

# SRI KRISHNADEVARAYA UNIVERSITY :: ANANTAPUR

## College of Engineering & Technology

### Academic Regulations 2015 (R15) for

#### B. Tech (Regular-Full time)

(With effect from the Academic Year 2015-16 for the students admitted into I year I semester)

#### 1. Award of B.Tech. Degree

A student will be declared eligible for the award of the B.Tech. Degree if he/she fulfils the following academic regulations:

- i. Pursue a course of study for not less than four academic years and in not more than eight academic years. However, for the students of availing Gap year facility this period shall be extended up to 2 year at the most and these two years would not be counted for the maximum time for graduation.
- ii. Register for 228 credits and secure all 228 credits.
- iii. Students, who fail to fulfill all the academic requirements for the award of the degree within Eight (Ten for GAP year students) academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled.

#### 2. Courses of study

The following courses of study are offered at present under B. Tech. program with effect from the academic year 2015-16.

S. No.	Branch
01.	Civil Engineering
02.	Computer Science & Engineering
03.	Electrical and Electronics Engineering
04.	Electronics and Communication Engineering
05.	Mechanical Engineering

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

The entire course of study is of four academic years in semester pattern (for regular students) and of three academic years in semester pattern (for lateral entry students).

#### 3. Credits

	Semester	
	Periods/Week	Credits
Theory	04	04
Practical	03	02
Drawing	03	02
	06	04
Online examination	-	02
Project	12	8

#### 4. Course pattern:

- i. The entire course of study is of four academic years on semester pattern.
- ii. A student eligible to appear for the end examination in a subject, but absent in it or has failed in the end examination may appear for that subject at the next supplementary examination offered.
- iii. When a student is detained due to lack of credits / shortage of attendance, he may be re-admitted when the semester / year is offered next after fulfillment of academic regulations.

#### 5. Distribution and Weightage of Marks

- i. The performance of a student in each semester for academic year I, II, III, IV shall be evaluated subject wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition Mini Project, Seminar, Comprehensive Viva Voce and Project Work shall be evaluated for 50, 50, 100 and 150 marks respectively.

- ii. For theory subjects the distribution shall be 30 marks for Internal Evaluation (25 marks for internal test and 05 marks for assignments) and 70 marks for the External Examination.
- iii. For theory subjects, during the semester there shall be 2 midterm examinations. Each midterm examination consists of subjective paper for 25 marks with duration of 1 hour 30 minutes.  
  
First midterm examination shall be conducted for the first half of the syllabus in the middle of the semester and second midterm examination shall be conducted for the second half of the syllabus towards the end of the semester. A weightage of 0.75 for better score and 0.25 for the other score will be considered for awarding the sessional marks in both the midterm examinations. There shall be two assignments in each semester for award of 05 marks so that midterm component will be 30 marks (25 for midterm examinations + 05 marks for assignments).
- iv. For practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 end examination marks. Day-to-day work in the laboratory shall be evaluated for 25 marks by the concerned laboratory teacher based on the report of experiments/jobs. The end examination shall be conducted by the laboratory teacher and another internal examiner.
- v. The Engineering Drawing/Graphics course, offered is to be treated as a Theory Course. Evaluation method adopted shall be same as for any other Theory Course. The Internal evaluation for sessionals will be 15 marks for day-to-day work in the class that shall be evaluated by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two mid term exams in a semester for a duration of 2 hrs each, evenly distributed over the syllabi, for 15 marks giving a weightage of 0.75 for the better score and 0.25 for the other score will be considered. The sum of day to day evaluation and the internal tests will be the final sessionals for the subject.
- vi. There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the department before presentation. The report and the presentation shall be evaluated by the Departmental committee consisting of Head of the department, seminar supervisor and a senior faculty member. The seminar shall be evaluated for 50 marks. There shall be no external examination for seminar.
- vii. There shall be two comprehensive online examinations conducted internally, one in II-II and another in III-II. A student is supposed to secure minimum of 35% marks to secure 2 credits.
- viii. There shall be two choice based credit courses (for other branch students), one in II- I and another in III-II. Each department shall offer a minimum of 3 subjects in such courses. A student shall be given a choice to select any one subject from the list of subjects offered by all faculties under choice based credit courses.
- ix. There shall be two choice based credit courses (same branch students) in IV- I semester. A minimum of six courses must be offered, out of which 2 courses shall be selected by the students.
- x. Massive Open Online Courses (MOOCs) are to be introduced. There shall be 2 MOOCs in the entire course duration.
- xi. A minimum of six online courses (MOOCs) must be offered, out of which 2 courses shall be selected by the students in any each semester as stated above. The students shall register for the opted online courses at the college or offered by authorized institutions/Agencies. The Certificate issued by the college/institution/agency after successful completion of the course shall be considered for the award of credits by the College.
- xii. Out of a total of 150 marks for the project work, 50 marks shall be for Internal Evaluation and 100 marks for the End Semester Examination. The End Semester Examination (viva-voce) shall be conducted by Board of Examiners consisting of Project Supervisor, Head of Department and an External Examiner. The evaluation of project work shall be conducted at the end of the IV year II Semester. The Internal Evaluation shall be on the basis of two seminars of each 25 marks, one will be presented to the project supervisor and another will be presented to the Department committee comprising Head of the Department, Project Supervisor, and one senior faculty of the Department.
- xiii. Comprehensive Viva Voce will be conducted by the Board of Examiners at the time of evaluation of the Project Work, to test the overall subject knowledge of the entire course.

## 6. Attendance Requirements:

- i. A student shall be eligible to appear for University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester/ I year.
- ii. Shortage of Attendance below 62% in aggregate shall in NO case be condoned.
- iii. Shortage of attendance in aggregate up to 13% (62% and above and below 75%) in each semester may be granted by the College Academic Committee valid on Genuine grounds with supporting evidence.
- iv. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
- v. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek re-admission for that semester when offered next.
- vi. A stipulated fee shall be payable towards condonation of shortage of attendance to the University.

## 7. Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

- i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together. For the Seminar he should secure 40% in the internal evaluation.
- ii. A student shall be promoted from II to III year only if he fulfills the academic requirement of securing **40** credits from the preceding regular and supplementary examinations.
- iii. A student shall be promoted from third year to fourth year only if he fulfils the academic requirements of securing **68** credits from the preceding regular and supplementary examinations.
- iv. Lateral Entry students shall be promoted from third year to fourth year only if he fulfills the academic requirements of securing **40 credits** from the preceding regular and supplementary examinations.
- v. Students who fail to earn 228 credits as indicated in the course structure within eight academic years (10 years for Gap year students) from the year of their admission shall forfeit their seat in B.Tech course and their admission shall stand cancelled.

## 8. Transitory Regulations:

Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 1.1.

Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, and they will be in the academic regulations into which the candidate is presently readmitted.

Candidate who were permitted with GAP year shall be eligible for rejoining into the succeeding year of their B.Tech from the commencement of class work and they will be in the academic regulations into which the candidate is presently rejoining.

### 9. With-holding of results:

If the candidate has any dues not paid to the College or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld and he/she will not be allowed / promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.

**10. GAP Year:** Concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after II year to pursue entrepreneurship full time. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The Head of the respective department shall forward such proposals submitted by the students to the College. An evaluation committee shall be constituted by the College to evaluate the proposal submitted by the student and the committee shall decide whether or not to permit student(s) to avail the Gap Year.

### 11. Award of Class:

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

Class Awarded	% of marks to be secured
First Class with Distinction	70% and above
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%
Pass Class	Below 50% but not less than 40%

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum). If any candidate passes through supplementary examinations beyond the duration of the course, he/she may be awarded class based on the % of marks secured as above, except distinction.

i. Grading System is to be introduced. After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

**Table – Conversion into Grades and Grade Points assigned**

Range in which the marks in the subject fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
80-89	A+ (Excellent)	9
70-79	A (Very Good)	8
60-69	B (Good)	7
50-59	C(Average)	6
40-49	D (Satisfactory)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

**12.** The minimum instruction days including exams for each semester shall be 90 days.

**13.** There shall be no branch transfers after the completion of admission process.

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

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

**16.** The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on roles with effect from the dates notified..

B.Tech I Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		Credits
			L	P	
1.		Functional English	4	-	4
2.		Mathematics	4	-	4
3.		Engineering Chemistry	4	-	4
4.		Problem Solving and Programming	4	-	4
5.		Engineering Mechanics	4	-	4
6.		Chemistry Lab	-	3	2
7.		Programming Lab	-	3	2
8.		Fundamentals of Engineering Drawing	-	3	2
					26

L – Lecture, P – Practical

B.Tech I Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		Credits
			L	P	
1.		Communicative English	4	-	4
2.		Mathematical Methods	4	-	4
3.		Engineering Physics	4	-	4
4.		Environmental Science	4	-	4
5.		Engineering Drawing	2	3	4
6.		Communication Skills Lab	-	3	2
7.		Physics Lab	-	3	2
8.		Engineering Workshop & IT Workshop	-	3	2
					26

L – Lecture, P – Practical

B.Tech II Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Probability & Statistics	4	1	-	4
2.		Engineering Thermodynamics	4	1	-	4
3.		Fluid Mechanics & Hydraulic Machinery	4	1	-	4
4.		Machine Drawing	4	1	-	4
5.		Basic Electrical & Electronics Engineering	4	1	-	4
6.		Choice Based Credit Courses (For Non Mechanical Students) 1. Mechanical Technology 2. Material Science 3. Work Shop Technology	4	1	-	4
7.		FMHM Lab	-	-	3	2
8.		EEE Lab	-	-	3	2
9.		Human Values and Professional Ethics	2	-	-	-
		TOTAL	26	6	6	28

L – Lecture, T – Tutorial, P - Practical

B.Tech II Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Managerial Economics & Financial Analysis	4	1	-	4
2.		Material Science & Metallurgy	4	1	-	4
3.		Kinematics of Machinery	4	1	-	4
4.		Manufacturing Technology	4	1	-	4
5.		Strength of Materials	4	1	-	4
6.		Thermal Engineering	4	1	-	4
7.		Manufacturing Technology Lab	-	-	3	2
8.		Strength of Materials Lab	-	-	3	2
9.		Comprehensive Online Examination				2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P - Practical

B.Tech III Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Turbo Machinery	4	1	-	4
2.		Mechanical Measurements	4	1	-	4
3.		Design of Machine Elements-I	4	1	-	4
4.		Dynamics of Machinery	4	1	-	4
5.		Heat Transfer	4	1	-	4
6.		Machine Tools	4	1	-	4
7.		Heat Transfer Lab	-	-	3	2
8.		Mechanical Measurements Lab	-	-	3	2
9.		Advanced Communications Skills Practice	-	-	3	-
		TOTAL	24	6	9	28

L – Lecture, T – Tutorial, P – Practical

B.Tech III Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Refrigeration and Air Conditioning	4	1	-	4
2.		Internal Combustion Engines	4	1	-	4
3.		Engineering Metrology	4	1	-	4
4.		Design of Machine Elements- II	4	1	-	4
5.		CAD / CAM	4	1	-	4
6.		Choice Based Credit Courses (For Non Mechanical Students) 1. Industrial Management 2. Power Plant Engineering 3. Optimization Techniques	4	1	-	4
7.		Machine Tools and Metrology Lab	-	-	3	2
8.		Refrigeration and Air Conditioning Lab	-	-	3	2
9.		Comprehensive Online Examination				2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P - Practical

B.Tech IV Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Tool Design	4	1	-	4
2.		Operations Research	4	1	-	4
3.		Automobile Engineering	4	1	-	4
4.		Robotics	4	1	-	4
5.		<b>Choice Based Credit Courses;; (for Mech students)</b> 1. Composite Materials 2. Nano Technology 3. Non Destructive Evaluation	4	1	-	4
6.		<b>Choice Based Credit Courses;; (for Mech students)</b> 1. Micro Electro Mechanical Systems 2. Energy Conversion from Conventional Sources of Energy 3. Total Quality Management	4	1	-	4
7.		CAD / CAM Lab	-	-	3	2
8.		Internal Combustion Engines Lab	-	-	3	2
		Mini Project	-	-	-	2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P – Practical

B.Tech IV Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Computational Fluid Dynamics	4	1	-	4
2.		Finite Element Methods	4	1	-	4
3.	MOOCs-I	<b>Massive Open Online Courses-I</b> 1. Modern Manufacturing Methods 2. Entrepreneurship 3. Hydraulic & Pneumatic Control 4. Thermal Power Engineering	4	1	-	4
4.	MOOCs-II	<b>Massive Open Online Courses-II</b> 1. Production & Operations Management 2. Automation in Manufacturing 3. Mechanical Vibrations 4. Cryogenics	4	1	-	4
5.		Project Work	-	-	-	8
6.		Seminar	-	-	-	2
7.		Comprehensive Viva-Voce	-	-	-	4
		TOTAL	8	2	-	30

L – Lecture, T – Tutorial, P – Practical



B.Tech I Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		Credits
			L	P	
1.		Functional English	4	-	4
2.		Mathematics	4	-	4
3.		Engineering Chemistry	4	-	4
4.		Problem Solving and Programming	4	-	4
5.		Engineering Mechanics	4	-	4
6.		Chemistry Lab	-	3	2
7.		Programming Lab	-	3	2
8.		Fundamentals of Engineering Drawing	-	3	2
					26

L – Lecture, P – Practical

**UNIT – I****Environmental Consciousness**

Green Cover, Pollution

Tenses, Prepositions, Prepositional Phrases, Writing Letters

**UNIT – II****Emerging Technologies**

Solar Thermal Power, Cloud Computing

Subject-Verb Agreement, Prefixes and Suffixes, Compound Nouns, Imperatives

**UNIT – III****Global Issues**

Child Labour, Food Crisis

Synonyms &amp; Antonyms, Verbs: Regular &amp; Irregular, Homonyms, Homophones and Homographs, Direct and Indirect Speech

**UNIT – IV****Global Issues**

E-Waste, Assistive Technology

Articles, Collocations, Conjunctions, Note-Making, Making Recommendations, If Conditional

**UNIT – V****Space Trek**

Hubble Telescope, A Home in the Sky

Degrees of Comparisons, Voice, Question Tags

**UNIT – VI****Media Matters**

The Evolution of Media, Ten Developments in Media, Advertisements

Paragraph Writing, Effective Writing, Writing Reports, Expansion of Proverbs and Idioms, Commonly Confused Words

**TEXT BOOKS:**

1. Mindscapes: English for Technologists and Engineers, Paper Back 2012 by Anna University.

**Unit-I**

Exact, linear and Bernoulli's equations, Orthogonal trajectories. Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x$ ,  $e^{ax}V(x)$ ,  $xV(x)$ . Method of variation of parameters.

**Unit-II**

Taylor's and Maclaurin's series-Functions of several variables-Jacobian-Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers with three variables only. Radius of curvature.

**Unit-III**

Multiple integral-Double and triple integrals-Change of variables-Change of order of integration.

**Unit-IV**

Vector Calculus: Gradient-Divergence-Curl. Vector Integration-Line integral-Area-Surface and Volume integrals. Vector integral theorems: Green's theorem-Stoke's theorem-Gauss Divergence theorem (Without proofs). Applications of Green's, Stoke's and Gauss Divergence theorems.

**Unit-V**

Laplace Transforms: Definition-Transform of elementary functions-Properties of Laplace Transforms-Transform of derivatives-Transform of integrals-Unit step function-multiplication by  $t^n$ -Division by  $t$ -Evaluation of integrals by Laplace Transforms-Laplace Transform of periodic functions.

**Unit-VI**

Inverse Laplace Transforms-Partial fractions-Other methods of finding inverse transforms-Convolution theorem-Applications of Laplace transforms to Ordinary differential equations of first and second order.

**TEXT BOOKS:**

1. A Text Book of Engineering Mathematics, Vol.1, T.K.V. Iyengar, B. Krishna Gandhi and others, S. Chand and Company.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna publishers.
3. Engineering Mathematics-I, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.

**REFERENCES:**

1. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.
2. Higher Engineering Mathematics, by B.V. Ramana, Mc Graw Hill Publishers.
3. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

**Unit –I :- Water**

Types Of Impurities In Water, Hardness Of Water And Its Units, Disadvantages Of Hard Water. Estimation Of Hardness By Edta Method. Analysis Of Water- Dissolved Oxygen. Problems On Hardness Of Water. Water Treatment For Domestic Purpose. Sterilisation:- Chlorination, Bleaching Powder, Ozonization. Water For Industrial Purpose:-For Steam Generation, Boilen Troubles – Carry Over (Priming & Foaming) Boiler Coreriosion – Scales And Sludges, Caustic Emfrittment. Water Treatment :-Internal Treatment :- Colloidal Phospate, Calgon, Carlronatic, Sodium Aluminates Treatment. External Treatment :- Ion – Exchange And Permutit Process Demineralisation Of Brakish Water – Reverse Osmosis And Electrodialysis.

**Unit –II :- Polymers**

Basic Concepts Of Polymerisation, Types Of Polymerisation Addition And Condensation Polymerisation. Plastomers :- Thermosetting And Therimoplastics Compasiti On Properties And Engineering Applications Of Pvc, Teflon, Bakelite And Nylons. Rubber – Processing Of Natural Rubber And Compounding Elastomers – Unas, Buna N, Polynmethane Rubber, Polysulphide Rubber. Conducting Polymers; Synthesis And Applications Of Polyacetylcnc And Polyaniline. Liquid Crystals Definition, Properties, Suitable Examples And Engineering Applications.

**Unit – III :-Electrochemistry**

Electrochemical Cells :- Measurement Of Emf, Standard Electrode Potential, Concentration Cells, Batteries (Ni-Cell), Lithium Batteries. Fuel Cells: (Hydrogen Oxygen Fuel Cell Adn Methanol Fuel Cell. Insulators :- Definition, Properties And Characteristics Of Insulating Materials, Engineering Applications. Corrosion:- Introduction, Type Of Corrosion ( Dry Corrosion (Direct Chemical Attack), Hlet Corrosion, Theorics Of Corresion. And Mechanism, Electrochemical Theory Of Corrosion. Galranic Series, Galronic Corrosion Concentration Cell Corrosion, Oxygen Absorption Type. Factors Influencing Corrosion – Control Of Corrosion- Cathodic Protection. (Sacrificial Anode And Impressed Current), Inhilitors (Anodic And Cathodic), Electroplating And Electrolese Plating.

**Unit – IV:- Nano Materials**

Definition, Properities And Applications; Explosives And Propellants : Explosives, Classification, Precantions During Storage, Blasting Fuses, Important Explosives Rocket Propellants, Classification Of Propellants. Lubricants : - Principlesa And Function Of Lubricants – Classification And Properties Of Lubricants – Viscosity, Flash And Fire Points, Cloud And Pour Points, Aniline Point, Neutralisation Number And Mechanical Strength.

**Unit –V:- Fuels And Combustion**

Definition And Classification Of Fuels. Solid Liquid And Gaseous Fuels, Characteristics Of A Good Fuel. Metallergical Coke – Characteristics And Manufacture (Otto – Halfmann). Petroleum: Refining Of Petroleum, Gasoline – Octane Number, Diesel -Cetane Number. Petroleum – Refining – Synthetic Petrol. Calorific Value And Its Determination (Bomb Calorimeter – Junkers Gas Calorimeter. Combustion: Flue Gas Analysis By Orsats Apparatus.

**Unit –VI:- Chemistry Of Engineering Meterials**

Cement : Composition Of Portland Cement, Classification, Preparation (Dry And Wet Processes), Setting And Handling Refractories :- Definition, Classification With Examples Criteria Of A Good Refractory Material; Causes For The Failure Of A Refractory Material Carbon Clusters: - Fullerenes And Carbon Nano Tubes.

**Unit I-** Overview of Computers and Programming - Electronic Computers then and Now, Computer Hardware, Computer Software, Algorithm, Flowcharts, Software Development Method, Applying the Software Development Method.

**Unit II-** Introduction to C Language - C Language Elements, Variable Declarations and Data Types, Executable Statements, General Form of a C Program, Arithmetic Expressions, Formatting Numbers in Program Out, Interactive Mode, Batch Mode and Data Files.

**Unit III-** Selection Structures : Control Structures, Conditions, The if Statement, if Statements with Compound Statements, Decision Steps in Algorithms, Nested if Statements and Multiple-Alternative Decisions, The switch Statement. Repetition and Loop Statements: Repetition in Programs, Counting Loops and the while Statement, Computing a Sum or a Product in a Loop, The for Statement, Conditional Loops, Loop Design, Nested Loops, The do-while Statement and Flag-Controlled Loops. Simple Data Types: Representation and Conversion of Numeric Types, Representation and Conversion of Type char, Enumerated Types, Iterative Approximations

**Unit IV-** Top Down Design with Functions: Building Programs from Existing Information, Library Functions, Top-Down Design and Structure Charts, Functions without Arguments, Functions with Input Argument. Modular Programming (Functions): Functions with Simple Output Parameters, Multiple Calls to a Function with Input/Output Parameters, Scope of Names, Formal Output Parameters as Actual Arguments, A Program with Multiple Functions. Arrays: Declaring and Referencing Arrays, Array Subscripts, Using for Loops for Sequential Access, Using Array Elements as Function Arguments, Array Arguments, Searching and Sorting an Array, Multidimensional Arrays.

**Unit V-** Pointers - Introduction, Features of Pointers, Pointer Declaration, Arithmetic Operations With Pointers, Pointers and Arrays, Pointers and Two-Dimensional Arrays, Array of Pointers, Pointers to Pointers, Void Pointers, Memory Allocation Functions, Programming Applications, Pointer to Functions, Command- Line Arguments. Strings: String Basics, String Library Functions: Assignment and Substrings, Longer Strings: Concatenation and Whole-Line Input, String Comparison, Arrays of Pointers, Character Operations, String-to-Number and Number-to-String Conversions.

**Unit VI-** Recursion: The Nature of Recursion, Tracing a Recursive Function, Recursive Mathematical Functions, Recursive Functions with Array and String Parameters, Problem Solving with Recursion, A Classic Case Study in Recursion: Towers of Hanoi. Structure and Union: User-Defined Structure Types, Structure Type Data as Input and Output Parameters, Functions Whose Result Values Are Structured, Problem Solving with Structure Types, Parallel Arrays and Arrays of Structures, Union Types.

**Unit VII-** Files - Introduction, Streams and File Types, Steps for File Operations, File I/O Structures, Read and Write, Other File function, Searching Errors in Reading/Writing of Files, Low Level Disk I/O, Command Line Arguments, Application of Command Line Arguments, File Status functions (error handling).

**Unit VIII-** Dynamic Memory Allocation, Introduction to Data Structures: Linear and Non Linear Data Structures, Searching and Sorting: Bubble Sort, Selection Sort, Linear Search, Binary Search.

#### **.TEXT BOOKS :**

1. Problem Solving and Programming Design in C, J.R.Hanly & Elliot B. Koffman 5<sup>th</sup> Edition, Pearson Addison Wessley.

#### **REFERENCES :**

2. Programming in C and Data Structures, J.R.Hanly, Ashok.N.Kamthane & A.AnandaRao, Pearson Education.
3. Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
4. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
5. C and Data Structures, a snapshot oriented treatise with live engineering examples, Dr.N.B.Venkateswarlu, Dr. E.V.Prasad, S. Chand
6. C and Data Structures, E.Balaguruswamy, Tata Mc Graw Hill
7. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning

**UNIT I**

**Basic Concepts** - System of forces– Moment of forces and its Application – Couples and Resultant of Force System

**Equilibrium of System of Forces** : Free body diagrams –Types of Supports – Support reactions for beams with different types of loading – concentrated, uniformly distributed and uniformly varying loading.

**UNIT II**

**Analysis of Perfect Frames** : Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints and methods of sections for vertical loads, horizontal loads and inclined loads.

**UNIT III**

**Friction** : Types of friction– laws of Friction–Limiting friction–Cone of limiting friction– static and Dynamic Frictions – Motion of bodies.

**UNIT IV**

**Centroid and Center of Gravity** : Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies – Centre of Gravity of Composite figures.

(Simple problems only).

**UNIT V**

**Area of Moment of Inertia** - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures

**Mass Moment of Inertia** : Moment of Inertia of Simple solids, Moment of Inertia of composite masses.(Simple problems only)

**UNIT VI**

**Mechanical Vibrations** : Definitions, Concepts. Simple harmonic motion. Free vibrations. Simple, Compound and Torsional pendulums- Numerical problems

**TEXT BOOKS:**

1. Engineering Mechanics, Shames & Rao – Pearson Education.
2. Engineering Mechanics, Fedrinand L.Singer – B.S. Publishers.
3. Engineering Mechanics, Bhavikatti and Rajasekharappa.

**REFERENCES:**

1. Engineering Mechanics-Statics and dynamics, A.Nelson, Tata MCGraw-Hill Company.
2. Mechanics of Materials by Timoshenko & Gere, CBS.
3. Engineering Mechanics – B. Bhathacharya- Oxford University Publications

B.Tech I Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week		Credits
			L	P	
1.		Communicative English	4	-	4
2.		Mathematical Methods	4	-	4
3.		Engineering Physics	4	-	4
4.		Environmental Science	4	-	4
5.		Engineering Drawing	2	3	4
6.		Communication Skills Lab	-	3	2
7.		Physics Lab	-	3	2
8.		Engineering Workshop & IT Workshop	-	3	2
					26

L – Lecture, P – Practical

**UNIT – I**

Lessons from the Past

The Importance of History, The Mother of Modern Corporatism

Pure Vowels, Just-A-Minute, Designing Posters

**UNIT – II**

Energy

In Search of Our Energy Solutions, Wind Energy

Diphthongs, Role Play, Making Conversation/Situational Dialogues

**UNIT – III**

Engineering Ethics

Learning from Disasters, Biotechnology: Ethical Questions

Consonant Sounds, Debate, Blog Making

**UNIT – IV**

Travel and Tourism

Ten Reasons Why Travel is a Waste of Time, Atithi Devo Bhava

Syllables, Word Stress Rules, Group Discussion

**UNIT – V**

Getting Job Ready

Boeing, Arvind Mills

Presentation Skills, Writing Emails, Creativity: Thinking and Writing

**UNIT – VI**

Getting Job Ready

Toyota Production System, Preparing for the Interviews

Types of Interviews, Mock Interviews, Personality Development.

**TEXT BOOKS:**

1. Mindscapes: English for Technologists and Engineers, Paper Back 2012 by Anna University.



**UNIT -I**

Matrices: Elementary row transformations – Rank – Echelon form, normal – Solution of Linear System of Homogeneous and Non Homogeneous equations –Eigen values, Eigen vectors – (Excluding proofs of Properties). Cayley – Hamilton Theorem(Excluding proof) – Inverse and powers of a matrices by Cayley-Hamilton theorem – Diagonalization of matrix. Calculation of powers of matrix.

**UNIT-2**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta method - Milne's Predictor-Corrector Method.

**UNIT-3**

Fourier series:Determination of Fourier coefficients- Fourier series of Even and odd functions- Fourier series in an arbitrary interval-Even and odd periodic continuation- Half range Fourier sine and cosine expansions.

**UNIT-4**

Fourier integral theorem (statement only) – Fourier sine and cosine integrals. Fourier transform- Fourier sine and cosine transforms- Properties- Inverse transforms- Finite Fourier transforms.

**UNIT-5**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions-Method of separation of variables-Solutions of one dimensional wave equation, heat equation and two-dimensional Laplace equation under initial and boundary conditions.

**UNIT-6**

z-transform –inverse z-transform-Properties-Damping rule –shifting rule- Initial and final value theorems. Convolution theorem-Solution of difference equations by transforms.

**TEXT BOOKS:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.
3. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad S. Chand publication.
4. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
5. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

**REFERENCES:**

1. Numerical Methods for Scientific and Engineering Communication, M.K.Jain,S.R.K. Iyengar& R.K.Jain, New Age international Publishers.
2. Mathematical Methods –Pal –Oxford.
3. Introduction to Numerical Analysis –S.S.Sastry Printice Hall of India
4. Mathematical Methods, S.K.V.S.Sri Ramachary, M. Bhujanga Rao, P.B.Bhaskar Rao & P.S.Subramanyam, BS Publications..

**UNIT I**

**OPTICS:** Interference- Interference in thin film by reflection-Newton's rings-Diffraction-Fraunhofer diffraction due to single slit-Fraunhofer diffraction due to double slit and diffraction grating.

**UNIT II**

**CRYSTALLOGRAPHY:** Introduction-Space lattice- Unit cell-Lattice parameters –Bravias lattice-Crystal system-Packing fraction of SC, BCC and FCC –Directions and planes in crystals-Miller indices-Interplanar spacing in cubic crystals-X-ray diffraction–Bragg's law.

**UNIT III**

**QUANTUM MECHANICS:** Matter waves-de Broglie hypothesis and properties-Heisenberg's uncertainty principle-Schrödinger's time dependent and independent wave equations-Physical significance of wave function-Particle in one dimensional infinite potential well.

**UNIT IV**

**SEMICONDUCTORS:** Intrinsic and Extrinsic semiconductors-Drift and Diffusion currents and Einstein's equation-Hall effect-Formation of p-n junction.

**MAGNETIC MATERIALS:** Basic definitions- Classification of magnetic materials into dia, para, ferro, antiferro and ferri magnetic materials-Hysteresis- Soft and Hard magnetic materials.

**UNIT V**

**SUPERCONDUCTIVITY:** Introduction-General properties-Meissner effect-Penetration depth-Effect of magnetic field-Type I and Type II superconductors-Flux quantization-Josephson effects-Application of superconductors.

**UNIT VI**

**LASERS:** Introduction- Spontaneous and stimulated emission of radiation-Einstein's coefficients-Population inversion-Ruby laser-He-Ne laser-Application of lasers.

**FIBER OPTICS:** Introduction-Principle of optical fiber-Acceptance angle and Acceptance cone-Numerical aperture-Types of Optical fibers-Application of optical fibers.

**Text Books:**

1. Engineering Physics-K. Thyagarajan, MacGraw Hill Education (India) Private Limited, New Delhi, 2015.
2. Engineering Physics- K. Vijay Kumar, S. Chand & Co. Ltd.

**References:**

1. Engineering Physics-P.K. Palaniswamy, 2<sup>nd</sup> Edition, SciTech Publications
2. Engineering Physics-S. Maniaidu-Pearson Education Private Ltd.
3. Physics for Engineers-N.K. Verma, 1<sup>st</sup> Edition, PHI Learning Private Ltd.

**UNIT-I**

**Introduction of Environmental Studies-Natural Resources:** Definition, The Global environment and its segments; Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere Scope and Importance of Environmental Studies – Need for Public Awareness. Renewable and non-renewable resources – Natural resources and associated problems – Forest resources: Introduction –deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources :Introduction– Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Introduction, 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. - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

**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: 1. Forest ecosystem. 2. Grassland ecosystem. 3. Desert ecosystem. 4. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**UNIT – III**

**Biodiversity and its conservation:** Introduction - Definition: genetic, species and ecosystem diversity. – Biogeographical 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:** Definition, Cause, effects and control measures of :1. Air pollution. 2. Water pollution 3. Soil pollution 4. Marine pollution 5. Noise pollution 6. Thermal pollution 7 Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

**UNIT-V**

**Social Issues and the Environment:** From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, and 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.

**UNIT-VI**

**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. ,Infectious diseases,-Tuber colossi,cancer,Water Borne Diseases-Malaria,Diheria -Women and Child Welfare. - Role of information Technology in Environment and human health. -Case Studies.

**TEXT BOOKS:**

1. Textbook of Environmental Studies for Undergraduate Courses by ErachBharucha for University Grants commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.
3. A Basic Course in environmental Studies by S.Deswal and A.Deswal ,Dhanpat Rai & Co.

**UNIT – I**

**Projection of points and Lines :** Principles of Orthographic Projection – Conventions – First and Third Angle Projections. Projections of Points, Lines inclined to one or both planes, Problems on projections, Finding True lengths & traces only.

**UNIT – II**

**Projections of Planes :** Projections of regular Plane surfaces – plane surfaces inclined to both planes.

**UNIT – III**

**Projections of Solids :** Projections of Regular Solids inclined to one plane.

**UNIT – IV**

**Sections & Developments of Solids:** Section Planes and Sectional views of Right Regular Solids–Prism, Cylinder, Pyramid and Cone – True shapes of sections.

Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid, Cone and their Sectional parts.

**UNIT – V**

**Isometric & Orthographic 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 – Conventions.

**UNIT – VI**

**Interpenetration of Right Regular Solids :** Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Square Prism Vs Square Prism.

**TEXT BOOKS:**

- 1.Engineering Drawing, N.D. Bhat / Charotar
2. Engineering Drawing, Johle /Tata McGraw-Hill
- 3.Engineering Drawing, Shah and Rana, 2/e Pearson education

**REFERENCES:**

1. Engineering Drawing and Graphics, Venugopal/ New age
2. Engineering Drawing, B.V.R. Guptha, J.K. Publishesrs

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Probability & Statistics	4	1	-	4
2.		Engineering Thermodynamics	4	1	-	4
3.		Fluid Mechanics & Hydraulic Machinery	4	1	-	4
4.		Machine Drawing	4	1	-	4
5.		Basic Electrical & Electronics Engineering	4	1	-	4
6.		Choice Based Credit Courses (For Non Mechanical Students) 1. Mechanical Technology 2. Material Science 3. Work Shop Technology	4	1	-	4
7.		FMHM Lab	-	-	3	2
8.		EEE Lab	-	-	3	2
9.		Human Values and Professional Ethics	2	-	-	-
		TOTAL	26	6	6	28

L – Lecture, T – Tutorial, P – Practical

**UNIT – I**

Probability: Sample Space and events – Probability – The axioms of Probability – Some Elementary theorems – Conditional Probability – Baye's theorem.

**UNIT – II**

Random Variables: Discrete and continuous - Distribution function and its Properties – Density and its properties. Theoretical distributions: Binomial, poisson and Normal distributions – Related properties – Fitting distributions.

**UNIT – III**

Sampling distributions : Population and samples – Sampling distribution of mean (known and unknown) Estimation: Point estimation – Interval estimation – Bayesian estimation.

**UNIT – IV**

Tests of Hypothesis – Hypothesis concerning Means and Proportions – One tail and two tail tests – Type I and Type II errors. Tests of significance – Student's t –test, F – test,  $\chi^2$  test – Goodness of fit – Contingency test.

**UNIT – V**

Analysis & Variance : Some general principles – Completely Randomized Design (CRD), Latin Square Design (LSD) and their applications – ANOVA for one way and two way classification.

**UNIT – VI**

Statistical Quality Control: Concept of quality of manufacturers product – Defects & defectives, causes of variation – Random & assignable – The principle of Sheward Control Chart – Control charts for measurements & attributes P -Chart, C-Chart, X- Chart and R-Chart.

**TEXT BOOKS:**

- 1) Probability and Statistics for Engineers by Richard A Johnson
- 2) Probability & Statistics for Engineers by R.A.Johnson & C.B.Gupta, Pearson Education 2006.
- 3) Probability & Statistics by T.K.V. Iyengar, B. Krishna Gandhi and others, S.Chand and company.

**REFERENCES:**

- 1) A Text book of Probability and Statistics by Dr. Shahnaz Bathul.
- 2) Fundamental Mathematical Statistics by S.C. Guptha and V.K. Kapoor – S. Chand Co

**Unit-I**

**Basic Concepts and Definitions :** Macroscopic & Microscopic approaches, Thermodynamic system, state, properties, processes and cycle, Thermodynamic Equilibrium, quasi-static process, Zeroth Law of Thermodynamics.

**Work and Heat Transfer:** path and point functions – Non flow (PdV) or displacement work in various processes, Heat Transfer, comparison of work and heat Transfer.

**Unit-II**

**First Law of Thermodynamics :** First law for a closed system undergoing a cycle and for a process, Joules experiment –specific heat at constant volume and constant pressure, enthalpy, PMM-I.

First Law Applied to Flow Systems: Control volume, steady flow process, applications of steady flow energy equation. Simple problems on steady flow energy equation.

**Unit-III**

**Second Law of Thermodynamics :** Heat engine, Kelvin-Plank statement, Clausius statement, refrigerator and heat pump, equivalence of Kelvin plank and clausius statements, reversibility and irreversibility, Carnot Cycle, Carnot's Theorem, corollary of Carnot's theorem, thermodynamic temperature scale, efficiency of a reversible heat engine, PMM-II - simple problems.

**Unit-IV**

**Entropy :** Clausius' theorem, Clausius inequality –Definition of entropy, principle of entropy increase, T-S plot, change in entropy in various reversible processes.

**Availability:** Available energy, maximum work in a reversible process, availability in non flow and flow processes.

**Unit-V****Ideal and Real Gases :**

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states.

Real gases - Deviations from perfect Gas Model – Vander Waals Equation of State.

**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, specific Heats and Entropy of Mixture of perfect Gases and Vapour.

**Unit-VI**

**Properties of Pure Substances :** Pure substance, phase transformation, Study of P-V,T-S diagrams for pure substances - quality and dryness fraction of steam - Use H-S or Mollier Diagram & steam tables - Simple problems on quality and dryness fraction.

**TEXT BOOKS:**

1. P.K. Nag Engineering Thermodynamics, TMH Publishers, New Delhi
2. Thermodynamics – Yadav" Central Publishers
3. Engineering Thermodynamics, K.Rama Krishna, Anuradha Publishers.

**Reference Books:**

1. B.P Mishra, Engineering Thermodynamics
2. E. Ratha Krishna, Fundamentals of Engineering Thermodynamics, PHI Publishers, New Delhi

**UNIT I**

Fluid Statics: Dimensions and units: Physical properties of fluids-specific gravity, viscosity, surface Tension vapor 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 lines and stream tube, classification of flows-steady & unsteady, uniform, non uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow. Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

**UNIT III**

Closed conduit flow: Laminar and turbulent flow through pipes: Reynolds experiment significance of Reynold's number, formulae for laminar flow through circular pipes, Turbulent flow-Darcy Weisbach equation, - Minor losses in pipes- pipes in series and pipes in parallel - Measurement of flow: pilot tube, venturimeter, and orifice meter.

**UNIT IV**

Basics of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**UNIT V**

Hydraulic Turbines : Introduction to hydroelectric power station-heads and efficiencies-Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies –draft tube theory-functions and efficiency. Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, governing ofturbines, cavitation, selection of type of turbine.

**UNIT VI:**

Centrifugal Pumps: Classification, working, Work done and efficiency, loss of head; specific speed, minimum starting speed and characteristic curves for centrifugal pumps. Pumps in series and parallel, NPSH. Reciprocating Pumps: Working, Discharge, slip.

**TEXT BOOKS:**

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by R. K. Rajput.
3. Fluid Mechanics and Hydraulic Machines by R.K. Bansal

**REFERENCES:**

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. (Chapter 12 – Fluid Flow Measurements).



**UNIT – I**

**Drawing Conventions :** Conventional representation of materials, common Machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

**Screwed Fastenings:** Various thread profiles, Square and hexagonal bolts and nuts, Assembly of bolt, nut and washer, Eye bolts. Locking arrangements for nuts, Foundation bolts.

**UNIT - II**

Keys, Cotter and Pin Joints: Different types of keys in assembly, cotter joint with sleeve, cotter joint with socket and spigot ends, cotter joint with gib, knuckle joint. **Bearings:** Solid and bushed journal bearing, Pedestal bearing, Footstep bearing.

**Unit-III**

Riveted Joints: Different types of riveted heads, Single riveted lap joint, double riveted chain and zigzag lap and butt joints.

**Unit-IV**

Shaft Couplings: Muff couplings, Flanged coupling, Compression coupling, Universal coupling and Oldham coupling.

**Unit - V**

**Assembly Drawing:** Assembly drawings of the following:

**Engine Parts:** Stuffing box, Steam engine Crosshead, eccentric. Petrol engine Connecting rod.

Machine Tool Parts and Accessories: Square tool post, Lathe Tail Stock and Shaper tool post.

**Unit - VI**

Miscellaneous Parts: Screw Jack, Swivel bearing, Plummer block and Pipe Vice.

**TEXT BOOKS:**

1. K.L.Narayana, K.Venkata Reddy, Machine Drawing, NAI Publication, New Delhi.
2. N.D. Junnarkar, Machine Drawing, Pearson Publication, New Delhi.
3. N.Sidheswar, P. Kannaiah, Machine Drawing, TMH Publishers, New Delhi

**REFERENCE BOOKS:**

1. K.R.Gopalakrishna, Machine Drawing, Subhash Publication, New Delhi.
2. P.S.Gill, Machine Drawing, Kataria Publication, New Delhi.

**UNIT – I**

**Electrical DC Circuits:** Basic definitions (electrical conductor, insulator, semiconductor, electrical circuit, electric current, electric potential, EMF and electric potential difference) - Types of elements(active and passive elements)- Ohm's Law and its limitations-electric power-electrical energy- Kirchhoff's Laws- Resistances in series- Resistances in parallel- Star to delta and delta to star transformations.

**UNIT – II : DC Machines**

**DC-Generators:** Working Principle and construction of DC Generator– Generated emf equation – types of DC Generators-simple problems regarding EMF.

**DC Motors :** Working Principle of DC Motor-types of DC Motors -back emf -torque equation –speed control of DC Shunt Motor – applications of DC machines -losses in DC machines- Swinburne's test and efficiency calculation –simple problems.

**UNIT - III**

**Transformers :** Principle of operation of single phase transformers –Constructional features –Theory of an Ideal Transformer- EMF equation –Practical Transformer on no load and load–Equivalent circuit-Impedance Ratio-Shifting of Impedances – losses- regulation -OC & SC test- efficiency –simple problems.

**UNIT - IV**

**Electrical Instruments :** Introduction-Types of electrical instruments –Principle of Operation of indicating instruments– Essentials of Indicating Instruments-Deflecting Torque-Controlling Torque –Damping Torque-PMMC and Moving Iron Instruments (Operation and Construction only).

**UNIT - V**

**Diode and its Characteristics :** Formation of n- type and p-type semiconductor –Construction of P-n junction diode, symbol - V-I Characteristics- Diode Applications-Rectifiers – Half wave-Full wave-mid point and bridge type-simple Problems.

**UNIT - VI**

**Transformers and CRO :** Formation of PNP and NPN transistors – CE configuration of NPN and PNP transistors- applications -Transistor as an amplifier-SCR characteristics and applications- construction and Principle of CRO(operation only)-Applications.

**TEXT BOOKS:**

1. Principles of Electrical and Electronics Engineering by V.K.Mehta, S.Chand & Co.
2. Introduction to Electrical Engineering – M.S Naidu and S. Kamakshaiah, TMH Publ.

**REFERENCES:**

1. Basic Electrical Engineering by Kothari and Nagarith, TMH Publications, 2nd Edition.
2. Electronics and Devices by salivahan, TMH Publications

**UNIT-I:**

Classification - Working of Cochran and Babcock Wilcox Boilers - Modern High Pressure Boilers - Lamont, Loeffler and Benson Boilers.

**UNIT-II:**

Steam Turbines - Impulse (De Laval) and Reaction Turbines. Internal Combustion ( I.C) Engines - Working principle of petrol and Diesel Engines - Four stroke and two stroke Cycles.

**UNIT-III**

Refrigeration - Principle of Vapour Compression and Vapour absorption Systems - Refrigerants  
Air Conditioning - Terminology - Classifications - Summer Air Conditioning for Hot and Dry weather - Window Room Air Conditioner.

**UNIT-IV**

Patterns - Basic principles of moulding - Simple examples of mould making - Making of Cast Iron - Crucible furnace and Cupola - Working principles - Casting defects.

**UNIT-V**

Principles of forging - Mechanical power hammers - Hot and Cold forging processes - Rolling, Extrusion and Wire Drawing.

**UNIT-VI**

Principles of Welding - Fundamentals of Arc Welding - Gas Welding and Gas Cutting - Thermit Welding - Soldering and Brazing.

**TEXT BOOKS:**

1. Basic Mechanical Engineering by K.Venugopal and V.Prabhu Raja.
2. Mechanical Technology by Khurmi.
3. Thermal Engineering / Rajput / Lakshmi Publications.
4. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt. Ltd., Mumbai,

**REFERENCES:**

1. P.C. Sharma, "A text book of production technology", S.Chand and Company,
2. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand.

**UNIT – I:****ATOMIC AND IONIC ARRANGEMENTS:**

Amorphous Materials : Principles and Technological Applications, Lattice, Unit cell, Basis, and Crystal Structures, Points, Directions, and Planes in the unit cell, Crystal Structures of Ionic Materials

**Implementation in the Atomic and Ionic Arrangements:**

Points Defects, Dislocations, Significance of Dislocations, Schmid's Law, Surface defects

**UNIT – II:****MECHANICAL PROPERTIES: FUNDAMENTALS AND TENSILE, HARDNESS, AND IMPACT**

**TESTING:** The Tensile Test: Use of the Stress – Strain Diagram, True Stress and True Strain, The Bend Test for Brittle Materials, Hardness of Materials, Strain Rate effects and Impact Behaviour

**UNIT – III:**

**Heat Treatment of Steels and Cast Irons:** Designations and Classification of Steels, Simple Heat treatments, Isothermal Heat treatments, Quench and Temper Heat treatments, Surface treatments, Weldability of Steel.

**UNIT – IV:**

**FRACTURE MECHANICS, FATIGUE, AND CREEP BEHAVIOUR:** Fracture Mechanics, The Importance of Fracture Mechanics, Microstructural Features of Fracture in Metallic Materials., Microstructural Features of Fracture in Ceramics, Glasses, and Composites, Fatigue, Result of the Fatigue test, Application of Fatigue test, Creep, Stress Rupture, and Stress Corrosion, Evaluation of creep Behaviour

**UNIT – V:**

**POLYMERS:** Classifications of Polymers, Typical Thermoplastics, Structure - Property Relationship in thermoplastics, Effect of Temperature on thermoplastics, Mechanical Properties of thermoplastics, Elastomers (Rubbers), Thermosetting Polymers

**Ceramic Materials:** Applications of Ceramics, Properties of Ceramics, Characteristics of Sintered ceramics, Glass Ceramics, Refractories.

**UNIT – VI:**

**COMPOSITES: TEAMWORK AND SYNERGY IN MATERIAL:** Particulate Composites, Fibre – Reinforced Composites, Characteristics of Fibre – Reinforced composites, Manufacturing Fiber and Composites, Fiber Reinforced Systems and Applications, Laminar Composite Materials, Examples and Applications of Laminar Composites.

**TEXT BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Material Science & Metallurgy / Dr.C.D.Yesudian & Dr.Harris Samuel/Scitech Publications.
3. Essential of Materials science and engineering/ Donald R.Askeland/Thomson.

**REFERENCES:**

1. High temperature materials technology /Campbell E.E. and Sherwood /John Wiley and Sons, 1967
2. High temperature technology /Campbell I.E. /John Wiley
3. High temperature materials /Hehmann R.F./Wiley and sons/1967.
4. Behaviour of high temperature alloys/Proceeding of International conference/ 1979.

**UNIT-I**

**Casting Process:** Casting, casting terms, pattern materials, types of patterns, pattern allowances, color code for patterns, Molding sands, core sands, properties of moldings and its ingredients, different types of molding machines, use of chaplets, chills, riser and gating system.

**UNIT-II**

**Special Casting Process:** CO2 molding, die casting, centrifugal casting, shell molding, investment or lost wax process; Casting defects causes and remedies. Furnaces used in foundry–cupola, pit furnace, electric arc furnaces.

**UNIT- III**

**Fabrication Process:** Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Laser, Electron beam welding – Friction welding – Diffusion welding

**UNIT – IV**

Engine lathe – Principle of working, specification of lathe – types of lathes – work holders, tool holders – Box Tools, Taper turning, thread turning and attachments for Lathes. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout.

**UNIT – V**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine-deep hole drilling machine.

**UNIT – VI**

Milling machine – Principles of working – specifications – classifications and principle features of milling machines – machining operations, Types and geometry of milling cutters– methods of indexing –Direct Rapid indexing, Plain or simple indexing, Compound indexing, Differential indexing and angular indexing.

**TEXT BOOKS:**

1. Hajra Choudhury, “Elements of Workshop Technology, Vol. I and II”, Media Promoters Pvt. Ltd., Mumbai,
2. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited,
3. Workshop Technology – Vol II, B.S. Raghuvamshi.
4. Production Technology by R.K Jain

**REFERENCES:**

1. P.C. Sharma, “A text book of production technology”, S.Chand and Company,
2. Begman, ‘Manufacturing Process’, John Wiley & Sons,
3. Manufacturing science by Amitab Ghosh and Ashok Kumr Mallik, Tata-McGraw-Hill Publications

B.Tech II Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Managerial Economics & Financial Analysis	4	1	-	4
2.		Material Science & Metallurgy	4	1	-	4
3.		Kinematics of Machinery	4	1	-	4
4.		Manufacturing Technology	4	1	-	4
5.		Strength of Materials	4	1	-	4
6.		Thermal Engineering	4	1	-	4
7.		Manufacturing Technology Lab	-	-	3	2
8.		Strength of Materials Lab	-	-	3	2
9.		Comprehensive Online Examination				2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P – Practical

**UNIT I**

**Introduction to Managerial Economics:** Definition, Nature and Scope of Managerial Economics–Demand Analysis: Demand determinants, Law of Demand and its exceptions.

**UNIT II**

**Elasticity of Demand:** Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting (survey methods, statistical methods, expert opinion method, test marketing, controlled experiments, judgmental approach to demand forecasting)

**UNIT III**

**Business & New Economic Environment:** Characteristic features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, Changing Business Environment in Post-liberalization scenario.

**UNIT IV**

**Capital and Capital Budgeting:** Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance.

Nature and scope of capital budgeting, features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems)

**UNIT V**

**Introduction to Financial Accounting:** Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

**UNIT VI**

**Financial Analysis through ratios:** Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt- Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

**TEXT BOOKS:**

1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2005.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003.

**REFERENCES:**

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui, Managerial Economics & Financial Analysis, New age International Space Publications.
6. Domnick Salvatore: Managerial Economics In a Global Economy, 4th Edition, Thomson.
7. Narayanaswamy: Financial Accounting—A Managerial Perspective, PHI.
8. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech.
9. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas.
10. Truet and Truet: Managerial Economics:Analysis, Problems and Cases, Wiley.Dwivedi:ManagerialEconomics, 6th Ed., Vikas.

**UNIT – I**

**Structure of Metals:** Crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size- Mechanical properties of engineering materials.

**Constitution of Alloys:** Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

**UNIT-II**

**Testing of Engineering Materials:** Testing of materials under tension, Compression and shear loads, Hardness tests- Brinell, Vicker's and Rockwell, Impact test- Izod and Charpy tests.

**UNIT - III**

**Equilibrium Diagrams:** Experimental methods of construction of equilibrium diagrams, equilibrium cooling and heating of alloys, Lever rule, coring, eutectic systems, peritectic reaction. Transformations in the solid state –allotropy, eutectoid, peritectoid reactions, phase rule.

**UNIT -IV**

**Cast Irons and Steels:** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons.

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

**UNIT – V**

**Heat Treatment of Alloys:** Effect of alloying elements on Fe-Fe<sub>3</sub>C system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Harden ability, surface - hardening methods, Age hardening treatment, sub zero treatment of alloys.

**UNIT - VI**

**Powder Metallurgy:** Introduction, advantages of Powder Metallurgy, Preparation of metal powders- Mixing, Blending, Compacting, Sintering & Hot-pressing – applications of powder metallurgy.

**TEXT BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avenner.
2. Material Science & Metallurgy / Dr.C.D.Yesudian & Dr.Harris Samuel/Scitech Publications.
3. Material Science and Metallurgy/ O.P.khanna
4. Essential of Materials science and engineering/ Donald R.Askeland/Thomson.

**REFERENCES:**

1. Material Science and Metallurgy/ kodgire.
2. Science of Engineering Materials / Agarwal
3. Material Science and Metallurgy/ Pakkirappa



**UNIT – I**

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

**Machines :** Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism –inversions of quadric cycle, chain – single and double slider crank chains.

**UNIT - II**

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

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement, velocity and acceleration of slider – Acceleration diagram for a given mechanism, Klein’s construction.

**UNIT-III**

**Plane and Motion of Body:** Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

**Straight Line Motion Mechanisms:** Exact and approximate copiers and generated types –Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph.

**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. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases.

**UNIT – V**

**Toothed Gearing :** Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference.Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

**UNIT – VI**

**Gear Trains :** Introduction – Train value – Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains.

**TEXT BOOKS:**

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers
2. Theory of Machines by Thomas Bevan/ CBS.
3. Theory of machines by Jjagadishlal.

**REFERENCES:**

1. Theory of Machines R.S Khurmi & J.K Gupta.
2. Theory of Machines / R.K Bansal

**UNIT-I**

**Casting Process:** Casting, casting terms, pattern materials, types of patterns, pattern allowances, color code for patterns, Molding sands, core sands, properties of moldings and its ingredients, different types of molding machines, use of chaplets, chills, riser and gating system.

**UNIT-II**

**Special Casting Process:** CO2 molding, die casting, centrifugal casting, shell molding, investment or lost wax process; Casting defects causes and remedies. Furnaces used in foundry–cupola, pit furnace, electric arc furnaces.

**UNIT- III**

**Fabrication Process:** Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding - Gas metal arc welding – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Laser, Electron beam welding – Friction welding – Diffusion welding – Flame cutting – Weld defects – Brazing and soldering process – Filler materials and fluxes, Design Considerations in welding.

**UNIT- IV**

**Bulk Deformation Processes:** Hot working –types and cold working of metals-types – Forging processes – Open and close die forging –Types of Forging Machine – Typical forging operations –Rolling of metals – Flat strip rolling – Types of Rolling mills –Forces in rolling and power requirement-Tube piercing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion .

**UNIT-V**

**Sheet Metal Processes:** 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.

**UNIT- VI**

**Processing of Plastics:** Types of plastics, properties, applications and their processing methods & equipments (Blow and injection molding).

**TEXT BOOK:**

1. Hajra Choudhury, “Elements of Workshop Technology, Vol. I and II”, Media Promoters Pvt. Ltd., Mumbai,
2. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited,
3. Manufacturing Engineering and Technology/ Kalpakjain.S/ Pearson Education.
4. Production Technology by R.K Jain

**REFERENCE BOOKS:**

1. B.S.Magendran Parashar & R.K. Mittal, “Elements of Manufacturing Processes”, Prentice Hall of India,
2. P.C. Sharma, “A text book of production technology”, S.Chand and Company,
3. Begman, ‘Manufacturing Process’, John Wiley & Sons,
4. Manufacturing Process by Pakkirappa

**UNIT – I**

**Simple Stresses and Strains:** Elasticity and plasticity – Types of stresses and strains – Hook'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.

**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 cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – 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 modulus 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 beam sections like rectangular, circular, triangular, I, T angle sections.

**UNIT – IV**

**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**

**Torsion of Circular Shafts :** Theory of pure torsion – Derivation of Torsion equations:  $T/J = q/r = N\theta/L$  – Assumptions made in the theory of pure torsion – Torsion moment of resistance – Polar section modulus – Power transmitted by shafts

**Thin Cylinders:** Stresses and Strains in thin cylinders, Thin Spherical Shells.

**UNIT – VI**

**Columns and Struts:** Introduction – Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns- assumptions- derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Long columns subjected to eccentric loading – Secant formula – Empirical formulae – Straight line formula – Prof. Perry's formula.

**TEXT BOOKS:**

1. Strength of Materials by S. Ramamrutham
2. Strength of Materials by B.C. Punmia
3. Mechanics of Materials by Gere & Thimoshenko

**REFERENCES:**

1. Strength of Materials by Schaum's out line series – Mc. Graw hill International Editions.
2. Strength of Materials by S. Ramakrishna and R.Narayan – Dhanpat Rai publications

**UNIT – I**

**Thermodynamic processes of vapour:** constant volume process, constant pressure process, constant temperature process, hyperbolic process, adiabatic process, polytrophic process

**Thermodynamic vapour cycles:** introduction- carnot cycle with steam as working substances-performance of thermodynamic cycles-rankine cycle, its efficiency- modified rankine cycle, its efficiency.

**UNIT-II**

**Fuels-** classification of fuels-calorific values of fuels-experimental determination of calorific values-bomb calorimeter, boys calorimeter

**Combustion of fuels-**combustion equation of fuels(solids,gaseous fuels)-minimum mass and volume of air required for combustion-conversion of mass into volume and volume into mass analysis-excess air required.

**UNIT – III**

**Steam Boilers :** Classification based on Working principles & Pressures of operation -L.P & H.P.Boilers – Mountings and Accessories – Boiler horse power, equivalent evaporation, efficiency and heat balance, performance of steam boilers – boiler **Draught:** classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced draught.

**UNIT IV**

**Steam engines-** simple and compound steam engines- classification of steam engines, work done and power developed by steam engines.

**Performance of steam engines-**efficiencies of steam engine-governing of steam engines-missing quantity and steam consumption

**UNIT – V**

**Steam Nozzles:** Function of nozzle – applications - 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 for design of nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line –Shock at the exit.

**UNIT – VI**

**Steam Condensers :**Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency–air leakage, sources and its effects, air pump- cooling water requirement, cooling towers and types of cooling towers

**TEXT BOOKS:**

1. Thermal Engineering – R.S. Khurmi & J.K.Gupta –S.Chand
2. Thermal Engineering / Rajput / Lakshmi Publications.

**REFERENCES:**

1. Thermal Engineering, Rudramoorthy - TMH
2. Thermodynamics & Heat Engines, B. Yadav, Central Book Depot., Allahabad
3. Thermal engineering data book-B.Srinivasulu Reddy, JK International Pub

B.Tech                      III Year I Semester                      Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Turbo Machinery	4	1	-	4
2.		Mechanical Measurements	4	1	-	4
3.		Design of Machine Elements-I	4	1	-	4
4.		Dynamics of Machinery	4	1	-	4
5.		Heat Transfer	4	1	-	4
6.		Machine Tools	4	1	-	4
7.		Heat Transfer Lab	-	-	3	2
8.		Mechanical Measurements Lab	-	-	3	2
9.		Advanced Communications Skills Practice	-	-	3	-
		TOTAL	24	6	9	28

L – Lecture, T – Tutorial, P – Practical

**UNIT – I**

**Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics), 2nd law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbo machines - Euler's pump equation and Euler's turbine equation

**UNIT – II**

**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 –Turbo jet, Turbo prop, Pulse jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods. Introduction to Rocket propulsion.

**UNIT – III**

**Centrifugal Compressors and Fans:** Components and description, velocity diagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking.

**Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors

**UNIT – IV**

**Axial Flow Compressors and Fans:** Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations

**UNIT – V**

**Gas power cycles:** Ideal and practical gas turbine cycle, heat exchange cycle, reheat cycle, intercooled cycle, Comparison of various cycles.

**Thermodynamic Cycles:** Advantages, disadvantages and performance characteristics of Ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, turbo fan engine, Calculation of specific thrust and efficiency

**UNIT – VI**

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –Closed and Semiclosed

Cycles – merits and demerits, Brief concepts about compressors, combustion chambers and turbines of Gas Turbine Plant, impulse and reaction type gas turbines, Velocity triangles and calculation of work done, efficiency etc.

**TEXT BOOKS**

1. Gas turbines, V. Ganesan, Tata McGraw-Hill
2. Subramanya, K., Hydraulic Machine, Tata McGraw Hill 2013
3. Thermal Engineering, A.S.Rao
4. Thermal Engineering, R.S.Khurmi, J.K.Gupta, S.CHAND Publications

**REFERENCES:**

1. Gas Turbines – V.Ganesan /TMH
2. Gas Turbines and Propulsive Systems – P.Khajuria & S.P.Dubey - /Dhanpatrai
3. Thermal Engineering-M.L.Mathur & Mehta/Jain bros

**UNIT-I**

Definition –Introduction, basic principles of measurement - Measurement systems, generalized configuration and functional descriptions of measuring instruments - examples. Dynamic performance characteristics sources of error, Classification and elimination of error.

**Transducers:** Introduction, Theory and construction of various transducers to measure displacement - Inductive, capacitance, Piezo electric, resistance and Photo electric transducers.

**UNIT-II**

**Measurement of temperature:** Introduction, Classification - Ranges - Various Principles of measurement – Liquid filled thermometers, Filled system thermometers, Electrical Resistance thermometers, Thermistor, Thermocouple.

**Measurement of pressure:** Introduction, Classification - different principles used- Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement - Thermal conductivity gauges - ionization pressure gauges, Mcleod pressure gauge.

**UNIT - III**

**Measurement of level:** Introduction, Direct method, float type, indirect methods – electrical, capacitive, magnetic, gamma ray liquid level indicators.

**Flow measurement:** Introduction, types of flow measuring instruments, Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot - wire anemometer, Laser Doppler Anemometer (LDA).

**Measurement of speed:** Introduction, Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer .

**UNIT -IV**

**Measurement of Acceleration and Vibration:** Introduction, Different instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

**Measurement of humidity** –Introduction, Moisture content in the gases, sling psychrometer, Absorption psychrometer.

**UNIT - V**

**Stress & strain measurements:** Introduction, Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains.

**Measurement of force, torque and power-** Elastic force meters, load cells, Torsion meters, Dynamometers.

**UNIT - VI**

**Elements of control systems:** Introduction, Importance - Classification - Open and closed systems- Examples with block diagrams – Servomechanisms - Temperature, speed & position control systems.

**TEXT BOOKS:**

1. Mechanical Measurements, Beckwith, Thomos (Rearson education Asia).
2. Mechanical Measurements, D.S Kumar.

**REFERENCES:**

1. Instrumentation, Measurement & Analysis, B.C.Nakra & K.KChoudhary, TMH.
2. Instrumentation and Control Systems, S.Bhaskar, Anuradha Agencies

**UNIT-I**

**Introduction :** The art and science of machine design- Types of design methods - stages in machine design- selection of engineering materials based on mechanical properties-Types of loads, Factor of safety.

**Stresses in Machine Members:** Simple stresses - Combined stresses – Torsional and bending Stresses – impact stresses– Various theories of failure – Design for strength and rigidity, eccentric loading.

**UNIT-II**

**Strength of Machine Elements:** Stress concentration–notch sensitivity, Fatigue stress concentration factor – Design for fluctuating stresses – Endurance limit, S-N Curve – Estimation of Endurance strength – Goodman's criteria – Soderberg's criteria.

**UNIT-III**

**Riveted Joints :** Types of riveted joints - modes of failure-strength and efficiency of riveted joints, pitch of the rivets, design stresses - boiler joints, - Riveted joints under eccentric loading.

**Welded Joints :** Types of welded joints, strength of welds, Design of simple welded joints.

**UNIT-IV**

**Bolted Joints :** Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses – Design of joints under eccentric loading– Bolts of uniform strength.

**Keys, Cotter and Knuckle Joints:** Types of Keys, stresses in Keys, design of rectangular and square Keys. Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints.

**UNIT-V**

**Design of Shafts and Couplings-** Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads. Design of Rigid couplings: Muff, Split muff and Flange couplings.

**UNIT-VI**

**Mechanical Springs :** Classification of springs-Stress and deflections of helical Springs-Springs for fatigue loading -Energy storage capacity- Leaf springs-Coaxial springs.

**TEXT BOOKS:**

1. Machine design, R.S Khurmi and JK Gupta.S.Chand & Chand
2. V.B.Bhandari, Design of Machine Elements, TMH Publishers, New Delhi.
3. Machine Design, Kannaiah, Sciotech.
4. Machine Design by S.Md. Jalaluddin, Anardha Publishers, Chennai.

**REFERENCES:**

1. Machine design, J.E. Shigley.
2. Design of Machine Elements, M.F. Spotts, PHI



**UNIT – I**

**Precession:** Gyroscopes, effect of precession motion on the stability of aero planes and ships, moving vehicles such as motor car, motor cycle.

**Friction:** Introduction, Friction of screw and nuts, screw jack, torque required to lift the load and to lower the load by using screw jack, efficiency of screw jack, over locking and self-locking screw, friction of V-threads, friction of pivot and collar bearings, uniform pressure, uniform wear, Friction circle.

**UNIT – II**

**Clutches:** Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

**Brakes:** Introduction, type of brakes, Simple block brakes, internal expanding brake, band and block brake, braking of vehicle.

**UNIT – III**

**Force analysis and fly wheel:** Static force analysis of a slider crank mechanism, Inertia force and inertia torque, D'Alembert's Principle, Dynamic analysis of slider crank mechanism. Introduction to flywheel, Turning moment diagrams for steam engine, I.C. Engine and multi cylinder engine. Fluctuation of energy, Coefficient of Fluctuation of energy, coefficient of Fluctuation of speed. Energy stored in fly wheels and their design.

**UNIT-IV**

**Governors:** Introduction, type of governors, Centrifugal governor, Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

**UNIT – V**

**Balancing:** Introduction, Static balancing, dynamic balancing, balancing of several masses rotating in the same plane, balancing of several masses rotating in different planes.

Balancing of reciprocating masses, partial balancing of locomotives, effects of partial balancing in locomotives, secondary balancing, balancing of inline engines.

**UNIT – VI**

**Vibrations:** Type of vibrations, Undamped Free vibrations of a single degree freedom (Spring-mass system)- Derivation of differential equation, Solution of differential equation. Damped Free vibrations of single degree freedom system, Different types of dampings- Over damped system, Critically-damped system, Under-damped system, Logarithmic decrement. Forced vibrations of single degree with harmonic excitation, Vibration isolation, Critical or whirling speed of a shaft.

**Torsional vibrations:** Natural frequency of free torsional vibrations, free torsional vibrations of a single rotor system, free torsional vibrations of a two rotor system. Torsionally equivalent shaft.

**TEXT BOOKS:**

1. Theory of Machines, S.S Ratan, MGH,
2. Theory of Machines, R.S Khurmi & Gupta, S.Chand publ.
3. Mechanical Vibrations by G.K. Grover

**REFERENCES:**

1. Mechanism and Machine Theory, JS Rao and RV Duggipati, New Age Publ.
2. Theory of Machinery, Ballaney, Dhanpat Ray

**UNIT – I**

**Introduction:** Modes of heat transfer – Basic laws of heat transfer – General applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical coordinates - Heat conduction through plane walls and composite walls - hollow and composite cylinders - hollow and composite spheres - critical thickness of insulation - heat conduction with internal heat generation for wall and cylinder – Problems.

**UNIT II**

Heat flow through extended surfaces - infinite long fin – fin insulated at the tip- fin losing heat at the tip - Efficiency and effectiveness of the fin.

**One Dimensional Transient Heat Conduction:** Heat conduction in solids having infinite thermal conductivity (negligible internal resistance) — Significance of Biot and Fourier Numbers - Chart solutions - Problems.

**UNIT – III**

**Convective Heat Transfer:** Non-dimensional numbers - Significance of non-dimensional numbers - correlations for convective heat transfer.

**Forced convection:** Introduction to hydrodynamic boundary layer - Concepts and definitions- thermal boundary layer - correlations for forced convection – flow over flat plates and walls - flow inside pipes - turbulent flow over flat plate, cylinders - Problems.

**UNIT IV**

**Free Convection:** Bulk mean temperature and mean film temperature - local and average heat transfer coefficients - correlations for free convection – horizontal plates, cylinders – problems.

**Heat Transfer with Phase Change:** Boiling – Regimes (Theory only),

**Condensation:** Film wise and drop wise condensation (Theory only).

**UNIT: V**

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

**UNIT VI****Radiation Heat Transfer:**

Introduction - surface emission properties - absorptivity, reflectivity, and transmissivity - concept of black body & grey body - Stefan Boltzmann law - Kirchhoff, Wein & Lambert's cosine law - shape factor and view factor features of shape factor.

**TEXT BOOKS:**

1. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Ltd.
2. Heat and Mass Transfer, D.S.Kumar.SK Kataria & Sons.

**REFERENCE BOOKS:**

1. Fundamentals of Engg. Heat and Mass Transfer, R.C.Sachdeva, 3/e, New Age International.
2. Heat Transfer, P.K.Nag, 2/e, TMH, 2010

**UNIT – I**

Geometry of single point cutting tools and angles-Mechanism of chip formation in machining ductile and brittle materials- and types of chips –Built-up-Edge (BUE) formation and its effects, Use of Chip breaker in machining-principles and methods of chip breaking. Mechanics of Orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, tool life and wear, economics of machining-coolants-methods of applications of cutting fluids, mach inability –Tool materials.

**UNIT – II**

Engine lathe – Principle of working, specification of lathe – types of lathes – work holders, tool holders – Box Tools, Taper turning, thread turning and attachments for Lathes. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout.

**UNIT – III**

Shaping, Slotting and planing machines – their Principles of working – Principal parts – specification, classification, Operations performed-Machining time calculations. Shaper size, shaper mechanism, Crank and slotted link mechanism, Whit worth quick return mechanism, Hydraulic shaper mechanism,

**UNIT – IV**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine-deep hole drilling machine.

**UNIT – V**

Milling machine – Principles of working – specifications – classifications and principle features of milling machines – machining operations, Types and geometry of milling cutters– methods of indexing –Director Rapid indexing, Plain or simple indexing, Compound indexing, Differential indexing and angular indexing.

**UNIT –VI**

Introduction to grinding, lapping, honing and broaching machines-classification- comparison of grinding, lapping and honing- Lapping, Honing and Broaching machines- Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel.

**TEXT BOOKS:**

1. Elements of Workshop Technology: Vol: II machine tools; By Choudhury, S. K. Hajara, Choudhury, A. K. Hajara & Roy, Nirjhar.
2. Workshop Technology – Vol II, B.S. Raghuvamshi.
3. Metal cutting by Bhattacharya

**REFERENCE BOOKS**

1. Manufacturing science by Amitab Ghosh and Ashok Kumr Mallik, Tata-McGraw-Hill Publications

B.Tech III Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Refrigeration and Air Conditioning	4	1	-	4
2.		Internal Combustion Engines	4	1	-	4
3.		Engineering Metrology	4	1	-	4
4.		Design of Machine Elements- II	4	1	-	4
5.		CAD / CAM	4	1	-	4
6.		Choice Based Credit Courses (For Non Mechanical Students) 1. Industrial Management 2. Power Plant Engineering 3. Optimization Techniques	4	1	-	4
7.		Machine Tools and Metrology Lab	-	-	3	2
8.		Refrigeration and Air Conditioning Lab	-	-	3	2
9.		Comprehensive Online Examination				2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P – Practical

**UNIT – I**

**Introduction to Refrigeration :** Refrigerants– Desirable properties of idle refrigerant – classification of refrigerants – Nomenclature – secondary refrigerants. Unit of refrigeration – COP - Air refrigerator working on reversed Carnot cycle & Bell Coleman cycle - Simple Problems.

**UNIT – II**

**Vapour Compression Refrigeration :** Introduction – advantages and limitations - Basic cycle (p-h chart) – working principle and essential components of the system – types of vapour compression cycles – effect of sub cooling and super heating – Actual cycle - effect of suction pressure and discharge pressure.

**UNIT III**

**Vapour Absorption Refrigeration System :** Simple vapour absorption system- practical vapour absorption system - advantages and disadvantages of VAR over VCR - COP of idle VAR system – domestic Electrolux system .

**UNIT IV**

**Steam Jet Refrigeration System :** Working Principle and Basic Components – Principle and operation of Thermo-Electric Refrigerator.

**UNIT – V**

**Introduction to Air Conditioning :** Introduction to Psychrometry – psychometric terms – psychometric chart - Daltons Law of partial pressures - psychometric Processes- Need for Ventilation – Infiltrated air – Heat Load concepts - RSHF, GSHF - Problems.

**Air Conditioning equipment:** Fans and blowers- types.

**UNIT – VI**

**Comfort Air Conditioning :** Requirements of human comfort and concept of Effective Temperature- Comfort chart –Comfort Air Conditioning – summer, winter & year round air conditioning.

**Heat Pump** – Heat sources – different heat pump circuits.

**TEXT BOOKS:**

1. A text book of Refrigeration and Air Conditioning, R.S.Khurmi & J.K.Gupta, S.Chand & Co.
2. Refrigeration and Air Conditioning, CP Arora, 3/e, TMH, 2008
3. A Course in Refrigeration and Air conditioning, SC Arora & Domkundwar, Dhanpatrai

**REFERENCES:**

1. Refrigeration and Air Conditioning, Manohar Prasad, 2/e, New Age.
2. Principles of Refrigeration, Dossat, 4/e, Pearson Edu

**UNIT – I**

**Power Cycles:** Carnot cycle, Air standard cycles -Description and representation of Otto cycle, Diesel cycle & Dual cycles on P–V and T-S diagram -Thermal Efficiency – Comparison of Otto, Diesel and Dual cycles. Simple problems on Otto, Diesel and Dual cycles

**UNIT-II**

**I.C.Engines:** Energy conversion– basic engine components - Working principle of two stroke and four stroke engines - comparison of two stroke and four stroke, SI and CI engines – Classification of I.C. Engines, Valve and port timing diagrams, application of I.C Engines.

**UNIT – III**

**Engine Systems:** Working principle of Magneto & Battery Ignition System - Simple Carburettor - Common rail fuel Injection System - Air & Thermostat cooling system - Petroil & Pressure Lubrication system.

**Super Charging:** Introduction, types of superchargers, methods of supercharging, advantages and limitations of supercharging.

**UNIT - IV**

**Combustion in S.I. Engines:** Homogeneous Mixture - Stages of combustion - Importance of flame speed and factors influencing the flame speed –Abnormal Combustion - Phenomenon of Knocking, Summary of Engine variables affecting the knocking, pre-ignition– Combustion Chambers, requirements, types - Rating of S.I Engine fuels.

**UNIT - V**

**Combustion in C.I. Engines:** Heterogeneous Mixture - Stages of combustion – Delay period and its importance – factors affecting the Delay Period – Phenomenon of Knock – Comparison of knock in SI & CI Engines - Combustion chambers (DI & IDI), requirements, types- Rating of C.I Engine fuels.

**UNIT – VI**

**Testing and Performance:** Engine Performance Parameters - Determination of, Brake power, friction power and indicated power – Performance test – Heat balance sheet and chart- Exhaust gas composition - Simple problems on performance and heat balance sheet.

**TEXT BOOKS:**

1. I.C. Engines / V. GANESAN- TMH
2. Thermal Engineering / R.K Rajput / Lakshmi Publications.

**REFERENCES:**

1. I.C Engines – Mathur & Sharma – Dhanpath Rai & Sons.
2. Engineering fundamentals of I.C Engines – Pulkrabek / Pearson /PHI

**UNIT – I**

**Limits, Fits, Tolerances and Gauges :** Introduction, Limits, tolerance, tolerance build-up, compound tolerances, terminology for limits and fits, system of writing tolerance, Unilateral, Bi-lateral systems; Relation between tolerance and cost; types of fits, hole and shaft basis systems, standard limit systems-Indian standard system, interchange ability and selective assembly. Taylor's principle – Design of go and No go gauges, plug, ring, snap, gap, taper, profile and position gauges.

**UNIT – II**

**Standards of Measurements :** Line standards, End standards and Wavelength standards.

**Linear and Angular Measurement :** Vernier calipers, vernier height gauge, micrometers, telescopic gauge, dial bore gauge, slip gauges, Dial indicators, vernier and optical bevel protractor, optical dividing head, sine principle and sine bars, angle gauges, spirit level, clinometers, rollers and spheres used to determine the tapers.

**UNIT –III**

**Comparators :** Introduction; Need of comparator; Basic Principles of Operation, uses, essential characteristics; classification of comparators; Mechanical, optical, mechanical optical, Electrical and Electronic Comparators, pneumatic comparators, fluid displacement comparators, multicheck comparators, Eden-Rolt-Millionrh comparator and their uses in mass production.

**UNIT – IV**

**Screw Thread Measurement :** Screw thread terminology, errors in threads; pitch errors; measurement of various elements of thread; measurement of major, minor and effective diameter; Tool maker's microscope and its uses, optical projector.

**Gear Metrology:** Terminology of gear tooth, measurement of tooth thickness- chordal thickness method-constant chord method-base tangent method-measurement over pins or balls Parkinson gear tester.

**UNIT – V**

**Surface Texture :** Introduction, factors affecting the surface roughness, reasons for controlling surface texture, orders of geometrical irregularities, Elements of surface texture, methods of measuring surface finish, analysis of surface traces.

**UNIT – VI**

**Acceptance Tests for Machine Tools :** Introduction; alignment tests on lathe, milling, drilling shaping, slotting, surface grinder; performance tests, preparation of acceptance charts.

**TEXT BOOKS:**

1. Engineering Metrology / R.K. Jain / Khanna Publishers.
2. A text book of Metrology / M. Mahajan. / Danpath Ray& Co.

**UNIT – I**

**Bearings :** Types of Journal bearings – Lubrication – Bearing Modulus–bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, bearing life.

**UNIT – II**

**Design of I.C.Engine Parts :** Design of connecting rod-stress due to whipping action on Connecting rod – design of trunk type piston for I.C. engine, design of crank and crankshafts.

**UNIT – III**

**DESIGN OF PRESSURE VESSELS AND PIPES:** Introduction- classification of pressure vessels-stresses in thin cylinder, circumferential& hoop stresses, longitudinal stresses-thin and thick cylinders-Pipe joints-design of circular, oval & flanged pipe joints- standard pipe flanges for steam-hydraulic pipe joints for high pressures

**UNIT – IV**

**Power Transmission Systems :** Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes, design procedure for chain drives.

**UNIT-V**

**Spur & Helical Gears :** Classification of gears, design of spur gears, Lewis equation –bending strength, dynamic load and fatigue of gear tooth- Design of Helical gears.

**UNIT-VI**

**Power Screws :** Design of screw, Square ACME, Buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures.

**TEXT BOOKS**

1. V.B.Bhandari, Design of Machine Elements, TMH Publishers, New Delhi.
2. Machine Design, Kannaiah/ Scietech
3. Machine Design, S MD Jalaludin, Anuradha Publishers

**REFERENCES:**

1. Sadhu Singh [2000], Machine Design, Khanna Publishers, New Delhi.
2. M.F.Spotts, Design of Machine Elements, PHI Publishers, New Delhi.



**UNIT – I**

Product cycle, steps involved in Designing a CAD, CAD tools, CAM tools, CPU, input devices, output devices, Memory types, Application of computers for design, benefits of CAD, storage devices.

**UNIT – II**

**Computer Graphics & Drafting:** Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, Geometric commands, layers, display control commands, editing, dimensioning.

**UNIT – III**

**Geometric modeling:** Wire frame models, Wire frame entities, curve representation, parametric representation of synthetic curves, curve manipulations.

**UNIT –IV****Numerical control:**

Basic components of an NC, Classifications- CNC, DNC, classification of several output devices used in NC systems, feedback devices, NC coordinate systems, NC motion control systems, application of NC, Machining center, turning center, NC Part Programming, A.P.T- language.

**UNIT – V**

**Group Tech:** Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

**UNIT – VI**

**Computer Aided Quality Control:** Terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods-optical non-contact inspection methods-non-optical computer aided testing, integration of CAQC with CAD/CAM.

**TEXT BOOKS:**

1. CAD/CAM, A Zimmers & P.Groover, PE, PHI.
2. CAD/CAM-Principles and applications, P.N. Rao, TMH.

**REFERENCES:**

1. Automation, Production systems & Computer integrated Manufacturing, Groover, P.E.
2. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age

**UNIT-I**

**Introduction:** Concepts of Management and Organization – Functions of Management – Evolution of Management Thought : Taylor's Scientific Management, Fayol's Principles of Management, Douglas McGregor's Theory X and Theory Y, Mayo's Hawthorne Experiments, Herzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs – Systems Approach to Management.

**UNIT-II**

**Plant Location & Layout:** Plant location, definition, factors affecting the plant location, comparison of rural and urban sites- methods for selection of plant- Matrix approach. Plant Layout – definition, objectives and types of plant layout.

**UNIT-III**

**Work Study:** Principles of Management- Management Tools – time and motion study, work simplification-process charts and flow diagrams, Production Planning, Specification of Production requirements.

**Production Planning & Control:** Introduction, functions of PPC , Scheduling.

**UNIT-IV**

**Materials Management:** Objectives, Inventory – functions, types, associated costs, inventory control techniques-ABC and VED analysis. Stores Management and Stores Records. Purchase management, duties of purchase of manager, associated forms.

Introduction to MRP- Inputs to MRP, benefits, MRP-II

**UNIT-V**

**Quality control:** Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM.

**UNIT-VI**

Job Evaluation and merit rating: introduction-Job evaluation-objectives, benefits and limitations of job evaluation-methods of job evaluation: simple ranking system, grade description method, factor comparison method, point method-merit rating-objectives of job evaluation-methods of merit rating: Ranking method, paired comparison method, checklist method, graphic rating method, rating by result-requirements for success of merit rating system.

**TEXT BOOKS:**

1. Khanna O.P.: Industrial Engineering
2. T.R. Banga : Industrial Engineering and Management
3. DR. Ravi Shankar: Industrial Engineering and management/Galgotia publications pvt. Ltd.

**REFERENCE BOOKS:**

1. Sharma B.R: Environmental and Pollution Awareness.
2. Industrial engineering and operations management by S.K. Sharma and Savita Sharma

**UNIT I**

Introduction To The Sources Of Energy – Resources and Development of Power in India.

Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection,

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 – Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment – Pollutants and Pollution Standards – Methods of Pollution Control. Inspection And Safety Regulations.

**UNIT II**

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal – Overfeed and Under Feed 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. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders.

**UNIT III**

Diesel Power Plant: Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage

Gas Turbine Plant : Introduction – Classification - Construction – Layout With Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

**UNIT IV**

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.

**UNIT V**

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle Of its Working, Wind Energy – Types of Turbines – HAWT & VAWT-Tidal Energy. MHD power Generation.

**UNIT VI**

Nuclear Power Station: Nuclear Fuel – Nuclear Fission, Chain Reaction, 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.

**Text Books:**

1. Power plant Engineering, P.K. Nag, TMH, 3rd edition, 2013.
2. A course in power plant Engineering, Arora and S. Domkundwar.

**Reference Books:**

1. A Text Book of Power Plant Engineering , Rajput , Laxmi Publications, 4th edition, 2012.
2. Power plant Engineering, Ramalingam, Scietech Publishers
3. power plant engineering P.C. Sharma, S.K. Kataria Publications,2012

## UNIT - I

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem - design vector - design constraints - constraint surface - objective function - objective function surfaces - classification of Optimization problems.

## UNIT - II

**Classical Optimization Techniques :** Single variable Optimization - multi variable Optimization without constraints - necessary and sufficient conditions for minimum/maximum - multivariable Optimization with equality constraints.  
Solution by method of Lagrange multipliers - multivariable Optimization with inequality constraints - Kuhn - Tucker conditions.

## UNIT - III

**Linear Programming:** Standard form of a linear programming problem - geometry of linear programming problems - definitions and theorems - solution of a system of linear simultaneous equations - pivotal reduction of a general system of equations - motivation to the simplex method - simplex algorithm.

## UNIT - IV

**Transportation Problem:** Finding initial basic feasible solution by north - west corner rule, least cost method and Vogel's approximation method - testing for optimality of balanced transportation problems.

## UNIT - V

**Unconstrained Nonlinear Programming:** One - dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method

## UNIT - VI

**Unconstrained Optimization Techniques:** Univariate method, Powell's method and steepest descent method.

## TEXT BOOKS:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.

2. " Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer(India), Pvt .Ltd.

## REFERENCE BOOKS:

1 " Optimization Methods in Operations Research and systems Analysis" - by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.

2. Operations Research - by Dr. S.D.Sharma.

3. "Operations Research : An Introduction" - by H.A. Taha, PHI Pvt. Ltd., 6th edition

4. Linear Programming - by G. Hadley

B.Tech IV Year I Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Tool Design	4	1	-	4
2.		Operations Research	4	1	-	4
3.		Automobile Engineering	4	1	-	4
4.		Robotics	4	1	-	4
5.		<b>Choice Based Credit Courses;; (for Mech students)</b> 1. Composite Materials 2. Nano Technology 3. Non Destructive Evaluation	4	1	-	4
6.		<b>Choice Based Credit Courses;; (for Mech students)</b> 1. Micro Electro Mechanical Systems 2. Non Conventional Sources of Energy 3. Total Quality Management	4	1	-	4
7.		CAD / CAM Lab	-	-	3	2
8.		Internal Combustion Engines Lab	-	-	3	2
		Mini Project	-	-	-	2
		TOTAL	24	6	6	30

L – Lecture, T – Tutorial, P – Practical

**UNIT -I**

**Design of single point cutting tools:** Single point, cutting tools-various systems of specifications, geometry and their inter relation, theories of formation of chip and their effect, design of broach.

**UNIT - II**

**Design of multipoint cutting tools:** Drill geometry, Design of Drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, Milling cutters, cutting speeds and feed-machining times-design-form cutters, combination tools, reamers etc.

**UNIT -III**

**Design of jigs and fixtures:** Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

**UNIT-IV**

**Design of sheet metal blanking and piercing:** Fundamentals of die cutting operating, power press types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout, short run tooling for piercing.

**UNIT-V**

**Design of sheet metal bending, forming and drawings die:** Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

**UNIT -VI**

**Tool life and tool wear:** theories of tool wear-adhesion, abrasive and diffusion wear mechanisms forms of wear, tool life criteria and Mach inability index, tool wear criterion, measurement of tool wear.

Introduction to Plastic tooling-commonly used plastic tooling materials.

**TEXT BOOKS:**

1. Tool Design, Donaldson, Lecain and Goold, TMH.
2. Principles of Metal cutting, A Bhattacharya, New Central Book Agency, Calcutta

**REFERENCES:**

1. Production Engineering Design (Tool Design), Surendra Kenav and Umesh Chandra, Satyaprakashan, New Delhi 1994.
2. Design of Cutting Tools. Use of Metal Cutting Theory, Amitabh Bhattacharya and Inyong Ham, ASTME publication Michigan USA, 1969.
3. Fundamentals of Machining and Machine Tools, RK Singal and Others, I.K. International, 2008.
4. Metal Cutting Principles, Shaw, Oxford Univ. Press

**UNIT – I**

**Linear Programming:** Introduction-structure of linear programming model- Formulation–Graphical solution – Simplex method, Big-M method, Two phase method (maximization case and minimization case), Special cases- Duality, dual simplex method.

**UNIT-II**

**Transportation:** Introduction-methods of finding initial solution-optimal solution-variations in transportation problem-maximization.

**Assignment problems:** Hungarian method of Assignment problem- variations of the assignment problem- Travelling sales man problem.

**UNIT-III**

**Replacement and maintenance models:** Introduction-types of failure-replacement of items whose efficiency deteriorates with time- replacement of items that fail completely-staffing problem.

**UNIT-IV**

**Queuing theory:** introduction-characteristics of queuing system-probability distributions in queuing system-single server queuing models-multi server queuing models.

**Job sequencing:** n jobs - two machines, n jobs - three machines, two jobs - n machines.

**UNIT-V**

**Inventory:** introduction-functional role of inventory-reasons for carrying inventory-inventory control models without shortages and with shortages-EOQ models with quantity discounts-instantaneous probabilistic demand without set-up cost,P-system and Q-system.

**UNIT-VI**

**Introduction to PERT / CPM :** Project management, network modeling-probabilistic model, various types of activity times estimation-programme evaluation review techniques- Critical Path-probability of completing the project, deterministic model, critical path method (CPM)-critical path calculation-crashing of simple of networks.

**Network Flow Models:** maximal flow, minimal flow.

**TEXT BOOKS:**

1. Operations Research- theory and applications, second edition, J.K. Sharma/MacMillian publications.
2. Introduction to operations research, Hamdy A. Taha/PHI publications.
3. Production & operation management , Panner selvam

**UNIT – I**

**Introduction :** Components of an automobile – chassis and body – power unit – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, oil filters, oil pumps – crank case ventilation-Fuel gauge – oil pressure gauge, Engine temperature indicator.

**UNIT – II****Fuel Supply Systems:**

S.I. Engine: Types of Fuel Supply system, Mechanical and electrical fuel pump – filters– Carburetors (Simple & Zenith) – air filters – petrol injection systems-types, Mechanical, MPFI and electronic injection system.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, CRDE, fuel pumps, testing of fuel pumps.

**UNIT – III**

**Cooling System:** Cooling Requirements, Air Cooling, Thermostat Liquid cooling, Radiators – Types, Cooling Fan, water pump, thermostat, antifreeze solutions.

**Ignition System:** Function of an ignition system, Principle of Electronic Ignition System, Distributer less Electronic Ignition System.

**Unit – IV**

**Emission Control:** Introduction, Emission Norms - Pollution standards – types of emissions-Reduction of formation of pollutants, closed crankcase ventilation, fuel tank and carburettor ventilation, redesigning the combustion chamber, changes in fuel supply system, modifications in ignition system, treating the exhaust gasses to reduce pollutants – use of alternative fuel.

**Starting system:** Introduction, Starting Motor, Starting drives, Bendix drive mechanism- starting motor switches - Accessories, Horn, Speedometer, Wind screen wiper.

**UNIT – V**

**Transmission System:** Clutches - Principle- types, single plate, multi plate, and centrifugal clutches – gear box – types, constant mesh, synchromesh, epi-cyclic, over drive, torque converter- Propeller shaft – Hotch Kiss drive, Torque tube drive, universal joint, differential, rear axles.

**UNIT – VI**

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

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

**Braking System:** Introduction, Classification, Mechanical brake system, Hydraulic brake system, air and vacuum brake systems.

**TEXT BOOKS:-**

1. Automobile Engineering, – Vol.1 & Vol.2, Kirpal Singh.
2. Automotive Mechanics, William Crouse. Hanna Publishers.

**REFERENCE BOOKS:-**

1. Automobile Engineering, G.B.S.Narang khanna publishers.
2. Automobile Engineering, R.B.Gupta



**UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

**UNIT – II**

**Components of the Industrial Robotics:** Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

**UNIT III**

**Robot actuators and Feedback components:** Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors. Robot Applications in Manufacturing, welding, Assembly and Inspection.

**UNIT – IV**

**Motion Analysis:** Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

**UNIT – V**

Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

**UNIT VI**

Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages.

**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

**REFERENCES:**

1. Robotics / Fu K S/ McGraw Hill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chironze / Kogam Page Ltd. 1983 London.

**UNIT-I**

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

**UNIT-II**

**Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

**UNIT-III**

**Manufacturing methods:** Hand lay-up, Spray lay-up, Vacuum bagging, Pultrusion, Resin Transfer Molding (RTM), Filament winding.

**UNIT-IV**

**Macro-Mechanical Analysis of a Lamina:** Introduction ,Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials – Anisotropic material, monoclinic material and orthotropic material, Hooke's Law for a Two Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**UNIT-V**

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina, Strength Failure theories of an angle lamina- Maximum stress Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory.

**UNIT-VI**

**Micro-Mechanical Analysis of a Lamina:** Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli – Longitudinal young's modulus, Transverse young's modulus, Major Poisson's ratio and In-plane shear modulus by Strength of Materials Approach, Semi Empirical Models, Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibres, Ultimate Strengths of a Unidirectional Lamina- Longitudinal tensile strength, Transverse tensile strength, Longitudinal compressive strength, Transverse compressive strength.

**TEXT BOOKS:**

1. Mechanics of Composite Materials, (Mechanical Engineering), Autar K. Kaw, 2/e, CRC Pubi.
2. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford Univ. Press, 1994.
3. Mechanics of Composite Materials, R. M. Jones, Mc Graw Hill Company, New York, 1975.

**REFERENCE BOOKS:**

1. Analysis and performance of fibre Composites, B. D. Agarwal and L.J. Broutman Wiley- Inter science, New York.
2. Composite Materials Science and Engineering, Kishan K. Chawla, Springer, 2009

**UNIT-I**

**General Introduction:** Basics of Quantum Mechanics, Harmonic oscillator, magnetic Phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, Anisotropy.

**UNIT-II**

**Silicon Carbide:** Application of Silicon carbide, nano materials preparation, Sintering of SiC, X-ray Diffraction data, lectron microscopy sintering of nano particles.

**Nano particles of Alumina and Zirconia:** Nano materials preparation, Characterization, Wear materials and nano composites.

**Unit -III**

**Mechanical Properties:** Strength of nano crystalline SiC, Preparation for strength measurements, Mechanical properties, Magnetic properties.

**UNIT-IV**

Process of synthesis of nano powders, Electro deposition, important nano materials.

**UNIT-V**

**Investigating and Manipulating Materials in the Nanoscale:** Electron microscopic, scanning probe microscopic, optical microscopic for nano science and technology, X-ray diffraction.

**Nanobiology:** Interaction between bio-molecules and nano particle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology

**UNIT-VI**

**Nano Medicines:** Developing of Nano medicines Nano sytems in use, Protocols for nano drug Administration, Nanotechnology in Diagnostics applications, materials for used in Diagnostics and Therapeutic applications.

**TEXT BOOKS:**

1. T.Pradeep [2007], Nano: The Essentials- Tata Mc Graw Hill Publishing Company Limited New Delhi.
2. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.

**REFERENCE BOOKS:**

1. Nano materials by J.Dutta & H.Hofman.
2. Nano structures & Nano materials by Guozhong cao, Imperial college press

**UNIT I**

**Introduction:** An Overview, Factors influencing the Reliability of NDE, Defects in materials, Defects in composites. NDT methods used for evaluation of materials and composites.

**Visual Inspection:** Basic Principle and Applications.

**UNIT II**

**Liquid Penetrant Testing:** Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test

**UNIT III**

**Radiographic Inspection:** Principles of X – ray radiography, equipment, Absorption, Scattering, X-ray film processing, General radiographic procedures, Reading and Interpretation of Radiographs, Industrial radiographic practice, Limitations and Applications, Welding defects detection. Gamma ray radiography.

**UNIT IV**

**Ultrasonic Testing:** Principle of wave propagation, Ultrasonic equipment, Variables affecting an ultrasound test, Basic methods: Pulse Echo and Through Transmission, Types of scanning.

**Applications of UT:** Testing of products, Welding Inspection, Tube Inspection, Thickness Measurement, Elastic Constant Determination, Ultrasonic testing of composites.

**UNIT V**

**Magnetic Particle Inspection:** Methods of generating magnetic field, Demagnetization of materials, Magnetic particle test: Principle, Test Equipment and Procedure, Interpretation and evaluation.

**Introduction to Accostic Emission Testing and Thermography.**

**UNIT VI**

**Eddy Current Testing:** Principle of eddy current, Factors affecting eddy currents, Test system and test arrangement, Standardization and calibration, Application and effectiveness. Comparison and Selection of NDT Methods, Codes and Standards

**TEXT BOOK:**

1. Non-Destructive Testing by Baldev Raj et. al., Narosa Publishing House.

**REFERENCE BOOKS:**

1. Non-Destructive Testing by P. Halmshaw
2. Metals Handbook Vol.II, Nondestructive inspection and quality control
3. Non-Destructive Testing by Warren J.Mcgomnagle, McGrawhill

**UNIT - I**

**Introduction:** Overview-Microsystems and microelectronics - Working principle of Microsystems -micro actuation techniques-micro sensors-types-microactuators-types-micropump-micromotors-micro-valves-microgrippers-scaling laws.

**UNIT – II**

**Materials:** Substrates and wafer-single crystal silicon wafer formation-ideal substrates-mechanical properties-silicon compounds - SiO<sub>2</sub>, SiC, Si<sub>3</sub>N<sub>4</sub> and polycrystalline silicon - Silicon piezoresistors - Gallium arsenide, Quartz-piezoelectric crystals-polymers for MEMS -conductive polymers.

**UNIT – III**

**Fabrication Process:** Photolithography - Ion implantation - Diffusion – Oxidation –CVD - Physical vapour deposition - Deposition by epitaxy - etching process.

**UNIT – IV:**

**Micromechanics :** Introduction-static bending of thin plates-circular plates with edge fixed - rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- micro accelerometers.

**UNIT – V**

**Micro System Manufacturing :** Clean room technology-Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging-materials-die level-device level-system level-packaging techniques-die preparation-surface bonding-wire bonding-sealing.

**UNIT-VI**

**Micro System Design :** Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications.

**TEXT BOOKS:**

1. Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, Tata McGraw-Hill, 2006.

**REFERENCE BOOKS:**

1. Mohamed Gad-el-Hak, The MEMS Hand book, CRC press 2002.
- Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim, Microsensors MEMS and Smart Devices, John Wiley & sons Ltd.,2001

**UNIT – I**

**Principles of Solar Radiation :** Introduction - solar constant - Role and potential of new and renewable source, Environmental impact of solar power, physics of the sun, instruments for measuring solar radiation .

**UNIT-II**

**Solar Energy Collectors :** Introduction – type - Flat plate and concentrating (Parabolic) collectors - Merits & Demerits of Flat plate and Concentrating (Parabolic) Collectors.

**UNIT - III**

**Solar Energy Storage and Applications :** Introduction - Different methods - Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion- photovoltaic Cells.

**UNIT-IV**

**Wind Energy :** Introduction – Basic Principle of wind energy conversion - Basic components – classification – Horizontal & Vertical Axis wind mill – Merit & demerits.

**UNIT-V**

**Geothermal Energy :** Introduction – nature of geothermal fields – geothermal sources – hybrid systems – merits and demerits- applications.

**Ocean Energy :** Introduction – OTEC (open, closed & hybrid cycle) – Energy from Tides – components – Operating methods – Ocean waves – wave energy conversion devices.

**UNIT-VI**

**Biomass :** Principles of Bio-Conversion - Anaerobic/Aerobic Digestion – Design of a community Biogas plant for a village-classification of biomass gasifiers- up draught, down draught & cross draught gasifiers.

**TEXT BOOKS:**

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Renewable Energy Sources /Twidell & Weir.
3. Non-Conventional Energy Sources /G.D. Rai.

**REFERENCE BOOKS:**

1. Solar Energy /Sukhatme.
2. Solar Power Engineering / B.S Magal Frank Kreith & J.F Kreith

**UNIT I**

**Basic Concepts :** Evolution of total quality Management - Definition of quality - Comparison between traditional approach and TQM, Deming – Crosby – Juran - Taguchi, Ishikawa theories - Quality costs - Product quality Vs Service quality Strategic planning - Goal setting - Steps involved in strategic planning - TQM implementation.

**UNIT II**

**TQM Principles:** Customer Satisfaction – Types of customers, customer supplier chain, Customer perception of quality customer feed back - Customer complaints - Customer retention - Service quality. Employee involvement – Employee motivation - Maslow’s hierarchy of needs - Herzberg theory - Empowerment and team work.

**UNIT III**

**Basic Tools:** Introduction to seven basic tools – Check sheets, histograms - Control charts, Pareto diagram - Cause and effect diagram – Stratification - Scatter diagrams.

**UNIT IV**

**Advanced Tools:** Affinity diagram - Relations diagram - Tree diagram - Matrix diagram - Matrix data analysis diagram – Process decision program chart - Arrow diagram.

**UNIT V**

**Advanced QC tools:** Advanced QC tools like QFD - Root cause analysis - Taguchi method - Mistake proofing (poka-yoke) - Failure mode and effects analysis (FMEAs), failure mode and effects criticality analysis (FMECAs) and Fault tree analysis (FTAs) etc. - Quality Management Systems.

**UNIT VI**

**Maintainability:** Introduction - Choice of maintenance strategy - Mean time- to repair (MTTR) - Factors contributing to Mean Down Time (MDT) - Fault diagnosis, and routine testing for unrevealed faults - Factors contributing to Mean Maintenance Time - (MMT) on condition maintenance - Periodic condition monitoring - Continuous condition monitoring - Economics of maintenance.

**TEXT BOOKS**

1. Joel E. Rose, *Total Quality Management*, 2nd Edition, Kogan Page Ltd., USA 1993.
2. Srinath, L. S., *Reliability Engineering*, Affiliated East West Press, New Delhi 1995.

**REFERENCE BOOKS**

1. Balagurusamy, E., *Reliability Engineering* Tata McGraw Hill publishing Co., New Delhi, 1984.
2. Greg Bound, et.al, *Beyond Total Quality Management towards the emerging paradigm*, McGraw Hill
3. Zeiri, *Total Quality Management for Engineers*, Wood Head Publishers, 1991

B.Tech IV Year II Semester Course Structure

S.No.	Abbreviation	Subject	Periods / Week			Credits
			L	T	P	
1.		Computational Fluid Dynamics	4	1	-	4
2.		Finite Element Methods	4	1	-	4
3.	MOOCs-I	<b>Massive Open Online Courses-I</b> 1. Modern Manufacturing Methods 2. Entrepreneurship 3. Hydraulic & Pneumatic Control 4. Thermal Power Engineering	4	1	-	4
4.	MOOCs-II	<b>Massive Open Online Courses-II</b> 1. Production & Operations Management 2. Automation in Manufacturing 3. Mechanical Vibrations 4. Cryogenics	4	1	-	4
5.		Project Work	-	-	-	8
6.		Seminar	-	-	-	2
7.		Comprehensive Viva-Voce	-	-	-	4
		<b>TOTAL</b>	<b>8</b>	<b>2</b>	<b>-</b>	<b>30</b>

L – Lecture, T – Tutorial, P – Practical



**UNIT I**

**Introduction to Computational Fluid Dynamics and Principles of Conservation:** Conservation of mass, linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation, Reynolds transport theorem, Classification of Partial Differential Equations and Physical Behaviour: Elliptic, parabolic and hyperbolic partial differential equations

**Approximate Solutions of Differential Equations:** Error Minimization Principles, Approximate solutions of differential equations, variational approach, Weighted residual approach: trial function and weighting function, Essential and natural boundary conditions, Least square method, Galerkin's method, Rayleigh-Ritz method

**UNIT II**

**Fundamentals of Discretization:** Pre-processing, Solution, Post processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), 1-D steady state heat conduction without and with constant source term.

**Finite Volume Method:** FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Source term linearization, Implementation of boundary conditions, 1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme

**UNIT III**

**Solution techniques for systems of linear algebraic equations:** Elimination, Iteration and Gradient Search method, L-U decomposition technique, Tridiagonal matrix algorithm (TDMA):

**Thomas algorithm Iteration methods:** Generalized analysis of the iterative methods, Sufficient condition for convergence, Scarborough criteria of for convergence Relaxation methods, Preferential characteristics of iterative methods, Multigrid method, Line by line TDMA, Alternating direction implicit method, Gradient search methods: Steepest descent method, Conjugate gradient method

**UNIT IV**

**Discretization of Convection-Diffusion Equations:** A Finite Volume Approach: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, The concept of false diffusion, QUICK scheme.

**Discretization of Navier Stokes Equations:** Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm

**UNIT V**

**Introduction to Turbulence Modeling:** Vorticity transport equation, Homogeneous turbulence and isotropic turbulence, Reynolds average Navier stokes (RANS) equation, Necessity of turbulence modeling, Turbulence model: Eddy viscosity, Mixing length, The  $\kappa$ - $\epsilon$  model, RNG  $\kappa$ - $\epsilon$  model,  $\kappa$ - $\omega$  model, Reynolds stress model (RSM), Large eddy Simulation (LES), Direct numerical simulation (DNS)

**UNIT VI**

**The basic structure of a CFD code:** Pre-processor, Solver and Postprocessor, User-defined-subroutines, Solution to some basic problems in heat transfer and fluid flow

**TEXT BOOK:**

1. Computational Fluid Dynamics, John Anderson, McGraw Hill Publication

**REFERENCE BOOKS**

2. Computational Fluid Dynamics, Jiynan Tu, Butter Worth Henman. 1998
3. Computational Fluid and Heat Transfer, Anderson & Tannehill, Taylor & Francis Publication. 1997
4. Computational Methods for Fluid Dynamics, Joel H. Ferziger, Springer Publication. 2009
5. Computational Heat Transfer, Jaluria Y., Taylor and Francis Publication. 1996

**UNIT-I**

Fundamental concepts in finite element methods, advantages and applications of FEM, steps followed in FEM- Stress and Equilibrium. Strain - Displacement relations. Stress - strain relations. Plane stress, plane strain conditions.

**UNIT-II**

**Finite element technique:** Finite element modeling coordinates and shapes functions- Principle of minimum Potential Energy- Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

**UNIT-III**

**Analysis of Bar And Truss Structures:** One-dimensional Bar element- derivation of element stiffness matrix, simple problems on bar element, Thermal stresses in 1-D bar element- Two-dimensional truss element, stiffness matrix for two-dimensional truss, simple problems on two-dimensional truss structures.

**UNIT-IV**

**Analysis of Beam Structures:** Beam elements, stiffness matrix for beam element, simple problems on beam structures – stresses and deflection of beams – cantilever and simply supported beams.

**UNIT-V**

**Two Dimensional Stress Analyses:** Finite element modeling for two-dimensional stress analysis, element stiffness matrix for constant strain triangle (CST) and treatment of boundary conditions.

**UNIT-VI**

**Steady State Heat Transfer Analysis:** Derivation of basic differential equation, One-dimensional heat transfer through a fin and composite wall.

**TEXT BOOKS**

1. Tirupati Chandrapatla and Bellagundu Introduction to Finite Element in Engineering, Pearson Education, New Delhi.
2. S.Md. Jalaluddin Introduction of finite element Analysis, Anuradha Publishers, Chennai.
3. David V. Hutton Fundamentals of Finite Element Analysis, TMH Publishers, New Delhi.

**REFERENCES**

1. C.S. Krishna Moorthy, Finite Element Analysis, TMH Publishers, New Delhi.
2. S.S.Rao Finite Element Methods, Pergamom Press, New York