbine:** Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson’s reaction turbine – Condition for maximum efficiency.

**UNIT IV**

**Steam Condensers**: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement.

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

**UNIT – V**

**Jet Propulsion :** Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

**Rockets:** Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

**TEXT BOOKS:**

1. Thermal Engineering / Rajput / Lakshmi Publications
2. Gas Turbines – V.Ganesan /TMH
3. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot
4. Thermal Engineering / Ajoy Kumar/ Narosa

**REFERENCE BOOKS:**

1. Gas Turbines and Propulsive Systems – P.Khajuria & S.P.Dubey - /Dhanpatrai Pub
2. Thermal Engineering – Ballaney / Khanna Pub.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
4. Thermal Engineering – R.S. Khurmi & J.S.Gupta / S.Chand Pub.

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 **4 0 0 4**

**MACHINE TOOLS and Metrology**

**Course Objectives:**

1. Acquire the knowledge of engg. metrology and its practice which is having increasing importance in industry.

2. Specifically makes the student to improve applications aspect in the masurements and control of process of manufacture

 3. Impart the fundamental aspects of the metal cutting principles and their application in studying the behavior of various machining processes.

 4. Train in knowing the fundamental parts of various machine tools and their kinematic schemes.

5. Discuss various principles of jigs and fixtures which will be used hold the workpieces in various machine tools

**Course Outcome:** At the end of the course, the student would be able to

|  |
| --- |
| * Identify techniques to minimize the errors in measurement.
 |
| * Identify methods and devices for measurement of length, angle, gear & thread parameters, surface roughness and geometric features of parts.
 |
| * Understand working of lathe, shaper, planer, drilling, milling and grinding machines.
 |
| * Comprehend speed and feed mechanisms of machine tools.
 |
| * Estimate machining times for machining operations on machine tools
 |

**UNIT – I**

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips.

Engine lathe – Principle of working, types of lathe, specifications.Taper turning,– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

**UNIT – II**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines - Principles of working – machining time calculations.

# UNIT – III

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters – methods of indexing.

Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations

# UNIT – IV

Limits, fits and tolerances- Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

**Limit Gauges :** Taylor’s principle, Design of GO and NO GO gauges

Measurement of angles, Bevel protractor, Sine bar.

Measurement of flat surfaces, straight edges, surface plates, optical flat and auto collimator.

# UNIT – IV

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf.

Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines.

Coordinate Measuring Machines: Types and Applications of CMM.

**TEXT BOOKS:**

1. Engineering Metrology / I C Gupta./ Danpath Rai
2. Engineering Metrology / R.K. Jain / Khanna Publishers
3. Principles of Machine Tools, Bhattacharya A and Sen.G.C. New Central Book Agency.
4. Production Technology by R.K. Jain and S.C. Gupta.

**REFERENCE BOOKS:**

1. Production Technology by H.M.T. (Hindustan Machine Tools)
2. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
3. Fundamentals of Dimensional Metrology 4e / Connie Dotson / Thomson
4. Workshop Technology – Vol.-II, B.S. Raghui Vamsi
5. Elements of Work Shop Technology – Vol. II, Hajra Choudry, Media Promoters.
6. Fundamentals of Metal Machining and Machine Tools, Geofrey Boothroyd, McGraw Hill

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**THERMAL ENGINEERING LAB**

**Pre-Requisite: Thermodynamics & Thermal Engineering - I**

**Objective:** To understand the working principles of IC Engines, Compressors, Refrigeration and Air Conditioning Systems.

**Tables/Codes: Refrigeration Tables, Psychrometric Chart**

**Question Paper Pattern:**

## Syllabus

1. Flash and Fire Points ( Open cup & Closed cup method)
2. Viscosity determination by Redwood & Saybolt methods
3. Bomb/ Junkers Gas Calorimeter.
4. I.C. Engines Valve / Port Timing Diagrams
5. I.C. Engines Performance Test for 4 Stroke SI engines
6. I.C. Engines Performance Test for 2 Stroke SI engines
7. I.C. Engines Morse, Retardation, Motoring Tests
8. I.C. Engines Heat Balance – CI/SI Engines
9. I.C. Engines Economical speed Test on a SI engine
10. I.C. Engines effect of A/F Ratio in a SI engine
11. Performance Test on Variable Compression Ratio Engine
12. IC engine Performance Test on a 4S CI Engine at constant speed
13. Performance Test on Reciprocating Air – Compressor Unit
14. Dis-assembly / Assembly of Engines
15. Study of Boilers

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###  MACHINE TOOLS AND METROLOGY LAB

**Objectives:**

1. To import practical exposure to the metrology equipment & Machine tools

2. To conduct experiments and understand the working of the same.

**Prerequisites**:

Theoritical exposure to Metrology and machine tools.

1. Step turning and taper turning on lathe machine (2 exercises)
2. Thread cutting and knurling on lathe machine (2 exercises)
3. Measurement of cutting forces on lathe
4. Machining of holes using Drilling and boring machines.
5. Gear cutting on the Milling machine
6. Grinding of Tool angles using Cylindrical / Surface Grinding
7. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
8. Measurement of bores by internal micrometers and dial bore indicators.
9. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
10. Angle and taper measurements by bevel protractor and sine bars.
11. Thread measurement by 2-wire and 3-wire methods.
12. Surface roughness measurement by Tally Surf.
13. Use of mechanical comparator

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**ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LAB**

1. **Introduction**

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use ‘good’ English and perform the following:

* Gathering ideas and information to organise ideas relevantly and coherently.
* Engaging in debates.
* Participating in group discussions.
* Facing interviews.
* Writing project/research reports/technical reports.
* Making oral presentations.
* Writing formal letters.
* Transferring information from non-verbal to verbal texts and vice-versa.
* Taking part in social and professional communication.
1. **Objectives:**

This Lab focuses on using multi-media instruction for language development to meet the following targets:

* To improve the students’ fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
* Further, they would be required to communicate their ideas relevantly and coherently in writing.
* To prepare all the students for their placements.

**Learning Outcomes**

* Accomplishment of sound vocabulary and its proper use contextually.
* Flair in Writing and felicity in written expression.
* Enhanced job prospects.
* Effective Speaking Abilities

**3. Syllabus**:

The following course content to conduct the activities is prescribed for the Advanced Communication Skills (ACS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing* – planning for writing – improving one’s writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

**4. Minimum Requirement:**

The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodate at least 35 students in the lab:

* Spacious room with appropriate acoustics
* Round Tables with movable chairs
* Audio-visual aids
* LCD Projector
* Public Address system
* P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
* T. V, a digital stereo & Camcorder
* Headphones of High quality

**5. Prescribed Lab Manual:** A book titled ***A Course Book of Advanced Communication Skills* *(ACS) Lab*** published by Universities Press, Hyderabad.

**6. Suggested Software:**

 The software consisting of the prescribed topics elaborated above should be procured and used.

* **Oxford Advanced Learner’s Compass**, 8th Edition
* **DELTA’s key to the Next Generation TOEFL Test: Advanced Skill Practice.**
* **Lingua TOEFL CBT Insider**, by Dreamtech
* **TOEFL & GRE** (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
* **The following software from ‘train2success.com’**
* **Preparing for being Interviewed**
* **Positive Thinking**
* **Interviewing Skills**
* **Telephone Skills**
* **Time Management**

**7. Books Recommended:**

1. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
3. **Advanced Communication Skills Laboratory Manual** by Sudha Rani, D, Pearson Education 2011.
4. **Technical Communication** by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. **Business and Professional Communication:** Keys for Workplace Excellence. Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications. 2011.
6. **The Basics of Communication:** **A Relational Perspective**. Steve Duck & David T. McMahan. Sage South Asia Edition. Sage Publications. 2012.
7. **English Vocabulary in Use** series, Cambridge University Press 2008.
8. **Management Shapers Series** by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
9. **Handbook for Technical Communication** by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
10. **Communication Skills** by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
11. **Handbook for Technical Writing** by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
12. **Job Hunting** by Colm Downes,Cambridge University Press 2008.
13. **Master Public Speaking** by Anne Nicholls, JAICO Publishing House, 2006.
14. **English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.**
15. Books on **TOEFL/GRE/GMAT/CAT/** **IELTS** by Barron’s/DELTA/Cambridge University Press.
16. **International English for Call Centres** by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

**DISTRIBUTION AND WEIGHTAGE OF MARKS**:

***Advanced Communication Skills Lab Practicals****:*

1. The practical examinations for the ACS Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned, by inviting the External Examiner from outside. In case of the non-availability of the External Examiner, other teacher of the same department can act as the External Examiner.

**Mini Project: As a part of Internal Evaluation**

1. **Seminar/ Professional Presentation**
2. **A Report on the same has to be prepared and presented.**

**\* *Teachers may use their discretion to choose topics relevant and suitable to the needs of students.***

***\* Not more than two students to work on each mini project.***

***\* Students may be assessed by their performance both in oral presentation and written report.***

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**JET PROPULSION & ROCKET ENGINEERING**

**OPEN ELECTIVE-II**

**Prerequites: None**

**Course Objectives:** Given the basic geometry and idealized component performance, to be able to estimate the thrust and specific impulse of a gas turbine and a rocket engine from fluid and thermodynamic principles.

**Course outcomes: After doing this course, student should be in position to**

* + - 1. Understand Turbo Jet Propulsion System
			2. Analyze the flight performance
			3. Understand Principles of Jet Propulsion and Rocketry & Nozzle Theory and Characteristics
			4. Learn the Aero thermo chemistry of the combustion products
			5. Understand the phygics of Solid propellant rocket engine, Liquid Rocket Propulsion System &Ramjet and Integral Rocket Ramjet Propulsion System**:**

**Unit - 1:**

**Turbo Jet Propulsion System:**

Gas turbine cycle analysis – layout of turbo jet engine. Turbo machinery- compressors and turbines, combustor, blade aerodynamics, engine off design performance analysis.

**Flight Performance:**

Forces acting on vehicle – Basic relations of motion – multi stage vehicles.

**Unit - 2:**

**Principles of Jet Propulsion and Rocketry:**

Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet , turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines.

**Nozzle Theory and Characteristics Parameters:**

Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity – thrust, thrust coefficient, Ac / At of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

**Unit - 3: Aero Thermo Chemistry of The Combustion Products:**

Review of properties of mixture of gases – Gibbs – Dalton laws – Equivalent ratio, enthalpy changes in reactions, heat of reaction and heat of formation – calculation of adiabatic flame temperature and specific impulse – frozen and equilibrium flows.

**Solid Propulsion System:**

Solid propellants – classification, homogeneous and heterogeneous propellants, double base propellant compositions and manufacturing methods. Composite propellant oxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws, factors influencing the burning rate, methods of determining burning rates.

**Unit - 4:**

Solid propellant rocket engine – internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end burning and burning grains, grain design. Rocket motor hard ware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices.

**Liquid Rocket Propulsion System:**

Liquid propellants – classification, Mono and Bi propellants, Cryogenic and storage propellants, ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Uncooled engines, injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

**Unit - 5: Ramjet and Integral Rocket Ramjet Propulsion System:**

Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification – critical, super critical and sub-critical operation of air intakes, engine intake matching, classification and comparison of IIRR propulsion systems.

**TEXT BOOKS:**

1. Gas Turbines and propulsive systems-P.Khajuria& S.P.Dubey/Dhanpatrai pub.
2. Gas Dynamics & Space Propulsion M.C.Ramaswamy / Jaico Publishing House.

**REFERENCE BOOKS:**

1. Rocket propulsion –Sutton
2. Gas Turbines /Cohen, Rogers & Sarvana Muttoo/Addision Wesley & Longman.
3. Gas Turbines-V.Ganesan /TMH.

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**ERGONOMICS**

**OPEN ELECTIVE-II**

**Prerequists: None**

**Objectives:**

 Provide a broad based introduction to ergonomic principles and their application in the design of work, equipment and the workplace. Consideration is given to musculo-skeletal disorders, manual handling, ergonomic aspects of the environment as well as to the social and legal aspects.

**Course Outcomes** On completing this course successfully the student will be able to: • understand and apply ergonomic principles to the creation of safer, healthier and more efficient and effective activities in the workplace; • understand ergonomic risk assessments and appropriate control measures; • understand the causes of upper limb disorders and how to reduce them; • appreciate workplace layout and equipment design; • appreciate environmental aspects of good ergonomic design.

**UNIT I**

Introduction to Ergonomics, Human, Machine Systems, Basic Work Systems, Human Relations and Occupational Psychology, Hawthrone Experiments, Participation, Occupational Medicine, Human Performance Psychology, FMJ versus FJM, Human Factors and Ergonomics. Modern Work Systems and Neo, Taylorism, Attempts to Humanize Work, Generic Tools in Ergonomics, Effectiveness and Cost Effectiveness of Ergonomics in General.

**UNIT II**

Design and Evaluation of Manual Handing Tasks, Anatomy and Biomechanics of Manual Handling, Prevention of Manual Handling Injuries in the Workplace, Design of Manual Handling Tasks.

Body Mechanics at Work: Risk Assessment and Design, Low Back Pain, Biomechanics of Spinal Loading, Ergonomics and Musculoskeletal System in General, Effectiveness and Cost Effectiveness.

**UNIT III**

Physically Demanding Work: Stress and Fatigue, Physically and Psychologically Demanding Work, Muscles, Structure and Function, and Capacity, Physical work capacity.

User, Cantered Workspace Design Anthropometric Data, Statistical Essentials, Types of Anthropometric Data, Applications Of Anthropometry in Design, Multiple Workspace Configurations, Status of Anthropometry in Ergonomics.

**UNIT IV**

Human Error, Accidents, and Safety­, Micro ergonomics, Human Error, and Accidents, Prevention of Error in Human, Machine Interaction, Macroergonomices: Performance Shaping Factors.

**UNIT V**

Visual Environment: Measurements and Design, Vision and the Eye, Measurement of Light, Lighting Design Considerations, Visual figure, Eyestrain, and Near Work, Status of Methods in Risk Assessment and Task design.

Hearing, Sound, Noise and Vibration, Measurement of Sound, Hearing Protection, Design of Acoustic Environment.

**Text books**

.Introduction to Ergonomics(Third Edition)/ R.S.Bridger/CRC Press , Taylor & Francis Group

**References**

* 1. Human factors in Engineering and Design/E.J.McCormick/ TMH Edison
	2. Motion and Time Design and Measurement of work/ Barnes Ralph., / John Wiley & sons Newyork, 2002

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**MECHATRONICS**

**OPEN ELECTIVE-II**

**Pre-requisites:** To learn the importance and use of combination of mechanical & electronics.

**Course objectives:**

* They should be able to link up mechanical and electronics.
* To understand the need for metrology, machine tools, cad/cam, production technology.

**Outcomes:**

* Develop a relationship between mechanical elements and electronics elements for proper functioning of mechanical systems.

**UNIT – I**

INTRODUCTION:Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**SIGNAL CONDITIONING : I**ntroduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**PRECISION MECHANICAL SYSTEMS :**

Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Note: (text book: Mechatronics HMT – chapter 5)**

**ELECTRONIC INTERFACE SUBSYSTEMS :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC’s - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

**UNIT – III**

**ELECTROMECHANICAL DRIVES :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM’s - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**MICROCONTROLLERS OVERVIEW** : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C ( LED Blinking , Voltage measurement using ADC).

**UNIT – IV**

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -Analog input / output - PLC Selection - Application.

**UNIT – V**

**PROGRAMMABLE MOTION CONTROLLERS** : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

**TEXT BOOKS :**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

**REFERENCE:**

1. “Designing Intelligent Machines”. open University, London.
2. Michel B. Histand and David G. Alciatore,”
3. Introduction to Mechatronics and Measurement systems, “Tata MC Graw hill
4. I. C.W. Desi ha, “Control sensors and actuators,” Prentice Hall.
5. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
6. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers.

Mechatronics System Design / Devdas shetty/Richard/Thomson.

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**AUTOMOBILE ENGINEERING**

**Pre-requisites**:Thermodynamics& Thermal Engineering -1

Course Objectives: The purpose of this course is to impart adequate knowledge in both practically and theoretically, covering the various types of power-driven vehicles and to familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system. The students are acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles.

 **Course Outcomes**: At the end of the course, the student will be able to: Understand the basic lay-out of an automobile. Understand the operation of engine cooling, lubrication, ignition, electrical and air conditioning

systems. Understand the principles of transmission, suspension, steering and braking systems. Understan

automotive electronics. Study latest developments in automobiles.

**UNIT – I**

**Introduction :** Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarburization, Nitriding of crank shaft..

Emission from Automobiles – Pollution standards, National and international – Pollution Control – Techniques – Noise Pollution & control.

**UNIT – II**

**Fuel System :** S.I. Engine : Fuel supply systems, Mechanical and electrical fuel pumps – carburetor – types – air filters – petrol injection.

**C.I. Engines :** Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, Alternative fuels for Automobiles-injection,Classification,Properties, Hybrid vehicles injection timing, testing of fuel, pumps.

**UNIT – III**

**Cooling System :** Cooling Requirements, Air Cooling, Liquid Cooling and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.

Ignition System : Function of an ignition system, battery ignition system, constructional features of storage battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

**UNIT – IV**

**Electrical System :** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

**Transmission System :** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter.

Propeller shaft – Hoatch – Kiss drive, Torque tube drive universal joint, differential rear axles – types – wheels and tyres.

**UNIT – V**

**Steering System :** Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

**Suspension System :** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**Braking System :** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

**TEXT BOOKS :**

1. Automobile Engineering ,Vol. 1 & Vol. 2/ Kripal Singh
2. Automobile Engineering , Vol. 1 & Vol. 2 ,by K.M Gupta,Umesh publication

**REFERENCE BOOKS :**

1. A System approach to Automotive Technology by Jack Erjavec YesDee publishing pvt Ltd.
2. Automobile Engineering / William Crouse
3. Automotive Mechanics / Heitner
4. Alternative fuels of Automobiles by P.RamiReddy,Frontline publications.

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**COMPUTER GRAPHICS**

**DEPARTMENT ELECTIVE- I**

**Objectives:**

* To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
* To make the student present the content graphically.

**Outcomes:**

* Students can animate scenes entertainment.
* Will be able work in computer aided design for content presentation..
* Better analogy data with pictorial representation.

**UNIT-I:**

**Introduction:** Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

**Output primitives**: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms.Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms

**UNIT-II:**

**2-D geometrical transforms**: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems

**2-D viewing** : The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm

**UNIT-III:**

**3-D object representation** : Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon rendering methods.

**3-D Geometric transformations**: Translation, rotation, scaling, reflection and shear transformations, composite transformations.3-D viewing : Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

**UNIT-IV:**

**Visible surface detection methods**: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

**UNIT-V:**

**Computer animation**: Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

**Text Books:**

1. “Computer Graphics *C version*”, Donald Hearn and M.Pauline Baker,

 Pearson Education

1. “Computer Graphics Principles & practice”, second edition in C,

 Foley, VanDam, Feiner and Hughes, Pearson Education.

**References:**

1. Computer Graphics”, second Edition, Donald Hearn and M.Pauline Baker, PHI/Pearson Education.

2. Computer Graphics Second edition”, Zhigand xiang, Roy Plastock, Schaum’s outlines, Tata Mc-Graw hill edition.

3. rocedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.

4. Principles of Interactive Computer Graphics”, Neuman and Sproul, TMH.

5. Principles of Computer Graphics, Shalini Govil, Pai, 2005, Springer.

6. Computer Graphics, Steven Harrington, TMH

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**UNCONVENTIONAL MACHINING PROCESSES**

**Departmental Elective-I**

**Course Objectives:**

1. To understand the need for the development of UnConventional machining processes.

2. To know various methods of material removal processes.

3. To know the principles and applications of Non-Conventional machining processes.

**Prerequisites:**

Theory of meteal cutting, machine tools

**Out comes:**

1. Student will identify the problem faced in traditional metal cutting and come to an understanding of the need for the development of Unconventional machining processes.

2. Gain the knowledge of basic mechanism of various Unconventional maching processes and related equipment, variables, advantages, disadvantages, applications.

3. Given a set of physical, electrical and other parameters. Student can identify a suitable Unconventional machining process.

**UNIT – I**

**INTRODUCTION** – Need for non-convention machining methods, Classification of non -conventional machining processes, considerations in process selection, materials, general characteristics and applications of un-conventional machining processes.

**UNIT – II**

**MECHANICAL MATERIAL REMOVAL PROCESSES:** Ultrasonic machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining – basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT – III**

**THERMAL MATERIAL REMOVAL PROCESSES:** Electro Discharge Machining, Wire EDM, Laser Machining, Electron Beam Machining, Ion Beam Machining - basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT – IV**

**CHEMICAL MATERIAL REMOVAL PROCESSES:** Electro Chemical Machining, Electro Chemical Grinding, Electro Chemical Honing, and Electro Chemical Deburring - basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT-V**

**MICRO MACHINING:** Bulk micromachining, surface micromachining and LIGA process – General description, basic principles, components, process variables, advantages and disadvantages, applications.

**TEXT BOOKS:**

1. Non-Traditional Machining/ P.K.Mishra (New Age)

2. Advanced machining processes/ VK Jain/ Allied publishers

**REFERENCE BOOKS :**

1. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH
3. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984.

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**INDUSTRIAL ENGINEERING PRACTICES**

**Departmental Elective-I**

***Pre-Requisites*:** None

***Course Objectives*:**

Learn to

* + - 1. conduct the method study
			2. Design the work place
			3. Understand the relationship between man & machine

***Course Outcomes:*** At the end of this course student able to conduct method study, time study, work place deisgn. Should be able to job evaluation meritrating & estimating costing.

## UNIT I:

Work Study: Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study.

Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

## UNIT II:

Work place design: Anthropometry, structural body dimensions, use of anthropometry data, work space dimensions – work space for personal when seated – minimum requirement for restricted spaces work surfaces , horizontal work surfaces , work surfaces when seated, standing science of seating, principles of seat design.

## UNIT III:

Nature of Man- Machine system – Fundamental Man – Machine system assumptions – Types of Systems – Data base of human factors – Human performance – types of human error in system tasks – task data- empirical task data – Judgmental task data

Visual displays – Process of seeing - types of visual activity – conditions that effect visual discriminations – Quantitative visual display – Basic design of dynamic quantitative displays – specific features of quantitative scales – Quantitative visual display – Strategy indicators – signal and warning lights.

## UNIT IV:

Job evaluation – methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

Merit rating – job evaluation Vs merit rating – objectives of merit rating - method for merit rating – ranking method – paid company method – checklist method.

## UNIT V:

Estimating and Costing, Estimation: Importance – Aims – Functions – Qualities of estimator, Cost – definition Aims standard cost – difference between estimating and costing – costing methods – elements of costs – menstruation. Estimating of Material cost – machine shop – sheet metal shop – forging – welding shop

 **Reference Books:**

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons
2. Work Study by ILO
3. Human factors in Engineering & Design by Ernest J McCormick / TMh
4. Production & Operation Management by Paneer Selvam /PHI
5. Industrial Engineering Management by RaviShankar/ Galgotia
6. Mechanical Estimating & Costing by T.R.Banga,S.C.Sharma/Khanna
7. “Industrial Engineering Hand Book” by Maynard

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**OPERATIONS RESEARCH**

**DEPARTMENT ELECTIVE-II**

**Objectives:** Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

**Prerequisites:** None

**Outcome:** Understanding the problem, identifying variables & constants, formulas of optimization model and applying appropriate optimization

**UNIT – I**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**ALLOCATION:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II**

**TRANSPORTATION PROBLEM** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT – III**

**SEQUENCING** – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines

**REPLACEMENT:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

**UNIT – IV**

**THEORY OF GAMES:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**INVENTORY:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT – V**

**WAITING LINES:** Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**DYNAMIC PROGRAMMING:**

Introduction – Terminology- Bellman’s Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

**TEXT BOOK :**

1. Operation Research /J.K.Sharma/MacMilan.
2. Operations Research / ACS Kumar/ Yesdee

**REFERENCE BOOKS :**

1. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
2. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hillier & Libermann (TMH).

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**TRIBOLOGY**

**DEPARTMENT ELECTIVE-II**

Pre-requisites: Fluid mechanics, Design of machine members-II

Course objectives:

* To expose the student to different types of bearings, bearing materials,
* To understand friction characteristics and power losses in journal bearings.
* To learn theory and concepts about different types of lubrication.

Outcomes:

* Understanding friction characteristics in journal bearings.
* Knowledge about different theories of lubrication to reduce friction and wear.

**UNIT – I**

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index, determination of viscosity, different viscometers used.
Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

**UNIT – II**

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold’s equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

**UNIT – III**

Friction and power losses in journal bearings :Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical consideration of journal bearing design considerations.

**UNIT – IV**

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect.Study of current concepts of boundary friction and dry friction.

**UNIT-V**
Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings.

**Bearing materials :** General requirements of bearing materials, types of bearing materials.

**TEXT BOOK :**

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co.

**REFERENCE :**

1. Tribology – B.C. Majumdar

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**POWER PLANT ENGINEERING**

**DEPARTMENT ELECTIVE- II**

**Objectives**

The goal of this course is to become prepared for professional engineering design of conventional and alternative power-generation plants. The learning objectives include

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
2. A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.
3. Awareness of the economic, environmental, and regulatory issues related to power generation.

**Outcomes:**

After taking this course the students should be able to

1. Select the suitability of site for a power plant.

2. Calculate performance of thermal power plant.

3. Propose ash handling, coal handling method in a thermal power plant.

4. Explain working principle of different types of nuclear power plant.

5. Calculate load factor, capacity factor, average load and peak load on a power plant. 6. Indicate safety aspects of power plants

**UNIT – I**

Introduction to the Sources of Energy – Resources and Development of Power in India.**Steam Power Plant :** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

**Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

**UNIT – IIInternal Combustion Engine Plant:**

DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.**Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparision.**Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

**UNIT – III**

**Hydro Electric Power Plant:** Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.**Hydro Projects And Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.**Power From Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

**UNIT – IV**

**NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.**Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

**UNIT – V**

**Power Plant Economics And Environmental Considerations**: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

**TEXT BOOK :**

1. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub
2. A Course in Power Plant Engineering: / Arora and S. Domkundwar.

**REFERENCES :**

1. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications
2. Power plant Engineering/ Ramalingam/ Scietech Publishers
3. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
4. An Introduction to Power Plant Technology / G.D. Rai.
5. Power plant Engg - Elanchezhian- I.K. International Pub

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**FLUID POWER SYSTEMS**

**Departmental Electives-II**

**UNIT I INTRODUCTION**

Need for Automation, comparison with other power systems-ISO symbols for fluid power elements-Economic consideration of fluid power systems-Oil hydraulics, pneumatic-introduction and selection criterion.

**UNIT II HYDRAULIC POWER GENERATION, CONTROL AND REGULATING ELEMENTS**

Basic elements in a fluid power system-Hydraulic pumps, Gear, Vane, piston-selection and specification, drive characteristics Hydraulic actuators-Linear and Rotary, selection specification and characteristics, cushioning.

**UNIT III PNEUMATICS AND ELECTRO PNEUMATICS**

Generation and control of compressed air-Elements in pneumatic circuits, Fluidic devices and its applications Flip-Flop, SRT Flip flop-Use of electrical switches, relays, timers in fluid power circuits-

Electro pneumatics.

**UNIT IV CIRCUIT DESIGN**

Design and methodology-sequential circuits, cascade, Karnaugh-Veitch map, step counter methods-Compound and combination circuit design. Typical Industrial and hydraulic circuits-Synchronising and accumulator circuits-Circuits for machine tools-Aerospace application-Design and selection criteria. Electro pneumatic circuit design, Ladder diagram.

**UNIT V COMPUTER CONTROL & MAINTENANCE OF FLUID POWER CIRCUITS**

Fuzzy logic in fluid power circuits-PLC in fluid powers-PLC ladder diagram. Installation-Fault diagnosis in fluid power circuits.

**REFERENCES:**

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

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**DESIGN OF MACHINE MEMBERS-II**

**NOTE :**

Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

**Pre-requisites**: Study of engineering mechanics, design of machine members-I and theory of machines.

**Course objectives**:

* To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs , belts, gears etc.
* To design the components using the data available in design data books.

**Outcomes:**

* Knowledge about journal bearing design using different empirical relations.
* Estimation of life of rolling element bearings and their selection for given service conditions.
* Acquaintance with design of the components as per the standard, recommended procedures

which is essential in design and development of machinery in industry.

**UNIT – I**

**Sliding contact bearings :** Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

**UNIT – II**

**Rolling contact bearings:** Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

**UNIT – III**

**Engine Parts :**

Connecting Rod : Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

**UNIT – IV**

**Mechanical Springs :**  Stresses and deflections of helical springs – Extension and compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs – Design of co-axial springs, Design of leaf springs.

**Belts & Pulleys** : Transmission of power by Belt and Rope ways, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

**UNIT – V**

**Gears :** Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

**TEXT BOOKS:**

1. Machine Design / Pandya & Shah / Charotar

2. Machine tool design / V. Bhandari TMH

**REFERENCE BOOKS :**

1. Machine Design / P.Kannaiah / Scitech
2. Machine Design Volume II / S.Md.Jalaludeen

3. Design Data Book / PV Ramana Murti & M .Vidyasagar/ BS Publications

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 **4 1 0 4**

**HEAT TRANSFER**

**Pre-requisite**: Thermodynamics

**Course Objectives**:

To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

**Outcome**: At the end of this course, student will be able to

* Understand the basic modes of heat transfer
* Compute one dimensional steady state heat transfer with and without heat generation
* Understand and analyze heat transfer through extended surfaces
* Understand one dimensional transient conduction heat transfer
* Understand concepts of continuity, momentum and energy equations
* Interpret and analyze forced and free convective heat transfer
* Understand the principles of boiling, condensation and radiation heat transfer
* Design of heat exchangers using LMTD and NTU methods

**UNIT – I**

**Introduction:** Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions

**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

**UNIT – II**

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

**One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

**UNIT – III**

**Convective Heat Transfer:** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

**UNIT – IV**

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

**Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

**Heat Exchangers:** Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

**UNIT V**

**Heat Transfer with Phase Change:**

**Boiling**: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling

**Condensation:** Film wise and drop wise condensation –Nusselt’s Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

**Radiation Heat Transfer :** Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

**TEXT BOOK :**

1. Fundamentals of Heat Transfer –Incropera& Dewitt/John wiley
2. Fundamentals of Enggineering,Heat & Man Transfer-R.C.Sachdeva/NewAge.
3. Heat& Man Transfer-D.S.Kumar/S.K.Kataria& sons

**REFERENCE BOOKS:**

1. Heat Transfer – A Practical Approach – Yunus Cengel, Boles / TMH
2. Heat Transfer / HOLMAN/TMH
3. Engineering Heat and Mass Transfer – Sarit K. Das / Dhanpat Rai Pub
4. Heat and Mass Transfer – R. Yadav /CPH
5. Essential Heat Transfer - Christopher A Long / Pearson Education
6. Heat Transfer-P.K.Nag /TMH
7. Heat Transfer –Ghoshdastidar/Oxford University press.

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**III Year B.Tech. Mech. Engg. II-Sem L T P C**

 **0 0 3 2**

**KINEMATICS AND DYNAMICS LABORATORY**

(A Minimum of 10 experiments are to be conducted)

# Prerequisites by Topics:

 Prerequisites for the graduate-level course are Kinematics, Dynamics, differential equations, motion simulation, displacement, velocity, acceleration, force, torque, power, Newton’s motion laws, vibration, Gyroscopic Effect, Cams, Bearings.

# Objectives:

The objective of the lab is to Understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.

#  Outcomes:

#  Upon successful completion of this lab, students should be able to:

* Understand types of motion
* Analyze forces and torques of components in linkages
* Understand static and dynamic balance
* Understand forward and inverse kinematics of open-loop mechanisms

**Experiments:**

1. Determination of damped natural frequency of vibration of the vibrating system with

 different viscous oils.

2. Determination of steady state amplitude of a forced vibratory system.

3. Static balancing using steel balls.

4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.

5. Field balancing of the thin rotors using vibration pickups.

6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and

 representation of vectors.

7. Determination of natural frequency of given structure using FFT analyzer.

8. Diagnosis of a machine using FFT analyzer.

9. Direct Kinematic analysis of a robot.

10. Inverse Kinematic analysis of a robot.

11. Trajectory planning of a robot in joint space scheme.

12. Palletizing operation using Robot programming.

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 **0 0 3 2**

 **HEAT TRANSFER LAB**

**Pre-requisite**: Thermodynamics

**Course Objectives**: To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications

**Outcome**: At the end of the lab sessions, the student will be able to

* Perform steady state conduction experiments to estimate thermal conductivity of different materials
* Perform transient heat conduction experiment
* Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoretical values
* Obtain variation of temperature along the length of the pin fin under forced and free convection
* Perform radiation experiments: Determine surface emissivity of a test plate and Stefan- Boltzmann’s constant and compare with theoretical value

**Experiments:**

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.

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 **0 0 3 2**

**Advanced Thermodynamics Lab**

1. Dryness fraction estimation of steam.

2. Determination of Temperature – Pressure relationship of steam using Marcet Boiler

3. Calibration of temperature measurement apparatus

4. Performance study in a cooling tower

5. Performance of a nozzle using Nozzle performance Test unit

6. Performance study of Impulse turbine

7. Performance study of Reaction Turbine

8. Simulation of fluid flow and thermal networks for design and optimization (5 experiments)

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**IV Year B.Tech. Mech. Engg. I-Sem L T P C**

 **CAD/CAM**

**Pre-requisites:** To learn the importance and use of computer in design and manufacture

**Course objectives:** To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

**Course Outcomes:** Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components .To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT – I**

Fundamentals of CAD,CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

**Geometric Modeling:** 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

**UNIT-II**

**Surface modeling:** Algebraic and geometric form, Parametric space of surface, Blending functions,parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

**Solid Modelling:** Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

**UNIT – III**

**NC Control Production Systems :** Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

**UNIT – IV**

**Group Technology:** Part families, Parts classification and coding. Production flow analysis, Machine cell design.

**Computer aided process planning:** Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

**Computer aided manufacturing resource planning:** Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

**UNIT – V**

**Flexible manufacturing system**: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

**Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM

**TEXT BOOKS:**

1. CAD/CAM Principles and Applications, P.N.Rao, TMH
2. CAD/CAM Concepts and Applications, Alavala, PHI

**REFERENCE BOOKS :**

1. CAD/CAM /Groover M.P., Pearson education
2. CAD / CAM Theory and Practice,/ Ibrahim Zeid,TMH
3. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

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**IV Year B.Tech. Mech. Engg. I-Sem**

**UNCONVENTIONAL MACHINING PROCESSES**

**Departmental Elective-III**

**Course Objectives:**

1. To understand the need for the development of UnConventional machining processes.

2. To know various methods of material removal processes.

3. To know the principles and applications of Non-Conventional machining processes.

**Prerequisites:**

Theory of meteal cutting, machine tools

**Out comes:**

1. Student will identify the problem faced in traditional metal cutting and come to an understanding of the need for the development of Unconventional machining processes.

2. Gain the knowledge of basic mechanism of various Unconventional maching processes and related equipment, variables, advantages, disadvantages, applications.

3. Given a set of physical, electrical and other parameters. Student can identify a suitable Unconventional machining process.

**UNIT – I**

**INTRODUCTION** – Need for non-convention machining methods, Classification of non -conventional machining processes, considerations in process selection, materials, general characteristics and applications of un-conventional machining processes.

**UNIT – II**

**MECHANICAL MATERIAL REMOVAL PROCESSES:** Ultrasonic machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining – basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT – III**

**THERMAL MATERIAL REMOVAL PROCESSES:** Electro Discharge Machining, Wire EDM, Laser Machining, Electron Beam Machining, Ion Beam Machining - basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT – IV**

**CHEMICAL MATERIAL REMOVAL PROCESSES:** Electro Chemical Machining, Electro Chemical Grinding, Electro Chemical Honing, and Electro Chemical Deburring - basic principles, components, process variables, advantages and disadvantages, applications.

**UNIT-V**

**MICRO MACHINING:** Bulk micromachining, surface micromachining and LIGA process – General description, basic principles, components, process variables, advantages and disadvantages, applications.

**TEXT BOOKS:**

1. Non-Traditional Machining/ P.K.Mishra (New Age)

2. Advanced machining processes/ VK Jain/ Allied publishers

**REFERENCE BOOKS :**

1. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH
3. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984.

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**IV Year B.Tech. Mech. Engg. I-Sem**

**ADVANCED IC ENGINES**

**Department Elective -III**

**Pre-requisites:** Thermodynamics, Internal Combustion Engines

**Course Objectives**: the main objectives of this course are

* Understand the cyclic process
* Gas Exchanger Process
* Charge Motion
* Combustion Analysis in S.I & C.I engines

**Course Outcomes:** At the end of the course, the student will be able to, Classify combustion chambers of IC engines and understand combustion phenomena in IC engines. Understand the working of stratified charge engine, low heat rejection engine and rotary combustion engine. Analyze exhaust emissions, methods to control the pollutants and list the emission standards. Study the design and development of viable engines working with alternate fuels. Understand advanced combustion processes including HCCI, PCCI and RCCI engines.

**UNIT - I:** Introduction – Historical Review – Engine Types – Design and operating Parameters.

**Cycle Analysis:** Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

**UNIT - II:** **Gas Exchange Processes:** Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging.

**Charge Motion**: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

**UNIT - III:** **Engine Combustion in S.I engines:** Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors, MPFI, SI engine testing.

**Combustion in CI engines**: Essential Features – Types off Cycle. Pr. Data – Fuel

Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system

**UNIT - IV:** **Pollutant Formation and Control:** Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

**UNIT - V:**

Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

**Modern Trends in IC Engines**

* + Lean Burning and Adiabatic concepts
	+ Rotary Engines.
	+ Modification in I.C engines to suit Bio - fuels.
	+ HCCI and GDI concepts

**REFERENCES BOOKS:**

1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol.II
3. I.C. Engines: Obert/Int – Text Book Co.
4. I.C. Engines: Maleev
5. Combustion Engine Processes: Lichty
6. I.C. Engines: Ferguson
7. Scavenging of Two – stroke Cycle Engines – Switzer.

8. I.C.Engines by V.Ganesan

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**REFRIGERATION AND AIR CONDITIONING**

**Department Elective -III**

**PREREQUISITES: None**

**COURSE OBJECTIVES**: The course is intended to

* Familiarize students with the terminologies associated with refrigeration & air conditioning
* Cover the basic principles of psychometric and applied psychometrics
* Familiarize students with system analysis
* Familiarize students with load calculations and elementary duct design
* Familiarize students with refrigerants; vapor compression refrigeration and multi-stage vapor compression systems
* Understand the components of vapor compression systems and other types of cooling systems.

## COURSE OUTCOMES: At the end of the course, the student will be able to:

|  |
| --- |
| * Understand physical and mathematical aspects of refrigeration and air-
* conditioning systems.
 |
| * Apply theoretical and mathematical principles to simple, complex vapour
* compression and vapour absorption refrigeration systems.
 |
| * Understand conventional and alternate refrigerants and their impact on
* environment.
 |
| * Design air-conditioning systems.
 |

**UNIT – I**

**VAPOUR COMPRESSION REFRIGERATION:** Performance of Complete vapor compression system.  **Components of Vapor Compression System:** The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit.

**Compound Compression**: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

**UNIT – II**

 **PRODUCTION OF LOW TEMPERATURE:** Liquefaction system; Cascade System – Applications.– Dry ice system.

**Vapor absorption system** – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram.

 Lithium – Bromide system Three fluid system – HCOP.

**UNIT – III**

**AIR REFRIGERATION:** Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.

**Steam Jet refrigeration system**: Representation on T-s and h-s diagrams – limitations and applications.

**Unconventional Refrigeration system** – Thermo-electric – Vortex tube & Pulse tube – working principles.

**UNIT – IV**

**AIR –CONDITIONING:** Psychometric properties and processes – Construction of Psychometric chart.Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature.Summer, winter and year round air – conditioning systems.

Cooling load Estimation: Occupants, equipments, infiltration, duet heat gain fan load, Fresh air load.

**UNIT – V**

**AIR –CONDITIONING SYSTEMS:** All Fresh air , Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP,RSHF, ESHF and GSHF for different systems. **Components:** Humidification and dehumidification equipment – Systems of Air cleaning – Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

**REFERENCES:**

1. Refrigeration & Air Conditioning /C.P. Arora/TMH
2. Basic Refrigeration & Air Conditioning – P.N. Ananthanarayanan – McGraw Hill
3. Refrigeration and Air Conditioning – Dr. S.S. Thipse - Jaico
4. Principles of Refrigeration/Dossat /Pearson
5. Refrigeration & Air Conditioning /Arora & Domkundwar/ Dhanpat Rai
6. Refrigeration and Air Conditioning /Manohar Prasad/
7. Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill
8. Refrigeration and Air Conditioning /Jordan& Preister /Prentice Hall
9. Refrigeration and Air Conditioning/Dossat /Mc Graw Hill

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**ADVANCED MANUFACTURING PROCESSES**

**Prerequisites:** Production Technology

**Course Objectives:** The main objectives are

* Understand the surface treatment
* Various nontraditional machining processes & their mechanics
* Understand the working principle parametric analysis & other aspects of laser machining process

**Course Outcomes:** At the end of the course, the student will be able to

* + - * Understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
			* Understand different types of composite material characteristics, types of micro & macro machining processes.
			* Understand the e-manufacturing & nano materials.
			* Understand the processing of Ceramics

**UNIT - I:**

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

**UNIT - II:**

Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM.

**UNIT - III:**

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

**UNIT - IV:**

Processing of ceramics : Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application , finishing of ceramics.

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

**UNIT - V:**

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film

Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics.

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

**TEXT BOOKS:**

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
2. Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.
3. Foundation of MEMS/ Chang Liu/Pearson, 2012.
4. Advanced Machining Processes, V.K.Jain, Allied Publications.
5. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

#### IV Year B.Tech. Mech. Engg. I-Sem

#### ADVANCED METAL FORMING

**(Elective-1)**

**Prerequisites: Production Technology**

**Objectives:** the main objectives of this course are

* Understand the fundamentals of the metal forming
* Understand the Rolling process, forces involve and geometrical relationship
* Understand the forging process & forging of various shapes
* Understand the sheet metal process

**Course Outcomes:** At the end of the course, the student is able

* To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
* To study the thermo mechanical regimes and its requirements of metal forming

**UNIT - I:**

Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method temperature of metal working, hot working, cold working, friction and lubricants.

**UNIT - II:**

Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

**UNIT - III:**

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.problems on flow stress ,true strain and forging load.

Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

**UNIT - IV:**

Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Problems on extrusion load.

Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing.Problems on drawforce.

**UNIT - V:**

Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming.problems on Blanking force,Blank diagram in Cup Diagram, Maximum considering shear.

**Text Books:**

1. Mechanical Metallurgy / G.E. Dieter / Tata McGraw Hill, 1998. III Edition
2. Principles of Metal Working / Sunder Kumar

**References:**

1. Principles of Metal Working processes / G.W. Rowe
2. ASM Metal Forming Hand book.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**VIBRATION ANALYSIS AND CONDITION MONITORING**

**(Elective-1)**

**Prerequisites:** Dynamics of Machinery

**Course Objectives**: The main objectives of this course are

* study the causes & effects of vibration in mechanical systems
* Identification of discrete & continuing systems
* Development of models for physical system
* Understand the role of damping, stiffness & inertia in machine tools
* Design and analysis of machine support structures, Vibration Isolators, Vibration Absorbers.

**Course Outcomes**: At the end of the course, the student will be able to

* Exemplify and summarise the causes and effects of vibration in mechanical systems and identify discrete and continuous systems.
* Model the physical systems in to schematic models and formulate the governing equations of motion
* Infer the role of damping and stiffness and inertia in machine tools
* Analyze the Rotating/reciprocating systems and abele to compute the critical speeds.
* Analyze and design machine supporting structures, Vibration Isolators, Vibration Absorbers.
* Summarize the concept of mode, node and frequencies and calculate the free and forced vibration responses of multi degree of freedom systems through model Analysis.

**UNIT-I FUNDAMENTALS OF VIBRATION**: Basic concepts of Vibration, Vibration, Elementary parts of vibrating systems, Degree of freedom. Free Vibration of Single Degree of Freedom Systems: Introduction, Free Vibration of an Undamped Translational System, Equation of Motion using Newton’s second law of motion, Equation of motion using other methods, Equation of motion of a spring, mass system in vertical position, solution, Harmonic Motion Free Vibration of an Undamped Torsional System- Equation of motion. Free Vibration with Viscous Damping- Equation of motion.

 **UNIT-II FORCED VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEMS**: Introduction, Response of an Undamped system under harmonic force, Total response, Beating Phenomenon. Response of a Damped System under Harmonic Force- Total Response, Quality Factor and Bandwidth, Response of a Damped system under the Harmonic Motion of the base, Fore Transmitted, Relative Motion.

**UNIT- III TWO DEGREE OF FREEDOM SYSTEMS**: Introduction, Equations of Motion for forced Vibration, Free Vibration Analysis of and undamped system, Torsional system, Coordinate Coupling and Principal Coordinates, forded Vibration Analysis, Semi definite Systems, Self- Excitation and stability Analysis.

 **UNIT-IV MULTI-DEGREE OF FREEDOM SYSTEMS**: Introduction Modeling of Continuous systems as Multi-degree of Freedom systems, Using Newton’s second law to derive equations of motion, Influence Coefficients. Potential and kinetic energy expressions in matrix form, Generalized coordinates and generalized forces, Using Lagrange’s equations to derive equations of motion, Equations of motion of undamped systems in matrix form, Eigen value problem, solution of the Eigen value problems – solution of the characteristic equation, orthogonality of normal modes, repeated Eigen values.

**UNIT-V DETERMINATION OF NATURAL FREQUENCIES AND MODE SHAPES**: Introduction, Dunkerley’s formula, Rayleigh’s Method- Properties of Rayleigh’s Quotient, Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts. Holzer;s Method-Torsional systems, Spring Mass Systems. Jacobis method, Standard Eigen value Problems.

**REFERENCE:**

 1. Mechanical Vibrations/Groover/Nem Chand and Bros

 2. Elements of Vibration Analysis by Meirovitch, TMH, 2001

3. Mechanical Vibrations/Schaum Series/ McGraw Hill

 4. Mechanical Vibrations / SS Rao/ Pearson/ 2009, Ed 4,

 5. Mechanical Vibrations/Debabrata Nag/Wiley

 6. Vibration problems in Engineering / S.P. Timoshenko.

7. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI

8. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/New Age Intl. Publishers/Revised 2nd Edition

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem
 DESIGN FOR MANUFACTURING OF MEMS**

**(Elective-1)**

**Prerequisites: None**

**Course objectives:** the main objective of this course work is

* Understand the principles of MEMS and micro systems
* Engineering science for

**Course Outcomes:** At the end of the course, the student will be able to

* Synthesize and characterize nanomaterials for engineering applications
* Design and analyze methods and tools for micro and nano manufacturing.
* Improve the quality of MEMS by analysing the variables of the underlying micro and nano manufacturing method
* Select appropriate industrially-viable process, equipment and tools for a specific product.

**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 Forces, 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, Thermomechanics , 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 inContinum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer 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.Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002

2. Foundation of MEMS/ Chang Liu/Pearson, 2012

**REFERENCES:**

1. Maluf, M., “An Introduction to Microelectromechanical Systems Engineering”. Artech House, Boston 2000
2. Trimmer , W.S.N., “Micro robots and Micromechnaical Systems”, Sensors & Actuators, Vol 19, 1989

Trim., D.W., “Applied Partial Differential Equations”., PWS-Kent Publishing, Boston, 1990

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**THEORY OF METAL CUTTING AND TOOL DESIGN**

**(Elective-2)**

**Pre- requisites:** Engineering graphics, Mechanics of solids, Heat Transfer, Machine Tools, Strength of Materials.

**Objectives:**

* 1. To impart the knowledge of basic methodology of metal cutting.
	2. To educate the student about the structure, working, forces involved in single point and multipoint cutting tools.
	3. To understand the concepts of tool life, machinability, wear, influence of heat.
	4. To design the jigs and fixtures required for machine tools.

**Outcomes:**Students can analyse the machining process interms of input variables like

1. Speed, feed , depth of cut and their influence on surface roughness,
2. Metal removal rate, tool wear rate, machining time, energy, work done, heat distribution.

**UNIT -I:**

**Mechanics of Metal Cutting:** Geometry of Metal Cutting Process, Chip formation, Chip Thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut - Types of Chips, Chip breakers.

Orthogonal and Oblique cutting processes-definition, Forces and energy calculations (Merchant’s Analysis).- Power consumed – MRR – Effect of Cutting variables on Forces, Force measurement using Dynamometers.

**UNIT -II:**

**Single Point Cutting Tool:** Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

**UNIT -III:**

**MultipointCutting Tools:** Drill geometry, design of drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed & feed – machining time – design - from cutters.

**Grinding:** Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio.Depth of cut, speed, machining time, temperature, power.

**UNIT -IV:**

**Tool Life and Tool Wear:** Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index.

Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle, Economics, cost analysis, mean co-efficient of friction.

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

**\UNIT -V:**

**Tool Design**: Determination of shank size for single point carbide tools, Determining the insert thickness for carbide tools.

Design of jigs and fixtures: Basic principles of location and clamping; Locating methods and devices. Jigs- Definition, Types. General consideration in the design of Drill jigs, Drill bushing, Methods of construction.Fixtures- Vice fixtures, Milling, Boring, Lathe Grinding fixtures**.**

**TEXT BOOKS:**

1. Metal Cutting Principles / M C Shaw / Oxford and IBH Publications, New Delhi,1969
2. Fundamentals of Machining / Boothryd / Edward Amold publishers Ltd. 1975

**REFERENCE BOOKS:**

1. Metal cutting theory and cutting tool design / V. Arshinov and G. Alekseev / Mir Publishers, Moscow
2. Fundamentals of Metal cutting and Machine tools / B.L.Juneja, G. S. Sekhom and Nitin Seth / New Age International publishers
3. Machine Tool Engineering/ G.R.Nagpal/ Khanna Publishers

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**PRECISION ENGINEERING**

**(Elective-2)**

**Pre Requisites:** Metrology & Machine tools

**Course Objectives:** Understand the tolerances according to ISO standards, selective assembly concept, principles of dimension chains, part and machine tools accuracy.

**Course Outcomes**: At the end of the course, the student will be able to:

* Apply fits and tolerances for parts and assemblies according to ISO standards.
* Apply selective assembly concept for quality and economic production.
* Assign tolerances using principles of dimensional chains for individual features of a part or assembly.
* Evaluate the part and machine tool accuracies.
* Analyze the causes for dimensional and geometrical errors prior to and during machining and suggest remedies

**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 Lags.

**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 to Tolerancing.

**UNIT - II:**

**Datum Systems:**Design of freedom, Grouped Datum Systems – 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.

**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 - IV**

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.

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**UNIT - V:**

**Fundamentals of Nanotechnology:**System 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.

**REFERENCE BOOKS:**

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

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**MECHATRONICS**

**(Elective-2)**

**Pre-requisites:** To learn the importance and use of combination of mechanical & electronics.

**Course objectives:**

* They should be able to link up mechanical and electronics.
* To understand the need for metrology, machine tools, cad/cam, production technology.

**Outcomes:**

* Develop a relationship between mechanical elements and electronics elements for proper functioning of mechanical systems.
* At the end of the course, the student will be able to:
* Model, analyze and control engineering systems.
* Control the behaviour of a process using appropriate sensors, transducers and actuators.
* Develop PLC programs for a given task.
* Evaluate the performance of mechatronic systems.

**UNIT-1:**

**Introduction**: Definition of Mechanics products, Design Considerations and Tradeoffs. Overview of Mechatronics 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.Popular control system configurations.S-curve, Motor/load inertia machining, design with linear studies.

**UNIT-II:**

Motion control Algorithms: Significance of feed control loops, shortfalls, fundamental concepts adaptive and fuzzy control, fuzzy logic compensatory control of transformation and deformation non – Z inearities

**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 systems, CAD/CAM data bases, Graphic data base, Introduction to object oriented concepts, Object oriented model languages interface, Procedure 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: Future and Pattern Reorganization Methods, Concepts of Precision and cognition in decision making

**TEXT BOOK:**

1. Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill

**REFERENCES:**

1. Designing Intelligent Machines, Michel B. Histand and David G. Alciatore, Open University London
2. Control Sensors and Actuators, ICW. Desiha, Prentice Hall

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**PRODUCT DESIGN AND DEVELOPMENT**

 **(Elective-3)**

**Prerequisites:** None

**Course Objectives:** Understandthe customer requirements

Understand the concept of generation and selection by various methods.

Understand the Product architecture & Industrial design

**Course Outcomes:**

* After doing this course, the student should be able to understand the need of Industrial Product & Development, customer needs & Design aspects of new products.
* Able to involve customer into the development of new products and managing requirements
* Able to understand the design of experiments and technical analysis
* Know product architecture
* Investigate the customer requirement and survey of problems
* Design for manufacture and do prototyping

**UNIT- I**:

**Introduction:** Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behavior analysis

Understanding customer – promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification.

**UNIT II** :

**Concept generation and concept selection**: Activity of concept generation – Structured approaches – Five step Method: clarify – Search-Externally and internally – explore systematically – reflect on the solutions and processes – **Concept selection** – Integral part of PDD process-methodology – benefits.

**UNIT III:**

**Product architecture**: Implications – Product change – variety – component standardization – product performance – manufacturability

**Industrial design**: Assessing the need for industrial design, impact – design process

Integrate design process – assessing the quality of industrial design.

ROBUST DESIGN-introduction, various steps in robust design.

**UNIT IV:**

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

**UNIT –V:**

**Design for manufacturing:** Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –cost of supporting production. Minimizing System complexity.

**Prototyping:** Prototype basics – Principles of prototyping – planning for prototypes – Economic analysis.

Understanding and representing tasks – baseline project planning – accelerating the project execution.

**TEXT BOOKS**:

1. Product Design and Development / Kari T. Ulrich and Steven D. Eppinger /McGraw Hill International Edns. 1999.
2. Effective Product Design and Development / Stephen Rosenthal / Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.

**REFERENCE BOOKS:**

1. Concurrent Engg/ integrated Product development / Kemnneth Crow / DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310)377-569, Workshop Book
2. Tool Design – Integrated Methodds for Successful Product Engineering / Staurt Pugh / Addison Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41639-5.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**VALUE ENGINEERING AND TOTAL QUALITY MANAGEMENT**

**(Elective-3)**

**Prerequisites:** None

**Course Objectives:**

* Understand meaning of value of product
* Understand the procedure for improving the value of products through value analysis.
* Understand the concept of total quality management, principles & implementation aspects

**Course Outcomes:**

At the end of the course student should be able

* To carry out value analysis for a given product so as to improve value of the product.
* To Implement TQM concept in the given organization.

**Unit1**

Introduction to Value Management Definition of value management History of values analysis Value Analysis verses Value Engineering Today’s Opportunities Project selection Assembling the team •

**Unit 2**

Information gathering Design documents - drawings, specifications, etc. Material / component cost Cost Models Annual Purchase Values and Quantities Commodity data Sample components Reject rates Warranty data Commercial consideration Supplier Suggestions/Supplier Walk-through •

**Unit 3**

 Analysis of function-cost relationship Define functions Analysis of Cost of Functions Select target function(s) • Idea generation Creativity Brainstorming Process Idea starters Idea forms • Evaluation of Ideas Eliminate the Noise Estimate of Savings Cost to Implement Time to Implement Ranking of Ideas – A, B, C, D Evaluation Tools Selecting the Best Ideas • Development of Implementation Plans • Reporting • Management of Implementation plans

**UNIT4**

**Introruction to Quality Management**

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

**STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY**

Meaning and significance of statistical process control (SPC) – construction of      control charts for variables and attributed.

Process capability – meaning, significance and measurement – Six sigmaconcepts of process capability.

Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

**UNIT 5**

 **TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**

Quality functionsdevelopment (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools.Seven new management tools.Bench marking and POKA YOKE.

 **QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements.Quality Audits.TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

**TEXT BOOKS**

1 Younker, DL, 2003, Value Engineering. Marcel Dekker, New Yo

2. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education

            (First Indian Reprints 2004).

**REFERENCE BOOKS:**

Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**MANUFACTURING SYSTEMS, SIMULATION MODELLING AND ANALYSIS**

**(Elective-3)**

 **Pre requisites:** Operations Research, Optimization Techniques and Applications and Probability Statistics

**Course Objectives:** Understand the

* various simulation models
* Procedure for developing appropriate simulation model
* Procedure for analyzing simulation model

**Course Outcomes :** After doing this course, a student should be able to

. Identify a type of system based on type of its dynamics, ways of analyzing system

. Develop simulation model for dynamic discrete-event stochastic system and analyze

 for specified steady-state performance measures

**UNIT - I:**

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 – types 1& 2 errors – Framing – strong law of large numbers.

**UNIT - I1:**

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 M/M/1 queue – comparison of simulation languages.

**UNIT - IV :**

Output data analysis – Types of Simulation w.r.t output dat analysis – warmup period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

**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, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation / Banks J. & Carson J.S., PH / Englewood Cliffs, NJ, 1984.

**REFERENCE BOOKS:**

1. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990.
2. A Course in Simulation / Ross, S.M., McMillan, NY, 1990.

Simulation Modelling and SIMNET / Taha H.A. / PH, Englewood Cliffs, NJ, 1987**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**CAD/CAM Lab**

**Pre-requisites:** To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.

**Course objectives:** To be able to understand and handle design problems in a systematic manner. To be able to apply CAD in real life applications. To be understand the basic principles of different types of analysis.

**Course out comes:** To understand the analysis of various aspects in of Manufacturing design

**Note: conduct any TEN excercises from the list gien below:**

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling:Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.
13. Quality Control and inspection.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. I-Sem**

**ADVANCED MANUFACTURING PROCESS AND SYSTEMS LAB**

**Prerequisites:** Advanced Manufacturing Process

**Course Objectives:** Understand the CNC programming

**Course:** Should be able to write a CNC program for given part

**Note :** Conduct any Ten exercises from the list given below :

1. Write a program at the machine or off line. Setup the machining operation and perform standards given on lathe operations to develop a simple part (with linear and circular interpolations).

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1. The bolt on the drawing made of AlMg1 is to be made on a CNC lathe in higher batch quantity. Prepare the manufacturing process with the MTS CNC Simulator including following steps: define work part zero, set up the processing sequence, determine tools, fixtures and technological data; generate, set up, test and correct the program at the CNC simulator. A bolt with an external diameter of ∅100 mm and the length of 93 mm is to be clamped for the test.
2. The jig plate on the drawing is to be produced on a CNC vertical milling machine from a blank of Al-alloy dimensioned 100 x 100 x 50 mm. Prepare the production on the CNC Simulator, work out the process layout and set-up form.
3. The contourplate on the drawing is to be produced on a CNC vertical milling machine from a blank of Al-alloy dimensioned 100 x 70 x 25 mm. Prepare the production on the MTS CNC Simulator, work out the process layout and set-up form.
4. Write a program to perform taper turning operations on Al-alloy workpiece of 40mm dia.
5. Write a program to perform thread cutting operations on Al-alloy workpiece of 40mm dia.
6. Write a program to perform rectangular and circular grooves on Al-alloy workpiece using CNC milling machine.
7. Robotic programming using SCARA
8. Low cost automation using pneumatic system – single cylinder exercise
9. Low cost automation using pneumatic system – double cylinder exercise
10. Metal cutting operations using EDM / ECM
11. Metal Cutting operations using AJM

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. II-Sem**

**MANAGEMENT SCIENCE**

**Pre-requisites:** None

**Course Objectives: To understand**

. The various phylospies of Management of different gurus, and their differences**.**

. Operations Management techniques

. Marketing, Human Resource, Project , Stragic Management Techniques

**Course Outcomes:** Understand the evolutionary development of management nature importance and general principles of management. Apply principles of marketing operations and concepts and tools for successful launch of a product. Understand the concepts of human resources management and role of administration in streamlining a production system. Apply project management tools to manage projects. Apply the inventory management tools in managing inventory. Apply quality engineering tools to the design of products and process controls.

**Unit I**

**Introduction to Management & Organisation:** Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor’s Scientific Management Theory – Fayol’s Principles of Management – Maslow’s theory of Hierarchy of Human Needs – Douglas McGregor’s Theory X and Theory Y – Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organisational Structures:Basic concepts related to Organisation - Departmentation and Decentralisation, Types and Evaluation of mechanistic and organic structures of organisation and suitability.

**Unit II**

**Operations & Marketing Management:** Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering Statistical Quality Control: control charts for Variables and Attributes, (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming’s contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records – JIT System, Supply Chain Management Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle, Channels of distribution.

**Unit III**

 **Human Resources Management (HRM):** Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels – Performance Management System.

**Unit IV**

**Project Management *(PERT/CPM*):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

**Unit V**

***Strategic Management and Contemporary Strategic Issues*:** Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Card as Contemporary Business Strategies.

**TEXT BOOKS:**

1. Aryasri: *Management Science*, McGraw Hill, 2012.

2. Vijay Kumar and Appa Rao *Management Science*, Cengage, 2012.

**REFERENCES :**

1. Kotler Philip & Keller Kevin Lane: Marketing Management, Pearson, 2012.
2. Koontz & Weihrich: *Essentials of Management*, McGraw Hill, 2012.
3. Thomas N.Duening & John M.Ivancevich *Management—Principles and Guidelines,* Biztantra, 2012.
4. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2012.
5. Samuel C.Certo: *Modern Management*, 2012.
6. Schermerhorn, Capling, Poole & Wiesner: *Management*, Wiley, 2012.
7. Parnell: *Strategic Management*, Cengage,2012.

8. Lawrence R Jauch, R.Gupta &William F.Glueck: *Business Policy and Strategic*

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

# IV Year B.Tech. Mech. Engg. II-Sem

# OPTIMIZATION TECHNIQUES AND APPLICATIONS

**Prerequisites:** Operations Research

**Objectives:** After doing this subject student should know

* the various optimization techniques for single variable optimization problem
* Direct search methods and Gradient methods for multi variable un constraint Optimization problems
* Formulate a Geometric Programming model and solve it by using Arithmetic Geometric in equality theorem
* Simulate the system
* Thorough of state of art optimization techniques like Genetic Algorithms, simulated Annealing

**Outcomes:** For a given system, as per customer requirement it is required to

* Formulate optimization problem.
* Solve the problem by using a appropriate optimization techniques

**UNIT- I*:***

**Single Variable Non-Linear Unconstrained Optimization:**Elimination methods :Uni-Model function-its importance, Fibonacci method,&Golden section method. Interpolation methods : Quadratic & Cubic interpolation methods.

## UNIT- II:

**Multi variable non-linear unconstrained optimization:** Direct search methods – Univariantmethod , Pattern search methods – Powell’s, Hook -Jeeves, Rosenbrock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method,& variable metric method.

## UNIT- III:

**Linear Programming** – Formulation, Simplex method&Artificial variable optimization techniques: Big M & Two phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition and deletion of variables, constraints.

Simulation – Introduction – Types- steps – applications: inventory & queuing – Advantages and disadvantages

## UNIT- IV:

**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, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

**UNIT- V:**

**Geometric Programming:** Posynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P(≤ type only)

**Non Traditional Optimization Algorithms:** Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Introduction to Particle Swarm Optimization(PSO)(very brief)

**TEXT BOOKS:**

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

**REFERENCE BOOKS:**

1. S.D.Sharma / Operations Research
2. Operation Research / H.A.Taha /TMH
3. Optimization in operations research / R.LRardin
4. Optimization Techniques /Benugundu&Chandraputla / Pearson Asia.
5. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. II-Sem**

**ADVANCED FINITE ELEMENT & BOUNDARY METHODS**

**(Elective – 4)**

**Perquisites**: None

**Objectives:**

1. To equip students with fundamentals of finite element principles.
2. To enable them to understand the behavior of various finite elements and to be able to select appropriate elements.
3. To solve physical and engineering problems with emphasis on structural and thermal engineering applications.

**Course Outcomes**: At the end of the course, the student will be able to

Understand the Finite Element Formulation procedure for structural Problems.

Understand the representation and assembly considerations for Beam and Frame elements.

Analyze Plane stress, Plane strain, axi-symmetric Problems.

Formulate and solve simple heat transfer and fluid mechanics problems

Identify significant applications of FEM in Manufacturing

**UNIT - I:**

Introduction to FEM: basic concepts, application of FEM, general description, advantages of FEM, comparison of FEM with other methods : finite difference method, variational method, Galerkin Method, basic element shapes, interpolation function. Virtual energy principle, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, basic equations of elasticity, strain displacement relations.

**UNIT - II:**

1-D structural problems : axial bar element – stiffness matrix, load vector, temperature effects, quadratic shape function, analysis of trusses – plane truss and space truss elements, Analysis of beams – Hermite shape functions, stiffness matrix, load vector problems, analysis.

**UNIT - III:**

2-D problems – CST, force terms, stiffness matrix and load vector, boundary conditions, Iso-parametric element, Quadric element, shape functions, Numerical Integration, 3-D problems – Tetrahedran element, Jacobian matrix, stiffness matrix.

**UNIT - IV :**

Scalar field problems – 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems, torsion.

**UNIT - V :**

Dynamic considerations, Dynamic equations, consistent mass matrix, Eigen values, Eigen vector, natural frequencies, mode shapes, modal analysis.

**TEXT BOOKS :**

1. Finite Element Methods, Alavala, PHI
2. Introduction to finite elements in engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.

**REFERENCE BOOKS :**

1. An Introduction to Finite Element Methods – S.S. Rao – Pegamon, New York.
2. The Finite element method in Engineering science – O.C. Aienkowitz, Mc. Graw Hill.
3. Concepts and applications of finite element analysis – Robert Cook.
4. Finite Element Methods in Engineering analysis – K.J. Bathe.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. II-Sem**

**QUALITY ENGINEERING IN MANUFACTURING**

**(Elective – 4)**

**Prerequisites:** Metrology and machine tools

**Objectives:**

* To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices.
* To train them in the area of precision and quality manufacturing.

 **Course Outcomes:** At the end of the course students will be able to

* Apply quality systems, principles, concepts.
* Utilize appropriate math, measurement and statistical tools.
* Technology to improve processes, product quality, and to enhance productivity.

**UNIT- I:**

 **LASER METROLOGY AND PRECISION INSTRUMENTS** Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometry applications – speckle interferometry – laser interferometers in manufacturing and machine tool alignment testing – laser Doppler technique – laser Doppler anemometry - Laser telemetric systems – detection of microscopic imperfections on high quality surface Pitter NPL gauge interferometer – classification of optical scanning systems – high inertia laser scan technique – rotating mirror technique vibrational deflectors – refractive and diffractive scanners. – laser gauging – bar coding – laser dimensional measurement system.

**UNIT- II: CO-ORDINATE MEASURING SYSTEM** Co-ordinate metrology – CMM configurations – hardware components – software – Probe sensors – Displacement devices – performance evaluations – software – hardware – dynamic errors – thermal effects diagram – temperature variations - environment control – applications – Roll of CMM in reverse engineering.

**UNIT- III: OPTO ELECTRONICS AND VISION SYSTEM**Opto electronic devices – CCD – On-line and in-process monitoring in production - applications - image analysis and computer vision – Image analysis techniques – spatical feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system

**UNIT- IV: QUALITY IN MANUFACTURING AND DESIGN ENGINEERING** Importance of manufacturing planning for quality – initial planning and concept of quality – self controls – defining quality responsibilities on the factory flow – automated manufacturing – overall view of manufacturing planning – process quality audits – Opportunities for improvement in product design – early warning concepts and design assurance – design for basic functional requirements – design for reliability – availability – designing for manufacturability and safety – cost of quality – design review - concurrent engineering – improving the effectiveness of product development.

 **UNIT –V: QUALITY MANAGEMENT SYSTEM AND CONTINUOUS IMPROVEMENT** Need for quality management system – design of quality management system – quality management system requirements – ISO 9001 and other management system and models – basic quality engineering tools - statistical process control – techniques for process design and improvement – Taguchi methods for process improvement – six sigma.

**TEXT BOOKS :**

1. Oakland J.S. Total Quality Management – Text with cases, Butter worth – Heinemann – An imprint of Elseiver, First Indian Print, New Delhi 2005.

 2. Elanchezhian.C, VijayaRamnath.B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.

**REFERENCES**:

1. ZuechNello, Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000

2. John A. Bosch, Giddings and Lewis Dayton, Co-ordinate Measuring Machines and Systems, Marcel Dekker, Inc, 1999.Juran J.M. and Gyna F.M., Quality Planning and Analysis, Tata-McGraw Hill, New Delhi, 1995.

 3. Awcock, G.J. and Thomas R, Applied Image Processing, Mc.Graw Hill, Inc. 1996.

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**IV Year B.Tech. Mech. Engg. II-Sem**

 **Additive Manufacturing**

 **(Elective-4)**

**Prerequisites:** None

**Objectives:** To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.

**Course outcomes:**

* To understand the fundamentals for additive manufacturing and how it is different and discuss about various types of liquid based, solid based and powder based AM technologies.
* To understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software’s used in AM.
* To know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields

**UNIT – I**

**Introduction**: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

**UNIT – II**

**Liquid-based AM Systems**: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Polyjet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Microfabrication.

**Solid-based AM Systems**: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

**UNIT – III**

**Powder Based AM Systems**: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

**Rapid Tooling**: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

**UNIT – IV**

**AM Data Formats**: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

**AM Software’s**: Need for AM software, Features of various AM software’s like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, SurgiGuide, 3-matic, Simplant, MeshLab.

**UNIT –V**

**AM Applications**: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customised Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visulization of Biomolecules. Web Based Rapid Prototyping Systems

**Suggested Reading**:

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S,

 World Scientific publications , Third Edition, 2010.

2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001

3. Wholers Report 2000 – Terry Wohlers, Wohlers Associates, 2000

4. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor &

 Francis Group, 2011.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech. Mech. Engg. II-Sem**

**ADVANCED COMPUTER AIDED DESIGN AND ANALYSIS LABORATORY**

**Note :**Conduct any Ten exercises from the list given below :

1. Two- dimensional drawing using CAD software.
2. Three-dimensional drawing using CAD software.
3. Various Dimensioning and tolerancing techniques on typical products using CAD software.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism, etc.
5. Truss analysis using FEA software.
6. Beam analysis using FEA software.
7. Frame analysis using FEA software.
8. Buckling analysis of columns using FEA software.
9. Harmonic analysis using FEA software.
10. Fracture analysis using FEA software.
11. Analysis of laminated composites using FEA software.
12. Couple-field analysis using FEA software.
13. Modal Analysis
14. Transient dynamic analysis.
15. Spectrum analysis.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**V Year B.Tech. Mech. Engg. I-Sem**

**AUTOMATION IN MANUFACTURING**

**Prerequisites:** Advanced Manufacturing Process

**Objectives:**

* Lower Cost and Improve Time-to-Market
* Automation investment life-cycle analysis
* Empowered teams of talented employees
* Partnering with automation suppliers
* On-line process analysis
* Procedural process control
* Information integration and data warehousing

**Outcomes:** Student will be able to

* Analyze online processes
* Understand how to lower the cost & improve the time to market
* Analyze life cycles of a product
* The importance of Information integration and data warehousing

**UNIT-I:**

**Introduction to Automation:** Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, , Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

**UNIT-II:**

**Introduction to Material Handling**, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

**UNIT -III:**

**Manual Assembly Lines** - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines,  Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

**UNIT-IV:**

**Transfer lines**, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

**UNIT-V:**

**Automated Assembly Systems**, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines , Partial Automation.

**TEXT BOOKS:**

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Eduction.

**REFERENCE BOOKS:**

1. CAD CAM : Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper& Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

#### V Year B.Tech. Mech. Engg. I-Sem

#### DESIGN FOR MANUFACTURING AND ASSEMBLY

**(Elective-5)**

**Prerequisites:** None

**Objectives:** At the end of this course the student should be able to apply the design for manufacturing principles in casting, welding, forming, machining and assembly, by considering various manufacturing constraints.

**Course Outcomes:** At the end of the course, the student will be able to

* Understand the quality aspects of design for manufacture and assembly.
* Apply Boothroyd method of DFM for product design and assembly.
* Apply the concept of DFM for casting, welding, forming and assembly.
* Identify the design factors and processes as per customer specifications.
* Apply the DFM method for a given product.

## 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 – 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 – Location of parting lines of dies – Drop forging die design – General design recommendations

## UNIT IV:

**EXTRUSION, SHEET METAL WORK & PLASTICS:** Design guidelines for Extruded sections - Keeler Goodman Forming Limit Diagram – Component Design for Blanking.

**PLASTICS**: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

**UNIT V:**

**DESIGN FOR ASSEMBLY**: General design guidelines for Manual Assembly- Development of 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- Effect of symmetry , Further design guidelines.

**TEXT BOOKS:**

1. Engineering design-Material & Processing Approach/ George E. Deiter, Mc. Graw Hill Intl. 2nd Ed.2000.
2. Product design for Manufacture and Assembly/ Geoffrey Boothroyd/Marcel Dekker Inc. NY, 1994.

**REFERENCE BOOKS:**

1. Product design and Manufacturing / A.K Chitale and R.C Gupta / Prentice – Hall of India, New Delhi, 2003.
2. Design and Manufacturing / Surender Kumar &Goutham Sutradhar / Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
3. Hand Book of Product Design/ Geoffrey Boothroyd Marcel Dekken Inc. NY, 1990.

Product Design/ Kevin Otto and Kristin Wood/ Pearson Education

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#### V Year B.Tech. Mech. Engg. I-Sem

**PRODUCTION AND OPERATIONS MANAGEMENT**

**(Elective 5)**

**Prerequisites:** Operations Research, Production Planning and Control

**Objectives:**

* Learn Aggregate planning, MRP Work study, and scheduling
* Learn Value analysis, design the plant layout for the specified production system

**Course Outcomes:** At the end of the course, the student is able to

* Understand the importance of production and operations Management, for getting the Competitive edge
* Do value analysis for a given product and design the plant layout for the specified production system.
* Do Aggregate planning, MRP Work study, and scheduling
* able to apply the project management techniques

**UNIT- I**

**Overview of Production & Operations Management (POM):**Introduction-Definition-Importance- Historical Development of POM-POM scenario today

**Product & Process design**: Role of product development- Product development process-Tools for efficient product development(briefly)- Determination of process characteristics- Types of processes and operations systems- Continuous –Intermittent-Technology issues in process design- Flexible Manufacturing Systems- Automated Material Handling Systems

**UNIT -II**

**Value Analysis**:Defintion-Objectives-Types of Values-Phases- Tools -FAST diagram-Steps- Advantages-Matrix method-Steps.

**Plant Location& Plant layout:**Factors affecting locations decisions-Location planning methods-Location factor rating -Centre of Gravity method-Load distance method. Plant layout- Definition-Objectives-Types of layouts-Design of product layout-Line balance-Terminology-RPW method.

**UNIT- III**

**Aggregate Planning:** Definition- Objectives-Basic strategies for aggregate production planning- Aggregate production planning method-Transportation model- Master Production Scheduling.

**Material Requirement Planning:** Terminology-Logic-Lot sizing methods-Advantages & Limitations

**UNIT - IV**

**Work Study :**Work study: method study –definition-objectives-steps-Charts used- Work measurement-Time study- Definition-steps- Determination of standard time- Performance rating- Allowances. Work sampling- steps- comparison with time study.

**Quality Management:** Economics of quality assurance-Control charts for variables and for attributes –Acceptance sampling plans-Total Quality Management-ISO 9000 series standards-Six sigma

**UNIT - V**

**Scheduling:**Need-basis for scheduling- Scheduling rules- Flow shop & Job shop scheduling. Line of Balance.

**Project management:** PERT- Critical path determination- Probability of completing project in a given time- CPM- Types of floats- Critical path determination- Crashing of simple networks- Optimum project schedule.

**TEXT BOOKS:**

1. Operations Management for Competitive Advantages- Chase Aquinano-TMH,2009

2. Operations Management: Theory and Practice: B.Mahadevan Pearson.

3. Industrial Engineering and Mangement: Dr.Ravi Shankar- Galgotia.

**REFERENCES:**

1. Modern Production and Operations Managemet: Buffa, Wiley
2. Theory and Problems in Production and Operations Managemet:SN Chary TMH.
3. Operations Management 8e Process and Value Chains: Lee Krajewskiet. all Pearson

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#### V Year B.Tech. Mech. Engg. I-Sem

**FLEXIBLE MANUFACTURING SYSTEMS**

**(Elective-5 )**

**Prerequisites:** None

**Objectives:** Learn different types of FMS, Designing and analyzing the same using simulation and different analytical techniques.Helps to learn the tool management in FMS & to handle the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS

**Course Outcomes:** At the end of the course, the student shall be able to

* Classify and distinguish FMS and other manufacturing systems including job-shop and mass production systems.
* Explain processing stations and material handling system used in FMS environments.
* Design and analyze FMS using simulation and analytical techniques.
* Understand tool management in FMS.

Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS

**Unit1**

Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type

**Unit 2**

Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

 **Unit3**

 Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station

 **Unit 4**

Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

**Unit 5**

Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS Case studies: Typical FMS problems from research papers

**Text books**

1. William W Luggen, “Flexible Manufacturing Cells and System” Prentice Hall of Inc New Jersey, 1991

2. Reza A Maleki “Flexible Manufacturing system” Prentice Hall of Inc New Jersey, 1991

3. John E Lenz “Flexible Manufacturing” marcel Dekker Inc New York ,1989.

**References**

* 1. . Groover, M.P “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall

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#### V Year B.Tech. Mech. Engg. I-Sem

**ADVANCED CASTING AND WELDING TECHNOLOGY**

**(Elective-6)**

**Prerequisites**: Production Technology, Heat transfer, FEM.

**Objectives:**

* To study the metallurgical concepts and applications of casting and welding process.
* To acquire knowledge in CAD of casting and automation of welding process.

**Course Outcomes:** At the end of the course, the student is able

* To impart the knowledge of advanced welding and casting techniques.
* To apply computer aided engineering to welding and casting.
* To analyse the advanced welding and casting processes and can relate variables with performance measures.

**UNIT – I:**

**Laser Beam Welding:** Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fibre optics in LBW.

**Friction Stir Welding:** Details of process and process parameters, specific applications.

**Electron Beam Welding:** The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies.

**Ultrasonic Welding:** Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product forultrasonic welding, details of equipment and case studies, cutting and gauging, flame cutting, plasma arc welding, laser assisted cutting.

**UNIT – II:**

**Heat flow in welding:** Significance, theory of heat flow, cooling rate determination, selection of welding parameters based on heat flow analysis, residual stresses and distortion. Joint design, analysis of fracture and fatigue of welded joints.Automated welding systems.

**UNIT - III:**

Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity flow - pressure casting, directional and monocrystal solidification, squeeze casting, semisolid metal casting, rheocasting, .

**UNIT –IV:**

Solidification, Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and riseringdesing calculations, Fluidity and its measurement.

**UNIT - V:**

**CAE Of Welding And Casting:**Design of weldment, application of finite element method in welding – determination of distortion in weldments, modeling of temperature distribution - case studies. Design for casting, application of finite element method in casting - determination of hot spots, location of turbulence and other defects, modeling of flow in molds, modeling of heat transfer in castings – case studies.

**REFERENCE BOOKS:**

1. Ravi B, “Metal Casting: Computer Aided Design and Analysis”, Prentice Hall, 2005.

2.   Richard L Little, “Welding and Welding Technology”, Tata McGraw Hill, 2004.

3.   John Campbell, “Casting Practice”, Elsevier Science Publishing Co., 2004.

4.   Larry Jeffus, "Welding: Principles and Applications", Delmar Publishers, 2004.

5.   John Campbell, "Casting", Butterworth Heinemann, 2003.

6.   KlasWeman, “Welding Processes Handbook”, 2003.

7.   Howard B Cary, “Modern Welding Technology”, Prentice Hall, 2002.

8.   Larry Jeffus, “Welding for Collision Repair”, Delmar Publishers, 1999.

9. ASM Hand Book, “Casting”, ASM International, 1998.

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#### V Year B.Tech. Mech. Engg. II-Sem

**MATERIAL TECHNOLOGY**

**(Elective-6)**

**Perquisites:** Mechanics of solids

**Objectives:**

* To make the students to understand on elastic, plastic and fractured behaviour of engineering materials.
* To train the students in selection of metallic and non-metallic materials for the various engineering applications.

**Course Outcomes:**

* Apply phase transformation phenomena to improve the performance of materials.
* Apply principles of deformation to modify structure and properties of materials.
* Characterize and evaluate materials for specific applications.
* Design metallurgical processes to produce products as per specifications.
* Evaluate products using non-destructive testing methods and modify processes.
* Identify mechanisms for protecting engineering materials from degradation.
* Synthesize ceramic, polymer, composite and non-ferrous materials.
* Design advanced materials for aerospace, biological, nuclear and high temperature applications.
* Apply project management techniques effectively to address issues related to metallurgical industries.
* Practice professional ethics and engage in lifelong learning for improved professional advancement, moral and human values.

**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:**

Griffth’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 Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

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**UNIT – IV:**

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.

Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep

**UNIT – V:**

**Modern Metallic Materials:**Dual Phase 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, Adhesives and Coatings, Structure, Properties and Applications of engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, Al2 O3 , SiC, Si3 N4 , CBN and Diamond – properties, Processing and applications.

**TEXT BOOKS:**

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

**REFERENCE BOOK:**

1. Selection and use of Engineering Materials,Charles J.A, Butterworth Heiremann.

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#### V Year B.Tech. Mech. Engg. II-Sem

**INDUSTRIAL ROBOTICS**

**(Elective-6)**

**Prerequisites:** Kinematics of machinery

 **Objectives**:

To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

**Course Outcomes:** After doing this course, the student should be able to

* Understand the evolution, classification, structures and drives for robots.
* To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors
* To expose the students to build a robot for any type of application

**UNIT I**

**Introduction:** Automation and Robotics, Robot configuration, motions, joint notation, work volume, robot drive system, Robot actuators: Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics. End Effectors:Types, operation, mechanism, force analysis, consideration in gripper selection and design.RobotVision:Basics and steps, Robot Programming Methods.

**UNIT II:**

**Motion Analysis and Control:** Manipulator kinematics, position representation, Basic and Composite Rotation Matrices, Equivalent Axis and Angle – Euler Angles - Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators,

**UNIT III:**

Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

**UNIT IV:**

**Robot Dynamics:** Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators.

**UNIT V:**

**Robot Cell Design and Control:** Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

**Robot Applications:** Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

**TEXT BOOKS:**

1. Robot Analysis and Control /Asada H. and J. E. Slotin, Wiley, New York
2. Theory of Applied Robotics: Kinematics , Dynamics and Control/ Reza N. Jazar, Springer, India

**REFERENCE BOOKS:**

1. Industrial robotics / MikellP.Groover / McGraw Hill
2. Robotics / K.S.Fu / McGraw Hill.
3. Introduction to Robotics Mechanics & Control/ John J.Craig/Pearson
4. Robot Analysis/Lung Wen Tsai/John Wiley & Sons
5. Robotics & Control/RK Mittal & IJ Nagrath/ Tata Mc-GrawHill

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#### V Year B.Tech. Mech. Engg. I-Sem

**NANOTECHNOLOGY**

**(Elective-7)**

**Prerequisites:** None

**Objectives:**

* To expose the students to the evolution of Nano systems, to the various fabrication techniques.
* Also to impart knowledge to the students about nano materials and various nano measurements techniques.

**Course outcomes:**

* An ability to apply knowledge of mathematics, science, and engineering.
* An ability to design and conduct experiments, as well as to analyze and interpret data.
* An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
* An ability to function on multidisciplinary teams.
* An ability to identify, formulate, and solve engineering problems.
* An understanding of professional and ethical responsibility.
* An ability to communicate effectively.
* The broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context.
* A recognition of the need for, and an ability to engage in life-long learning.
* A knowledge of contemporary issues.
* An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

 **UNIT- I:** OVER VIEW OF NANOTECHNOLOGY 6 Definition – historical development – properties, design and fabrication Nanosystems, working principle ,applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

 **UNIT –II:** NANODEFECTS, NANO PARTILES AND NANOLAYERS 8 Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots.Nano layers – PVD,CVD ,Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

 **UNIT- III**: NANOSTRUCTURING 8 Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

UNIT- IV: SCIENCE AND SYNTHESIS OF NANO MATERIALS 12 Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNIT –V: CHARACTERIZATION OF NANO MATERIALS 11 Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TEXT BOOKS :

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.

 2. FahrnerW.R.,Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011. 3. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.

 4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003

5. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5

REFERENCES:

 1. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8 29

2. Sami Franssila, Introduction to Micro fabrication , John Wiley & sons Ltd, 2004. ISBN:470-85106-6

3. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003

 4. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

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#### V Year B.Tech. Mech. Engg. I-Sem

**NEURAL NETWORKS AND FUZZY LOGICS**

**(Elective-7)**

**Perquisites:** None

**Objectives:**

* Understand the concepts of artificial neural Networks
* Understand the topology of multi layer perception
* Understand the recurrent neural networks
* Understand the concepts of fuzzy logics

**Course Outcomes:** One should be able to develop neural networks and fuzzy logics to a system and analyze.

**UNIT-I :Evolution of neural networks; Artificial Neural Network**: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline.

**UNIT–II** :Topology of Multi-layer perceptron, Back propagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen’s self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

**UNIT–III** :Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

**UNIT–IV**: Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy

arithmetic; composition and inference; Considerations of fuzzy decision-making.

**UNIT-V**

 Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

***Suggested Reading:***

1.          Limin Fu, *“Neural Networks in Computer Intelligence,”* McGraw Hill, 2003.

2.          Fakhreddine O. Karray and Clarence De Silva., *“Soft Computing*

*and Intelligent Systems Design, Theory, Tools and Applications,”*Pearson Education, India, 2009.

3.          Timothy J. Ross, *“Fuzzy Logic with Engineering Applications,”*

McGraw Hill,1995.

 4.          B.Yegnanarayana, *“Artificial Neural Networks,”* PHI, India, 2006.

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#### V Year B.Tech. Mech. Engg. I-Sem

**SCALING LAWS AND MICRO MANUFACTURING**

**(Elective-7)**

**Prerequisites:** Unconventional machining process

**Objectives:**

Understanding the micro machining processes like abrasive jet micro machining, electro discharging micro machining, nano policing , Micro forming and welding etc

**Course outcomes:** After doing this course, the student should be able to

* Understand various micro machining processes
* learn about nano polishing and micro forming and welding

**UNIT- I: MICRO MACHINING I** Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

**UNIT- II: MICRO MACHINING II**  Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Hybrid Micro machining – Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.

**UNIT-III : NANO POLISHING**Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemomechanicalPolishining.

**UNIT- IV: MICRO FORMING AND WELDING** Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.

 **UNIT- V: RECENT TRENDS AND APPLICATIONS** Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.

TEXT BOOKS

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012 1. Janocha H., Actuators – Basics and applications, Springer publishers – 2012

 2. Jain V.K., ‗Introduction to Micro machining‘ Narosa Publishing House, 2011

**REFERENCES**:

1. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.

 2. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.

3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002

4. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

5. www.cmxr.com/industrial/ 8. www.sciencemag.org.handbook

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#### V Year B.Tech. Mech. Engg. II-Sem

**Project Stage-1**

**DISSERTATION PART – A**

**Prerequisites:** None

## Course Outcomes:

* Identify a topic in advanced areas of Advanced Manufacturing Systems, materials
* Review literature to identify gaps and define objectives & scope of the work
* Employ the ideas from literature and develop research methodology
* Develop a model, experimental set-up and / or computational techniques necessary to meet the objectives.

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#### V Year B.Tech. Mech. Engg. II-Sem

**SEMINAR**

**Prerequisites:** None

**Course Objectives:**

Reading and understand of the research papers publish in the relevant field.

## Course Outcomes:

## At the end of the course, the student will be able to:

* Identify and compare technical and practical issues related to the area of course specialization.
* Outline annotated bibliography of research demonstrating scholarly skills.
* Prepare a well organized report employing elements of technical writing and critical thinking
* Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

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#### V Year B.Tech. Mech. Engg. I I-Sem

**Project Stage-II**

**DISSERTATION PART – B**

**Prerequisites:** None

## Course Outcomes:

* Identify methods and materials to carry out experiments/develop code
* Reorganize the procedures with a concern for society, environment and ethics
* Analyze and discuss the results to draw valid conclusions
* Prepare a report as per the recommended format and defend the work.
* Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

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#### V Year B.Tech. Mech. Engg. II-Sem

**COMPREHENSIVE VIVA – VOCE**

**Prerequisites:** Knowledge of All the subjects of I year I sem & II semester

**Objectives:** Having Idea of awareness of concepts of subjects studied during the I year I Semester & II semester.

## Course Outcomes:

* Comprehend the knowledge gained in the course work
* Infer principles of working of mechanical components
* Demonstrate the ability in problem solving and to communicate effectively