

**JNTUH COLLEGE OF ENGINEERING HYDERABAD  
(AUTONOMOUS)  
B.TECH. FOUR YEAR DEGREE COURSE  
(MECHANICAL ENGINEERING)  
COURSE STRUCTURE**

**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
<b>Total Credits</b>						<b>18</b>

**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 Skill lab	0	0	2	1
8.	*MC	Sports & Games	0	0	2	0
<b>Total Credits</b>						<b>18</b>

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**II YEAR****I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BSC	Engineering 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
<b>Total Credits</b>						<b>21</b>

**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
<b>Total Credits</b>						<b>21</b>

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**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	Professional Elective-I	3	0	0	3
6.	HSMC	Business Economics and Financial Analysis	3	0	0	3
7.	PCC-Lab 7	Thermal Engineering- I Lab	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
<b>Total Credits</b>						<b>22</b>

**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	Professional Elective-II	3	0	0	3
6.	OEC-1	Open Elective-I	3	0	0	3
7.	PCC-Lab 10	Heat Transfer Lab	0	0	2	1
8.	PCC-Lab 11	Thermal Engineering –II Lab	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)	-	-	4	-
<b>Total Credits</b>						<b>22</b>

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**IV YEAR****I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	PCC-17	Finite Element Methods	3	0	0	3
2.	PEC-3	Professional Elective-III	3	0	0	3
3.	PEC-4	Professional Elective-IV	3	0	0	3
4.	ESC	Composite Materials	2	0	0	2
5.	OEC-2	Open Elective-II	3	0	0	3
6.	PCC Lab 12	CAD/ CAM Lab	0	0	2	1
7.		Seminar	0	0	2	1
8.		Mini project	-	-	4	2
9.	UG	Project-I	0	0	6	3
<b>Total Credits</b>						<b>21</b>

**IV YEAR****II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1.	PEC-5	Professional Elective-V	3	0	0	3
2.	PEC-6	Professional Elective-VI	3	0	0	3
3.	OEC-3	Open Elective-III	3	0	0	3
4.	Project	Project-II	0	0	16	8
<b>Total Credits</b>						<b>17</b>

**Professional Elective-I:**

1. Operations Research
2. Industrial Robotics
3. Mechanical Vibrations

**Professional Elective-II:**

1. Unconventional Machining Processes
2. Machine Tool Design
3. Production Planning & Control

**Professional Elective-III:**

1. Additive Manufacturing
2. Automation in Manufacturing
3. MEMS

**Professional Elective-IV:**

1. Power Plant Engineering
2. Automobile Engineering
3. Renewable Energy Sources

**Professional Elective-V:**

1. Computational Fluid Dynamics
2. Turbo Machinery
3. Fluid Power Systems

**Professional Elective-VI:**

1. Industrial Management
2. Production Operation and Management
3. Tribology

**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<sup>th</sup> / 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; Rank 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, 36<sup>th</sup> Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9<sup>th</sup> Edition, John Wiley & Sons, 2006.

**References**

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

**ENGINEERING PHYSICS****COMMON FOR (Civil, Mechanical, Metallurgy, Chemical)****I Year, B.Tech. I-Sem****L T P C****COURSE OBJECTIVES:** The course should enable the students to:**3 1 0 4**

1. understand the concepts of interference and diffraction.
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, Magnetostriction 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. Upadhyaya, 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 Associativity, 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.

**Sorting and Searching:** Selection sort, Bubble sort, Insertion sort, Linear search and Binary search methods.

**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 C by 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

**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, 3<sup>rd</sup> 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 Durgaiiah.
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

**ENGINEERING PHYSICS LAB**  
**COMMON FOR (Civil, Mechanical, Metallurgy, Chemical)**

**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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**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:  $1+x+x^2+x^3+\dots+x^n$

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 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 C by 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

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3. C Programming & Data Structures by P. Dey, M Ghosh R Thereja, Oxford University Press

**Appendix- III**

**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<sup>th</sup> / 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  $xV(x)$ ; 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, 36<sup>th</sup> Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9<sup>th</sup> Edition, John Wiley & Sons,2006

**References**

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9<sup>th</sup> Edition, Pearson, Reprint, 2002
2. Paras Ram, Engineering Mathematics, 2<sup>nd</sup> Edition, CBS Publishes
3. S. L. Ross, Differential Equations, 3<sup>rd</sup> 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<sub>2</sub>, O<sub>2</sub> 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 ozonation. 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 analysis 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=O, 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, 5<sup>th</sup> 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 – Conventions Auto 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 Drawing by 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 plumbing, 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. I-Sem

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

(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.

**COURSE OUTCOMES**

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 Clichés in 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<sup>th</sup> 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.

**8 L**

**UNIT-I: Basic Probability**

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

**10 L**

**UNIT-II: Probability distributions**

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

**10 L**

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

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.

**10 L**

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

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, 9<sup>th</sup> Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7<sup>th</sup> 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, 8<sup>th</sup> 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-jointed, 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 is able to understand basic idea of 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 Rothery's 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<sub>3</sub>C.

**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 plain 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<sub>3</sub>C 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, cermets, abrasive materials, nonoxides – 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. Avner.
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 positions, Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

**UNIT-III:**

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

**UNIT-IV:**

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth. Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements Stamping, forming and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT-V:**

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

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

**TEXT BOOKS:**

1. Manufacturing Technology 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 Technology by 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 – Vander Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables, Mixtures of perfect Gases – Mole Fraction, Mass fraction 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 Wylen & 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 Yunus Cengel & Boles, TMH
2. Thermodynamics – J.P. Holman by McGraw Hill
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.
- Develop 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**

**Course Objectives:** Students will be able to:

	L	T	P	C
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	2	0	0	0
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 trajectories of various kinematic 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, Ratchet & Paul Geneva Mechanism.

**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.

Klien's 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 machinery by Norton, 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 analyse air standard cycles and to understand and evaluate the performance 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 the basic 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 vacuum pressure- measurement of pressure- piezometer, U-Tube and Differential Manometers.

**UNIT-II:**

**Fluid kinematics:** stream line, path line and streak line and stream line, classification of flows steady & unsteady, 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 & Bernoulli's equations for flow along a stream line, moment equation and its applications on force on pipe bend. Measurement of flow: pitot tube, venturi 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.Kumar, Kotaria and sons.
2. Fluid mechanics and machinery by D. Rama Durgaiyah, 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 impart 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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**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 & CONTROL SYSTEMS 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****II Year 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 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.

**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 and ecosystem 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-spots 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, Universities Press
- 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 Theory by 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 Design by 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 by Pandya & Shah, Chartor publications

**METROLOGY & MACHINE TOOLS****III Year B.Tech. I-Sem**

L	T	P	C
3	0	0	3

**Pre-requisites:** 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 Tools by 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 Tools by Geoffrey 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 Course-1)

**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, Arthur 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 Course-1)

**III Year B.Tech. I-Sem**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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, comparison of Actuators, Feedback **Components:** 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 Course-1)

**III Year B.Tech. I-Sem**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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:** Rayleigh'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 Vibrations by V. Ram Murthy.
4. Vibration problems in Engineering by S.P. Timoshenko.
5. Mechanical Vibrations by Seto, Schaum's Outlines, 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 impart 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

**(Minimum 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 of engineering mechanics, design of machine members-I and theory of machines.

**Course objectives:**

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

**Outcomes:**

- 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 design by 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  $\Pi$  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, New Age.
3. Heat & Mass Transfer by D.S. Kumar, S.K. Kataria & sons

**REFERENCE BOOKS:**

1. Heat Transfer by Ghoshdastidar, Oxford University Press.
2. Heat Transfer by A Practical Approach, Yunus Cengel, Boles, TMH
3. Heat Transfer by HOLMAN, TMH
4. Engineering Heat and Mass Transfer by Sarit K. Das, Dhanpat Rai Pub
5. Heat and Mass Transfer by 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 Subrahmanyam 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

**Pre-requisites: None****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 – Ozone Depletion – Global Warming – Azeotropes and Zeotropes

**UNIT IV:**Vapor Absorption System – Calculation of max COP – description and working of NH<sub>3</sub> – 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:**

Psychrometric Properties &amp; 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-Conditioning by Ananthanarayanan, TMH

**UNCONVENTIONAL MACHINING PROCESSES**  
(Professional Elective Course-2)

**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 machining 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 processes by 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 Course-2)

**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 Control by N.K. Mehta, TMH, New Delhi, 2010.
2. Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, 2009.
3. Design of Machine Tools by D. K Pal, S. K. Basu, 5<sup>th</sup> Edition, Oxford IBH, 2008.

**Reference Books:**

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

**PRODUCTION PLANNING & CONTROL**  
(Professional Elective Course-2)

**III Year B.Tech. II-Sem**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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 quantity 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

**REFERENCE 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.

**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

- Apply the principles of various modes of heat transfer to evaluate thermal conductivity of different metal and non metal objects under steady state conditions
- Apply 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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**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 3<sup>rd</sup> 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, 7<sup>th</sup> 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. 2<sup>nd</sup> Edition
2. **Academic Writing: A Handbook for International Students** by Stephen Bailey, Routledge, 5<sup>th</sup> 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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**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. Analyze 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 by Chandrupatla, 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 Finite 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 Course-3)**

IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes

**Course outcomes:**

- To understand the fundamentals for additive manufacturing and how it is different and discuss about various types of liquid based, solid based and powder based AM technologies.
- To understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software's used in AM.
- To know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields

**UNIT – I:**

**Introduction:** Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

**UNIT – II:**

**Liquid-based AM Systems:** Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Polyjet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Microfabrication.

**Solid-based AM Systems:** Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

**UNIT – III:**

**Powder Based AM Systems:** Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

**Rapid Tooling:** Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

**UNIT – IV:**

**AM Data Formats:** Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

**AM Software's:** Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, SurgiGuide, 3-matic, Simplant, MeshLab.

**UNIT –V:**

**AM Applications:** Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customised Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

**Text Books:**

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001

**Reference Books:**

1. Wohlers Report 2000 – Terry Wohlers, Wohlers Associates, 2000
2. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

**AUTOMATION IN MANUFACTURING**  
**(Professional Elective Course – 3)**

IV Year B.Tech. I-Sem

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites:****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

**UNIT-I:**

**Introduction to Automation:** Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

**UNIT-II:**

**Introduction to Material Handling:** Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

**UNIT -III:**

**Manual Assembly Lines:** Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

**UNIT-IV:**

**Transfer lines:** Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

**UNIT-V:**

**Automated Assembly Systems,** Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

**TEXT BOOKS:**

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Education.
2. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)

**REFERENCE BOOKS:**

1. Automation, Buckingham W, Haper& Row Publishers, New York, 1961
2. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.



**MEMS**  
**(Professional Elective Course –3)**

IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

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

- Synthesize and characterize nanomaterials for engineering applications
- Design and analyze methods and tools for micro and nano manufacturing.
- Improve the quality of MEMS by analysing the variables of the underlying micro and nano manufacturing method
- Select appropriate industrially-viable process, equipment and tools for a specific product.

**UNIT - I:**

**Overview and working principles of MEMS and Microsystems:** MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics

**UNIT - II:**

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

**UNIT - III:**

**Engineering Mechanics for Microsystems Design:** Static Bending of Thin plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis.

**UNIT - IV:**

**Thermo Fluid Engineering & Microsystems Design:** Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations 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 Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

**POWER PLANT ENGINEERING**  
(Professional Elective Course- 4)

**IV Year B.Tech. I-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 comparison. **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 Course– 4)

**IV Year B.Tech. I-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, reborning, 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 YesDee 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 Course -4)

IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

**Prerequisites:** None**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.

**OUTCOMES:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**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<sub>2</sub> 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.

- a. **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.
- b. **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 by Bent Sorensen, Elsevier, Academic Press, 2011

**COMPOSITE MATERIALS****IV Year B.Tech. I-Sem**

L	T	P	C
2	0	0	2

**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 able to understand 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 boron carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosets, 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 Reinhold, New York, 1969.



**CAD/CAM LAB****IV Year B.Tech. I-Sem**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**Pre-requisites:**

To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.

**Course objectives:**

- To be able to understand and handle design problems in a systematic manner.
- To be able to apply CAD in real life applications.
- To be understand the basic principles of different types of analysis.

**Course out comes:**

- To understand the analysis of various aspects in of Manufacturing design

**CAD Experiments****DRAFTING:**

1. Development of part drawings for various components in the form of orthographic and isometric.

**PART MODELING:**

1. Generation of various 3D Models through pad, shaft, shell sweep.
2. Feature based and Boolean based modelling surface and Assembly Modelling. Design simple components.
3. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
4. To make an isometric dimensional drawing of a connecting rod.
5. Draw Different type's bolts and nuts with internal and external threading in Acme and Square threading standards. Save the bolts and nut as blocks suitable for insertion.
6. A Study of a FEA package and modeling stress analysis of a Bars of constant cross sectional area, tapered and stepped bars.
7. Analysis of various Trusses – (Minimum 2 exercises).
8. Analysis of different types of Beams i.e.; Simply supported, cantilever, beams with UDL, beams with varying load etc (Minimum 6 exercises)

**CAM Experiments:**

1. To write the manual part program to the given dimensions and execute in CNC Lathe for Box Turning Cycle.
2. To write the manual part program to the given dimensions and execute in CNC Lathe for Multiple Turning Cycle.
3. To write the manual part program to the given dimensions and execute in CNC Lathe for Taper Turning Cycle.
4. Write the manual part program to the given dimensions and execute in CNC Lathe for Multiple Grooving Cycle.

**COMPUTATIONAL FLUID DYNAMICS**  
(Professional Elective Course – 5)

**IV Year B.Tech. II-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 formulate governing equations for physical problems and to solve them 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 apply appropriate numerical techniques
- Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM
- Understand and to appreciate the need for validation of numerical solution

**UNIT – I:**

Review of Modes of Heat Transfer – Governing Equations – Initial and boundary conditions

Methods to solve a physical problem –Relative advantages and disadvantages of experimental, analytical and numerical methods – Scope of CFD – Its applications and limitations - Brief comparison between different numerical methods, viz., FDM, FEM &amp; FVM Methods to solve a system of simultaneous Linear Algebraic Equations, - Direct Method – Banded Matrices – Thomas algorithm / TDMA - iterative schemes of Matrix Inversion.

**UNIT – II:**

Classification of PDE – Elliptic, parabolic and hyperbolic PDE as governing equations – Examples and their physical significance

FDM – Discretization of Partial Derivative Terms using Taylor's series of approximation – Finite Difference Formulae – Application and implementation aspects of finite-difference equations –Consistency

Application of FDM to elliptic equations, viz., Laplace Equations – solution of 1D steady state heat conduction using FDM – Systems with heat generation –Systems with variable thermal conductivity - Fins

**UNIT – III:**

Application of FDM to solve 1D steady state heat conduction in Curvilinear geometry – Singularities – Treatment of singularities

Application of FDM to solve 2D steady state heat conduction– with and without heat generation and subjected to different boundary conditions

**UNIT – IV:**

Parabolic Equations – Use of Explicit, implicit and semi implicit methods – Errors and Stability analysis - application of FDM to solve 1D transient heat conduction equations – ADI Scheme – Treatment and Implementation

**UNIT-V:**

Numerical methods for incompressible flow – Governing equations –Difficulties in solving N-S equations – Stream function and Vorticity method – Advantages and disadvantages – treatment of boundary conditions – Determination of Pressure for viscous flows – Disadvantages – Staggered Grid – SIMPLE algorithm for pressure liked equations.

**Text Books:**

1. Computational Fluid Flow and Heat Transfer/ Muralidharan&Sundarajan/ Narosa Publications
2. Finite Difference Method in Heat Transfer – NecatiOzisik, CRC Press
3. Computer Simulation of Flow and Heat Transfer – Ghoshdastidar, Tata McGraw Hill
4. Numerical Methods – Chapra and Canale, TMH
5. Numerical Methods –Balaguruswamy/TMH

**Reference Books:**

1. Computational Fluid Dynamics basics with applications- John.D, Anderson / Mc graw hill.
2. Computational Methods for Fluid Dynamics –Firziger&peric/springer.

**TURBO MACHINERY**  
(Professional Elective Course – 5)

IV Year B.Tech. II-Sem

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites:** Thermodynamics 1 & 2**Course Objectives:** The course is intended to

- Understand the fundamental concepts of turbo machines.
- Apply concepts of fluid mechanics in turbo machines.
- Understand the thermodynamic analysis of steam nozzles and turbines.
- Understand the different types of compressors and evaluating their performances in the form of velocity triangles.
- Familiarize the basic concepts of gas dynamics and analyze the performance of axial flow gas turbines

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

- To design and analyse the performance of Turbo machines for engineering applications
- To understand the energy transfer process in Turbo machines and governing equations of various forms.
- To understand the structural and functional aspects of major components of Turbo machines.
- To design various Turbo machines for power plant and aircraft applications
- Understand the design principles of the turbo machines
- Analyze the turbo machines to improve and optimize their performance

**UNIT-I:**

**FUNDAMENTALS OF TURBO MACHINES:** Classifications, Applications, Thermodynamic analysis, isentropic flow, Energy transfer, Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas, unsteady flow in turbo machines

**UNIT -II:**

**STEAM NOZZLES:** Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis, Designs of nozzles.

**Steam Turbines:** Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

**UNIT-III:**

**GAS DYNAMICS:** Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Super sonic flow, oblique shock waves. Normal shock recoveries, Detached shocks, Aerofoil theory.

**Centrifugal compressor:** Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodola's formula's, Effect of inlet mach numbers, Pre whirl, Performance

**UNIT-IV:**

**AXIAL FLOW COMPRESSORS:** Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

**Cascade Analysis:** Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

**UNIT-V:**

**AXIAL FLOW GAS TURBINES:** Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifel's relation, Design cascade analysis, Soderberg, Hawthorne, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

**Text Books:**

1. Principles of Turbo Machines by DG Shepherd, Macmillan
2. Fundamentals of Turbomachinery by William W Perg, John Wiley & Sons
3. Element of Gas Dynamics by Yahya, TMH

**Reference Books:**

1. Principles of Jet Propulsion and Gas Turbine by NJ Zucrow, John Wiley & Sons, Newyork
2. Turbines, Pumps, Compressors by Yahya, TMH
3. Practice on Turbo Machines by G.Gopal Krishnan &D. Prithviraj, Sci Tech Publishers, Chennai
4. Theory and practice of Steam Turbines by WJ Kearton, ELBS Pitman, London
5. Gas Turbines Theory and Practice by Zucrow/John Wiley & Sons, Newyork
6. Element of Gas Dynamics by Liepeman and Roshkow, Dover Publications
7. Elements of Gas Turbine Propulsion by Jack D. Mattingly
8. Turbines, Compressors and Fans by S M Yahya, MGH.

**FLUID POWER SYSTEMS**  
(Professional Elective Course – 5)

IV Year B.Tech. II-Sem

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites:** Fluid Mechanics and Hydraulics Machinery**Course outcomes:** After doing this, student should be able to

- Understand the Properties of fluids, Fluids for hydraulic systems, governing laws. distribution of fluid power,
- Design and analysis of typical hydraulic circuits.
- Know accessories used in fluid power system, Filtration systems and maintenance of system.

**UNIT-I:**

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performance curves and parameters.

**UNIT-II:**

Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

**UNIT-III:**

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

**UNIT-IV:**

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system.

Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

**UNIT-V:**

Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time-dependent control, combined control, Program Control, Electro-pneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

**Testbooks:**

1. Fundamentals of Fluid Power Control by John Watton, 1<sup>st</sup>Ed. Cambridge University Press, 2009 Prerequisite
2. Fluid Power Control by Blackburn J. F., G. Reethof, and J. L. Shearer, New York: Technology Press of M. I.T. and Wiley.
3. Fluid Power with applications by Anthony Esposito, Pearson Education.

**Reference Books:**

1. Hydraulic operation and control of Machine tools by Ian Mencal, Ronald Press.
2. Hydraulic and Pneumatic power for production by Sterwart, Industrial Press.
3. Fundamentals of Pneumatics/electropneumatics by Hasebrink J.P., and Kobler R., FESTO Didactic publication No. 7301, Esslingen Germany, 1979.
4. Pneumatic Control-An introduction to the principles by Werner Deppert and Kurt Stoll, Vogel-Verlag.
5. The analysis and Design of Pneumatic Systems by Blaine W. Andersen, John Wiley

6. Oil Hydraulic Power and its Industrial Applications by Ernst, W., New York: McGraw Hill.
7. Design of Hydraulic Control Systems by Lewis E.E., and H.Stern, New York: McGraw Hill.
8. Electro hydraulic Servomechanism by Morse A. C., New York: McGraw Hill.
9. Fluid Power Control systems by Pippenger, J.J., and R.M.Koff, New York: McGraw Hill.
10. Fluid Power Control Systems by Fitch, Jr. E.C., New York: McGraw Hill.
11. Hydraulic and Pneumatic Control of Machine Tools by Khaimovitch,
12. Fluid Power Systems: modeling, simulation and microcomputer control by John Watton, Prentice Hall International.
13. Hydraulic control systems by Herbert E. Merritt, John Wiley and Sons Inc.

**INDUSTRIAL MANAGEMENT**  
**(Professional Elective Course –6)**

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 McGregor, 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

**PRODUCTION OPERATION AND MANAGEMENT**  
(Professional Elective Course – 6)

IV Year B.Tech. II-Sem

L	T	P	C
3	0	0	3

**Prerequisites:** Operations Research, Production Planning and Control**Objectives:**

- Learn Aggregate planning, MRP Work study, and scheduling
- Learn Value analysis, design the plant layout for the specified production system

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

- Understand the importance of production and operations Management, for getting the Competitive edge
- Do value analysis for a given product and design the plant layout for the specified production system.
- Do Aggregate planning, MRP Work study, and scheduling
- able to apply the project management techniques

**UNIT-I:****Overview of Production & Operations Management (POM):** Introduction-Definition-Importance- Historical Development of POM-POM scenario today**Product & Process design:** Role of product development- Product development process-Tools for efficient product development (briefly)- Determination of process characteristics- Types of processes and operations systems- Continuous –Intermittent-Technology issues in process design- Flexible Manufacturing Systems- Automated Material Handling Systems**UNIT –II:****Value Analysis:** Defintion-Objectives-Types of Values-Phases- Tools -FAST diagram-Steps- Advantages-Matrix method-Steps.**Plant Location& Plant layout:** Factors affecting locations decisions-Location planning methods-Location factor rating -Centre of Gravity method-Load distance method. Plant layout- Definition-Objectives-Types of layouts- Design of product layout-Line balance-Terminology-RPW method.**UNIT- III:****Aggregate Planning:** Definition- Objectives-Basic strategies for aggregate production planning- Aggregate production planning method-Transportation model- Master Production Scheduling.**Material Requirement Planning:** Terminology-Logic-Lot sizing methods-Advantages & Limitations**UNIT – IV:****Work Study:** Work study: method study –definition-objectives-steps-Charts used- Work measurement-Time study- Definition-steps- Determination of standard time- Performance rating- Allowances. Work sampling- steps-comparison with time study.**Quality Management:** Economics of quality assurance-Control charts for variables and for attributes –Acceptance sampling plans-Total Quality Management-ISO 9000 series standards-Six sigma**UNIT – V:****Scheduling:** Need-basis for scheduling- Scheduling rules- Flow shop & Job shop scheduling. Line of Balance.**Project management:** PERT- Critical path determination- Probability of completing project in a given time- CPM- Types of floats- Critical path determination- Crashing of simple networks- Optimum project schedule.**TEXT BOOKS:**

1. Operations Management for Competitive Advantages by Chase Aquinano, TMH, 2009
2. Operations Management: Theory and Practice by B.Mahadevan Pearson.
3. Industrial Engineering and Mangement by Dr.Ravi Shankar, Galgotia.

**REFERENCE BOOKS:**

1. Modern Production and Operations Management by Buffa, Wiley
2. Theory and Problems in Production and Operations Management by SN Chary TMH.
3. Operations Management 8e Process and Value Chains by Lee Krajewskiet all Pearson

**TRIBOLOGY**  
**(Professional Elective Course – 6)**

IV Year B.Tech. II-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, hydrodynamic 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 modulus, 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