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.)

(Applicable for the batches admitted from 2018-2019)

JNTUH COLLEGE OF ENGINEERING HYDERABAD

(Autonomous)

Kukatpally- Hyderabad – 500085

Telangana- India

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
Integrated Dual Degree Programme (IDP) (B.Tech + M.Tech)

MECHANICAL ENGINEERING

COURSE STRUCTURE (R18)

Applicable from 2018-19 admitted Batch

I YEAR **I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BSC	Mathematics–I (Linear Algebra and Calculus)	3	1	0	4
2.	BSC	Engineering Physics	3	1	0	4
3.	ESC	Programming for Problem Solving	3	0	0	3
4.	ESC	Classical Engineering Mechanics	3	1	0	4
5.	BSC Lab	Engineering Physics Lab	0	0	3	1.5
6.	ESC Lab	Programming for problem solving Lab	0	0	3	1.5
Total Credits						**18**

I YEAR **II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BSC	Mathematics –II (Advanced Calculus)	3	1	0	4
2.	BSC	Engineering Chemistry	3	1	0	4
3.	ESC	Engineering Graphics	1	0	4	3
4.	ESC	Engineering Workshop	1	0	3	2.5
5.	HSMC	English	2	0	0	2
6.	BSC Lab	Engineering Chemistry Lab	0	0	3	1.5
7.	HSMC Lab	English Language and Communication Skills lab	0	0	2	1
8.	*MC	Sports & Games	0	0	2	0
Total Credits						**18**

II YEAR **I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BSC	Mathematics –III (Probability Distributions and Complex Variables)	3	1	0	4
2.	PCC-1	Mechanics of Solids	3	0	0	3
3.	PCC-2	Material Science & Metallurgy	3	0	0	3
4.	PCC-3	Production Technology	3	0	0	3
5.	PCC-4	Thermodynamics	3	1	0	4
6.	PCC-Lab1	Production Technology Lab	0	0	2	1
7.	PCC-Lab2	Machine Drawing Practice	1	0	2	2
8.	PCC-Lab3	Material Science & Mechanics of Solids Lab	0	0	2	1
9.	*MC	Indian Constitution	2	0	0	0
Total Credits						**21**

II YEAR **II SEMESTER**

S. No	Course Code	Course Title	L	T	P	Credits
1.	PCC-5	Kinematics of Machinery	3	1	0	4
2.	PCC-6	Thermal Engineering-I	3	1	0	4
3.	PCC-7	Fluid Mechanics and Hydraulic Machinery	3	1	0	4
4.	PCC-8	Instrumentation & Control Systems	3	0	0	3
5.	ESC	Basics of Electrical & Electronics Engineering	3	0	0	3
6.	PCC-Lab 5	Fluid Mechanics and Hydraulic Machinery Lab	0	0	2	1
7.	PCC-Lab 6	Instrumentation & Control Systems Lab.	0	0	2	1
8.	ESC-Lab	Basics of Electrical & Electronics Engineering Lab	0	0	2	1
9.	*MC	Environmental Science	2	0	0	0
Total Credits						**21**

III YEAR **I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	PCC-9	Dynamics of Machinery	3	1	0	4
2.	PCC-10	Design of Machine Elements-I	3	0	0	3
3.	PCC-11	Metrology & Machine Tools	3	0	0	3
4.	PCC-12	Thermal Engineering-II	3	0	0	3
5.	PEC-1	Operations Research Industrial Robotics Mechanical Vibrations	3	0	0	3
6.	HSMC	Business Economics and Financial Analysis	3	0	0	3
7.	PCC-Lab 7	Thermal Engineering Lab- I	0	0	2	1
8.	PCC-Lab 8	Metrology & Machine Tools Lab	0	0	2	1
9.	PCC-Lab 9	Kinematics & Dynamics Lab	0	0	2	1
Total Credits						**22**

III YEAR **II SEMESTER**

S. No	Course Code	Course Title	L	T	P	Credits
1.	PCC-13	Design of Machine Elements-II	3	0	0	3
2.	PCC-14	Heat Transfer	3	1	0	4
3.	PCC-15	CAD & CAM	3	0	0	3
4.	PCC-16	Refrigeration & Air Conditioning	3	0	0	3
5.	PEC-2	Unconventional Machining Processes Machine Tool Design Production Planning & Control	3	0	0	3
6.	OEC-1	Quantitative Techniques for Business Decisions	3	0	0	3
7.	PCC-Lab 10	Heat Transfer Lab	0	0	2	1
8.	PCC-Lab 11	Thermal Engineering Lab–II	0	0	2	1
9.	HSMC-Lab	Advanced English Communication Skills lab	0	0	2	1
10.	UG	Mini Project (Evaluated in IV-I and Credits will be Allotted in IV - I)	-	-	-	-
Total Credits						**22**

IV YEAR **I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	OEC-II (UG)	Basic Mechanical Engineering	3	0	0	3
2.	PCC-17 (UG)	Finite Element Methods	3	0	0	3
3.	PEC-3 (UG)	Additive Manufacturing Tribology Micro Electro Mechanical Systems (MEMS)	3	0	0	3
4.	PC-1 (PG)	Advanced Manufacturing Processes	3	0	0	3
5.	PE-1 (PG)	Advanced Metal Forming Vibration Analysis and Condition Monitoring of Machine Tools Precision Engineering	3	0	0	3
6.	UG	Seminar	0	0	2	1
7.	UG	Mini project	-	-	4	2
8.	UG	Project Stage - I	0	0	6	3
9.	PG Lab-1	Advanced Manufacturing Processes and Systems Lab	0	0	4	2
10.	PG Lab-2	Material Testing and Evaluation Lab	0	0	4	2
11.	PG	Audit Course	2	0	0	0
Total Credits (UG 15 + PG 10)						**25**

IV YEAR **II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	PEC- 4 (UG)	Power Plant Engineering Automobile Engineering Renewable Energy Sources	3	0	0	3
2.	PEC- 5 (UG)	Industrial Management Concurrent Engineering Composite Materials	3	0	0	3
3.	PC – 2 (PG)	Geometrical Modeling	3	0	0	3
4.	PC – 3 (PG)	Automation in Manufacturing	2	0	0	2
5.	PE-2 (PG)	Product Design and Development Mechatronics Optimization Techniques and Applications	3	0	0	3
6.	PG Lab-3 (PG)	Advanced Computer Aided Design and Analysis Lab	0	0	4	2
7.	UG	Project – II	0	0	16	8
8.	PG	Mini Project with Seminar	0	0	4	2
Total Credits (UG 14 +PG12)						**26**

V YEAR **I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	PC – 4 (PG)	Theory of Metal Cutting and Tool Design	3	0	0	3
2.	PE – 3 (PG)	Advanced Finite Elements Analysis Quality Engineering in Manufacturing Concepts of Computational Fluid Dynamics	3	0	0	3
3.	PE – 4 (PG)	Flexible Manufacturing Systems Design for Manufacturing and Assembly Manufacturing Systems, Simulation Modeling and Analysis	3	0	0	3
4.	PE – 5 (PG)	Advanced Robotics Advanced Casting and Welding Technology Advanced Material Technology	3	0	0	3
5.	OPE (PG)	Nano Technology Neural Networks and fuzzy Logics Scaling Laws and Mechanical Micro Machining	3	0	0	3
6.	PG	Project Stage – 1	0	0	20	10
7.	PG Lab	Automation and Robotics Lab	0	0	4	2
Total Credits						**27**

V YEAR **II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1	PG	Project Stage – 2	0	0	32	16
Total Credits						**16**

MATHEMATICS- I

(Linear Algebra and Calculus)

(For CIVIL, EEE, MECH, ECE, CSE, METT Engineering Branches)

I Year I Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge of 12^{th} / Intermediate level

Objectives: To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigenvalues and Eigenvectors and to reduce the quadratic form to canonical form
- Concept of Sequence.
- Concept of nature of the series.
- Geometrical approach to the mean value theorems and their application to the mathematical problems
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative
- Finding maxima and minima of function of two and three variables.

UNIT-I: Matrices **10 L**

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; Rrank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations, Gauss elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigenvalues and Eigenvectors **10 L**

Linear Transformation and Orthogonal Transformation: Eigenvalues and Eigenvectors and their properties: Diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT-III: Sequences& Series **10 L**

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences.

Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

UNIT-IV: Calculus **10 L**

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-V: Multivariable calculus (Partial Differentiation and applications) **8 L**

Definitions of Limit and continuity.

Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence & independence, Maxima and Minima of functions of two variables and three variables using method of Lagrange multipliers.

Course outcomes: After learning the contents of this paper the student must be able to

- Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
- Find the Eigenvalues and Eigenvectors
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyse the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions
- Find the extreme values of functions of two variables with/ without constraints.

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

References

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

ENGINEERING PHYSICS

COMMON FOR (Civil, Mechanical, Metallurgy, Chemical)

I Year, B.Tech. I-Sem

COURSE OBJECTIVES: The course should enable the students to:	**L**	**T**	**P**	**C**
1. understand the concepts of interference and diffraction.	**3**	**1**	**0**	**4**

2. learn the basic principles of laser and optical fiber.
3. know about band theory and the classification of materials into three groups.
4. exposed to present generation engineered materials and their properties.
5. have knowledge about principles of wave mechanics.

COURSE OUTCOMES: The student will able to:

1. Analyze and get knowledge about diffraction grating and polarization.
2. Justify applications and principles of laser and how the graded index optical fiber is more efficient than step index optical fiber in fiber optic communication system.
3. Gain clear knowledge about Fermi level and energy band diagram.
4. Get clear knowledge about fabrication and characterization of nanomaterials.
5. Learn about Principles and applications of ultrasonic waves and acoustics of buildings.

UNIT-I: Wave Optics

Introduction, Huygen's principle, Superposition of waves, Interference of light by wave front splitting- Young's double slit experiment , amplitude splitting- Newton's rings, Fresnel and Fraunhofer diffractions, Fraunhofer diffraction at a single slit and double slit, Diffraction grating: Grating spectrum and resolving power, Introduction to polarization, Double refraction-Construction & working principle of Nicol prism.

UNIT-II: Lasers and Fibre Optics

Lasers: Introduction, Absorption, Spontaneous and Stimulated emission of radiation, Characteristics of Lasers, Active medium, Resonating cavity, Pumping mechanisms, Population inversion, Einstein coefficients and relation between them, Construction and working of lasers: Ruby laser, He-Ne laser and application of lasers.

Fibre Optics: Introduction, Principle and Construction of an optical fibre, Acceptance angle, Numerical aperture, Types of Fibres-Single & Multimode, Glass & Plastic, Step Index & Graded Index Optical fibers, Losses associated with optical fibres, Basic components in optical fiber communication system, Applications of optical fibres.

UNIT-III: Introduction to solids

Introduction, Free electron theory of metals, Classical and quantum free electron theory, Estimation of Fermi energy, Dependence of Fermi level on temperature, Density of states, Bloch's theorem, Kronig – Penny model, E-K diagram, Origin of energy bands, Classification of materials on the basis of energy bands, Direct and Indirect band gaps, Effective mass of electron.

UNIT-IV: Synthesis & Characterization of Nanomaterials

Introduction, nanoscale, Quantum confinement, Surface to volume ratio, Bottom-up Fabrication: Sol-Gel, Precipitation, Combustion Methods; Top-Down Fabrication: Chemical Vapor

Deposition, Physical Vapor Deposition, Characterization Techniques (XRD, SEM &TEM) and Applications of nanomaterials.

UNIT-V: Ultrasonics & Acoustics of Buildings

Ultrasonics: Introduction, Production of ultrasonic waves, Magneto striction method, Piezo electric method, Detection of ultrasonic waves, Properties of ultrasonic waves, Use of ultrasonics for non-destructive testing, Applications of ultrasonics.

Acoustics of buildings: Introduction, Basic requirements of acoustically good hall, Reverberation and time of reverberation, Sabine's formula for reverberation time, Measurement of absorption coefficient of a material, Factors affecting the architectural acoustics and their remedies, Acoustic quieting.

Text Books:

1. A textbook of Engineering Physics, Dr. M.N. Avadhanulu, Dr. P.G Kshirsagar – S.Chand.

2. Haliday and Resnick, Physics – Wiley.

References:

1. Classical Mechanics by J.C. Upadyaya, Himalaya Publishing House, 2005.

2. Introduction to Solid State Physics by Charles Kittel, Wiley student edition.

3. O. Svelto, "Principles of Lasers".

4. Ajoy Ghatak, "Optics", Mc Graw-Hill Education, 2012.

PROGRAMMING FOR PROBLEM SOLVING

I Year, B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Nil

Course objectives:
1. To learn the fundamentals of computers.
2. To understand the various steps in Program development.
3. To learn the syntax and semantics of C Programming Language.
4. To learn the usage of structured programming approach in solving problems.

Outcomes: The student will learn
1. To write algorithms and to draw flowcharts for solving problems.
2. To translate the algorithms/flowcharts to programs (in C language).
3. To code and test a given logic in C programming language.
4. To formulate simple algorithms for arithmetic and logical problems.
5. To decompose a problem into functions and to develop modular reusable code.
6. To use arrays, pointers, strings and structures to formulate algorithms and programs.
7. Searching and sorting problems.

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.

UNIT – II:
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.
Designing Structured Programs: Functions, basics, user defined functions, inter function communication, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Preprocessor commands, example C programs

UNIT – III:
Arrays and Strings: Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays, C program examples. Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

UNIT – IV:
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.
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:
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.
SortingandSearching: Selection sort, Bubble sort, Insertion sort, Linear search and Binary search methods.

TEXT BOOKS:

1. C Programming & Data Structuresby B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in Cby J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language by B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

REFERENCE BOOKS:

1. C for Engineers and Scientistsby H.Cheng, Mc.Graw-Hill International Edition
2. Data Structures using C by A. M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education, PHI
3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

CLASSICAL ENGINEERING MECHANICS

I Year B.Tech. I-Sem.

L	T	P	C
3	1	0	4

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:
At the end of the course, the student will be able to:
- Resolve forces and moments for a given system.
- Analyse the friction for moving bodies
- Determine centroid and second moment for a given area of a body.

UNIT-I:
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.

UNIT-II:
Friction: Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions -Motion of Bodies -Wedge Screw, Screw-jack and differential screw –jack

UNIT-III:
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.

UNIT-IV:
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.

UNIT-V:
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 by K. Vijaya Kumar Reddy and J. Suresh Kumar, BS Publications, 3rd Edition(SI Units)Fifth impression 2013.
2. Engg. Mechanics by Irving Shames, G. Krishna Mohan Rao, Prentice Hall

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

ENGINEERING PHYSICS LAB

COMMON FOR (Civil, Mechanical, Metallurgy, Chemical)

I Year B.Tech.I-Sem

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
2. To introduce the concepts and techniques which have a wide application in experimental science, but have not been introduced in the standard courses.
3. To teach how to write a technical report which communicates scientific information in a clear and concise manner.

Learning Outcomes: By the end of the course students will be able:

1. To make careful experimental observations and draw conclusions from such data.
2. To distinguish between inferences based on theory and the outcomes of experiments.
3. To write a technical report which communicates scientific information in a clear and concise manner.

List of Experiments

1. Melde's experiment: To determine the frequency of tuning fork.
2. Torsional pendulum: To determine the rigidity modulus of the material of a given wire.
3. Newton's rings: To determine the radius of curvature of a plano-convex lens by forming Newton's rings.
4. Diffraction grating: To determine the wavelength of a given source.
5. Dispersive power: To determine the dispersive power of a prism by using spectrometer.
6. Coupled Oscillator: To determine the spring constant by single coupled oscillator.
7. LCR Circuit: To determine the resonant frequency and quality factor of LCR circuit.
8. LASER: To study the L-I & P-I characteristics of LASER sources.
9. Losses in optical fibre: To determine the bending losses of optical fibres.
10. Optical fibre: To determine the numerical aperture of a given fibre.
11. Sonometer: To determine the frequency of AC mains.
12. Stewart – Gee's experiment: Determination of magnetic field along the axis of a current carrying coil.

Note: Any 8 experiments are to be performed by each student

PROGRAMMING FOR PROBLEM SOLVING LAB

I Year B.Tech. I-Sem.

L	T	P	C
0	0	3	1.5

Objectives

1. To learn the fundamentals of computers.
2. To understand the various steps in Program development.
3. To learn the syntax and semantics of C Programming Language.
4. To learn the usage of structured programming approach in solving problems.

Outcomes: The student will learn

1. To write algorithms and to draw flowcharts for solving problems.
2. To translate the algorithms/flowcharts to programs (in C language).
3. To code and test a given logic in C programming language.
4. To formulate simple algorithms for arithmetic and logical problems.
5. To decompose a problem into functions and to develop modular reusable code.
6. To use arrays, pointers, strings and structures to formulate algorithms and programs.
7. Searching and sorting problems.

Week 1:

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.

Week 2:

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

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

7. Write a C program to solve Towers of Hanoi problem.

8.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)

Week 3:

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

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

i) Addition of Two Matrices

ii) Multiplication of Two Matrices

Week 4:

11. 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.

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

13.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.

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

Week 5:

15. Write a C program to generate Pascal's triangle.

16.Write a C program to construct a pyramid of numbers.

17. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression:$1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$

For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Print x, n, the sum

Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.

Week 6:

18.2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.

19. Write a C program to convert a Roman numeral to its decimal equivalent.

Week 7:

20. 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.)

Week 8:

21. 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.)
22. 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)

Week 9:

26. 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 iii) Insertion sort

Week 10:

27. 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

TEXT BOOKS:

1. C Programming & Data Structures by B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in Cby J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language by B.W. Kernighan and Dennis M.Ritchie, PHI, Pearson Education

REFERENCE BOOKS:

1. C for Engineers and Scientists by H.Cheng, Mc.Graw-Hill International Edition
2. Data Structures using C by A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education, PHI
3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

MATHEMATICS- II

(Advanced Calculus)

(For CIVIL, EEE, MECH, ECE, CSE, METT Engineering Branches)

I Year II Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge of 12^{th} / Intermediate level

Objectives: To learn

- Methods of solving the differential equations of first and higher order.
- Evaluation of multiple integrals and their applications
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals

UNIT-I: First Order ODE **8 L**

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II: Ordinary Differential Equations of Higher Order **10 L**

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax}, $\sin ax$, $\cos ax$, polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Multivariable Calculus (Integration) **10 L**

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallel piped).

UNIT-IV: Vector Differentiation **10 L**

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration **10 L**

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Course outcomes: After learning the contents of this paper the student must be able to

- Identify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real world problems
- Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and gravity for cubes, sphere and rectangular parallel piped
- Evaluate the line, surface and volume integrals and converting them from one to another

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006

References

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002
2. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

ENGINEERING CHEMISTRY

I Year B.Tech. II-Sem.

L	T	P	C
3	1	0	4

OBJECTIVES:

1. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
4. To acquire the skills pertaining to spectroscopy and to apply them for medical field etc.
5. To impart then knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways

OUTCOMES: The basic concepts included in this course will help the student to gain:

1. The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
2. The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
3. The required skills to get clear concepts on basic spectroscopy and application to medical field etc.
4. The knowledge and configurationally and conformational analysis of molecules and reaction mechanisms.

Unit-1: Molecular structure and Theories of Bonding: (9)

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and NO molecules. Bond order.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Factors affecting in magnitude of splitting. Magnetic and colour properties.

Band structure of solids and effect of doping on conductance. N-doping,P-doping.

Unit-2: Water and its treatment: (10)

Introduction – hardness of water – Causes of hardness. Types of hardness: temporary and permanent. Expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water –Boiler troubles Scale, Sludge, Priming, Foaming and Caustic embrittlement. Treatment. Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water. Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems.

Unit-3: Electrochemistry and corrosion: (9)

Electrochemical cells – electrode potential, standard electrode potential, types of electrodes – Calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Causes and effects of corrosion – Theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion. Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of electro chemical corrosion, Corrosion control methods-Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings –Methods of coating- Hot dipping, cementation – Hot dipping-Galvanization and Tinning. Electroless plating of Copper.

Unit-4: Stereochemistry, Reaction Mechanism and synthesis of drug molecules: (9)

Representation of 3-dimensional structures, Isomers-Structural and stereoisomers, Enantiomers, diastereomers, symmetry and chirality. optical activity Absolute configuration. Conformational alanalysis of n- butane. Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and CrO_3. Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

Unit-5: Spectroscopic techniques and applications: (9)

Principles of electronic spectroscopy: Beer's Lamberts law, numerical problems. Types of electronic excitations. Applications of uv-visible spectroscopy. IR Spectroscopy: Principle, modes of vibrations, selection rules, Force constant, some common organic Functional groups wave no. regions (C-H,NH,OH, -COOH, C=0, C≡N, c+C and C≡C) Applications of IR Spectroscopy, H NMR (NMR Spectroscopy) Principle of NMR spectroscopy Chemical shift, chemical shifts of some common organic protons. Introduction to MRI.

Text Books:

1. Text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing company (P) Ltd., New Delhi..

Reference Books:

1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan
3. University Chemistry, by B.H. Mahan
4. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
5. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.

ENGINEERING GRAPHICS

I Year B.Tech. II-Sem

L	T	P	C
1	0	4	3

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

- Prepare 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 – ConventionsAuto CAD: Basic principles only

TEXT BOOKS:

1. Engineering Drawing by N.D. Bhatt, Charotar
2. Engineering Drawing and Graphics by Rane and Shah, Pearson Edu.

REFERENCE BOOKS:

1. A Text Book of Engineering Drawing by Dhawan R K, S. Chand
2. Engineering Graphics with Auto CAD by James D Bethune, Pearson Edu.
3. Engineering Graphics by K R Mohan, Dhanpat Rai.
4. Text book on Engineering Drawingby KL Narayana, P Kannaih, Scitech

ENGINEERING WORKSHOP

I Year B.Tech. II-Sem.

L	T	P	C
1	0	3	2.5

Pre-requisites: **Practical skill**

Objectives:

- 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, equipment 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 understand 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:

- 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.

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

TRADES FOR EXERCISES:

1. Carpentry – 2 Lectures
2. Fitting- 1Lecture
3. Tin-Smithy- 1Lecture
4. Black Smithy-1Lecture
5. House-wiring-1Lecture
6. Foundry- 2 Lectures
7. Plumbing-1Lecture

Trades for Demonstration & Exposure

1. Demonstration of power tools -1 Lecture
2. Welding – 2 Lecture
3. Machine Shop -2 Lectures
4. **IT Workshop I:** Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, simple diagnostic exercises.
5. **IT Workshop II:** Installation of operating system windows and linux simple diagnostic exercises.

TEXT BOOKS:

1. Workshop Practice by B.L.Juneja Cengage Learning
2. Elements of Workshop Technology–S. K.Hajra Choudhury and A. K. Hajra Choudhury.

English
(Common to All Branches)

I Year, B.Tech. II - Sem.

L	T	P	C
2	0	0	2

(Based on *AICTE Model Curriculum for First Year UG Degree Courses in Engineering & Technology-2018)*

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development in the areas of Vocabulary, Grammar, Reading and Writing Skills, fostering ideas and practice of language skills in various contexts.*

LEARNING OBJECTIVES

The course will help students to

a. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
b. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
c. Develop study skills and communication skills in formal and informal situations.

COURSEOUTCOMES

Students should be able to

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. The student will acquire basic proficiency in English including reading and listening comprehension, writing, and speaking skills.

SYLLABUS

- (**Note**: As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is* ***Open-ended,***it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the class.)

Unit –I

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing Precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence.

Unit –II

Vocabulary: Synonyms and Antonyms.
Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.
Reading: Improving Comprehension Skills – Techniques for Good Comprehension.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

Unit –III

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning
Writing: Writing Introduction and Conclusion - Essay Writing.

Unit –IV

Vocabulary: Standard Abbreviations in English
Grammar: Redundancies and Clichésin Oral and Written Communication.
Reading: Comprehension**-** Intensive Reading and Extensive Reading.
Writing: Writing Practices---Précis Writing.

Unit –V

Vocabulary: Technical Vocabulary and their usage
Grammar: Common Errors in English
Reading: Reading Comprehension-Exercises for Practice
Writing: **Technical Reports**- Introduction – Characteristics of a Report – Categories of Reports
Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Note: ***Listening and Speaking skills which are given under Unit-6 are covered in the syllabus of ELCS Lab Course.***

References:

i. *Practical English Usage.* Michael Swan. OUP. Fourth Edition 2016.
ii. *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2018.
iii. *English: Context and Culture* by Board of Editors published by Orient BlackSwanPvt. Ltd.
iv. *Remedial English Grammar.* F.T. Wood. Macmillan.2007.
v. On Writing Well. William Zinsser. Harper Resource Book. 2001
vi. *Study Writing.* Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
vii. *Exercises in Spoken English*. *Parts I –III. CIEFL, Hyderabad.* Oxford University Press

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ENGINEERING CHEMISTRY LAB

I Year B.Tech. II-Sem.

L	T	P	C
0	0	3	1.5

OBJECTIVES: The chemistry laboratory course consists of experiments related to the principles of chemistry required to the engineering student. The course will make the student to learn:

1. Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
2. To determine the rate constant of reactions from concentrations as a function of time.
3. The measurement of physical properties like adsorption and viscosity.
4. To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

OUTCOMES: The experiments included in the chemistry laboratory will make the student to gain the skills on

1. Determination of parameters like hardness and chloride content in water.
2. Estimation of rate constant of a reaction from concentration – time relationships.
3. Determination of physical properties like adsorption and viscosity.
4. Calculation of R_f values of some organic molecules by TLC technique.

1. Determination of total hardness of water by complexometric method using EDTA
2. Estimation of Fe^{+2} by Dichrometry.
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe^{2+} by Potentiometry using $KMnO_4$
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate
8. Synthesis of Aspirin and Paracetamol
9. Thin layer chromatography calculation of R_f values. eg ortho and para nitro phenols
10. Determination of acid value of coconut oil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
12. Determination of viscosity of Coconut oil and ground nut oil by using Ostwald's viscometer.
13. Determination of surface tension of a give liquid using stalagmometer.
14. Determination of partition coefficient of acetic acid between n-butanol and water.

References

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's text book of practical organic chemistry 5^{th} edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB
(Common to all Branches)

I Year, B.Tech.II-Sem.

L	T	P	C
0	0	2	1

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

Objectives

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

Learning Outcomes

Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Syllabus

English Language and Communication Skills Lab (ELCS) shall have two parts:

a. **Computer Assisted Language Learning (CALL) Lab**
b. **Interactive Communication Skills (ICS) Lab**

Listening Skills

Objectives

1. To enable students, develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts

• Oral practice: Just A Minute (JAM) Sessions
• Describing objects/situations/people
• Role play – Individual/Group activities

- **The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab)**

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III
CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

Exercise – IV
CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Making a Short Speech – Extempore.

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests.

ICS Lab:

1. Introduction to Interview Skills.
2. Common errors in speaking.

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration

ii) High Fidelity Headphones

2. 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, an LCD and a projector etc.

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Engineering Mathematics - III

(Probability Distributions and Complex Variables)

(For Mechanical, Metallurgical and Chemical Engineering Branches)

II Year I Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematics courses of first year of study.

Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

UNIT-I: Basic Probability **8 L**

Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT-II: Probability distributions **10 L**

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution, Continuous random variables and their properties, distribution functions and density functions,
Normal and exponential, evaluation of statistical parameters for these distributions

UNIT-IV: Estimation & Tests of Hypotheses **10 L**

Introduction, Statistical Inference, Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.
Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Tests Concerning a Single Mean, Tests on Two Means, Test on a Single Proportion, Two Samples: Tests on Two Proportions.

UNIT-IV: Complex Variables (Differentiation) **10 L**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Variables (Integration) **10 L**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties. (All theorems without Proofs)

Course outcomes:

After learning the contents of this paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral

and residue theorems

- Taylor's and Laurent's series expansions of complex function

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

References

1. Fundamentals of Mathematical Statistics, Khanna Publications, S C Guptha and V.K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

MECHANICS OF SOLIDS

II Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Basics of Engineering Mechanics

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

- 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

REFERENCE BOOKS:

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

MATERIAL SCIENCE & METALLURGY

II Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

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

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

- Understand and analyze 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-Fe_3C.

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-Fe_3C 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 by Sidney H. Avener.
2. Material science & Metallurgy by Kodgire

REFERENCE BOOKS:

1. Science of Engineering Materials by Agarwal
2. Materials Science by Vijendra Singh
3. Elements of Material science by V. Rahghavan
4. An introduction to material science by W.g.vinas & HL Mancini

5. Material science & material by C.D.Yesudian & harris Samuel
6. Engineering Materials and Their Applications by R. A Flinn and P K Trojan, Jaico Books.

PRODUCTION TECHNOLOGY

II Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Physics, Chemistry, Workshop

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

- 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.Cores and Core Materials.

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

UNIT–II:

Welding: Classification – Types of welds and welded joints; welding postions, 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 requirementsStamping, 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 by P.N. Rao, TMH.
2. Production Technology by Sarma P C

REFERENCE BOOKS:

1. Production Technology by R.K. Jain
2. Metal Casting by T.V Ramana Rao, New Age

3. Principles of Metal Castings by Rosenthal.
4. Welding Process by Parmar
5. Manufacturing Engineering and Technologyby Kalpakjin S, Pearson Edu.

THERMODYNAMICS

II Year B.Tech. I-Sem.

L	T	P	C
3	1	0	4

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 for the analysis of thermal equipment

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

- Differentiate between different thermodynamic systems and processes
- Apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis
- Analyze the Thermodynamic cycles and evaluate performance parameters

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

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 – Constant Volume and Pressure - gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT-II:

First law of Thermodynamics – Corollaries – First law applied to a Closed System – 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,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,Brayton – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Refrigeration Cycles:

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

TEXT BOOKS:

1. Fundamentals of Classical Thermodynamics by G. Van Wylan& R.E. Sonntag, John Wiley Pub.
2. Engineering Thermodynamics by PK Nag, TMH, III Edition
3. Thermodynamics by Achutan, PHI.

REFERENCE BOOKS:

1. Thermodynamics – An Engineering Approach by YunusCengel& Boles, TMH
2. Thermodynamics – J.P.Holman by McGrawHill
3. Engineering Thermodynamics by Jones & Dugan
4. An introduction to Thermodynamics by YVC Rao, New Age
5. Thermodynamics & Heat Engines by Yadav, Central Book Depot, Allahabad.
6. Thermodynamics by G.C. Gupta, Pearson Publications.

PRODUCTION TECHNOLOGY LAB

II Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

Pre-requisites: Production Technology

Course Outcomes:

- To measure the properties of moulding sands and pattern making.
- To fabricate joints using gas welding and arc welding.
- To evaluate the quality of welded joints.
- To use 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

MACHINE DRAWING PRACTICE

II Year B.Tech. I-Sem.

L	T	P	C
1	0	2	2

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: At the end of the course, the student will be able to
- Prepare of engineering and working drawings with dimensions and bill of material during design and development.
- Develope assembly drawings using part drawings of machine components.

Question Paper Pattern:
Question paper will consist of Part-A and Part-B. Part -A has five questions out of which answer three (each 10 marks). Part-B has one question (assembly with three views) and it is to be answered compulsorily (it carries 40 marks)
PART-A:
Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
Title boxes, their size, location and details - common abbreviations and their liberal usage
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.Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.Keys, cottered joints and knuckle joint.Rivetted joints for plates, Shaft coupling, spigot and socket pipe joint.Journal, pivot and collar and foot step bearings.

PART-B:
Assembly Drawings:
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.
Steam engine parts – stuffing boxes, cross heads, Eccentrics.
Machine tool parts: Tail stock, Tool Post, Machine Vices.
Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block
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 BOOKS:
1. Machine Drawing by K.L.Narayana, Wiley Eastern.
2. Machine Drawing by Junnarkar N.D., Pearson Edu.

REFERENCE BOOKS:
1. Machine Drawing by P.S.Gill.

MATERIAL SCIENCE &MECHANICS OF SOLIDS LAB

II Year B.Tech. I-Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Chemistry & Physics

Objectives:

In this laboratory, students will have the opportunity to apply loads to various materials under different equilibrium conditions. The student will perform tests on materials in tension, compression, torsion, bending, and impact. These conditions and/or constraints are designed to reinforce classroom theory by having the student perform required tests, analyze subsequent data, and present the results in a professionally prepared report. The machines and equipment used to determine experimental data include universal testing machines, torsion equipment, spring testing machine, compression testing machine, impact tester, hardness tester, etc. Data will be collected using Dial indicators, extensometers, strain gages and strain indicator equipment, as well as load and strain readouts on the machinery and graphing capabilities to print relevant plots for analysis.

- Provide the student hands-on experiences in materials science through laboratory experiments that explore the properties of materials and the interplay between processing and performance.
- Provide the student practical experience in the search, retrieval, and analysis of technical/scientific information.
- Provide the student practical experience in the acquisition, analysis and reporting of experimental results
- Instruct students in methodologies for materials selection to student-led projects.

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

MATERIAL SCIENCE 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.

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

INDIAN CONSTITUTION
(Mandate Course)

II Year B.Tech., I-Sem

L	T	P	C
2	0	0	0

Course Objectives: Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

UNIT 1:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT 2:
Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT 3:
Contours of Constitutional Rights & Duties:
Fundamental Rights
Right to Equality
Right to Freedom
Right against Exploitation
Right to Freedom of Religion
Cultural and Educational Rights
Right to Constitutional Remedies
Directive Principles of State Policy
Fundamental Duties

UNIT 4:
Organs of Governance:
Parliament
Composition
Qualifications and Disqualifications
Powers and Functions
Executive
President
Governor
Council of Ministers
Judiciary, Appointment and Transfer of Judges, Qualifications
Powers and Functions

UNIT 5:
Local Administration:
District's Administration head: Role and Importance,
Municipalities: Introduction, Mayor and role of Elected Representative,
CEO of Municipal Corporation.
Pachayati raj: Introduction, PRI: ZilaPachayat.
Elected officials and their roles, CEO ZilaPachayat: Position and role.
Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials,
Importance of grass root democracy

UNIT 6:
Election Commission:
Election Commission: Role and Functioning.
Chief Election Commissioner and Election Commissioners.
State Election Commission: Role and Functioning.
Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:
Students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

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KINEMATICS OF MACHINERY

II Year B.Tech. II-Sem.

L	T	P	C
3	1	0	4

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 outcomes: At the end of the course, the student will be able to
- To evaluate the relative motions obtained in all the above type of components used in mechanical Engineering.
- To analyze different mechanisms
- To draw the tragectories of various kinemiatic objects

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, Intermittent motion Mechanism, Rutchet & Paul Generca Mechanicsm.

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 by S.S.Rattan, Tata McGraw Hill Publishers.
2. Kinematics & Dynamics Of machinerybyNorton, TMH

REFERENCE BOOKS:

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

THERMAL ENGINEERING – I

II Year B.Tech. II-Sem.

L	T	P	C
3	1	0	4

Pre-requisite: Thermodynamics

Course Objective: To apply the laws of Thermodynamics to analyseair standard cycles and to understand and evaluate the perform analysis of the major components and systems of IC engines, refrigeration and air conditioning 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 and their analysis-fuels

UNIT-II:

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–III:

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-IV:

Measurements, 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

UNIT-V:

Air Compressors-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

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

FLUID MECHANICS & HYDRAULIC MACHINERY

II Year B.Tech. II-Sem.

L	T	P	C
3	1	0	4

Pre-requisites: Engineering Mathematics I

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

- Understand and apply thebasic static, kinematic and dynamic principles and conservation laws to simple potential fluid flow problems in engineering applications.
- Design experimental procedure for physical model studies and hydraulic machines
- Compute drag and lift coefficients using the theory of boundary layer flows.

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

REFERENCE BOOKS:

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

INSTRUMENTATION AND CONTROL SYSTEMS

II Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

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

Course Objectives: Understanding the basic characteristics 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: At the end of the course, the student will be able to

- To know the constructional details and working principles of various instruments and their purpose
- To identify and analyze various errors that would occur in instruments.
- To understand static and dynamic characteristics of instrument and should be able to determine loading response time.
- To specify transducer,for given range of displacement 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 by Alavala, Cengage Learning
2. Instrumentation, Measurement & Analysis by B.C.Nakra & K.K.Choudhary, TMH
3. Mechanical Measurements & Controls by D.S. Kumar

REFERENCE BOOKS:

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

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING

II Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Objectives:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations

UNIT-I:

D.C. CIRCUITS: Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT-II:

A.C. CIRCUITS: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit.
Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III:

TRANSFORMERS: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV:

ELECTRICAL MACHINES: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT-V:

ELECTRICAL INSTALLATIONS: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

TEXT BOOKS:

1. Basic Electrical Engineering by D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, 2010.
2. Basic Electrical Engineering by D. C. Kulshreshtha, McGraw Hill, 2009.

REFERENCE BOOKS:

1. Fundamentals of Electrical Engineering by L. S. Bobrow, Oxford University Press, 2011.
2. Electrical and Electronics Technology by E. Hughes, Pearson, 2010.
3. Electrical Engineering Fundamentals by D. Toro, Prentice Hall India, 1989.

FLUID MECHANICS & HYDRAULIC MACHINERY LAB

II Year B.Tech. II-Sem.

L	T	P	C
0	0	2	1

Pre-requisites: None

Course Outcomes:

- Develop procedure for standardization of experiments.
- Calibrate flow discharge measuring device used in pipes channels and tanks.
- Determine fluid and flow properties.
- 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)

INSTRUMENTATION & CONTROLSYSTEMS LAB

II Year B.Tech.II - Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Mathematics-I, Thermodynamics, Basic of Electrical and Electronics Engineering.

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.

BASICS OF ELECTRICAL& ELECTRONICS LAB

IIYear B.Tech. II - Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical Engineering

Course Objectives:

- To analyze a given network by applying various electrical laws and network theorems
- To know the response of electrical circuits for different excitations
- To calculate, measure and know the relation between basic electrical parameters.
- To analyze the performance characteristics of DC and AC electrical machines

Course Outcomes:

- Get an exposure to basic electrical laws.
- Understand the response of different types of electrical circuits to different excitations.
- Understand the measurement, calculation and relation between the basic electrical parameters
- Understand the basic characteristics of transformers and electrical machines.

List of experiments/demonstrations:

1. Verification of Ohms Law
2. Verification of KVL and KCL
3. Transient Response of Series RL and RC circuits for DC excitation
4. Transient Response of RLC Series circuit for DC excitation
5. Resonance in series RLC circuit
6. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
7. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer
8. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
9. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)
10. Measurement of Active and Reactive Power in a balanced Three-phase circuit
11. Performance Characteristics of a Separately/Self Excited DC Shunt/Compound Motor
12. Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor
13. Performance Characteristics of a Three-phase Induction Motor
14. Torque-Speed Characteristics of a Three-phase Induction Motor
15. No-Load Characteristics of a Three-phase Alternator

TEXT BOOKS:

1. Basic Electrical Engineeringby D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, 2010.
2. Basic Electrical Engineeringby D. C. Kulshreshtha, McGraw Hill, 2009.

REFERENCE BOOKS:

1. Fundamentals of Electrical Engineeringby L. S. Bobrow, Oxford University Press, 2011.
2. Electrical and Electronics Technologyby E. Hughes, Pearson, 2010.
3. Electrical Engineering Fundamentalsby D. Toro, Prentice Hall India, 1989.

ENVIRONMENTALSCIENCE
(MC)

II Year B.Tech. II-Sem

L	T	P	C
2	0	0	0

Objectives:
- Creating the awareness about environmental problems among students.
- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating students to participate in environment protection and environment improvement.

Outcomes: At the end of the course, it is expected that students will be able to:
- Identify and analyze environmental problems as well as the risks associated with these problems
- Understand what it is to be a steward in the environment
- Studying how to live their lives in a more sustainable manner

UNIT- I
MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:
Definition, Scope and Importance – Need for Public Awareness.
NATURAL RESOURCES: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT - II
ECOSYSTEMS: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT - III
BIODIVERSITY AND ITS CONSERVATION: Introduction - Definition: genetic, species andecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - . Biodiversity at global, National and local levels. - . India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT - IV
Environmental Pollution and control:
Environmental Pollution: Classification of pollution, **Air Pollution**: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards.

Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil**.**
Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V
SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. –Consumerism and waste products. -Environment Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness.
HUMAN POPULATION AND THE ENVIRONMENT: Population growth, variation among nations. Population explosion - Family Welfare Programme. -Environment and human health. -Human Rights. -Value Education. -HIV/AIDS. -Women and Child Welfare. -Role of information Technology in Environment and human health. –Case Studies.

TEXT BOOK:
1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, UniversitiesPress
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE:
1. ***Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.***

DYNAMICS OF MACHINERY

III Year B.Tech. I-Sem.

L	T	P	C
3	1	0	4

Pre-requisite: Kinematics of Machinery

Course Outcomes: At the end of course the student is able to

- Design 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 by S.S.Rattan.
2. Theory of Machines by R.S.Khurmi

REFERENCE BOOKS:

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

DESIGN OF MACHINE ELEMENTS - I

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

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 apply the general design procedures and principles in the design of machine elements.
- To apply different materials of construction and their properties and factors determining the selection of material for various applications.
- To evaluate stresses under different loading conditions.
- To apply 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 Designby V. Bhandari, TMH Publishers

REFERENCE BOOKS:

1. Design of Machine Elements by V.M. Faires
2. Machine design by Schaum Series.
3. Mechanical Engineering Design by JE Shigley
4. Machine Design by RS Khurmi
5. Machine Design by PC Sharma
6. Machine Design bypandya & shah, Chartor publications

METROLOGY & MACHINE TOOLS

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requesites: Production Technology

Course Outcomes: 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–V:

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 by I C Gupta., Danpath Rai
2. Engineering Metrology by R.K. Jain, Khanna Publishers
3. Principles of Machine Toolsby 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 by B.S. Raghui Vamsi, Vol.-II
5. Elements of Work Shop Technology by Hajra Choudry, Vol. II, Media Promoters.
6. Fundamentals of Metal Machining and Machine Toolsby Geofrey Boothroyd, McGraw Hill

THERMAL ENGINEERING - II

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Thermodynamics

Course Objective: To apply the laws of Thermodynamics to analyse steam and gas turbine cycles and to perform the 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 by Rajput, Lakshmi Publications
2. Gas Turbines by V.Ganesan, TMH
3. Thermodynamics and Heat Engines by R. Yadav, Central Book Depot
4. Thermal Engineering by Ajoy Kumar, Narosa

REFERENCE BOOKS:

1. Gas Turbines and Propulsive Systems by P.Khajuria&S.P.Dubey, Dhanpatrai Pub
2. Thermal Engineering by Ballaney, Khanna Pub.
3. Gas Turbines by Cohen, Rogers and SaravanaMuttoo, Addison Wesley, Longman

OPERATIONS RESEARCH

(Professional Elective -1, UG)

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Prerequisites: None

Objectives:

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

Outcome:

- To identify problem variables & constraints and apply appropriate optimization model

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 BOOKS:

1. Operation Research by J.K.Sharma, MacMilan.
2. Operations Researchby ACS Kumar, Yesdee

REFERENCE BOOKS:

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

INDUSTRIAL ROBOTICS

(Professional Elective **-1, UG)**

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Basic principles of Kinematics and mechanics

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

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

UNIT–I:

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT–II:

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics: D-H notation, D-H method of Assignment of frames, D-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulator.

UNIT–III:

Differential transformation of manipulators, Jacobians – problems.

Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint interpolated motion – straight line motion.

UNIT-IV:

Robot actuators and Feedback components:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparision of Actuators, Feedback C**omponents**: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

UNIT-V:

Robot Application in Manufacturing:

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS:

1. Industrial Robotics by Groover M P, Pearson Edu.
2. Robotics by Fu K S, McGraw Hill.
3. Theory of Applied Robotics (kinematics,Dynamics and Control-Jazar,Springer.

REFERENCE BOOKS:

1. Robotics and Control by Mittal R K & Nagrath I J, TMH.
2. Robot Dynamics and Controls by Spony and Vidyasagar, John Wiley
3. Robot Analysis and control by Asada and Slotine, Wiley Inter-Science
4. Introduction to Robotics by John J Craig, Pearson Education

MECHANICAL VIBRATIONS

(Professional Elective **-1, UG)**

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Dynamics of Machines

Course objectives: Understand various levels of vibrations and remedies for each of them.

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

- Understand the causes and effects of vibration in mechanical systems.
- Develop schematic models for physical systems and formulate governing equations of motion.
- Understand the role of damping, stiffness and inertia in mechanical systems
- Analyze rotating and reciprocating systems and compute critical speeds.
- Analyze and design machine supporting structures, vibration isolators and absorbers.

UNIT- I:

Single degree of Freedom systems - I: Undamped and damped free vibrations, viscous damping, coulomb damping, forced vibrations, Response to excitation, rotating unbalance and support excitation, vibration isolation and transmissibility.

UNIT- II:

Single degree of Freedom systems - II: Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions, response to arbitrary excitations, The Convolution Integral, shock spectrum, System response by the Laplace Transformation method.

UNIT- III:

Two degree freedom systems: Principal modes- undamped, damped free and forced vibrations, undamped vibration absorbers.Vibration measuring instruments: Vibrometers**:** velocity meters & accelerometers.

UNIT- IV:

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients, Eigen value problem, normal modes and their properties, Free and forced vibration by Modal analysis, Method of matrix inversion, Torsional vibrations of multi- rotor systems and geared systems, Discrete-Time systems.

UNIT-V:

Continuous system: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Numerical Methods: Rayliegh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

TEXT BOOKS:

1. Elements of Vibration Analysis by Meirovitch, TMH, 2001
2. Mechanical Vibrations and sound engineering by A.G.Ambekar, PHI

REFERENCE BOOKS:

1. Mechanical Vibrations by SS Rao, Pearson, 2009, Ed 4,
2. Mechanical Vibration by Rao V.Dukkipati & J Srinivas, PHI, 2010.
3. Mechanical Vibratins by V. Ram Murthy.
4. Vibration problems in Engineering by S.P. Timoshenko.
5. Mechanical Vibrations by Seto, Schaum's Outilines, McGraw Hill.

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

III Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Course Objective: To prepare engineering students to analyze cost/ revenue/ financial data and to make economic and financial analysis in decision making process and to examine the performance of companies engaged in engineering.

Course Outcome: To perform and evaluate present and future worth of the alternate projects and to appraise projects by using traditional and DCF Methods. To carry out cost benefit analysis of projects and to calculate BEP of different alternative projects.

Unit- I: Introduction to Engineering Economics- Basic Principles and Methodology of Engineering Economics– Fundamental Concepts - Demand – Demand Determinants - Law of Demand- Demand Forecasting and Methods - Elasticity of Demand - Theory of Firm – Supply- Elasticity of Supply.

Unit- II: Macro Economic Concepts: National Income Accounting - Methods of Estimation- Various Concepts of National Income - Inflation – Definition – Causes of Inflation and Measures to Control Inflation - New Economic Policy 1991 (Industrial policy, Trade policy, and Fiscal policy) Impact on Industry.

UNIT- III: Production, Cost, Market Structures & Pricing:
Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

Unit- IV: Capital Budgeting Techniques: Significance of Capital Budgeting - cash flows- Time Value of Money- Choosing between alternative investment proposals- Methods of Appraisal Techniques- Pay Back Period - Average Rate of Return – Net Present Value- Internal Rate of Return – Profitability Index.

Unit- V: Introduction to Accounting: Accounting Principles (GAPP), concepts, conventions- - Double entry system of Book keeping – Accounting rules- Journal- ledger- Trial balance- Trading and Profit and Loss account- Balance Sheet. (Simple Problems).

Suggested Readings:

1. Henry Malcom Steinar-Engineering Economics, Principles, McGraw Hill Pub.
2. D.D.Chaturvedi, S.L.Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
3. Jain and Narang" Accounting, Kalyani Publishers.
4. Arora, M.N." Cost Accounting, Vikas Publication.
5. S.N.Maheshwari, Financial Management, Vikas Publishing House.

THERMAL ENGINEERING LAB-I

III Year B.Tech. I-Sem.

L	T	P	C
0	0	2	1

Pre-Requisite: Thermodynamics & Thermal Engineering - I

Objective: To apply the working principles of IC Engines, Compressors, Refrigeration and Air Conditioning Systems and evaluate the performance parameters

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

- To measure the thermal and transport properties of fuels and lubricants
- Take measurements and evaluate performance parameters of IC engines, compressor and other thermal equipment, including refrigeration and air conditioning equipment

Tables/Codes: Refrigeration Tables, Psychrometric Chart

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 Heat Balance
8. I.C. Engines Economical speed test on a SI engine
9. I.C. Engines effect of A/F Ratio in a SI engine
10. Performance Test on Variable Compression Ratio Engine
11. Performance Test on Reciprocating Air – Compressor Unit
12. I.C Engines Morse Test to Evaluate Frictional Power
13. I.C Engines Retardation Test to Evaluate Frictional Power
14. I.C Engines William Motoring Test to Evaluate Frictional Power

METROLOGY& MACHINE TOOLS LAB

III Year B.Tech. I-Sem

L	T	P	C
0	0	2	1

Prerequisites: Theoretical exposure to Metrology and Machine tools.

Objectives:
1. To import practical exposure to the metrology equipment & Machine tools
2. To conduct experiments and understand the working of the same.

Outcomes: At the end of the course, the student will be able to use different measuring instruments towards quality control.

1. Step turning and taper turning on lathe machine
2. Thread cutting and knurling on lathe machine
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

(Minium of six experiments in each lab)

KINEMATICS &DYNAMICS LAB

III Year B.Tech. I-Sem.

L	T	P	C
0	0	2	1

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.

DESIGN OF MACHINE ELEMENTS-II

III Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

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 ofengineering 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:

- To apply the design principles for the design of various engine parts
- Estimate the 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- important Design parameters – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

TEXT BOOKS:
1. Machine tool designby V. Bhandari TMH

REFERENCE BOOKS:
1. Machine Design by P.Kannaiah, Scitech
2. Machine Design Volume II by S.Md.Jalaludeen
3. Machine Design Data Book by PV Ramana Murti & M .Vidyasagar, BS Publications
4. Machine Design by Pandya & Shah, Charotar

HEAT TRANSFER

III Year B.Tech. II - Sem.

L	T	P	C
3	1	0	4

Pre-requisite: Thermodynamics

Course Objective: To understand different modes of heat transfer and apply these basics in the design of thermal systems

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

- Represent the physical problems of heat transfer in terms of governing equations or mathematical models
- Differentiate between different boundary conditions and apply the same for solving heat transfer problems
- Design thermal systems applying the concepts of heat transfer under steady state and well as unsteady state conditions.

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.

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

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.

UNIT – IV:

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 BOOKS:

1. Fundamentals of Heat Transfer by Incropera& Dewitt, John wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat& Mass Transferby D.S.Kumar, S.K.Kataria& sons

REFERENCE BOOKS:

1. Heat Transfer by Ghoshdastidar, Oxford University press.
2. Heat Transfer by A Practical Approach, YunusCengel, Boles, TMH
3. Heat Transfer by HOLMAN, TMH
4. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub
5. Heat and Mass Transferby R. Yadav, CPH
6. Essential Heat Transfer by Christopher A Long, Pearson Education
7. Heat Transfer by P.K.Nag, TMH

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment

CAD/CAM

III Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

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:
- To apply 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.

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

REFERENCE BOOKS:
1. CAD/CAM by Groover M.P., Pearson education
2. CAD/CAM Theory and Practice,/ Ibrahim Zeid,TMH

3. CAD/CAM/CIMby Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing by Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming by Warren S Seames, Thomson.

REFRIGERATION & AIR CONDITIONING

III Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Thermodynamics

Pre-requisite: Thermodynamics
Course Objective: To apply the principles of Thermodynamics to analyse different types of refrigeration and air conditioning systems and to understand the functionality of the major components.
Course Outcomes: At the end of the course, the student should be able to

- Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems
- Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters
- Apply the principles of Psychrometrics to design the air conditioning loads for the industrial applications

UNIT – I:
Introduction to Refrigeration: - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.
Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Actual Air refrigeration system – Refrigeration needs of Air crafts – Application of Air Refrigeration, Justification – Types of systems – Problems.

UNIT – II:
Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

UNIT III:
System Components: Compressors – General classification – comparison – Advantages and Disadvantages.
Condensers – classification – Working Principles
Evaporators – classification – Working Principles
Expansion devices – Types – Working Principles
Refrigerants – Desirable properties – common refrigerants used – Nomenclature – OzoneDepletion – Global Warming – Azeotropes and Zeotropes

UNIT IV:
Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system – Li – Br system. Principle of operation Three Fluid absorption system, salient features.
Steam Jet Refrigeration System – Working Principle and Basic Components
Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

UNIT – V:
Introduction to Air Conditioning:
Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP.
Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.
Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers.
Heat Pump – Heat sources – different heat pump circuits – Applications.

TEXT BOOKS:

1. A Course in Refrigeration and Air conditioning by SC Arora &Domkundwar, Dhanpatrai
2. Refrigeration and Air Conditioning by CP Arora, TMH.
3. Refrigeration and Air Conditioning by Manohar Prasad, New Age

REFERENCE BOOKS:

1. Principles of Refrigeration by Dossat, Pearson Education
2. Basic Refrigeration and Air-Conditioningby Ananthanarayanan, TMH

UNCONVENTIONAL MACHINING PROCESSES

(Professional Elective-2, UG)

III Year B.Tech. II - Sem.

L	T	P	C
3	0	0	3

Prerequisites: Theory of metal cutting, machine tools

Course Objectives:

- To understand the need for the development of UnConventional machining processes.
- To know various methods of material removal processes.
- To know the principles and applications of Non-Conventional machining processes.

Outcomes:

- 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.
- Gain the knowledge of basic mechanism of various Unconventional maching processes and related equipment, variables, advantages, limitations, applications.
- Given a set of physical, electrical and other parameters. Student can identify a suitable Unconventional machining process.

UNIT–I:

INTRODUCTION: Need for non-conventional machining processes, Classification of non - conventional machining processes, considerations in process selection, materials, general characteristics and applications of non-conventional machining processes, Historical development.

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 Beam Machining, Electron Beam Machining, Ion Beam Machining - basic principles, components, process variables, advantages, limitations and 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, limitations and 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. Advanced machining processesby VK Jain, Allied publishers.
2. Non Traditional Manufacturing Processes by Gary F Benedict, CRC Press.

REFERENCE BOOKS:

1. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill
2. Modern Machining Process by Pandey P.C. and Shah H.S., TMH
3. New Technology by Bhattacharya A,the Institution of Engineers, India 1984.
4. Non-Traditional Machining by P.K.Mishra, New Age.
5. Micro Machining of Engineering Materials Edited by J.Mc Geough, CRC Press.

MACHINE TOOL DESIGN

(Professional Elective **-2, UG)**

III Year B.Tech. II - Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Machine Design, Machine Tools and Metrology, Machining Science, Theory of Machinery.

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

- Design machine tool structures.
- Design and analyze systems for specified speeds and feeds.
- Select subsystems for achieving high accuracy in machining.
- Understand control strategies for machine tool operations and apply appropriate quality tests for quality assurance.

UNIT-I:

Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

UNIT-II:

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT-III:

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

UNIT-IV:

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

UNIT-V:

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests

Text Books:

1. Machine Tool Design and Numerical ControlbyN.K. Mehta, TMH, New Delhi, 2010.
2. Principles of Machine Toolsby G.C. Sen and A. Bhattacharya, New Central Book Agency, 2009.
3. Design of Machine Toolsby D. K Pal, S. K. Basu, 5th Edition, Oxford IBH, 2008.

Reference Books:

1. Machine Tool Designby N. S. Acherkhan, Vol. I, II, III and IV, MIR publications, 1968.
2. Tool Design by Cyril Donaldson, 5th Edition, Mc Graw Hill.

PRODUCTION PLANNING AND CONTROL
(Professional Elective **-2, UG)**

III Year B.Tech. II - Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Management Science.
Course Objectives:
Understand the importance of Production planning & control. Learning way of carrying out various functions so as to produce right product, right quanity at right time with minimum cost.

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

- Understand production systems and their characteristics to evaluate MRP and JIT systems against traditional inventory control systems.
- Analyze aggregate planning strategies.
- Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

UNIT – I:
Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.
Forecasting: Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – II:
Inventory management: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only.
Aggregate planning – Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

UNIT –III:
Line Balancing: Terminology, Methods of Line Balancing, RPW method& Largest Candidate method. Routing– Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV:
Scheduling: Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

UNIT – V:
Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.
Follow up: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.

TEXT BOOKS:
1. Production Planning and Control by M.Mahajan, Dhanpati rai & Co
2. Production Planning and Control by Jain & Jain, Khanna publications

REFRENCE BOOKS:
1. Production Planning and Control- Text & cases by SK Mukhopadhyaya, PHI.
2. Production and operations Management by R.Panneer Selvam, PHI
3. Operations Management by Chase, PHI
4. Operations Management by William J. Stevensan, MC Graw Hills.

QUANTITATIVE TECHNIQUES FOR BUSINESS DECISIONS
(Open Elective –1)

III Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

Course Objective: To prepare engineering students to analyze cost/ revenue/ financial data and to make economic and financial analysis in decision making process and to examine the performance of companies engaged in engineering.

Course Outcome: To perform and evaluate present and future worth of the alternate projects and to appraise projects by using traditional and DCF Methods. To carry out cost benefit analysis of projects and to calculate BEP of different alternative projects.

UNIT- I:
Introduction to Engineering Economics- Basic Principles and Methodology of Engineering Economics– Fundamental Concepts - Demand – Demand Determinants - Law of Demand- Demand Forecasting and Methods - Elasticity of Demand - Theory of Firm – Supply- Elasticity of Supply.

UNIT- II:
Macro Economic Concepts: National Income Accounting - Methods of Estimation- Various Concepts of National Income - Inflation – Definition – Causes of Inflation and Measures to Control Inflation - New Economic Policy 1991 (Industrial policy, Trade policy, and Fiscal policy) Impact on Industry.

UNIT- III:
Production, Cost, Market Structures & Pricing:
Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

UNIT- IV:
Capital Budgeting Techniques: Significance of Capital Budgeting - cash flows-Time Value of Money-Choosing between alternative investment proposals- Methods of Appraisal Techniques- Pay Back Period - Average Rate of Return – Net Present Value- Internal Rate of Return – Profitability Index.

UNIT- V:
Introduction to Accounting: Accounting Principles (GAPP), concepts, conventions- - Double entry system of Book keeping – Accounting rules- Journal- ledger- Trial balance- Trading and Profit and Loss account- Balance Sheet. (Simple Problems)

Text Books:
1. Engineering Economics by Henry Malcom Steinar, Principles, Mc Graw Hill Pub.
2. Business Economics - Theory and Applications by D.D.Chaturvedi, S.L.Gupta, International Book House Pvt. Ltd. 2013.

Reference Books:
1. Accounting by Jain and Narang, Kalyani Publishers.
2. Cost Accounting by Arora, M.N., Vikas Publication.
3. Financial Management by S.N.Maheshwari, Vikas Publishing House.

HEAT TRANSFER LAB

III Year B.Tech. II-Sem.

L	T	P	C
0	0	2	1

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

- Appy the principles of various modes of heat transfer to evaluate thermal conductivity of different metal and non metal objects under steady state conditions
- Appy the principles of various modes of heat transfer to evaluate thermal conductivity of different objects under unsteady state conditions
- 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
- To apply the principles of radiation to evaluate the surface emissivity of a test plate and Stefan-Boltzmann's constant and compare with theoretical values

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.

THERMAL ENGINEERING LAB-II

III Year B.Tech. II-Sem.

L	T	P	C
0	0	2	1

Prerequisites: Thermodynamics, Thermal Engineering-II

Course outcomes: At the end of course student is able to

- Apply the principles of Thermodynamics to determine the properties of the Pure Substance like Steam
- Evaluate the performance parameters of various compressible flow equipment, viz.,nozzle and turbine
- To simulate the various flow and thermal networks and correlate them

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 of a nozzle using Nozzle performance Test unit
5. Performance study of Impulse turbine
6. Performance study of Reaction Turbine
7. Simulation of Flow Network for Basic Pipe Flow and Interconnection of Pipes
8. Simulation of Flow Network and Performance Evaluation of Rankine Cycle with Reheat and Regeneration
9. Simulation of Flow Network and Performance Evaluation of Brayton Cycle with Intercooling and Reheat
10. Simulation of Flow and Thermal Networks and Performance Evaluation of a Boiler along with Boiler, Economizer, Super heater and Reheater

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

III Year B.Tech. II - Sem.

L	T	P	C
0	0	2	1

1. Introduction

The introduction of the Advanced English 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 organize 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.

2. 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.

3. Syllabus:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) 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/* – 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 English Communication Skills (AECS) Laboratory shall have the following infrastructural 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. Suggested Software:

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

- **Oxford Advanced Learner's Compass**, 7th 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)

6. Books Recommended:

1. **Effective Technical Communication** by M Asharaf Rizvi**.** McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. **Academic Writing: A Handbook for International Students by** Stephen Bailey, Routledge, 5th Edition
3. **Learn Correct English – A Book of Grammar, Usage and Composition** by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
4. **Professional Communication** by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
5. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
6. **Technical Communication** by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
7. **English Vocabulary in Use** series, Cambridge University Press 2008.
8. **Handbook for Technical Communication** by David A. McMurrey& Joanne Buckley. 2012. Cengage Learning.
9. **Communication Skills** by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
10. **Job Hunting** by Colm Downes, Cambridge University Press 2008.
11. **English for Technical Communication for Engineering Students,** Aysha Vishwamohan**, Tata Mc Graw-Hil 2009.**

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BASIC MECHANICAL ENGINEERING
(Open Elective-2)

IV Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Instructional Objectives

- To familiarize with the basic machine elements
- To familiarize with the Sources of Energy and Power Generation
- To familiarize with the various manufacturing processes

UNIT-I:

Machine Elements: Helical and leaf springs – Springs in series and parallel. Cams: Types of cams andfollowers – Cam profile.

UNIT-II:

Power Transmission Elements: Gears terminology of spur, helical and bevel gears, gear trains. Belt drives (types). Chain drives.

UNIT-III:

Energy: Sources: Renewable and non-renewable (various types, characteristics Advantages/disadvantages). Power Generation: External and internal combustion engines Hydro, thermal and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). Simple Problems.

UNIT-IV:

Manufacturing Processes: Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). Welding: Types – Equipments – Tools and accessories– Techniques employed -applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT-V:

Machine Tools: Lathe machine: Types - Description of main components – Cutting tools – Work holding devices – Basic operations. Simple Problems. Drilling Machine: Introduction Types – Description – Tools. Simple Problems.

Text Books:

1. Basic Mechanical Engineering by Kumar, T., Leenus Jesu Martin and Murali, G., Suma Publications, Chennai,2007

Reference Books:

1. Basic Mechanical Engineering by Prabhu, T. J., Jai Ganesh, V. and Jebaraj, S., Scitech Publications, Chennai, 2000.
2. Elements of Workshop Technology by Hajra Choudhary, S.K. and HajraChoudhary, A. K., Vols.I & II, Indian Book Distributing Company Calcutta, 2007.
3. Power Plant Engineering by Nag P.K., Tata McGraw-Hill, New Delhi, 2008.
4. Theory of Machines by Rattan, S.S., Tata McGraw-Hill, New Delhi, 2010.

FINITE ELEMENT METHODS

IV Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Mechanics of Solids- Heat Transfer and Mechanical Vibrations- Mathematics

Course Objectives: The course is intended to

- Gain a fundamental understanding of the finite element method for solving 1-D structural problem.
- Formulate the finite element equations for truss and beam elements.
- Study two-dimensional problems such as plain stress and plain strain elasticity problems.
- Learn finite element analysis of 1-D and 2-D heat conduction and torsion problem Analysis the structures by considering the mechanical vibrations.

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

- Apply finite element method to solve problems in solid mechanics- fluid mechanics and heat transfer.
- Formulate and solve problems in one dimensional structures including trusses- beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress- plain strain- axi-symmetric and plate bending problems.
- Implement and solve the finite element formulations using MATLAB.

UNIT – I:

Introduction to Finite Element Methods for solving field problems- Methods of Engineering Analysis- Functional Approximation Methods: Rayleigh- Ritz Method- Weighted Residual Methods- Applications of FEM- Advantages and Disadvantages of FEM- Stress and Equilibrium- Strain – Displacement relations- Stress – strain relations for 2D and 3D Problems. Basic Steps of FEM- Characteristics of Finite Element- Principle of Minimum Potential Energy- Convergence Requirements.

UNIT – II:

One Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy- Properties of Stiffness Matrix- Characteristics of Shape Functions- Quadratic shape functions. Problems on uniform and stepped bars for different loading conditions.

Analysis of Trusses: Derivation of Stiffness Matrix for Trusses- Stress and strain Calculations- Calculation of reaction forces and displacements.

UNIT – III:

Analysis of Beams: Derivation of Stiffness matrix for two noded- two degrees of freedom per node beam element- Load Vector- Deflection- Stresses- Shear force and Bending moment- Problems on uniform and stepped beams for different types of loads applied on beams.

UNIT – IV:

Finite element – formulation of 2D Problems: Derivation of Element stiffness matrix for two dimensional CST Element- Derivation of shape functions for CST Element- Elasticity Equations- constitutive matrix formulation- Formulation of Gradient matrix. Two dimensional Isoparametric Elements and Numerical integration.

Finite element – formulation of 3D problems: Derivation of Element stiffness matrix for Tetrahedron Element- Properties of Shape functions for 3D Tetrahedral Element- Stress-Strain Analysis for 3D Element- Strain Displacement for Relationship Formulation.

UNIT – V:

Steady state heat transfer analysis: One Dimensional Finite Element analysis of fin and composite slabs. **Two dimensional steady state heat transfer problems:** Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST- Derivation of thermal force vector for 2D heat transfer problems.

Dynamic Analysis: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods- Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

TEXT BOOKS:

1. Introduction to Finite Elements in Engineering- Chandrupatla by Ashok and Belegundu- Prentice, Hall/Pearson
2. The Finite Element Methods in Engineering by SS Rao, Pergamon.

REFERENCE BOOKS:

1. Finite Element Methods: Basic Concepts and applications by Alavala, PHI
2. Finite Element Method by Zincowitz, Mc Graw Hill
3. Introduction to Fininte element analysis by S.Md.Jalaludeen, Anuradha Publications- print-2012
4. Finite Element Analysis by P.Seshu, PHI
5. Finite Element Analysis by Hutton, TMH
6. Finite Element Analysis by Bathe, PHI
7. Finite Element Method by Krishna Murthy, TMH

ADDITIVE MANUFACTURING
(Professional Elective – 3, UG)

IV B.Tech., (IDP, M.Tech) I-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Basics of Manufacturing, Basic knowledge in Calculus, Physics, Thermodynamics, and Chemistry

Course Objectives: The objective of the Course is to study methods used in additive manufacturing, theories governing the additive manufacturing, give information on materials, explain relations between materials to be processed and methods of additive manufacturing with introduction to common machines used for the technology and show applications and business opportunities with future directions.

Course outcomes:

- 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.
- 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.
- 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. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication.

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, Surgi Guide, 3-matic, Simplant, Mesh Lab.

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, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

Text Books:

1. Rapid prototyping: Principles and Applications by Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.

Reference Books:

1. Rapid Manufacturing by D.T. Pham and S.S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

TRIBOLOGY
(Professional Elective – 3, UG)

IV Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

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

REFERENCE BOOKS:
1. Tribology by B.C. Majumdar

MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)
(Professional Elective – 3, UG)

IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

Prerequisites: Electronic Circuits, Basic knowledge in material science

Course Objectives:

- To make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- To design, analysis, fabrication and testing the MEMS based components.
- To introduce the students various opportunities in the emerging field of MEMS.

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 analyzing 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 Micro scales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and 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 Piezo resistors, 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 Books:

1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002
2. Foundation of MEMS/ Chang Liu/Pearson, 2012

Reference Books:

1. An Introduction to Microelectromechanical Systems Engineering by Maluf M., Artech House, Boston 2000
2. Micro robots and Micromechnaical Systems by Trimmer, W.S.N., Sensors & Actuators, Vol 19, 1989
3. Applied Partial Differential Equations by Trim, D.W., PWS-Kent Publishing, Boston, 1990.

ADVANCED MANUFACTURING PROCESSES

IV B.Tech., (IDP, M.Tech) I-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Production Technology, Machine Tools, Metal Cutting, Material Science.

Course Objectives:

- To make acquainted the various unconventional manufacturing processes
- To know about the applications of advanced manufacturing processes (which are exceptional)
- To encourage the students for developing the models of Advanced Manufacturing Processes

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 beam processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials.

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, micromachining and High speed Machining, basic principles, working, applications, advantages.

Text Books:

1. Manufacturing Engineering and Technology by Kalpakijian, Adisson Wesley, 1995.
2. Foundation of MEMS by Chang Liu, Pearson, 2012.
3. Advanced Machining Processes by V.K.Jain, Allied Publications.

Reference Books:

1. Process and Materials of Manufacturing by R. A. Lindburg, 4th edition, PHI 1990.
2. Introduction to Manufacturing Processes by John A Schey, Mc Graw Hill.
3. Micro Machining of Engineering Materials by J.Mc Geough, CRC Press.
4. Non Traditional Manufacturing Processes by Gary F Benedict, CRC Press.
5. Advanced Methods of Machining by J.A Mc Geough, Springer.

ADVANCED METAL FORMING
(Program Elective- 1, PG)

IV Year B.Tech. I-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Production Technology, Metallurgy

Course Objectives:
- Illustrate capabilities and applications of metal forming processes.
- Forming load estimation during different metal forming processes.
- To analyze residual stresses

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 draw force.

UNIT-V:
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defects 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, diameters and cup diameters.

Text Books:
1. Mechanical Metallurgy by G.E. Dieter, Tata McGraw Hill, 1998. III Edition
2. Principles of Metal Working by Sunder Kumar

Reference Books:
1. Principles of Metal Working processes by G.W. Rowe
2. ASM Metal Forming Hand book.
3. Principles and applications of Metal Rolling by Sidhartha Roy, Combridge University Press, 2015.

VIBRATION ANALYSIS AND CONDITION MONITORING OF MACHINE TOOLS
(Program Elective-1, PG)

IV B.Tech. (IDP, M.Tech) I Sem.

L	T	P	C
3	0	0	3

Perquisites: Dynamics of Machinery, Machine Tools, Basics of Vibrations

Course Objectives:

- To apply modern vibration analysis techniques and principles for early fault detection.
- Damage prevention in critical costly industrial machines.
- Learn mechanical effects of a change in operating condition.
- Know the failure mode of each component.
- Learn prevention of unexpected break downs and perform machinery diagnosis.
- Manage the machinery reliability and trouble shooting.

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

- Exemplify and summarize 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
- 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.
- Ability To Use Different Techniques To Monitor The Machine Tool To Prevent From Failures

UNIT-I:

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 Tensional 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, Force Transmitted, Relative Motion.

UNIT- III:

Two Degree of Freedom Systems and Multi-degree of Freedom Systems: Introduction, Equations of Motion for forced Vibration, Free Vibration Analysis of Undamped systems, Tensional system, Coordinate Coupling and Principal Coordinates, forded Vibration Analysis, Semi definite Systems, Self-Excitation and stability Analysis.

Introduction to Modeling of Continuous systems as Multi-degree of Freedom systems, Using Newton's second law to derive equations of motion, Influence Coefficients.

UNIT-IV:

CONDITION MONITORING: Condition Monitoring Techniques for Machine Tools – Visual & temperature monitoring, Vibration and Leakage monitoring, Lubricant monitoring, condition monitoring of Lube and Hydraulic systems, Thickness monitoring, Image processing techniques in condition monitoring. Condition monitoring of noise and sound. Condition Monitoring of Machine Tools.

UNIT -V:

MACHINE TOOL DIAGNOSTICS: Objectives-Aims-Examples of Monitoring and Diagnosis-Control Structures for Machine Diagnosis- Utilization Of Diagnostic Results.

Text books:

1. Mechanical Vibrations by S.S.Rao, 4th Edition, Pearson Publications.
2. Elements of Vibration Analysis by Meirovitch.
3. Manfred Weck, "Hand Book Of Machine Tools – Vol.3, John Wiley & Sons, 1984

Reference Books:

1. Mechanical Vibrations by G.K. Groover.
2. Vibrations by W.T. Thomson Mechanical Vibrations by Schaum series.
3. Industrial Maintenance Management by Sushil Kumar Srivstava S.Chand & Company Ltd., New Delhi, 1998.
4. Automation Production System And Computer Integrated Manufacturing by Mikell P.Groover Prentice Hall Of India, Pvt. Ltd., 1995.

PRECISION ENGINEERING
(Programe Elective- 1, PG)

IV Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Machine Tools, Metrology

Course Objectives:
- To give the basic precision engineering methodology and state-of-the-art concepts for designing high-precision CNC machines and products.
- The course is specifically tailored to teach the novel design principles leading to improved machine performance and reliability.
- To apply the acquired knowledge to other design efforts and fields as well

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 Tolerance: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum –Datum Feature of Representation – Form Controls, Orientation Controls – Logical Approach to Tolerance.

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, C_p, C_{pk}, 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 central analysis, Examples. Design features to facilitate machining; Datum Features – functional and manufacturing. Components design – Machining considerations, Redesign for manufactured parts 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.

UNIT-V:
MEASURING SYSTEMS PROCESSING: In process 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 by Murthy R. L., New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing by James D.Meadows, Marcel Dekker Inc.1995.

Reference Books:
1. Engineering Design – A systematic Approach by Matousek, Blackie & Son Ltd, London.

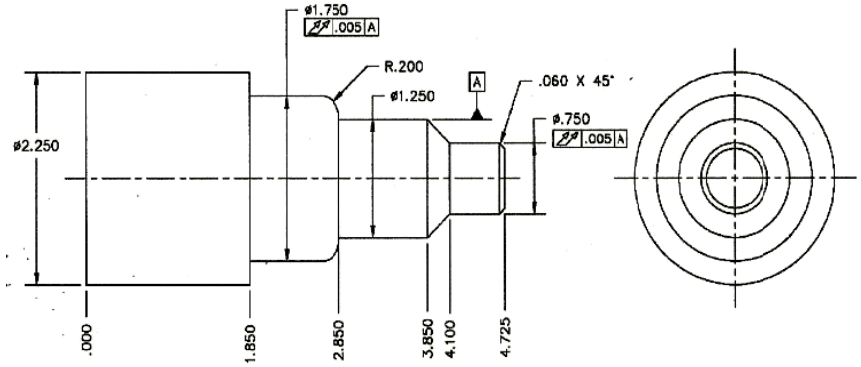
ADVANCED MANUFACTURING PROCESS AND SYSTEMS LAB
(PG Lab)

IV Year B.Tech. I Sem.

L	T	P	C
0	0	4	2

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).



2. The bolt 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 Ø100 mm and the length of 93 mm is to be clamped for the test.

3. The jig plate 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.

4. The contour plate 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.

5. Write a program to perform taper turning operations on Al-alloy work piece of 40mm dia.
6. Write a program to perform thread cutting operations on Al-alloy work piece of 40mm dia.
7. Write a program to perform rectangular and circular grooves on Al-alloy work piece using CNC milling machine.
8. Eriction / Erichsen cup test.
9. Deep drawing of cups
10. Plastic bottle and cap manufacturing.
11. Washer manufacturing.
12. Metal cutting operations using EDM / ECM performance evaluation.
13. Metal Cutting operations using AJM performance evaluation.

MATERIAL TESTING AND EVALUATION LAB
(PG Lab)

IV Year B.Tech I Sem.

L	T	P	C
0	0	4	2

(Any twelve experiments are to be conducted)

1. Determination of tensile strength of PMC / MMC
2. Determination of flexural strength of PMC/MMC
3. Determination of wear characteristics of PMC / MMC
4. Determination of fracture toughness of MMC using fatigue test
5. Study of fracture surface of different materials tested under UTM, fatigue test
6. Determination of Hardness of PMC/MMC using micro hardness testing machine
7. Determination of thermal conductivity of PMC / MMC
8. Preparation of nano powders using ball mill
9. Determination of water absorption in PMC.
10. Synthesis of a polymer composite
11. Synthesis of a semiconductor nanoparticles by chemical method
12. Preparation of metal oxide semiconductor thin film
13. Determination of optical absorption characteristics
14. Electrical transport properties of polymer composite
15. Electrical transport properties of thin film
16. Determination of thermal stability of polymer composite
17. Structural characterization of nanomaterials by XRD technique
18. Evaluation of the performance of material systems using the relationship between structure, properties and processing.

POWER PLANT ENGINEERING

(Professional Elective – 4, UG)

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

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.

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 – II:

Internal 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 BOOKS:

1. Power Plant Engineering by P.C.Sharma, S.K.Kataria Pub
2. A Course in Power Plant Engineering by Arora and S. Domkundwar.

REFERENCE BOOKS:

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

AUTOMOBILE ENGINEERING
(Professional Elective -4, UG)

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Thermodynamics & Thermal Engineering -1

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

REFERENCE BOOKS:

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

RENEWABLE ENERGY SOURCES
(Professional Elective -4, UG)

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

Prerequisites: None

Course Outcomes: At the end of the course, the student will be able to:
- Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
- Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
- Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
- Identify methods of energy storage for specific applications

OBJECTIVES:
- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

UNIT-I:
Global and National Energy Scenario: Over view of conventional & renewable energy sources- need & development of renewable energy sources - types of renewable energy systems - Future of Energy Use - Global and Indian Energy scenario - Renewable and Non-renewable Energy sources - Energy for sustainable development - Potential of renewable energy sources - renewable electricity and key elements - Global climate change - CO_2 reduction potential of renewable energy - concept of Hybrid systems.

UNIT-II:
Solar Energy: Solar energy system - Solar Radiation – Availability - Measurement and Estimation - Solar Thermal Conversion Devices and Storage - Applications Solar Photovoltaic Conversion solar photovoltaic - solar thermal - applications of solar energy systems.

UNIT-III:
Wind Energy: Wind Energy Conversion - Potential - Wind energy potential measurement - Site selection - Types of wind turbines - Wind farms - wind Generation and Control. Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - classification of wind – characteristics - applications of wind turbines - offshore wind energy – Hybrid systems - wind resource assessment - Betz limit - site selection - wind energy conversion devices. Wind mill component design - economics and demand side management - energy wheeling - and energy banking concepts. Safety and environmental aspects - wind energy potential and installation in India.

UNIT-IV:
Biogas: Properties of biogas (Calorific value and composition) - biogas plant technology and status - Bio energy system - design and constructional features. Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas Plants – applications - alcohol production from biomass - bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

UNIT-V:
Ocean Energy: Ocean wave energy conversion - principle of Ocean Thermal Energy Conversion (OTEC) - ocean thermal power plants - tidal energy conversion - Tidal and wave energy its scope and development - Scheme of development of tidal energy.
Small hydro Power Plant: Importance of small hydro power plants and their Elements- types of turbines for small hydro- estimation of primary and secondary power.
Geothermal Energy: Geothermal power plants- various types- hot springs and steam ejection.

Text Books:

1. Power plant technology by J Wakhil
2. Non-Conventional Energy Sources by G.D Rai

Reference Books

1. Solar Energy - Principles of thermal collection and storage by S. P. Sukhatme
2. Solar Engineering of Thermal Processes by J. A. Duffie and W. A. Beckman
3. Biomass Regenerable Energy by D. D. Hall and R. P. Grover.
4. Renewable Energy Sources by Twidell J.W. and Weir- A., EFN Spon Ltd.- 1986.
5. Renewable Energy Engineering and Technology by Kishore VVN Teri Press, New Delhi- 2012
6. Sustainable Energy Systems Engineering by Peter Gevorkian, McGraw Hill-2007
7. Principles of Solar Engineering by Kreith- F and Kreider- J. F., McGraw-Hill- 1978.
8. Renewable Energy- Power for a Sustainable Future by Godfrey Boyle Oxford University Press- U.K- 1996.
9. Alternative Energy Sources by Veziroglu, T.N. Vol 5 and 6, McGraw-Hill- 1990
10. Biochemical and Photosynthetic aspects of Energy Production by Anthony San Pietro, Academic Press- 1980.
11. Thermochemical processing of Biomass by Bridgurater A.V., Academic Press- 1981.
12. Renewable Energy- Elsevier by Bent Sorensen, Academic Press- 2011

INDUSTRIAL MANAGEMENT

(Professional Elective **-5, UG)**

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

Prerequisites: None

Course objectives: The main objectives of this course are the following:

- Philosophies of various management gurus & characteristics of various organization structures
- Various Industrial Engineering practices
- Human resource management practices
- Network analysis through PERT and CPM techniques

Course outcomes: At the end of course, students should be able to

- Practice the management theories proposed by Taylor, Fayol etc
- Consider various factors and identify plant location for given industry.
- Determine EOQ, classify items and implement P-system and Q-system
- Conduct workstudy(method study+ Work measurement:a) Time study & Work sampling))
- Practice HRM principles
- Analyze the networks by using PERT &CPM

UNIT - I:

Management and Organisation – Functions of Management - Contributions of Taylor, Fayol, Douglas Mc-Gregor, Mayo Hertzberg and Maslow. – Systems Approach to Management - *Organisational Structures:* Basic concepts related to Organisation - Departmentation and Decentralisation, Types of mechanistic and organic structures of organisation and their merits, demerits and suitability.

UNIT- II:

Operations Management-I: Plant location, definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection of plant- Matrix approach. Types of plant layout – various data analyzing forms-travel chart - Work study: Method study and Work measurement. Inventory – functions, types, Determination of Economic Order Quantity (EOQ), ABC and VED analysis. Inventory Control Systems-Continuous review system-periodical review system. Stores Management and Stores Records. Purchase management, duties of purchase of manager, JIT System.

UNIT –III:

Operations Management-II: Inspection and quality control, types of inspections - Statistical Quality Control-techniques- Charts for variables and attributes. Acceptance sampling plan- single sampling and double sampling plans-OC curves. Introduction to TQM-Quality Circles, ISO 9000 series procedures. Functions of Marketing, Marketing vs Selling, Marketing mix, Product Life Cycle.

Unit -IV:

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- V:

PERT / CPM: Project management, network modelling-probabilistic model, various types of activity time's estimation-programme evaluation review techniques- Critical Path-probability of completing the project, Critical Path Method (CPM) - Project crashing. Simple problems.

TEXT BOOKS

1. Aryasri, Management Science, McGraw hill, 2012
2. Kumar, Rao and Chhalill: Introduction to Management Science, Cengage 2012.

REFERENCE BOOKS:

1. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.
2. Amrine, Manufacturing Organization and Management, Pearson, 2012.
3. Chase, Jacobs, Aquilano, Operations Management, McGraw Hill, 2012.
4. Panner Selvam, Production and Operations Management, PHI, 2012.
5. Nadha Muni Reddy & Vijaya Kumar Reddy, Reliability Engineering & Quality Engineering, Galgotia, 2012.
6. Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2012.
7. L.S.Srinath, PERT / CPM, Affiliate East-West Press, New Delhi, 2012.
8. Gary Dessler, Human Resource Management, Pearson Education Asia, 2012.
9. Phillip Kotler, Marketing Management, Pearson, 2012.
10. S.K.Basu, K.C.Sahu,B.Rajiv : Industrial Organization and Management, PHI, 2012.
11. Dipak Kumar Bhattacharyya: Industrial Management, Vikas publishing house 2013

CONCURRENT ENGINEERING

(Professional Elective **-5, UG)**

IV Year B.Tech. II-Sem.

L	T	P	C
3	0	0	3

Prerequisites: Computer-Aided Design

Course objective: To provide a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support.

Course Outcomes:

- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Design assembly workstation using concepts of simultaneous engineering.
- Design automated fabricated systems – Case studies.

UNIT-I:

Introduction: Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

Use Of Information Technology: IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

UNIT-II:

Design Stage: Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design.

Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

UNIT-III:

Manufacturing Concepts and Analysis: Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system.

UNIT-IV:

JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

Project Management: Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost.

UNIT-V:

Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

Text Books:

1. Concurrent Engineering: Automation Tools and Technology by Andrew Kusaik, Wiley John and Sons Inc., 1992.

Reference Books:

1. Integrated Product Development by Anderson MM and Hein, L. Berlin, Springer Verlog, 1987.
2. Design for Concurrent Engineering by Cleetus, J.Concurrent Engineering Research Centre, Morgantown W V, 1992.

COMPOSITE MATERIALS

(Professional Elective **-5, UG)**

IVYear B.Tech. II Sem

L	T	P	C
3	0	0	3

Pre-requisites: To learn the importance and use of materials and mechanics of solids.

Course objectives: Provides the concepts of composite materials. To analyze macro and micro mechanical behavior of a lamina.

Course Outcomes: At the end of course students will be abletounderstand the design and failure analysis of composites in aero space and automobile applications.

UNIT-I:

Introduction to Composite Materials: Introduction ,Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

UNIT-II:

Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-III:

Macro mechanical Analysis of a Lamina: Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Angle of lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT-IV:

Macro mechanical Analysis of Laminates: Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus.

UNIT-V:

Failure Analysis of Laminates: Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

Text Books:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.

Reference Books:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw, Publisher: CRC
3. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

GEOMETRICAL MODELING

IV Year B.Tech. II Sem

L	T	P	C
3	0	0	3

Prerequisites: CAD/CAM

Course Objectives:

- Learn modeling curves (B-splines and Bezier)
- Learn modeling Bezier and B-spline surfaces
- Familiarity with NURBS
- Familiarity with advanced techniques such as subdivision and reconstruction
- Mastery of object construction and manipulation methods including lofting, surface of revolution, and tubularization.
- Mastery of Reconstruction from PCD and Mesh generation

Course Outcomes: After doing this course, the student should be able to do

- 2D & 3D transformations
- Develop cubic splines, Bezer curves and B-spline curves
- Write equations of surfaces, quadratic surfaces and anlyze mathematically

UNIT–I:

Geometrical Modeling: Introduction, History, Geometrical representation, Linear Algebra Boolean Algebra, Vectors, Matrices, Equations for curves- Intrinsic and Explicit ,parametric equations of curves, conic curves and points on curves, Problems

UNIT–II:

Transformations: 2-D and 3D Transformations, translation, Rotation, Homogeneous space, Scaling, stretching, Mirror reflection, Composite Transformations and problems

UNIT–III:

Cubic Splines: Algebraic and geometric force of cubic spline, parametric space of a curve, blending functions, Problems

Bezier Curves: Berustein's polynomials, equations, control points, convex hull property, truncating and subdividing composite and Rational Bezier curves, Problems

B-Spline Curves: Uniform and non-uniform B-Spline basis functions, quadratic and cubic B-spline basis functions, NURBS, Problems

UNIT–IV:

Surfaces: Explicit and Implicit equations of surfaces, quadratic surfaces, parametric equation of surfaces, Curve Nets and Embedded Curves, Generation, Mathematical Analysis, Applications of Bezier and B-Spline Surfaces, Surface patches. Problems

UNIT–V:

Solids: Parametric and Tricubicsolids, sweep solids, Topology of models, graph and boolean based models. Constructive solid Geometry (CSG), B-rep models. Problems; Feature modeling, rendering, lighting, animation.

Text Books:

1. Geometric Modeling by Micheal E. Mortenson, Third Edition, McGraw Hill Publishers
2. CAD/CAM concepts and Applications by Alavala, PHI

Reference Books:

1. Curves and surfaces for CAGD, Fifth Edition by Gerald Farin, Elsevier, India
2. Computer Graphics by Alavala, PHI, New Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
4. Elements of Computer Graphics by Roger & Adams, Tata McGraw Hill.

AUTOMATION IN MANUFACTURING

IV Year B.Tech. II Sem

L	T	P	C
2	0	0	2

Prerequisites: Production Technology, Machine Tools, Operations Research

Course 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

Course Outcomes: Upon completion of this course the student will be able to:

- Illustrate the basic concepts of automation in machine tools.
- Analyze various automated flow lines, Explain assembly systems and line balancing methods.
- Describe the importance of automated material handling and storage systems.
- Interpret the importance of adaptive control systems, automated inspection systems.

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 by Mikel P. Groover, Pearson Education.

Reference Books:

1. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
2. Automation by Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

PRODUCT DESIGN AND DEVELOPMENT
(Program Elective-2, PG)

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Management Science

Course Objectives:

- Competence with a set of tools and methods for product design and development.
- Confidence in own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
- Enhanced team working skills.

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 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 by Kari T. Ulrich and Steven D. Eppinger, McGraw Hill International Edns. 1999.
2. Effective Product Design and Development by Stephen Rosenthal, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.

Reference Books:

1. Concurrent Engineering and integrated Product development by Kemnneth Crow, DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274 (310) 377-569, Workshop Book.
2. Tool Design – Integrated Methods for Successful Product Engineering by Staurt Pugh, Addison Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41639-5.

MECHATRONICS
(Program Elective- 2, PG)

	L	T	P	C
IV Year B.Tech. II Sem	**3**	**0**	**0**	**3**

Prerequisites: Engineering mechanics and mechanics of materials, Electronic circuits - analysis and design, Mathematics - Calculus, differential equations, numerical methods

Course Objective:
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraint
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- To work efficiently in multidisciplinary teams

Course Outcomes: At the end of the course, the student will be able to:
- Model, analyze and control engineering systems.
- Control the behavior of a process using appropriate sensors, transducers and actuators.
- Develop PLC programs for a given task.
- Evaluate the performance of mechatronic systems.

UNIT-I:
Introduction: Definition of Mechatronics 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 maching, 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-linearities.

UNIT-III:
Architecture of intelligent machines: Introduction to microprocessor and programmable logic controllers and identification of system, system design classification. Motion control aspects in design

UNIT-IV:
Manufacturing Data bases: data base management 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 Books:
1. Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill

Reference Books:
1. Designing Intelligent Machines by Michel B. Histand and David G. Alciatore, Open University London
2. Control Sensors and Actuators by ICW. Desiha, Prentice Hall

OPTIMIZATION TECHNIQUES AND APPLICATIONS
(Program Elective – 2, PG)

.

IV Year B.Tech. II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Operations Research

Course Objectives: The main objectives of the course are: Learn

- Numerical optimization techniques for single variable and multi variable non- linear optimization problems.
- Sensitivity analysis on LPP queuing
- Simulation of annexing problem & inventory problem.
- Geometry cutting plane method & branch bound method for linear IPP.
- Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm.
- Formulation of GP model and solving it using arithmetic geometric inequality theorem.
- State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes: At the end of the course, the student is able to apply appropriate optimization techniques and solve.

- Based on the type of optimization problem like single variable or multivariable,
- Make sensitivity analysis to study effect of changes in parameters of LPP on the optimal solution without reworking.
- Simulate the system to estimate specified performance measures.
- Solve integer programming problem by either geometry cutting plane algorithm or branch band method.
- Apply chance constrained algorithm and solve stochastic linear programme.
- Formulate GP model and solve it.
- Solve given optimization problem by genetic algorithm or simulated annealing or PSO.

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 – Univariant method, 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 of variables, constraints. Simulation – Introduction – Types-steps – applications: inventory & queuing – Advantages and disadvantages

UNIT-IV:

Integer Programming: Introduction – formulation – Geometry 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 by S.S.Rao, New Age International.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

Reference Books:

1. Operations Research by S.D.Sharma
2. Operation Research by H.A.Taha, TMH
3. Optimization in operations research by R.LRardin
4. Optimization Techniques by Benugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M.C.Joshi, K.M.Moudgalya, Narosa Publications

ADVANCED COMPUTER AIDED DESIGN AND ANALYSIS LAB
(PG Lab)

IV Year B.Tech. II Sem.

L	T	P	C
0	0	4	2

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.

THEORY OF METAL CUTTING AND TOOL DESIGN

	L	T	P	C
V Year B.Tech. I Sem	**3**	**0**	**0**	**3**

Pre- requisites: Engineering graphics, Mechanics of solids, Heat Transfer, Machine Tools, Strength of Materials, Material Science and Metallurgy.

Objectives:

- To impart the knowledge of basic methodology of metal cutting.
- To educate the student about the structure, working, forces involved in single point and multipoint cutting tools.
- To understand the concepts of tool life, machinability, wear, influence of heat.
- To design the jigs and fixtures required for machine tools.

Outcomes: Students can analyse the machining processes in terms of input variables like

- Speed, feed, depth of cut and their influence on surface roughness and performance measures, 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:

Multi point Cutting 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 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, abrasion and diffusion wear mechanisms, forms of wear, Tool life criteria, machinability 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 variation, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Heat 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 by M C Shaw, Oxford and IBH Publications, New Delhi.
2. Fundamentals of Machining by Boothryd, Edward Amold publishers Ltd.

Reference Books:

1. Fundamentals of Metal cutting and Machine tools by B.L.Juneja, G. S. Sekhom and Nitin Seth, New Age International publishers.
2. Machine Tool Engineering by G.R.Nagpal, Khanna Publishers.
3. Tooling Data by P.H. Joshi, Wheeler Publishing.
4. Metal Cutting and Tool Design by B.J Ranganath, Vikas Publications.

ADVANCED FINITE ELEMENTS ANALYSIS
(Program Elective- 3, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisite: Fundamentals of finite element analysis

Course Objectives: The objective of this course is to learn advanced topics in FEM so that this tool can be used for analysis, design, and optimization of engineering systems

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: Advanced Theory and Applications of the Finite-Element Method to Structural and Mechanical Analysis. Set Notation, Function Notation, Vectors, Matrices, Tensors, Partial Differential Equations, Variational Calculus. Nonlinearity in Mechanics: Lagrangian and Eulerian Finite Elements In One Dimension: Total Lagrangian And Solution Methods, Updated Lagrangian And Solution Methods.

UNIT-II:
Continuum Mechanics: Deformation and motion, strain measures, polar decomposition and frame invariance, Governing equations: Lagrangian governing equations, Lagrangian meshes: governing equations, updated Lagrangian implementation, co-rotational formulations, total Lagrangian, weak from and its implementation.

UNIT-III:
Constitutive Models: Stress-Strain curve, 1D elasticity, nonlinear elasticity, 1D plasticity, multiaxial plasticity, stress update algorithms, continuum mechanics and constitutive models. Solution methods and stability: explicit methods, equilibrium solutions and implicit time integration, linearization, stability and continuation methods, numerical stability.

UNIT-IV: Nonlinear bending of beams, plates and shells: Basic Linear, beam, plate and shell elements, nonlinear plates and shells, time – dependent deformation of shells.

UNIT-V:
Nonlinear finite element of solids: Material Nonlinearities, objective rates, nonlinear elasticity, Plasticity, viscoplasticity, viscoelasticity. Dynamic fractures, stochastic finite elements, contact mesh generation, multi – scale methods, multi- Physics problems.

Text Books:

1. Nonlinear Finite Eelements for Continuam and Structures by Ted Belytschko, Wing Kam Liu, Brian Moran (2014), John Wiley & Sons, Ltd. (2014 edition)
2. Finite Element Methods in Engineering by K.J. Bathe, Prentice-Hall.

Reference Books:

1. The Finite Element Method in Engineering Science, O.C. Aienkowitz, Mc Graw Hill
2. The Finite Element Method: Linear Static and Dynamics Finite Element Analysis by T.J.R Hughes (2000), Dover Publications.
3. computational inelasticity by J.C Simo and T.J.R Hughes (1998), Springer.

QUALITY ENGINEERING IN MANUFACTURING
(Program Elective- 3, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Metrology and machine tools

Course Objectives :

- To Learn an application of scientific thinking to study the real world industry problems.
- To Understand, conduct and analyze comparative experiments.
- To Understand and apply control charts for analysis of observational data.
- To Design and conduct screening experiments, including graphical analysis.
- To Design, conduct and analyze complete factorial experiments using numerical and graphical methods.
- To Select fractional factorial experiment designs and conduct and analyze them

Course Outcomes: At the end of the course, the student is able to:

- To get knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices.

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.

Reference Books:

1. Elanchezhian.C, VijayaRamnath.B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.
2. ZuechNello, Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000
3. 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.
4. Awcock, G.J. and Thomas R, Applied Image Processing, Mc.Graw Hill, Inc. 1996.

CONCEPTS OF COMPUTATIONAL FLUID DYNAMICS

(Program Elective – 3, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objective: To apply the principles of Heat Transfer and Fluid Mechanics to solve simple heat transfer and fluid flow problems using different numerical techniques

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

- Differentiate between different types of Partial Differential Equations and to be able to apply appropriate numerical techniques
- Solve the simple heat transfer and fluid flow problems using different numerical techniques
- Understand and to appreciate the need for validation of numerical solution

UNIT-I:

Basic Equations of Fluid Dynamics: Conservation Laws – Differential Form of Equations – Characteristics of Governing Equations –Review of Boundary Conditions

General Solution Methods : Analytical, Experimental and Numerical Methods – Analytical Methods applied to simple 1D Steady state Heat Conduction – Need for Numerical Methods - Applications related casting, solidification and metal forming processes.

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

Types of Numerical Methods: Brief about FDM, FVM and FEM and comparison

UNIT-II:

Mathematical Behavior of Partial Differential Equations: Classification of Partial Differential Equations – Illustrations

Finite Difference Method (FDM): Taylor's series – Derivation of Finite Difference Formulae for Partial Derivative Terms - Consistency

FD formulation of 1D Elliptic PDEs - 1D steady state heat transfer problems – Systems with and without Heat Generation – Simple Fin Problems - Cartesian, cylindrical and spherical co-ordinate systems subjected to simple boundary conditions – Validation with Analytical Solutions

UNIT-III:

Finite Difference Method: 2D Elliptic PDEs – 2D Steady State Heat Conduction Problems subjected to Dirichlet Boundary conditions

Parabolic PDEs - Transient heat conduction – Application to Heat Treatment Processes– Errors and Stability - Explicit Method – Stability Analysis – Implicit and Crank Nickolson method - Finite Difference formulation simple 1D Transient Heat Conduction Problems using Explicit Method

UNIT-IV:

Finite Difference Formulation of 1D Hyperbolic PDEs–CFL Condition – FD Treatment of 1D Wave Equation

Convection and Diffusion: Review of Governing Equations –Navier Stokes Equations - General Form of Governing Equations for Fluid Flow and Heat transfer – Their Mathematical Behavior –Difficulties in solving the Navier Stokes Equations - Calculation of Flow Field - Stream function- Vorticity formulation – General Algorithm for Vorticity Stream Function Method – Treatment of Boundary Conditions - Its Advantages and Disadvantages

UNIT-V:

FD Formulation of Full Incompressible Fluid Flow Equations – Lax Wendroff and Mac Cormack's Techniques – Simple Treatment

FD Formulation of 1D Convection Heat Transfer: Burger's equation - Steady 1D Convection Diffusion – Exact Solution Vs Numerical Solution – Need for Upwind Differencing Scheme – Its Limitations – False Diffusion – Use of Second Order Upwind Scheme.

Text Books:

1. Computational Fluid Flow and Heat Transfer by Muralidharan & Sundarajan (Narosa Pub)
2. Computational Fluid Dynamics and Heat Transfer by P. S. Ghoshdastidar, Centage Pub
3. Computational Fluid Dynamics by Anderson (TMH)

Reference Books:

1. Computational Fluid Dynamics by Hoffman and Chiang, Engg Education System
2. Computational Methods for Fluid Dynamics by Ferziger, Peric (Springer)
3. Computational Fluid Dynamics by T.J. Chung, Cambridge University
4. Computational Fluid Dynamics – A Practical Approach by Tu, Yeoh, Liu (Elsevier)
5. Text Book of Fluid Dynamics by Frank Chorlton, CBS Publishers

FLEXIBLE MANUFACTURING SYSTEMS
(Program Elective – 4, PG)

	L	T	P	C
V Year B.Tech. I Sem.	**3**	**0**	**0**	**3**

Prerequisites: Machine Tools, Basics of Industrial Engineering

COURSE OBJECTIVES:
- To Understand the role of Flexible Manufacturing Systems(FMS) in manufacturing
- To Understand the concept of Group Technology
- To Understand the concept of Cellular Mfg Systems
- To Understand the benefits of automation
- To Know types of manufacturing industries
- To have a basic knowledge of automation equipment
- To Understand logic control and associated technologies

COURSE OUTCOMES: At the end of the course, the student shall be able to:
- Develop FMS using the most appropriate technique.
- Implement FMS concept in a manufacturing environment
- Use various types of sensors and actuators in PLC implementations
- Explain the role of automation in manufacturing
- Tell the difference between Group Technology and Cellular Manufacturing
- Classify automation equipment and assembly systems into different categories.

UNIT-I:
Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type

UNIT-II:
Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

UNIT-III:
Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/Deburring station

UNIT-IV:
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-V:
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. Flexible Manufacturing Cells and System by William W Luggen, Prentice Hall of Inc New Jersey, 1991
2. Flexible Manufacturing system by Reza A Maleki, Prentice Hall of Inc New Jersey, 1991
3. Flexible Manufacturing by John E Lenz, marcel Dekker Inc New York ,1989.

Reference Books:
1. Automation, Production Systems and Computer Integrated Manufacturing by Groover, M.P, Prentice Hall.

DESIGN FOR MANUFACTURING AND ASSEMBLY
(Programme Elective- 4, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Engineering Materials
Course Objectives: The objective of course is identify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.
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 by George E. Deiter, Mc. Graw Hill Intl. 2nd Ed.2000.
2. Product design for Manufacture and Assembly by Geoffrey Boothroyd, Marcel Dekker Inc. NY, 1994.

Reference Books:

1. Product design and Manufacturing by A.K Chitale and R.C Gupta, Prentice, Hall of India, New Delhi, 2003.
2. Design and Manufacturing by Surender Kumar & Goutham Sutradhar, Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
3. Hand Book of Product Design by Geoffrey Boothroyd Marcel Dekken Inc. NY, 1990.
4. Product Design by Kevin Otto and Kristin Wood, Pearson Education

MANUFACTURING SYSTEMS, SIMULATION MODELLING AND ANALYSIS
(Programme Elective-4, PG)

V Year B.Tech. I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prerequisites: Operations Research, Optimization Techniques and Applications and Probability Statistics

Course Objectives:
- Learn way of analyzing the systems.
- Classification of systems based nature of dynamics and knowledge of elements.
- To develop simulation model for dynamic discrete – event stochastic system.
- To run the model and collect the data.
- To analyze the output data of simulation for specified for performance measures bases on type of simulation and method of output data analysis.

Course Outcomes:
At the end of course, student should able to
- Define the state of system W.R.T specified performance measures.
- Identify Dynamic Discrete- event stochastic system.
- Develop simulation model for the said system
- Analyze the model and present the results to specified confidence level.

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 - II:
Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT - III:
Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poison. 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 with respect to output data analysis – warm up 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 – New boy paper problem.

Text Books:
1. Simulation Modelling and Analysis by Law, A.M. & Kelton, McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation by Banks J. & Carson J.S., PH, Englewood Cliffs, NJ, 1984.

Reference Books:

1. Simulation of Manufacturing Systems by Carrie A., Wiley, NY, 1990.
2. A Course in Simulation by Ross, S.M., McMillan, NY, 1990.
3. Simulation Modelling and SIMNET by Taha H.A., PH, Englewood Cliffs, NJ, 1987

ADVANCED ROBOTICS
(Programme Elective-5, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Kinematics of machinery

Course Objectives:

- To Demonstrate knowledge of different types of actuators used in robotic systems.
- To Analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To Analyze the dynamics of a robot arm, implement in 2D.
- To Analyze sensor signals to implement real-time control algorithms.
- To Demonstrate knowledge of error propagation in electrical, mechanical and computational systems.
- To Construct, program, and test the operation of a robotic system to perform a specified task.

Course Outcomes: After doing this course, the student should be able to,

- Understand the evolution, classification, structures and drives for robots.
- Teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- Expose the students to build a robot for any type of application.

UNIT-I:

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

Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:

Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, 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-III:

Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV:

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

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

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. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
2. Industrial robotics by Mikell P.Groover, McGraw Hill.

Reference Books:

1. Industrial robotics by Mikell P.Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
5. Robot Analysis and Control by Asada H. and J. E. Slotin, Wiley, New York

ADVANCED CASTING AND WELDING TECHNOLOGY
(Pragramme Elective- 5, PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Production Technology, Heat transfer, FEM.

Course Objectives:
- To impart the knowledge of advanced welding and casting techniques.
- To apply computer aided engineering to welding and casting.

Course Outcomes: Student will be in a position to analyze 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 for ultrasonic 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 mono crystal solidification, squeeze casting, semisolid metal casting, rheocasting.

UNIT–IV:
Solidification, Gating and Rising, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and riser design 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.

Text Books:
1. Metal Casting: Computer Aided Design and Analysis by Ravi B, Prentice Hall, 2005.
2. Welding and Welding Technology by Richard L Little, Tata McGraw Hill, 2004.
3. Casting Practice by John Campbell, Elsevier Science Publishing Co., 2004.
4. Welding: Principles and Applications by Larry Jeffus, Delmar Publishers, 2004.

Reference Books:
1. Casting by John Campbell, Butterworth Heinemann, 2003.
2. Welding Processes Handbook by Klas Weman, 2003.
3. Modern Welding Technology by Howard B Cary, Prentice Hall, 2002.
4. Welding for Collision Repair by Larry Jeffus, Delmar Publishers, 1999.
5. Casting, ASM Hand Book, ASM International, 1998.

ADVANCED MATERIALS TECHNOLOGY
(Programme Elective-5, PG)

V Year B.Tech. I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prequisites: Mechanics of soilds

Course Outcomes: At the end of the course- the student is able
- To understand on elastic- plastic and fractured behaviour of engineering materials.
- To do appropriate selection of metallic and non-metallic materials for the various engineering applications.

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- $Al_2 O_3$ - SiC- $Si_3 N_4$ - CBN and Diamond – properties-Processing and applications.

TEXT BOOKS:
1. Mechanical Behaviour of Materials by Thomas H. Courtney, 2nd Edition, McGraw Hill, 2000.
2. Mechanical Metallurgy by George E. Dieter, McGraw Hill, 1998.

REFERENCE BOOK:
1. Selection and use of Engineering Materials by Charles J.A, Butterworth Heiremann.

NANO TECHNOLOGY
(Open Elective-PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

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. MEMS and Microsystems Design and Manufacture by Tai Ran Hsu, Tata-McGraw Hill, New Delhi-2002.
2. Nanotechnology and Nanoelectronics by FahrnerW.R Springer (India) Private Ltd., 2011.

REFERENCE BOOKS:

1. Fundamentals of Microfabrication by Mark Madou, CRC Press, New York- 1997.
2. Nano Technology by Norio Taniguchi - Oxford University Press, New York- 2003.
3. MEMS Handbook by Mohamed Gad-el-Hak, CRC press, 2006, ISBN: 8493-9138-5.
4. Emerging Nanotechnologies for Manufacturing by Waqar Ahmed and Mark J. Jackson, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8 29.
5. Introduction to Micro fabrication by Sami Franssila, John Wiley & sons Ltd, 2004, ISBN: 470-85106-6.
6. Introduction to Nano technology by Charles P Poole, Frank J Owens, John Wiley and Sons, 2003.
7. Hardner Micro Sensors- Principles and Applications by Julian W - CRC Press 1993.

NEURAL NETWORKS AND FUZZY LOGICS
(Open Elective-PG)

V Year B.Tech. I Sem.

L	T	P	C
3	0	0	3

Prerequisite: Operations research, Optimisation Techniques**,** Control Systems

Course Objectives: The goal of this course is to give a good basic understanding of Neural Networks and Fuzzy Logic. This course is mainly intended for engineers who desire to learn more about these techniques

Course outcomes: After completion of this course, the student should be able to

- Learn concepts of neural networks and fuzzy logics
- Understand the topology of multi-layer perceptron, recurrent neural networks and
- Fuzzification & Defuzzification.
- understand the basic structure and operation of Fuzzy logic control systems

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.

Text Books:
1. Neural Networks in Computer Intelligence by Limin Fu, McGraw Hill, 2003.
2. Soft Computing and Intelligent Systems Design, Theory, Tools and Applications by Fakhreddine O. Karray and Clarence De Silva., Pearson Education, India, 2009.

Reference Books:
1. Fuzzy Logic with Engineering Applications by Timothy J. Ross, McGraw Hill, 1995.
2. Artificial Neural Networks by B.Yegnanarayana, PHI, India, 2006.

SCALING LAWS AND MECHANICAL MICRO MACHINING
(Open Elective-PG)

V Year B.Tech. I Sem

L	T	P	C
3	0	0	3

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. Micro Manufacturing Processes by Jain V. K - CRC Press- Taylor & Francis Group- 2012.
2. Actuators – Basics and applications by Janocha H, Springer publishers, 2012.
3. Nano Materials by Bandyopadhyay. A.K, New age international publishers, New Delhi, 2008, ISBN: 8122422578.

Reference Books:
1. Introduction to Micro machining by Jain V.K. Narosa Publishing House- 2011.
2. Bharat Bhushan- Handbook of nanotechnology, springer, Germany, 2010.
3. Advanced Machining Processes by Jain V.K., Allied Publishers- Delhi, 2002.
4. Micromachining of Engineering Materials by Mcgeoug J.A., CRC press 2001, ISBN:10:0824706447.

AUTOMATION AND ROBOTICS LAB
(PG Lab)

V Year B.Tech. I Sem.

L	T	P	C
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Note: Conduct any Ten exercises from the list given below:

1. Draw the circuit diagram to operate single acting pneumatic cylinder using 3/2 push button direction control valve.
2. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 direction control valve using push button momentary switch/push button latch.
3. Draw the circuit diagram to operate single acting pneumatic cylinder using 5/2 air spring valve & PLC.
4. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 air spring valve & PLC.
5. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using push button switch/latch switch.
6. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction.
7. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using PLC.
8. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/3 direction control valve (solenoid control) using PLC.
9. Direct Kinematic Analysis of a Robot.
10. Inverse Kinematic Analysis of a Robot.
11. Trajectory planning of a Robot joint in Space scheme.
12. Palletizing Operation using Robot Programming.
13. Robotic programming using SCARA.