COURSE STRUCTURE & DETAILED SYLLABUS

MECHANICAL ENGINEERING

B. TECH FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2020-2021)

ACE

Engineering College

Ankushapur(V), Ghatkesar(M), Medchal Malkajgiri (Dist.), Telangana - 501 301.

(An Autonomous Institution, Affiliated to JNTUH ,Hyderabad)

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(Autonomous)

B.TECH. FOUR YEAR DEGREE COURSE

MECHANICAL ENGINEERING

COURSE STRUCTURE

I Year				I Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	BSC	MA101BS	Mathematics – I	3	1	0	4
2	BSC	PH103BS	Engineering Physics	3	1	0	4
3	ESC	CS103ES	Programming for Problem Solving	3	1	0	4
4	ESC	ME104ES	Engineering Graphics	1	0	4	3
5	BSC	PH106BS	Engineering Physics Lab	0	0	3	1.5
6	ESC	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC	MC107ES	Environmental Science	3	0	0	0
8	*MC	MC108	Business English	2	0	0	0
			Induction Programme				
Total				**15**	**3**	**10**	**18**

I Year				II Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	BSC	MA201BS	Mathematics – II	3	1	0	4
2	BSC	CH202BS	Engineering Chemistry	3	1	0	4
3	ESC	ME203ES	Engineering Mechanics	3	1	0	4
4	ESC	ME205ES	Engineering Workshop	1	0	3	2.5
5	HSMC	EN205HS	English	2	0	0	2
6	BSC	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	HSMC	EN207HS	English Language and Communication Skills Lab	0	0	2	1
8	*MC	MC209	Python Programming	1	0	2	0
9	*MC	MC210	Aptitude & Reasoning	3	0	0	0
Total				**16**	**3**	**10**	**19**

Note: *MC = Satisfactory/Unsatisfactory

II Year				I Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	BSC	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	PCC	ME302PC	Mechanics of Solids	3	1	0	4
3	PCC	ME303PC	Material Science and Metallurgy	3	0	0	3
4	PCC	ME304PC	Production Technology	3	0	0	3
5	PCC	ME305PC	Thermodynamics	3	1	0	4
6	PCC	ME306PC	Production Technology Lab	0	0	2	1
7	PCC	ME307PC	Machine Drawing Practice	0	0	2	1
8	PCC	ME308PC	Material Science and Mechanics of Solids Lab	0	0	2	1
9	*MC	MC309HS	Constitution of India	3	0	0	0
10	*MC	MC310ME	Auto CAD	0	0	3	0
Total				**18**	**3**	**9**	**21**

II Year				II Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	ESC	EE401ES	Principles of Electrical and Electronics Engineering	3	0	0	3
2	PCC	ME402PC	Kinematics of Machinery	3	1	0	4
3	PCC	ME403PC	Thermal Engineering – I	3	1	0	4
4	PCC	ME404PC	Fluid Mechanics and Hydraulic Machines	3	1	0	4
5	HSMC	SM405MS	Business Economics & Financial Analysis	3	0	0	3
6	PCC	ME406PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
7	PCC	ME407PC	Thermal Engineering Lab	0	0	2	1
8	ESC	EE409ES	Principles of Electrical and Electronics Engineering Lab	0	0	2	1
9	*MC	MC409HS	Gender Sensitization Lab	0	0	2	0
10	*MC	MC410ME	CREO	0	0	2	0
Total				**15**	**3**	**10**	**21**

Note: *MC = Satisfactory/Unsatisfactory

III Year				I Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PCC	ME501PC	Dynamics of Machinery	3	1	0	4
2	PCC	ME502PC	Design of Machine Members-I	3	0	0	3
3	PCC	ME503PC	Metrology & Machine Tools	3	0	0	3
4	PCC	ME504PC	Instrumentation and Control Systems	3	0	0	3
5	PCC	ME505PC	Thermal Engineering-II	3	0	0	3
6	PCC	ME506PC	Operations Research	3	0	0	3
7	PCC	ME507PC	Instrumentation and Control Systems Lab	0	0	2	1
8	PCC	ME508PC	Metrology & Machine Tools Lab	0	0	2	1
9	PCC	ME509PC	Kinematics & Dynamics Lab	0	0	2	1
10	*MC	MC509	Intellectual Property Rights	3	0	0	0
11	*MC	MC510ME	Analysis Lab	0	0	3	0
12	*MC	MC511EC	Cyber Security	3	0	0	0
Total				**24**	**1**	**9**	**22**

Note: *MC = Satisfactory/Unsatisfactory

III Year				II Semester			
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PCC	ME601PC	Design of Machine Members-II	3	0	0	3
2	PCC	ME602PC	Heat Transfer	3	1	0	4
3	PCC	ME603PC	CAD & CAM	3	0	0	3
4	PCC	ME604PC	Finite Element Methods	3	0	0	3
5	PEC		Professional Elective – I	3	0	0	3
6	OEC		Open Elective – I	3	0	0	3
7	PCC	ME605PC	Heat Transfer Lab	0	0	2	1
8	PCC	ME606PC	CAD & CAM Lab	0	0	2	1
9	HSMC	EN608HS	Advanced English Communication Skills lab	0	0	2	1
10	*MC	MC107ES	Environmental Science	3	0	0	0
11	*MC	MC108	Business English	2	0	0	0
12	*MC	MC611EC	Artificial Intelligence	3	0	0	0
Total				**23**	**1**	**6**	**22**

Note: *MC = Satisfactory/Unsatisfactory

MC107ES - Environmental Science– Should be Registered by Lateral Entry Students Only. MC108 – Business English– Should be Registered by Lateral Entry Students Only.

***Open Elective** – Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

IV Year							I Semester
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PCC	ME701PC	Refrigeration & Air Conditioning	3	0	0	3
2	PEC		Professional Elective – II	3	0	0	3
3	PEC		Professional Elective – III	3	0	0	3
4	PEC		Professional Elective – IV	3	0	0	3
5	OEC		Open Elective – II	3	0	0	3
6	PROJ	ME703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	PROJ	ME705PC	Seminar	0	0	2	1
8	PROJ	ME706PC	Project Stage - I	0	0	6	3
Total				**15**	**0**	**12**	**21**

***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Note: Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

IV Year							II Semester
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PEC		Professional Elective – V	3	0	0	3
2	PEC		Professional Elective - VI	3	0	0	3
3	OEC		Open Elective - III	3	0	0	3
4	PROJ	ME801PC	Project Stage - II	0	0	14	7
Total				**9**	**0**	**14**	**16**

Professional Elective – I	
ME611PE	Unconventional Machining Processes
ME612PE	Machine Tool Design
ME613PE	Production Planning & Control

Professional Elective – II	
ME711PE	Additive Manufacturing
ME712PE	Automation in Manufacturing
ME713PE	MEMS

Professional Elective – III	
ME721PE	Power Plant Engineering
ME722PE	Automobile Engineering
ME723PE	Renewable Energy Sources

Professional Elective – IV	
ME731PE	Computational Fluid Dynamics
ME732PE	Turbo Machinery
ME733PE	Fluid Power Systems

Professional Elective – V	
ME811PE	Industrial Robotics
ME812PE	Mechanical Vibrations
MM813PE	Composite Materials

Professional Elective – VI	
ME821PE	Industrial Management
ME822PE	Production and Operations Management
ME823PE	Tribology

Open Elective -I	
ME600OE	Quantitative Analysis for Business Decisions

Open Elective-II	
ME700OE	Basic Mechanical Engineering

Open Elective-III	
ME800OE	Non-Conventional Sources of energy

R20 B.Tech ME I Year

MA101BS: MATHEMATICS – I

(Linear Algebra and Calculus)
(Common to CE, EEE, ME, ECE, CSE, IT, IOT, AI&ML, DSE)

B.Tech. I Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MA101BS	BSC	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Mathematical Knowledge of 12th / Intermediate level

Course Objectives: To learn

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

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

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

UNIT – I: Matrices

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

UNIT – II: Eigen values and Eigen vectors

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

UNIT - III: Sequences & Series

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

UNIT – IV: Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series. Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT – V: Multivariable calculus (Partial Differentiation and applications)

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

Text Books:

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

Reference Books:

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

Web References:

1) SWAYAM Online Courses: https://storage.googleapis.com/uniquecourses/online.html
2) Directory of Open Access Journals: https://doaj.org/
3) Springer Open Journals: https://www.springeropen.com/journals
4) UG/PG MOOCs: http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php

E-Text Books:

1) National Digital Library: https://ndl.iitkgp.ac.in/
2) NCERT Text Books: http://ncert.nic.in/textbook/textbook.htm
3) Directory of Open Access Books: https://www.doabooks.org/

PH103BS: ENGINEERING PHYSICS

B. Tech. I Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
PH 103BS	**BSC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**
Contact Classes:45	**Tutorial Classes:15**	**Practical Classes: Nil**				**Total Classes :60**		

Prerequisites: Intermediate level Physics and Mathematics

COURSE OBJECTIVES:

To make the students

1. Gain knowledge on the mechanism of physical bodies upon the action of forces on them
2. Understand different types of vibrations
3. Learn on the nature, generation & transmission of different types of waves
4. Get familiarized with the optical phenomena like Interference and diffraction
5. Understand the methods of production of lasers & the basic concepts of optical fibers

COURSE OUTCOMES:

After completion of this course the students will be able to

1. Apply the fundamental concepts of Mechanics to solve numerical problems
2. Explain the characteristics of different types of vibrations
3. Describe the propagation, transmission and reflection of waves
4. Express the basic idea of interference and diffraction
5. Describe different types of lasers, their characteristics and propagation of light through fibers

UNIT - I: INTRODUCTION TO MECHANICS

Transformation of scalars and vectors under Rotation transformation, Forces in Nature, Newton's laws and its completeness in describing particle motion, Form invariance of Newton's second law, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction, Extension to cylindrical and spherical coordinates

UNIT - II: HARMONIC OSCILLATIONS

Mechanical and electrical simple harmonic oscillators-Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator- Relaxation time, Quality factor- Mechanical and electrical oscillators, Mechanical and electrical impedances- Steady state motion of forced damped harmonic oscillator, Power absorbed by an oscillator.

UNIT - III: WAVES IN ONE DIMENSION

Transverse wave on a string- wave equation on a string- Harmonic waves, Reflection and transmission of waves at a boundary-Impedance matching -Standing waves and their Eigen frequencies-Longitudinal waves- wave equation- Acoustic waves and speed of sound, Standing sound waves.

UNIT - IV: WAVE OPTICS

Huygens' principle-Superposition of waves- Interference of light by the division of wave front and amplitude -Young's double slit experiment-Newton's rings, Michelson's interferometer- Fraunhofer diffraction from a single slit and circular aperture, Diffraction grating- Grating Spectrum- Rayleigh's criterion- Resolving power.

UNIT - V: LASERS AND FIBER OPTICS
Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fiber Optics: Introduction, Optical fiber as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibers, Losses associated with optical fibers, Applications of optical fibers.
TEXT BOOKS: 1. MK Harbola, Vijaykrishna&Madhumohan, "Engineering Physics"- Cengage Learning, 2018. 2. HJ Pain, "The physics of vibrations and waves", Wiley, 2006
REFERENCEBOOKS: 1. IG Main, "Vibrations and waves in physics', 3rd ed., Cambridge University Press, 2018. 2. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010. 3. MK Verma, "Introduction to Mechanics", Universities Press 4. AjoyGhatak, "Optics", McGraw Hill Education, 2012. 5. MK Harbola, "Engineering Mechanics", 2nd ed., Cengage Learning
WEBREFERENCES: 1. http://link.springer.com/book 2. http://www.thphys.physics.ox.ac.uk 3. http://www.sciencedirect.com/science 4. http://www.e-booksdirectory.com
E -TEXT BOOKS: 1. http://www.peaceone.net/basic/Feynman/ 2. http://physicsdatabase.com/free-physics-books/ 3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf 4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

R20 B.Tech ME I Year

CS103ES: PROGRAMMING FOR PROBLEM SOLVING

B. Tech. I Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
CS103ES	**ESC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	0	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Basic knowledge of Computer

Course Objectives:

- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.
- To learn modular programming approach in programming
- To understand and learn the concept of derived data types.

Course Outcomes:

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into module (functions) and to develop modular reusablecode.
- To use derived data type to write advances C programs.

UNIT – I: COMPUTER FUNDAMENTALS AND INTRODUCTION TO C LANGUAGE

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems
Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming.
Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion,
The main method and command line arguments
Bitwise operations: Bitwise AND, OR, XOR and NOT operators
Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, go to, Iteration with for, while, do while loops
I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr.

UNIT – II: Derived Data Types

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays **Strings**: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings
Structures: Defining structures, initializing structures, unions, Array of structures

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self referential structures in linked list(no implementation) **Enumeration data type**

UNIT - III: Files

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef**Files**: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Functions

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions

Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT – V: Applications of Arrays & Analysis of algorithms

Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.

Basic searching in an array of elements (linear and binary search techniques),

Basic algorithms to sort array of elements (Bubble, Insertion, Selection, Quick and Merge sort algorithms)

Stack using Arrays and Queue using Arrays

Basic concept of order of complexity through the example programs

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures,Cengage Learning, (3rdEdition)

Reference Books:

1. 'C Programming: A Modern Approach (2nd Edition)' by K. N.King
2. Let us c by YawanthKanetkar
3. Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice Hall ofIndia
5. R.G. Dromey, How to solve it by Computer, Pearson (16thImpression)
6. Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.
7. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4thEdition

Web References:

1. https://github.com/EbookFoundation/free-programming-books/blob/master/free- programming-books.md#c
2. https://publications.gbdirect.co.uk//c_book/

E-Text Books:

1. https://books.goalkicker.com/CBook/
2.http://www2.cs.uregina.ca/~hilder/cs833/Other%20Reference%20Materials/The%20C%20Programming%20Language.pdf
3. https://www.stormingrobots.com/prod/tutorial/pdf/kingBook-ch1to10.pdf

ME104ES : ENGINEERING GRAPHICS

B.Tech. I Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME104ES	ESC	1	0	4	3	30	70	100
Contact Classes: 15	Tutorial Classes: 0	Practical Classes: 60				Total Classes: 75		

Prerequisite: NIL

Course Objectives:

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

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

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

UNIT – I

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

UNIT – II

Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.—Auxiliary Planes.

UNIT – III

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

UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder.

UNIT – V

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views –Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

Introduction to CAD: (For Internal Evaluation Weightage only)

Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package.

Text Books

1. Engineering Drawing N.D.Bhatt/Charotar.
2. Engineering Drawing / N. S. Parthasarathy and VelaMurali/Oxford.

Reference Books

1. Engineering Drawing / Basant Agrawal and McAgrawal/McGrawHill.
2. Engineering Drawing/ M. B. Shah, B.C. Rane/Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al –CBSPublishers.

Web References:

1.http://www.ndl.iitkgp.ac.in/

E-Text Books:

1.http://www.pdfdrive.com/engineering-drawing-books.html

2. http://www.examupdates.in/engineering-drawing-text-book/

PH106BS: ENGINEERING PHYSICS LAB

B.Tech. I Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
PH 106 BS	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	**-**	**3**	**1.5**	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		

Prerequisite: Nil

COURSE OBJECTIVES:

To make the student

1. To gain knowledge by applying the experimental methods to correlate with the theoretical concepts.
2. To learn the usage of mechanical, electrical, magnetic and optical systems for various measurements.
3. To Apply the analytical techniques to the experimental data
4. To develop communication skills while working in a group

COURSE OUTCOMES:

After completion of this course the student will be able to

1. Operate different sets of measuring tools like spectrometer, travelling microscope, diffraction grating and techniques, Melde's apparatus, diffraction grating, coupled oscillator, Torsional pendulum, LCR circuit, Fiber optic kit
2. Compute relevant physical quantities from the observed measurements and interpret through graphical methods
3. Compare the experimental results with their theoretical counterparts
4. Demonstrate basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

List of Experiments:

1) Dispersive power of the material of a prism – Spectrometer
2) Determination of wavelengths of white source – Diffraction grating
3) Newton's Rings – Radius of curvature of Plano convex lens
4) Melde's experiment – Transverse and longitudinal modes
5) Coupled Oscillator
6) L-C-R circuit – Resonance & Q-factor
7) Torsional pendulum – Rigidity modulus
8) Laser Diffraction-Determination of Wavelength
9) Calculation of attenuation coefficient of an optical fiber
10) Determination of Numerical aperture of an optical fiber

(Any eight experiments to be mandatorily performed by the student)

List of Equipment Required:

Name of the Equipment		Quantity
Spectrometers	**:**	**6**
Diffraction Gratings	**:**	**6**
Prisms	**:**	**8**
Sodium Vapour lamps	**:**	**2**
Mercury Vapour Lamps	**:**	**2**
Newton's Rings-Sets	**:**	**6**
Melde's Apparatus	**:**	**6**
Stewart- Gee's Apparatus	**:**	**6**
Circular Brass Discs	**:**	**8**
Coupled Oscillators	**:**	**6**

Text Books:

1. C. L. Arora, "Practical Physics", S. Chand & Co., New Delhi, 3rd Edition, 2012.
2. Vijay Kumar, Dr. T. Radhakrishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014
3 Y. Aparna, K. Venkateswarao, "Engineering Physics Lab Manual", VGS Book links 2010

Reference Books:

1. C.F. Coombs, "Basic Electronic Instrument Handbook", McGraw-Hill Book Co., 1972.
2. C.H. Bernard and C.D. Epp, John Wiley and Sons, "Laboratory Experiments in College Physics" Inc., New York, 1995.

Web References:

1. https://www.scribd.com/doc/143091652/engineering-physics-lab
2. https://www3.nd.edu/~wzech/LabManual_0907c.pdf
3. https://www.morebooks.de/store/gb/book/engineering-physics-lab-manual/isbn/978-3-330-34402.

CS106ES : PROGRAMMING FOR PROBLEM SOLVING LAB

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
CS106ES	ESC	0	0	3	1.5	30	70	100
Contact Classes: 0	Tutorial Classes: 0	Practical Classes:45				Total Classes:45		

Prerequisite: Basic Knowledge of Computer

Course Objectives: The students will learn the following:

- To work with an IDE to create, edit, compile, run and debug programs
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To Write programs using the Dynamic Memory Allocation concept.
- To create, read from and write to text and binary files

For all the Programs writing Algorithm and drawing Flow chart is Mandatory.

List of Experiments:

Basic programs

1. Write a simple program that prints the results of all the operators available in C (including pre/ post increment, bitwise and/or/not, etc.). Read required operand values from standard input.
2. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standard input.
3. Write a program to convert temperature from Fahrenheit to Celsius and vise versa.
4. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
5. Write a C program to find simple and compound interest.
6. Write a C program to find Gross salary of an Employee.

Decision Making statements

1. Write a program for fiend the max and min from the three numbers using if-else.
2. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*,/, % and use Switch Statement)
3. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.
4. Write a C program to find the roots of a Quadratic equation.
5. Write a C program to find grade of a student using else if ladder.
6. C program to read weekday number and print weekday name using switch.

Loop:

1. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:

5 x 1 = 5
5 x 2 = 10
5 x 3 = 15

2. Write a C program to print the following patterns:

```
 1          *          1          1          * * * *
 1 2        * *        2 3        2 2        * * *
 1 2 3       * * *     4 5 6      3 3 3      * *
                                   4 4 4 4    *
```

a.
```
 1
 2 3
 4 5 6
7 8 9 10
```

b.
```
 1
 01
 101
 0101
 10101
```

c.
```
 1
 22
 333
 4444
 55555
```

d.
```
    *
   ***
  *****
 *******
*********
 *******
  *****
   ***
    *
```

3. Find the sum of the series

a. 1^2+2^2+3^2+4^2+……+N^2
b. 1/2 - 2/3 + 3/4 - 4/5 + 5/6 - .....n
c. 1-X^2/2!+X^4/4!- .....
d. 1-x/2 +x^2/4-x^3/6 .....

Loop with Decision making Statements:

1. Write a program that shows the binary equivalent of a given positive number between 0 to 255.
2. Write a program that finds if a given number is a prime number
3. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
4. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
5. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
6. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+…….+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.
7. Write a C program to print all Perfect numbers between 1 to n.
8. C program to print all Armstrong numbers from 1 to N.

Function

1. Write a C program to calculate factorial of a given number using function & recursion.
2. Write a C Program for call by value & call by reference.
3. Write a C program to calculate GCD of two number using function & recursion.
4. Write a C program to calculate LCM of two number using function & recursion.
5. Write a C program to find x^n using recursion.
6. Write a C program o find minimum and maximum value from given two values using a macro.
7. Write a C program to demonstrate the storage classes.
8. Write a C program to demonstrate pre processor commands.

Arrays

1. Write a C program to find the minimum, maximum and average in an array of integers.
2. Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
3. Write a C program that uses functions to perform the following:
   i. Addition of Two Matrices
   ii. Multiplication of Two Matrices
4. Write a C program to merge to arrays into a single array.
5. Write a C program to implement Stack using array.
6. Write a C program to implement Queue using array.

Sorting and Searching:

1. Write a C program that uses non recursive function to search for a Key value in a given list of integers using linear search method.
2. Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers using binary search method.
3. Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.
4. Write a C program that sorts the given array of integers using selection sort in descending order
5. Write a C program that sorts the given array of integers using insertion sort in ascending order
6. Write a C program that sorts the given array of integers using merge sort and quick sort in ascending order

Pointers & Dynamic Memory Allocation

1. Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not be same.
2. Write a program for reading elements using pointer into array and display the values using array.
3. Write a program for display values reverse order from array using pointer.
4. Write a program through pointer variable to sum of n elements from array.

Strings:

1. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
2. Write a C program that converts a number ranging from 1 to 50 to Roman equivalent
3. Write a C program that uses functions to perform the following operations:
   a. To insert a sub-string in to a given main string from a given position.
   b. To delete n Characters from a given position in a given string.
4. Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
5. Write a C program that displays the position of a character ch in the string S or – 1 if S doesn‘t contain ch.

6. Write a C program to count the lines, words and characters in a given text.
7. Write a C program that sorts a given array of names

Structures

1. Define a structure for Student with Sno, Sname, marks of three subjects, avg. Write a C program to read 4 students information and display grade of the student.
2. Define a structure called books with book name, author, price, pages, and edition. Write a C program to read and display a book information using pointer.
3. Define a structure for complex number. Write functions on complex numbers (addition, subtraction, multiplication, division, complex conjugate) and implement them in a menu driven style.

Files:

1. Write a C program to display the contents of a file to standard output device.
2. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
3. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.
4. Write a C program that does the following:
   It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function) Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function) The program should then read all 10 values and print them back.
5. Write a C program to merge two files into a third file (i.e., the contents of the firs t file followed by those of the second are put in the third file).
6. Write a C program to display first n characters of a file in reverse order.

List of Equipment/Software (with Specifications or Range) Required:

A Computer System with Ubuntu operating system and GCC Compiler

References

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
4. Hall of India
5. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
6. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
7. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

MC107ES: ENVIRONMENTAL SCIENCE

B.Tech. I Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC107ES	**MC**	3	-	-	0	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Prerequisite: Nil

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

Course Outcomes:

- Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT - I: Ecosystems

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II: Natural Resources & Energy resources

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III: Biodiversity And Biotic Resources

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and eco system diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT – IV: Environmental Pollution and Control Technologies

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management.
Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation.
Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone

depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT – V: Environmental Policy, Legislation & EIA

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP).

Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text Books:

1 Textbook of Environmental Studies for Undergraduate Courses by ErachBharuchafor University Grants Commission.

2 Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela.2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

Web References:

1.Fundamental concepts in Environmental Studies by Dr.D.D Mishra

2.Basis of Environmental Science by MichealAllaby

E-Text Books:

1.[ebook] A Text Book of environmental studies by Shashi Chawla - Meripustak.com

2. [ebook] A Text Book of environmental studies by Dr.D.K.Asthana https://books.google.co.in

MC108: BUSINESS ENGLISH

B.Tech. I Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC108/208	MC	2	0	0	2	30	70	100
Contact Classes: 30	Tutorial Classes: NIL	Practical Classes: Nil				Total Classes: 30		

Prerequisite: Knowledge of functional English, basics in grammar, understanding of LSRW skills

Course Objectives:

The course aims to illustrate the significance of communication in professional life and emphasize the need for continuous learning in the context of globalization.

Course Outcomes:

Students should be able to

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately in formal and informal situations.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills to perform effectively in personal and professional contexts.

UNIT – I: COMMUNICATION

Reading: Goal of Reading, General Strategies for Reading Comprehension, Previewing, Predicting, Identifying the main Idea, Questioning, Making Inferences, Visualizing
Listening: A conversation on phone, Listening to a travel anecdote
Writing: Filling in an application form, Writing emails
Speaking: Breaking the Ice, JAM sessions
Vocabulary: Word Formation: Homophones, Homonyms, Homographs

UNIT – II: DEVELOPMENT AND TRAINING

Reading: Reading between the Lines, Reading and answering a quiz
Listening: Listening to an Interview on Radio, A conversation between colleagues
Writing: Letters- responding to an invitation, letter of enquiry, letter of apology
Speaking: Role Play: How to make decisions, Giving the summary of an article, Descriptions
Vocabulary: Synonyms and Antonyms, One-word substitutes

UNIT - III: CORPORATE CULTURE

Reading: Reading beyond the lines, An article on the power of customers' opinions online
Listening: Working in Teams, Talking about Meetings
Writing: A memo asking for suggestions, Minutes of the meetings
Speaking: Discussion- How to make work place more ecofriendly?
Vocabulary: Technical or business vocabulary, emails and website terms

UNIT – IV: BEING PERSUASIVE

Reading: Reading for Negative Facts, The art of agreeing and disagreeing
Listening: What makes people persuasive, People negotiating a sale at a trade fair
Writing: A survey report, Completing a business report
Speaking: Things that are important when making a presentation, short presentations
Vocabulary: Cohesive Devices or Linkers, Collocations

UNIT – V: THINKING GLOBALLY

Reading: Thinking outside the box, Reading and comparing two articles, Ways of using social media
Listening: Thinking Globally, Social Media and Customers, Netiquette
Writing: Mail for a Job application
Speaking: How to use social media for your professional enhancement
Vocabulary: Avoiding Clichés, Idioms and Phrases

Reference Books:

1. New International Business English Updated Edition Workbook, Cambridge University Press.
2. Swan, M. (2016). Practical English Usage. Oxford University Press.
3. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
4. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
5. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
6. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
7. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

Web References:

1. www.elt.oup.com/learning resources
2. www.cambridgeenglishonline.org
3. www.eslcafe.com
4. www.bbc.co.uk/worldservice/learningenglish
5. www.manythings.org

E-Text Books:

1. The secret to perfecting your grammar - Bloomsbury International

R20 B.Tech ME I Year

MA201BS: MATHEMATICS – II

(ADVANCED CALCULUS & ELEMENTARY COMBINATORICS)

(Common to CE, EEE, ME, ECE, CSE, IT, AI, AI&ML, DSE)

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MA201BS	BSC	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Mathematical Knowledge of 12th / Intermediate level

Course Objectives: To learn

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

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

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

UNIT – I: First Order ODE

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

UNIT – II: Ordinary Differential Equations of Higher Order

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

UNIT – III: Multivariable Calculus (Integration)

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

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

UNIT – IV: Vector calculus

Gradient, Divergence, Curl, Line integral, conservative fields, Green's theorem, surface area of solids of revolution, surface area, surface integral, Triple integrals and Gauss Divergence theorem, Stokes' theorem (without proofs)

UNIT - V: Counting (Recurrence Relations & Elementary Combinatorics)

Basic counting, Pigeonhole principle, Permutations and Combinations, Binomial Coefficients, Application of Recurrence Relations, Solution of Recurrence Relations, Generating functions, Inclusion – Exclusion and applications

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010
2. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGrawHill.

Reference Books:

1. S. L. Ross, Differential Equations, 3rd Ed., Wiley India,1984.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint,2002.
3. Higher Engineering Mathematics by B V Ramana, TataMcGraw-Hill
4. Discrete Mathematics for Computer Scientists and Mathematicians by Joe R. Mott, AbrahamKandel, Theodore P. Baker, Prentice-Hall of India Pvt.Ltd.

Web References:

1. SWAYAM Online Courseshttps://storage.googleapis.com/uniquecourses/online.html
2. Directory of Open Access Journalshttps://doaj.org/
3. Springer Open Journalshttps://www.springeropen.com/journals
4. UG/PG MOOCshttp://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php

E-Text Books:

1. National Digital Library:https://ndl.iitkgp.ac.in/
2. NCERT Text Bookshttp://ncert.nic.in/textbook/textbook.htm
3. Directory of Open Access Bookshttps://www.doabooks.org/

CH202BS: ENGINEERING CHEMISTRY

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
CH202BS	Basic Sciences	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Nil

Course Objectives:

- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.
- To acquire the knowledge of preparation, properties and applications of engineering materials.

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

- The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
- The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
- The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.
- The knowledge of preparation, properties and applications of engineering materials.

UNIT – I: MOLECULAR STRUCTURE AND THEORIES OF BONDING

Atomic and Molecular orbitals, Linear Combination of Atomic orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2,$O_2$and F_2molecules. Π- molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT – II: WATER AND ITS TREATMENT

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems

UNIT – III: ELECTROCHEMISTRY AND CORROSION

Electro Chemistry: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary

(Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application. Electroless plating of Nickel.

UNIT – IV: STEREOCHEMISTRY, REACTION MECHANISM AND SYNTHESIS OF DRUGMOLECULES

Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation analysis of n- butane. Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, $S_N2$reactions.

Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and Anti Markownikoff's additions. Grignard additions on carbonyl compounds.

Elimination reactions: Dehydrohalogenation of alkylhalides. Saytzeffrule.

Oxidation Reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid. Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$, $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT – V: MATERIAL SCIENCE (POLYMERS, COMPOSITE MATERIALS CERAMICS AND COMPOSITE MATERIALS) & SPECTROSCOPY

POLYMERS: Introduction, classification, Types of polymerization, Thermoplastics and thermosetting polymers, synthesis and applications of poly vinyl chloride, Bakelite, nylon 6,6

COMPOSITE MATERIALS: Composites - Constitution, classification, Particle reinforced composites, Fiber-reinforced composites, Metal-matrix composites, Carbon-carbon composites Structural composites, Advantages and applications.

CERAMICS: Different types of ceramic crystal structures, Clay products, Advanced ceramics, Ceramic ball bearings, Cements.

SPECTROSCOPY: Introduction to spectroscopy, IR spectra and its applications

Text Books:

1. A TEXT BOOK OF ENGINEERING CHEMISTRY BY DR S.S DHARA & DR.K.MUKKANTI. (S. Chand Publications)
2. A TEXT BOOK OF ENGINEERING CHEMISTRY BY DR BHARATHI KUMARI YALAMANCHALI. (V G S Techno Series)

Reference Books:

1. Physical Chemistry, by P.W.Atkins
2. Organic Chemistry: StructureandFunctionbyK.P.C. VolhardtandN.E.Schore, 5^{th}Edition.
3. University Chemistry, by B.M. Mahan, Pearson IVEdition.

Web References:

1. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S.Krishnan.
2. Engineering Chemistry by P. C. Jain & M. Jain; Dhanpat Rai Publishing Company (P)Ltd., NewDelhi.

E-Text Books:

1. [ebook] Central library IIT Indore (www.library.iiti.ac.in)
2. [ebook]Chemistry by Royal Society of Chemistry (https://www.rsc.org>ebooks)

ME203ES: ENGINEERING MECHANICS

B.Tech. I Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME203ES	**ESC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	0	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: 0**				**Total Classes: 60**		

Course Objectives: The objectives of this course are to

- Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
- Perform analysis of bodies lying on rough surfaces.
- Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
- Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
- Explain the concepts of work-energy method and its applications to translation, rotation and plane motion and the concept of vibrations

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

- Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces. And, solve problem of bodies subjected to friction.
- Find the location of centroid and calculate moment of inertia of a given section.
- Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
- Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

UNIT – I

Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2-D & 3- D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

UNIT – II

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, Centroid of composite sections; Centre of Gravity and its implications – Theorem of Pappus.

UNIT – III

Area Moment of Inertia: Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem.

Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT – IV

Review of particle dynamics – Rectilinear motion; Plane curvilinear motion (rectangular, path, And polar

coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT – V

Kinetics of Rigid Bodies -Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Text Books:

1. Shames and Rao (2006) , Engineering Mechanics,PearsonEducation.
2. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics&Dynamics.

Reference Books

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition,1983.
2. Engineering Mechanics by Dhubay, TMH
3. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education,2010.
4. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons,2008.
5. Andrew Pytel, JaanKiusalaas, "Engineering Mechanics", Cengage Learning,2014.
6. BeerF.P & Johnston E.RJr.Vector,"MechanicsforEngineers",TMH,2004.
7. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications,2011.
8. BasudebBhattacharyya,"EngineeringMechanics",OxfordUniversityPress,2008.

Web References

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://ndl.iitkgp.ac.in/

E-Text Books

1. https://books.google.co.in/books?id=AOY9fiIkB9AC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. https://drive.google.com/file/d/1Z53SsmbaRAbhutHQAF7SeKM5vsZTEm/view

ME205ES: ENGINEERING WORKSHOP

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME205ES	ESC	1	0	3	2.5	30	70	100
Contact Classes: 15	Tutorial Classes: 0	Practical Classes: 45				Total Classes: 60		

Prerequisite: Practical Skill

Course Objectives:

- To study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipment's and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at workplace.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

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

- Study and practice on machine tools and their operations
- Practiceonmanufacturingofcomponentsusingworkshoptradesincludingpluming, fitting, carpentry, foundry, house wiring and welding.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

1. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Ten on Joint)
2. Fitting – (V-Fit, Dovetail Fit & Semi-circular fit)
3. Tin-Smithy – (Square Tin, Rectangular Tray &Conical Funnel)
4. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
5. Welding Practice – (Arc Welding & Gas Welding)
6. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
7. Black Smithy – (Round to Square, Fan Hook and S-Hook)

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

Text Books:

1. Workshop Practice /B. L. Juneja/Cengage
2. Workshop Manual / K.Venugopal/Anuradha.

Reference Books:

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/SciTech
2. Workshop Manual /Venkat Reddy/BSP

EN205HS: ENGLISH

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
EN205HS	HSMC	2	0	0	2	30	70	100
Contact Classes: 30	Tutorial Classes: -	Practical Classes: Nil				Total Classes: 30		

Prerequisite: Knowledge of functional English, basics in grammar, understanding of LSRW skills

Course Overview:

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

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

Course Objectives:

The course will help to

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

Course Outcomes:

Students should be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills

UNIT – I: The Raman Effect

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

Grammar: Identifying Common Errors in Writing with Reference to Articles and Parts of Speech

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

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

UNIT - II: Ancient Architecture in India

Vocabulary: Synonyms and Antonyms.

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

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

UNIT – III: Blue Jeans

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- Defining- Describing Objects, Places and Events – Classifying- Providing Examples or Evidence

UNIT - IV: What Should You Be Eating

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension- Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing

UNIT – V: How a Chinese Billionaire Built Her Fortune

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Text Book:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge UniversityPress.

Reference Books:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford UniversityPress.

Web References:

1. www.cambridgeenglishonline.org
2. www.eslcafe.com
3. www.bbc.co.uk/worldservice/learningenglish

E-Text Books:

1.The secret to perfecting your grammar - Bloomsbury International

CH206BS: ENGINEERING CHEMISTRY LAB

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
CH206BS	BSC	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 45				Total Classes: 45		

Prerequisite: Nil

Course Objectives: The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

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

List of Experiments:

1. Determination of total hardness of water by complexometric method using EDTA
2. Determination of chloride content of water by Argentometry
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe2+ by Potentiometry using KMnO4
7. Synthesis of Aspirin and Paracetamol
8. Determination of acid value of coconut oil
9. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
10. Determination of viscosity of ground nut oil by using Ostwald's viscometer.
11. Determination of partition coefficient of acetic acid between n-butanol and water.
12. Determination of surface tension of a give liquid using stalagmometer.
13. Thin layer chromatography calculation of R_f values. eg ortho and para nitrophenols.
14. Determination of rate constant of acid catalysed hydrolysis of methylacetate

List of Equipment/Software (with Specifications or Range) Required:

1. CONDUCTIVITYMETER
2. POTENTIOMETER.
3. WATER DISTILLATION SET
4. WATER BATH
5. TLC CHAMBER
6. UV CHAMBER
7. SHAKER BATH

EN207HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.TECH I YEAR II SEMESTER								
COURSE CODE	**CATEGORY**	**HOURS/WEEK**			**CREDITS**	**MAXIMUM MARKS**		
EN207HS	**HSMC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**TOTAL**
		0	**0**	**2**	**1**	**30**	**70**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes:30**				**Total Classes :30**		

PREREQUISITES: Knowledge of functional English, basics in grammar, understanding of LSRW skills

Course Objectives:

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

COURSE OUTCOME:

Students will be able to attain

Better understanding of nuances of English language through audio- visual experience and group activities

- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

SYLLABUS

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

a. Computer Assisted Language Learning (CALL) Lab

b. Interactive Communication Skills (ICS) Lab

Listening Skills

Objectives

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation

2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

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

• Listening for general content

• Listening to fill up information

• Intensive listening

• Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts
• Oral practice: Just A Minute (JAM) Sessions
• Describing objects/situations/people
• Role play – Individual/Group activities

Module: I	**Exercise-I**
CALL Lab: Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening. Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants. **ICS Lab:** Understand: Communication at Work Place- Spoken vs. Written language. Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.	
Module: II	**Exercise-II**
CALL Lab: Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context. Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context. **ICS Lab:** Understand: Features of Good Conversation – Non-verbal Communication. Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.	
Module: III	**Exercise-III**
CALL Lab: Understand: Intonation-Errors in Pronunciation-the Interference of Mother Tongue (MTI). Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation. **ICS Lab:** Understand: How to make Formal Presentations. Practice: Formal Presentations.	
Module: IV	**Exercise-IV**
CALL Lab: Understand: Listening for General Details. Practice: Listening Comprehension Tests. **ICS Lab:** Understand: Public Speaking – Exposure to Structured Talks. Practice: Making a Short Speech – Extempore.	
Module: V	**Exercise- V**
CALL Lab: Understand: Listening for Specific Details. Practice: Listening Comprehension Tests. **ICS Lab:** Understand: Interview Skills. Practice: Mock Interviews.	

Reference Books:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

Web References:

1. www.elt.oup.com/learning resources
2. www.cambridgeenglishonline.org
3. www.eslcafe.com
4. www.bbc.co.uk/worldservice/learningenglish
5. www.manythings.org

E-Text Books:

2. The secret to perfecting your grammar - Bloomsbury International

MC209: PYTHON PROGRAMMING

B.Tech I Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC209	**MC**	**2**	**0**	**1**	**0**	**30**	**70**	**100**
Contact Classes:30	**Tutorial Classes: Nil**	**Practical Classes:15**				**Total Classes :45**		

PREREQUISITES: A course on "Python Programming".

COURSE OBJECTIVE:

At the end of the course students should be able to:

1. To learn how to use lists, tuples, and dictionaries in Python programs.
2. To learn how to write loops and decision statements in Python.
3. To learn how to read and write files in Python.
4. To learn how to use exception handling in Python applications for error handling.

COURSE OUTCOME:

At the end of the course students will be able to:

1. Explain basic principles of Python programming language.
2. Create, run and manipulate Python Programs using core data structures like Lists, Tuple, Set and
3. Dictionaries.
4. Understand and summarize different File handling operations.
5. Handle exceptions in programming.

UNIT – I

Algorithms, building blocks of algorithms (statements, state, control flow), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms. Python Basics, Features of Python, Python Applications, Installing and running Python with Different IDEs, Comments in Python, Memory Management in Python, Garbage Collection in Python, Python I/O : Printing to the Screen, Reading Keyboard Input.

UNIT – II

Operators in Python: Arithmetic, Relational and Comparison Operators, Python Assignment Operators, Logical Operators and Bitwise Operators, Membership Operators, Identity Operators, Operator Precedence and Associativity, Evaluating Expressions. Control Statements: A Word on Indentation, The if Statement, The if … else Statement, The if … elif … else Statement, The while Loop, The for Loop, Infinite Loops, Nested Loops, Loop manipulation using pass, continue, break and else Statement.

UNIT – III

Variables and Data Types in Python**:** How Python Sees Variables, Constants, Identifiers and Reserved words in Python, Naming Conventions in Python. Declaring and using Numeric data types: int, float, complex and boolean , Sequences: Using String data type, Lists and Tuples, Methods and Useful Built-in Functions, Dictionaries and Set Types

UNIT – IV

Python Programming using functions, modules and packages: Organizing python codes using functions, Formal and Actual Arguments, Positional Arguments, Keyword Arguments, Default Arguments, Variable Length Arguments, Pass by Object Reference, Local and Global Variables, Scope and Lifetime of variables, Nested Functions, Recursive

Functions, Powerful Lamda function.

UNIT – V

Python File Input-Output: Opening and closing file, Various types of file modes, reading and writing to files.
Python Exception Handling: Avoiding code break using exception handling , Various keywords to handle exception, try .. except .. else … finally, Raising Exceptions, Assertions, Python Custom

TEXT BOOKS:

1. Learning with Python3: How to Think Like a Computer Scientist, 3rd Edition – Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, Shroff/O‘Reilly Publishers.

REFERENCE BOOKS:

1.Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr.
2. Exploring Python, Timothy A. Budd, Mc Graw Hill Education
3. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press
4. PYTHON PROGRAMMING, Ashok Kamthane and Amit Ashok kamthane

E TEXT BOOKS:

1. https://www.davekuhlman.org/python_book_01.pdf
2. https://www.pdfdrive.com/python-programming-for-the-absolute-beginner-d34494394.html
3. http://index-of.es/Python/Exploring%20Python.pdf

MC210: APTITUDE AND REASONING

B.Tech. I Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC210	MC	3	-	-	0	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Nil

Course Objectives:

This is a foundation course and aims at enhancing employability skills in students. Students will be introduced to higher order thinking skills and problem solving on the following areas - Arithmetic ability, Numerical ability and General reasoning. Students will be trained to work systematically with speed and accuracy while problem solving. The major areas covered in this course include

1. Arithmetic Ability
2. Numerical Ability
3. Quantitative Aptitude
4. Verbal Reasoning
5. Logical reasoning
6. Visual Reasoning

Course Outcomes: Upon the completion of the course, students are expected to

1. Solve questions on the above mentioned areas using short cuts and smart methods
2. Understand the fundamentals concepts of Aptitude skills
3. Perform calculations with Speed & Accuracy
4. To improve Logical thinking.
5. To improve Application Knowledge

UNIT – I: ARITHMETIC ABILITY FOUNDATION

ARITHMETIC ABILITY FOUNDATION: Square root, Cube roots, Speed Maths using Vedic Maths, Surds & Indices, Logarithms Number Systems - Types of numbers, Divisibility tests, LCM and HCF, Unit digit, Number of zeroes, Factorial, No. of factors, Remainder concepts, Successive Divisors

UNIT – II: COMMERCIAL ARITHMETIC& ARITHMETIC ABILITY ADVANCED

COMMERCIAL ARITHMETIC: Percentages, Profit and Loss, Discount, Simple Interest & Compound Interest
ARITHMETIC ABILITY ADVANCED: Time, Speed & Distance- Basics, Average Speed, Problems on Trains, Relative Speed, Boats & Streams, Races & Games, Circular Motion Time and work, Work & Wages, Chain Rule, Pipes and Cisterns

UNIT- III: BIODIVERSITY AND BIOTIC RESOURCES

ALGEBRA: Linear Equations, Quadratic Equations and In-equations, Averages, Ratio, Proportion & Variations, Ages, Partnership
LOGICAL REASONING: Statements & Conclusions, Statements & Course of Actions, Statements & Assumptions, Cause & Effect, Coded Inequalities, Syllogism, Input Output

UNIT – IV: MODERNAPTITUDE

MODERN APTITUDE - I: Permutations & Combinations, Circular Permutation, Probability, Area and Volumes.
MODERN APTITUDE - II: Data Sufficiency, Data Interpretation – Line graph, Pie Charts, Bar graph

UNIT – V: VERBAL REASONING & VISUAL REASONING

VERBAL REASONING: Blood relations, Directions, Coding & Decoding, Number Ranking, Venn Diagrams, Alphanumeric Symbol Test, Mathematical operations. Series, Analogy, Classification, Analytical Reasoning - Information Ordering – Arrangements
VISUAL REASONING: Series, Analogy, Classification, Mirror & Water Images, Spotting out the Embedded figure, Pattern Incompletion, Paper Folding & Cutting, Analytical Figures, Cubes & Dice.

Text Books:

1. Quantitative Aptitude for Competitive Examinations – Dr. R.S Aggarwal, S. Chand Publisher, English Medium, Revised & Enlarged Edition.
2. A Modern Approach to Verbal Reasoning (Fully Solved) – Dr R.S Aggarwal, S. Chand Publisher, English Medium.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1. How to Prepare for Quantitative Aptitude for the CAT – Arun Sharma, Publisher: Mcgraw Hill TP, 8th Edition, English Medium.
2. A Modern Approach to Verbal & Non-Verbal Reasoning – Dr. R.S Aggarwal, S. Chand Publisher, English Medium, Revised Edition.
3. Quantitative Aptitude for All Competitive Examinations – Abhijit Guha, Publisher: Mcgraw Hill, 3rd Edition, English Medium.
4. Quantitative Aptitude - For Competitive Examinations – Rao U. M. Karanam, Publisher: Scitech Publications (India) Pvt. Ltd, ISBN: 9788183714631, English Medium.
5. Course in Mental Ability and Quantitative Aptitude - For Competitive Examinations – Edgar Thorpe, Publisher: Tata McGraw - Hill Education, 2nd Edition, English Medium.

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. II Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MA301BS	**BSC**	3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Mathematical Knowledge at pre-university level

Course Objectives: To learn

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

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

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

UNIT – I: Basic Probability, Random variables

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

UNIT - II: Probability distributions

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

UNIT – III: Testing of Hypothesis

Testing of Hypothesis: Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region. Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT - IV: Complex Variables (Differentiation)

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

UNIT – V: Complex Variables (Integration)

Complex Variables (Integration): Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.

Reference Books:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

Web References:

1. SWAYAM Online Courses https://storage.googleapis.com/uniquecourses/online.html
2. Directory of Open Access Journals https://doaj.org/
3. Springer Open Journals https://www.springeropen.com/journals
4. UG/PG MOOCs http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php

E-Text Books:

1. National Digital Library: https://ndl.iitkgp.ac.in/
2. NCERT Text Books http://ncert.nic.in/textbook/textbook.htm
3. Directory of Open Access Books https://www.doabooks.org/

ME302PC: MECHANICS OF SOLIDS

B.Tech II year I semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
ME302PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: 0**				**Total Classes: 60**		
Prerequisite: Engineering Mechanics, Mathematics								

Course Objectives: This course will advance the students' development of the following broad capabilities:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
2. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
3. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
4. Students will understand how to calculate normal and shear stresses

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Analyze the behavior of the solid bodies subjected to various types of loading;
2. Apply knowledge of materials and structural elements to the analysis of simple structures;
3. Undertake problem identification, formulation and solution using arrange of analytical methods;
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning.

UNIT-I

Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress– strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetricstrain– Elasticmoduli&therelationshipbetweenthem–Barsofvaryingsection–composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT-II

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 abeam.

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 beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses - Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses - Principal stresses and strains – Analytical and graphical solutions.
Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

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 – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

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

Text Books:

1. Strength Of Materials, by Ramamrutham S, Dhanpat Rai Publishing Company (P) Limited,
2. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.

Reference Books:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Solid Mechanics, by Popov
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash, TMH
5. Analysis of structures by Vazirani and Ratwani.
6. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
7. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
8. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
9. Strength of Materials by R.K Rajput, S. Chand &Company Ltd.
10. Strength of materials – R.S. Kurmi and Gupta.

ME303PC: MATERIAL SCIENCE AND METALLURGY

B.Tech II year I semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
ME303PC	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: 0	Practical Classes: 0				Total Classes: 45		

Prerequisite: None

Course Objectives: This course provides students an understanding of basic structure and crystal arrangement of materials, the phase diagrams, advantages of heat treatment and the method of heat treatment processes.

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Identify the properties of metals with respect to crystal structure and grain size
2. Interpret the phase diagrams of materials
3. Describe the concept of heat treatment of steels & strengthening mechanisms
4. Describe the concept of surface hardening of steels & strengthening mechanisms
5. Classify and Distinguish different types of cast irons, steels and non ferrous alloys

UNIT-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT-II

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-III

Heat treatment of Steel: Annealing, Normalising, Hardening, Tempering and Spheroidising, Isothermal transformation diagrams for Fe-C alloys and microstructures development.

UNIT-IV

Continuous cooling curves (TTT) and interpretation of final microstructures and properties-austempering, martempering, subzero treatment, case or surface hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT-V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys (Brass, bronze and cupro-nickel)- Aluminium and Al-Cu – Mg alloys- Titanium alloys.

Text Books :

1. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, WileyIndia

Reference Books :

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint,2002.
2. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011
3. Sidney H Avner , "Introduction to physical metallurgy", Second Edition, Tata McGraw-Hill Education
4. Narula, Narula & Gupta, "Material science", Tata McGraw-Hill Education, 1989

ME304PC: PRODUCTION TECHNOLOGY

B.Tech II year I semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME304PC	**Core**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 0**	**Practical Classes: 0**				**Total Classes: 45**		
Prerequisite: None								

Course Objectives:

1. To teach the process-level dependence of manufacturing systems through tolerances
2. To expose the students to a variety of manufacturing processes including their suitability and capabilities.
3. To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.
4. To teach the thermal and mechanical aspects, such as force, stress, strain, and temperature of the most common processes.
5. To provide a technical understanding of common processes to aid in appropriate process selection for the material and required tolerances
6. To provide a technical understanding of common processes to aid in appropriate material selection for a predetermined process.

Course Outcomes: Upon successful completion of the course, students will be able to:

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

UNIT-I

Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of moulding sands. Methods of Melting - Crucible melting and cupola operation – Defects in castings; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design. Casting processes–Types–Sand moulding, Centrifugal casting, die-casting, Investment casting,

shell moulding; Solidification of casting – Solidification of pure metal, Directional Solidification.

UNIT-II

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

UNIT-III

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

UNIT-IV

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth.
Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning – Bending and deep drawing. Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements.
Drawing and its types – wire drawing and Tube drawing –. Types of presses and press tools. Forces and power requirement in the above operations

UNIT-V

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion, Hydrostatic extrusion. Forces in extrusion
Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.
High Energy Rate Forming Processes: Limitations, Principles of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic forming and rubber pad Forming.

Text Books :

1. Manufacturing Technology / P.N. Rao Vol.1 & 2 / Mc GrawHill
2. Manufacturing Engineering & Technology / SeropeKalpakjian / Steven R. Schmid /Pearson

Reference Books :

1. Metal Casting / T.V Ramana Rao / NewAge
2. Production Technology / G. Thirupathi Reddy /Scitech
3. Manufacturing Processes/ J.P. Kaushish / PHIPublications

ME305PC: THERMODYNAMICS

B.Tech II year I semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
ME305PC	Core	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: 0				Total Classes: 60		

Prerequisite: Engineering Chemistry and Physics

Course Objectives:

To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

Course Outcomes: Upon successful completion of the course, students will be able to:

1. To Understand and differentiate between different thermodynamic systems and processes.
2. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis.
3. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

UNIT-I

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

UNIT-II

PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation. Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT-III

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction–Clausius–Clapeyron Equation

Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

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

UNIT-IV

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

UNIT-V

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

Refrigeration Cycles:

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

Text Books :

1. Engineering Thermodynamics / PK Nag / Mc GrawHill
2. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/Cengage

Reference Books :

1. Engineering Thermodynamics / Chattopadhyay/Oxford
2. Engineering Thermodynamics / Rogers /Pearson
3. Treatise on Heat Engineering, by V.P. Vasandani and D.S. Kumar Metropolitan book Co Pvt Ltd , 2000

ME306PC: PRODUCTION TECHNOLOGY LAB

B.Tech. II Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME306PC	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 30				Total Classes: 30		

Prerequisite: Production Technology

Course Objectives:

- Know about the basic Physical, Chemical Properties of materials
- Explain why some material(s) are better to be used in a product for given design requirements
- Learn the basic operation of various manufacturing processes
- Learn how various products are made using traditional, non-traditional, or Electronics manufacturing processes
- Design simple process plans for parts and products
- Understand how process conditions are set for optimization of production
- Learn how CNC machines work
- Write and execute CNC machining programs to cut parts on a milling machine
- Measure a given manufactured part to evaluate its size, tolerances and surface finish
- Design and fabricate a simple product

List of Experiments: Minimum of 12 Exercises need to be performed

I. Metal Casting Lab:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and permeability –1
3. Moulding Melting and Casting - 1Exercise

II. Welding Lab:

1. ARC Welding Lap & Butt Joint - 2Exercises
2. Spot Welding - 1Exercise
3. TIG Welding - 1Exercise
4. Plasma welding and Brazing - 2Exercises (Water Plasma Device)

III. Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound, and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV. Processing of Plastics

1. Injection Moulding
2. Blow Moulding

ME307PC: MACHINE DRAWING PRACTICE

B.Tech. II Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME307PC	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 30				Total Classes: 30		

Prerequisite: Engineering graphics

Course Objectives:

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

Course Outcomes:

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

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

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

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

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

Types of Drawings – working drawings for machine parts.

List of Experiments:

Drawing of Machine Elements and simple parts

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

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, setscrews.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints for plates
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and footstep bearings.

Assembly Drawings:

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

1. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts-Screws jacks, Petrol engine connecting rod, Plummer block, Fuel Injector
4. Valves - Steam stop valve, spring loaded safety valve, feed check valve and air cock.

TEXT BOOKS:

- Machine Drawing by / Bhattacharyya / Oxford
- Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson

REFERENCE BOOKS:

- Machine Drawing / Ajeet Singh / Mc Graw Hill
- Machine Drawing / N.D. Bhat / Charotar

R20 B.TECH ME II YEAR

ME308PC: MATERIAL SCIENCE & MECHANICS OF SOLIDS LAB

B.Tech. II Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME308PC	**Core**	-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Nil								

Course Objectives:

MATERIAL SCIENCE: Thepurposeofthiscourseistomakethestudentslearntheconceptsof Metallurgy and Material Science role in all manufacturing processes which convert raw materials into useful products adapted to human needs.

MECHANICS OF SOLIDS: The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force- deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

List of Experiments: MATERIAL SCIENCE

1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
4. Study of the Microstructures of Cast Irons.
5. Study of the Microstructures of Non-Ferrous alloys.
6. Hardenability of steels by Jominy End Quench Test.

List of Experiments: MECHANICS OF SOLIDS

1. Direct tension test
2. Bending test on Simple supported beam
3. Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test/ Rockwell hardness test
6. Tension springs
7. Izod Impact test/ Charpy Impact test

MC310ME: AutoCAD

B.Tech. II Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC310ME	**Core**	-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Nil								

Course Objectives:

1. Develop skills to generate mechanical engineering drawings using AUTOCAD tools
2. Learn various tools and functions in AUTOCAD

Course Outcomes:

1. Develop 2D and 3D models using modeling software.
2. Draw engineering drawings with different views, and an assembly of the objects that make up engineering systems, using a CAD system.
3. Describe the principles of Computer Aided Designing systems and the concepts of Geometric modeling, solid modeling, and feature-based design modeling.

List of Exercises:

1. CAD: Introduction to Computer Aided Drafting, Advantages and Disadvantages of CAD.
   AUTOCAD: Introduction and Features of AUTOCAD Software.

2. **Environment of AutoCAD:** Workspace, Application Menu, Quick Access Toolbar, Ribbon, Search for information, Pull-down menu, Status bar, Function keys.
   Coordinate systems: Used in AutoCAD - absolute and relative, Cartesian and polar coordinate systems.

   Basic Managing/ Display control Tools: New, Save, Qnew, Open, Close, Quit/Exit, Undo, Redo, Limits, Units, Zoom, Pan, Steering Wheel, View Cube etc.
   Basic Drafting Tools: Line, Polylines, Point, Circle, Arc, Spline, Ellipse, Rectangle, Polygons, Text, Hatch.

   Editing/ Inquiry Tools: Erase, oops, Move, Copy, Mirror, Rotate, Scale, Fillet, Chamfer, Trim, Extend, Break, Join, Stretch, Offset, Array, Distance, Radius, Angle, Area, Volume.
   Dimensioning Tools: Linear, Aligned, Radius, Diameter, Centre, Angular, Baseline, Continuous, Ordinate, Arc Length, Jogged Radius Dimension, Dimension Space, Dimension Break, Inspection Dimension, Multileader and its Style.

3. Coordinate systems (absolute, relative, polar, etc.)
4. Study of script, DXE & IGES Files.
5. Practice of 2D sketches.
6. Generation of various 3D Model through Extrude, Revolve, Blend and sweep.
7. Feature based and Boolean based modeling.
8. Design of simple components & Assembly.
9. Automatic conversion of 3D to 2D.
10. Project

REFERENCE BOOKS:

1. AutoCAD Workbook (Mechanical) by C.S.Changeriya (Author)
2. Engineering Graphics with AutoCAD, Revised Edition Kindle Edition by Anand P. Rastogi (Author)

ME402PC: KINEMATICS OF MACHINERY

B.Tech II year II semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME402PC	**Core**	**3**	**1**	**0**	**4**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: 0**				**Total Classes: 60**		
Prerequisite: Basic principles of Mechanics								

Course Objectives:

1. To understand the study of Kinematics concerned with relationship between geometry and motion of the parts of a machine and to understand the basic types of mechanisms and their inversions.
2. To impart skills to analyze the position, velocity and acceleration of various mechanisms.
3. To develop analytical competency in solving kinematic problems of mechanisms using different methods.
4. To understand and design cam mechanisms for specified output motions.
5. To understand the basic concepts of toothed gearing and kinematics of gear trains

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Identify mechanisms in real life applications and perform kinematic analysis of simple mechanisms.
2. Analyze velocity and acceleration of mechanisms by vector and graphical methods.
3. Synthesize planar mechanisms for the given motion parameters using analytical and graphical methods.
4. Design cams and followers for specified motion profiles.
5. Evaluate the gear tooth geometry of different gear drives for motion/power transmission and analyses the different gear trains.

UNIT-I

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

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

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

UNIT-II

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

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

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

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

UNIT-III

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

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

Hooke's Joint: Single and double Hooke's joint –velocity ratio – application – problems

UNIT-IV

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

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

UNIT-V

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

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

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

Text Books :

1. Theory of Machines and Mechanisms/JOSEPH E. SHIGLEY/Oxford
2. Theory of Machines / S. S. Rattan / Mc Graw Hill Publishers Education McGraw-Hill Education, Reprint 2012

Reference Books:

1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan/CBS.

ME403PC: THERMAL ENGINEERING-I

B.Tech II year II semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
ME403PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: 0**				**Total Classes: 60**		

Prerequisite: Thermodynamics

Course Objectives:

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

Course Outcomes:

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

UNIT-I

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

UNIT-II

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

Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables

Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating.

UNIT-III

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

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

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

UNIT-IV

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

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

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

UNIT-V

Gas Turbines: Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gas Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum Pressure Ration for Simple Gas Turbine Cycle. Parameters of Performance, Actual Cycle, Regeneration,
Inter cooling and Reheating – Closed and Semi-Closed Cycle

Text Books :

1. I.C. Engines / V. Ganesan / Mc GrawHill
2. Thermal Engineering / Mahesh M Rathore / Mc GrawHill

Reference Books:

1. Applied Thermodynamics for Engineering Technologists / Eastop /Pearson
2. Fundamentals of Classical Thermodynamics / Vanwylen G.J., Sonntag R.E. / WileyEastern
3. Internal Combustion Engines Fundamentals – John B. Heywood – McGraw HillEd

ME404PC: FLUID MECHANICS AND HYDRAULIC MACHINES

B.Tech II year II semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
ME404PC	Core	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: 0				Total Classes: 60		

Prerequisite: None

Course Objectives:

The objectives of the course are to enable the student.

- To understand the basic principles of fluid mechanics
- To identify various types of flows
- To understand boundary layer concepts and flow through pipes
- To evaluate the performance of hydraulic turbines
- To understand the functioning and characteristic curves of pumps

Course Outcomes:

- Able to explain the effect of fluid properties on a flow system.
- Able to identify type of fluid flow patterns and describe continuity equation.
- To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
- To select and analyze an appropriate turbine with reference to given situation in powerplants.
- To estimate performance parameters of a given Centrifugal and Reciprocating pump.
- Able to demonstrate boundary layer concepts.

UNIT-I

Fluid statics: Dimensions and units: physical properties of fluids-specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers

UNIT-II

Fluid kinematics: Streamline, path line and streak lines and stream tube, classification of flows - steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

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

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel – total energy line – hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

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.

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

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer

UNIT-V

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

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

Text Books :

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers
4. Fluid Mechanics Including Hydraulic Machines by A.K.Jain, Khanna Publishers, New Delhi, 8th Edition, 2003

ME406PC: FLUID MECHANICS AND HYDRAULIC MACHINES LAB

B.Tech. II Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME406PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: FMHM								

Course Objectives:

- To understand the basic principles of fluid mechanics.
- To identify various types of flows.
- To understand boundary layer concepts and flow through pipes.
- To evaluate the performance of hydraulic turbines.
- To understand the functioning and characteristic curves of pumps

Course Outcomes:

- Able to explain the effect of fluid properties on a flow system.
- Able to identify type of fluid flow patterns and describe continuity equation.
- To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
- To select and analyze an appropriate turbine with reference to given situation in power plants.
- To estimate performance parameters of a given Centrifugal and Reciprocating pump.
- Able to demonstrate boundary layer concepts

List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturi meter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli's Theorems.

ME407PC: THERMAL ENGINEERING LAB

B.Tech. II Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME407PC	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 30				Total Classes: 30		

Prerequisite: Thermodynamics & Thermal Engineering – I

Course Objectives:

- To understand the working principles of IC Engines, Compressors.

Course Outcomes:

List of Experiments:

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Performance Test on Variable Compression Ratio Engine
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air – Compressor Unit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers

Note: Perform any 10 out of the 12 Exercises.

MC410ME: CREO

B.Tech. II Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC410ME	**MC**	-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

Prerequisite: NIL

Course Objectives:

- Develop skills to generate mechanical engineering drawings using CREO tools.
- To help Engineers in developing a product design virtually.

COURSE OUTCOMES

- Utilize the interface, Sketcher, Modeling enhancements in CREO Parametric.

List of Exercises:

1. Introduction to CREO parametric
2. 2D sketch modeling
3. 2D sketch Edit tools
4. 3D modeling
5. 3D modeling Advanced Features
6. Pattern Feature
7. 3D practice models
8. Surface modeling
9. Assembly modeling
10. Sheet metal modeling

REFERENCE BOOK:

1. PTC Creo Parametric 3.0 for Designers Book By Prof. Sham Tickoo CADCIM Technologies.

ME501PC: DYNAMICS OF MACHINERY

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME501PC	**Core**	3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Kinematics of Machinery

Course Objectives:

1. To impart the knowledge of principles, operations and to analyze the different types of governors for controlling speed changes caused by changes in the load.
2. To study and understand the principles of gyroscope and its applications.
3. To understand the method of static force analysis and dynamic force analysis in mechanisms while transmitting motion and power.
4. To study the unbalanced forces and analyze the forces acting in different parts of reciprocating and rotating parts of an engine.
5. To determine the natural frequencies of undamped, damped and forced vibrating systems.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. Analyze and design various types of governors and their applications.
2. Apply the gyroscopic principle on aeroplane, ship, four wheel and two-wheel vehicles.
3. Understand various methods of static and dynamic analysis of planar and spatial mechanisms.
4. Understand the causes of rotating and reciprocating unbalance and balancing techniques for rotating/reciprocating masses, in-line, radial and v-engines.
5. Perform detailed analysis of the response of one degree of freedom systems with free and forced vibrations, critical speed of the shaft and simple vibration calculations of rotor systems.

UNIT – I

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

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

UNIT – II

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

UNIT – III

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate, and cone clutches. **Brakes and Dynamometers:** Types of brakes: Simple block brake, band, and block brake- internal expanding shoe brake-effect of braking of a vehicle. **Dynamometers** – absorption and transmission types. General description and methods of operation.

UNIT – IV

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

Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT – V

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

Textbooks:

1. Theory of Machines /S.S.Rattan / Mc Graw Hill.
2. Theory of Machines /Sadhu Singh/ Pearson.

Reference Books:

1. Theory of Machines and Mechanisms/Joseph E. Shigley / Oxford.
2. Theory of Machines / Rao,J.S & R.V. Duggipati/ New Age.

ME502PC: DESIGN OF MACHINE MEMBERS-I

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME502PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgy and material science.

Course Objectives:

1. To apply fundamental design practices with regard to material selection, material properties, manufacturing considerations, standards and codes.
2. To understand the general design procedures and principles in the design of machine elements.
3. To study different materials of construction and their properties and factors determining the selection of material for various applications.
4. To determine stresses under different loading conditions.
5. To learn the design procedure of different fasteners, joints, shafts and couplings.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria of failure.
2. Understands the concepts of principal stresses, stress concentration in machine members and fatigue loading.
3. Design on the basis of strength and rigidity and analyze the stresses and strains induced in a machine element.
4. Design keys, cotters and knuckle joints including riveted, bolted and welded joints.
5. Provide alternate design solutions based on requirement.

UNIT – I

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

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

UNIT - II

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor–Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Goodman's line– Soderberg's line.

UNIT – III

Riveted, Welded and Bolted Joints: Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

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

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

UNIT – IV

Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

UNIT – V

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. - Gaskets and seals (stationary & rotary)

Shaft Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Textbooks:

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill.
2. Machine Design / Jindal / Pearson.

Reference Books:

1. Design of Machine Elements / V. M. Faires / Macmillan.
2. Design of Machine Elements-I / Kannaiah, M.H / New Age.

ME503PC: METROLOGY & MACHINE TOOLS

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME503PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: None

Course Objectives: The course content enables students to

1. Acquire the knowledge of Engineering metrology and its practice which is having increasing importance in industry.
2. Specifically make the student to improve applications aspect in the measurements and control of process of manufacture.
3. Impart the fundamental aspects of the metal cutting principles and their application in studying the behavior of various machining processes.
4. Train in knowing the fundamental parts of various machine tools and their kinematic schemes.
5. Discuss various principles of jigs and fixtures which will be used to hold and guide the work pieces and cutting tools in various machine tools.

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

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

UNIT – I

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips. Engine lathe – Principle of working, types of lathe, specifications. Taper turning,– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT-II

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

UNIT – III

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations.

UNIT-IV

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

Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges, Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straight edges, surface plates, optical flat and auto collimator.

UNIT-V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

Text Books:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson.
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers.

Reference Books:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson.
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill.
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor & Kulkarni/ Tata Mc Graw Hill.

ME504PC: INSTRUMENTATION AND CONTROL SYSTEMS

B.Tech. III year I semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME504PC	**Core**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

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

Course Objectives:

1. Understanding the basic characteristic of a typical instrument.
2. Identifying errors and their types that would occur in an instrument.
3. Identifying properties used for evaluating the thermal systems.
4. The concept of transducer and Various types and their characters.
5. Analyze about speed measurement devices and their applications.

Course Outcomes:

1. To identify various elements and their purpose in typical instruments, to identify various errors that would occur in instruments.
2. Analysis of errors so as to determine correction factors for each instrument.
3. To understand static and dynamic characteristics of instrument and should be able to determine loading response time.
4. For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.
5. Summarize the calibration procedures of various instruments.

UNIT- I

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors. Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers; Calibration procedures.

UNIT – II

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

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

UNIT – III

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

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

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type Stroboscope;Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

UNIT – IV

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

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

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

UNIT-V

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

Text Books:

1. Principles of Industrial Instrumentation & Control Systems, - Alavala, - Cengage Learning.
2. Basic Principles – Measurements (Instrumentation) & Control Systems – S. Bhaskar – Anuradha Publications.

Reference Books:

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

ME505PC: THERMAL ENGINEERING-II

B.Tech. III year I semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME505PC	**Core**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermodynamics

Course Objectives:

1. Study and learn the processes and cycles followed in Thermal Power Plants and Gas turbine plants and components used in the power plants.
2. Gain the knowledge on steam power plants, gas turbine power plants and Jet propulsions, their analyses on fuel and fluidized bed combustion.
3. To apply the laws of Thermodynamics to analyze steam power cycle and to perform analysis of the major components of steam power plants and their applications.
4. To apply the laws of Thermodynamics to analyze gas turbine cycle and to perform analysis of the major components of gas turbine plants and their applications.
5. Understanding the concepts of jet propulsion and rockets and its types with thermodynamic analysis and performance evaluation.

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

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

UNIT-I

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

Boilers – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification

– Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT-II

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

UNIT-III

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

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

UNIT-IV

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

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

UNIT-V

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

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

Text Books:

1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill.

2. Gas Turbines – V. Ganesan /Mc Graw Hill.

Reference Books:

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson.
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI.
3. Thermal Engineering/ Rajput/ Lakshmi Publications.

ME506PC: OPERATIONS RESEARCH

B.Tech. III year I semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
ME506PC	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: None

Course Objectives:

1. Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.
2. Grasp the methodology of OR problem solving and formulate linear programming problem.
3. Develop formulation skills in transportation models and assignment problems and finding solutions, Understanding of sequencing and replacement theory.
4. Basic understanding of inventory and theory of games.
5. Understand the basics in the field of dynamic programming and waiting lines.

Course Outcomes:

1. Understanding the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique.
2. Formulate a given simplified description of a suitable real-world problem as a linear programming model and use the simplex method to solve small linear programming models.
3. Solve & interpret transportation models' and assignment problems, solve sequencing and replacement theory.
4. Solve basic game theory and gain knowledge in fundamental concepts in inventory.
5. Formulate and solve waiting lines and dynamic programming problems.

UNIT-I

Development-definition-characteristics and phases-Types of models-Operations Research models- applications.

Allocation: Linear Programming Problem Formulation-Graphical solution- Simplex method-Artificial variable techniques: Two-phase method, Big-M method.

UNIT-II

Transportation problem - Formulation-Optimal solution, unbalanced transportation problem- Degeneracy.

Assignment problem- Formulation-Optimal solution, - Variants of Assignment problem- Travelling salesman problem.

UNIT-III

Sequencing- Introduction-Flow-Shop sequencing- n jobs through two machines – n jobs through three machines- Job shop sequencing-two jobs through 'm' machines

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

UNIT-IV

Theory of Games: Introduction- Terminology- Solution of games with saddle points and without saddle points. 2 x 2 games- dominance principle- m x 2 & 2 x n games- Graphical method.

Inventory: Introduction- Single item, Deterministic models- purchase inventory models with one price break and multiple price breaks- Stochastic models _ Demand may be discrete variable or continuous variable- single period model and no setup cost.

UNIT-V

Waiting lines: Introduction- Terminology- Single channel- Poisson arrivals and Exponential service times with infinite population.

Dynamic Programming: Introduction- Terminology, Bellman's principle of optimality- Applications of Dynamic programming- shortest path problem- linear programming problem.

Text Books:

1. Operations Research/ J. K. Sharma4e./ MacMilan.
2. Introduction to OR/ Hillier & Libemann/TMH.

Reference Books:

1. Introduction to OR/Taha/PHI.
2. Operations Research/NVS Raju/SMS Education/3rd Revised Edition.
3. Operations Research /A. M. Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research/ Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K.Vijaya Kumar Reddy, J. Suresh Kumar/Cengage Learning.

ME507PC: INSTRUMENTATION AND CONTROL SYSTEMS LAB

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME507PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

Prerequisite: Basic principles of Instrumentation and control systems

Course Objectives:

1. Identifying errors and their types that would occur in an instrument.
2. Identifying properties used for evaluating the thermal systems.

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

1. Characterize and calibrate measuring devices.
2. Identify and analyze errors in measurement.
3. Analyze measured data using regression analysis.
4. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

List of Experiments: Minimum of 12 Exercises need to be performed

1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.
12. Measurement and control of Pressure of a process using SCADA system.
13. Measurement and control of level in a tank using capacitive transducer with SCADA.
14. Measurement and control of temperature of a process using resistance temperature detector with SCADA.

ME508PC: METROLOGY & MACHINE TOOLS LAB

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME508PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

Prerequisite: Theoretical exposure to Metrology and machine tools

Course Objectives:

1. To learn the Step turning and taper turning and thread cutting Drilling and Tapping on the lathe machine
2. To the operations of Shaping and Planing and milling
3. To conduct experiments and understand the working of the same.
4. To import practical exposure to the metrology equipment & Machine Tools.
5. To learn the measurement of the Angle and tapers by Bevel protractor, Sine bars, etc.

Course Outcomes:

1.Perform plain turning, step turning and Grooving on a circular rod

2. Perform the step turning and taper turning on a circular rod
3. Perform thread cutting and knurling on a circular C.S rod and using the lathe machine
4. Drill a hole and perform tapping once given work piece.
5. Slotting operation on a given specimen

List of Experiments:

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

ME509PC: KINEMATICS & DYNAMICS LAB

B.Tech. III Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME509PC	**Core**	-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

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

Course Objectives:

1. The objective of the lab is to understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.
2. To inspect the critical speed of shaft under the given load conditions.
3. To understand the gyroscopic effect and couple on motorized gyroscope.
4. To examine the balancing of rotating masses in dynamic balancing machine.
5. To Sketch the characteristic curves of Watt, Porter, Proell and Hartnell governors and motion curves for the given cam follower setup.

Course Outcomes:

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

1. Understand types of follower motion and cam mechanism.
2. Analyze forces and torques of components in linkages.
3. Understand static and dynamic balance.
4. Understand forward and inverse kinematics of open-loop mechanisms.
5. Measure vibration parameters in single degree freedom systems.

List of Experiments: (A Minimum of 10 experiments are to be conducted)

1. To determine the state of balance of machines for primary and secondary forces.
2. To determine the frequency of torsional vibration of a given rod.
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor.
4. Find the motion of the follower if the given profile of the cam.
5. The balance masses statically and dynamically for single rotating mass systems.
6. Determine the critical speed of a given shaft for different n-conditions.
7. For a simple pendulum determine time period and its natural frequency.
8. For a compound pendulum determine time period and its natural frequency.

9. Determine the effect of gyroscope for different motions.
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems.

*MC509: INTELLECTUAL PROPERTY RIGHTS

B.Tech. III year I semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Max Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC509	**MC**	**3**	**0**	**0**	**0**	**30**	**70**	**100**
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

UNIT-I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT-II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT-III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

UNIT-IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT-V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Text Books & Reference Books:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

*MC510ME: ANALYSIS LAB

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MC511ME	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	3	0	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		

Course Objectives:

1. Learn practical application of FEA using the ANSYS software
2. Learn the proper use of ANSYS code
3. Build computer models or transfer CAD models of structures, products, components, or systems.
4. Apply operating loads or other design performance conditions.

Course Outcomes:

At the end of this course the student will be able to

1. Understand the basics of ANSYS capabilities, terminology and the GUI.
2. Know how to perform a complete ANSYS analysis step-by-step.
3. Acquire the knowledge in building solid models & meshing, apply loads, solving & reviewing results
4. Be in a position to model and analyse for finding stress, temperature distribution etc, with the help of suitable boundary conditions.

List of Experiments: The following analysis can be performed by using any of the analysis software(s) like ANSYS, ALGOR, NASTRAN, NISA, ABAQUS etc.

1. STATIC ANALYSIS: Truss and Frame Structures
   - (i) 2-D truss
   - (ii) 3-D truss
   - (iii) Beam analysis
2. STATIC ANALYSIS: Two Dimensional Problems and Three Dimensional Problems
   - (i) 2-D structure with various loadings
   - (ii) 2-D structures with different materials
   - (iii) Plate with hole
   - (iv) Axi-Symmetric Component
   - (v) Stepped bar
3. DYNAMIC ANALYSIS: Modal and Transient Analyses
   - (i) Modal analysis
   - (ii) Transient Response (spring-mass system)
4. NON-STRUCTURAL PROBLEMS
   - (i) Steady State heat transfer

(ii) Transient heat transfer

LEARNING RESOURCES

REFERENCES:

1. Introduction to Finite elements in Engineering by Chandrupatla• & Belegundu, PHI, 2010.
2. Ansys, " Multiphysics User's Manual"

*MC511EC: CYBER SECURITY

B.Tech. III year I semester

Course Code	Category	Hours/Week			Credits	Max Marks		
		L	T	P	C	CIA	SEE	Total
MC511EC	MC	3	0	0	0	30	70	100
Contact Classes:50	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 50		

Prerequisites: Nil

Course objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks

Course Outcomes: The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.

UNIT-I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT-II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT-III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings

for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT-IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT-V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

Cybercrime: Examples and Mini-Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

Text Books:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

ME601PC: DESIGN OF MACHINE MEMBERS – II

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME601PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Study of engineering mechanics, design of machine members-I and theory of machines.

Course Objectives:

1. To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs, belts, gears etc.
2. To design the components using the data available in design data books.
3. To design a power transmission system through belt, rope and chain drive to meet desired needs in engineering applications.
4. To impart design skills to the students to apply these skills for the problems in real life industrial applications.
5. Apply failure theories in evaluating strength of machine elements.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. Knowledge about journal bearing design using different empirical relations.
2. Estimation of life of rolling element bearings and their selection for given service conditions.
3. Acquaintance with design of the components as per the standard, recommended procedures which is essential in design and development of machinery in industry
4. Apply the design concepts to estimate the strength of the gear.
5. Select suitable belt drives and associated elements from manufacturers catalogues under given loading conditions

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

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

UNIT – V

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

Textbooks:

1. Design of Machine Elements / Spotts/ Pearson.
2. Machine Design / Pandya & Shah / Charothar.

Reference Books:

1. Design of Machine Elements-II / Kannaiah / New Age.
2. Design of Machine Elements / Sharma and Purohit/PHI.
3. Design Data Book/ P.V. Ramana Murti & M. Vidyasagar/ B.S. Publications.
4. Design Data Handbook/ S. Md. Jalaludeen/ Anuradha Publishers.

ME602PC: HEAT TRANSFER

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME602PC	**Core**	3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermodynamics

Course Objectives:

1. To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications.
2. To understand the mechanisms of heat transfer under steady and transient conditions.
3. To understand the concepts of heat transfer through extended surfaces.
4. To learn the thermal analysis and sizing of heat exchangers (Use of standard HMT data book permitted)
5. To Understand the fundamentals of heat transfer processes occurring in natural and engineered systems and apply analytic procedures, numerical tools and problem-solving abilities to heat transfer problems.

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

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

UNIT – I

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

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

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

UNIT – II

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

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance

Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III

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

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

UNIT – IV

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

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

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

UNIT – V:

Heat Transfer with Phase Change:

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

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

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

Text Books:

1. Heat and Mass Transfer – Dixit /Mc Graw Hill.
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage.

Reference Books:

1. Essential Heat Transfer - Christopher A Long / Pearson.
2. Heat Transfer –Ghoshdastidar / Oxford.

ME603PC: CAD & CAM

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME603PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: To learn the importance and use of computer in design and manufacture.

Course Objectives:

1. To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.
2. To understand the need for integration of CAD and CAM.
3. To Develop programming and operating skills for computer numerical control (CNC) machines.
4. To Understand concept of Group Technology, FMS and CIM.
5. To Understand the fundamentals used to create and manipulate geometric models.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics.
2. Acquire the knowledge of geometric modeling and Execute the steps required in CAD software for developing 2D and 3D models and perform transformations.
3. Explain the basic concepts of CNC programming and machining.
4. Illustrate Group Technology, CAQC and CIM concepts.
5. Write the CNC part programming.

UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure.

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

UNIT – II

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

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

UNIT – III

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

UNIT – IV

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

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

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

UNIT – V

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

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

Computer Integrated Manufacturing: CIM system, Benefits of CIM.

Textbooks:

1. CAD/CAM Concepts and Applications / Alavala / PHI.
2. CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill.

Reference Books:

1. CAD/CAM/ Groover M.P/ Pearson.
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age.

ME604PC: FINITE ELEMENT METHODS

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME604PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Mechanics of Solids

Course Objectives:

1. To understand the basics of Finite Element Analysis.
2. To inspect available material models for structural materials, soils and interfaces/joints.
3. To understand modeling of engineering systems and Soil–Structure Interaction (SSI).
4. To create importance of interfaces and joints on the behavior of engineering systems.
5. To create awareness implementation of material model in finite element method and applications.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer.
2. Formulate and solve problems in one dimensional structure including trusses, beams and frames.
3. Formulate FE characteristic equations for two dimensional elements.
4. Analyze plain stress, plain strain, axi- symmetric and plate bending problems.
5. Evaluate eigen values and eigen vectors for stepped bar and beam, explain nonlinear geometric and material nonlinearity.

UNIT – I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements

One Dimensional Problems: 1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates, and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT – II

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector,

Deflection.

UNIT – III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and numerical integration.

UNIT – IV

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plate.

UNIT – V

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of softwares such as ANSYS, ABAQUS, NASTRAN using Hexahedral and Tetrahedral Elements.

Textbooks:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI.
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson.

Reference Books:

1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill.
2. Finite Element Analysis / SS Bhavikatti / New Age.
3. Finite Element Method/ Dixit/Cengage.

ME611PE: UNCONVENTIONAL MACHINING PROCESSES (Professional Elective - I)

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME611PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. To teach the modeling technique for machining processes.
2. To teach interpretation of data for process selection.
3. To teach the mechanics and thermal issues associated with chip formation.
4. To teach the effects of tool geometry on machining force components and surface finish.
5. To teach the machining surface finish and material removal rate.

Course Outcomes:

1. Understand the basic techniques of Unconventional Machining processes modeling.
2. Understand the need and applications of modern machining processes.
3. Estimate the material removal rate and cutting force, in an industrially useful manner, for Unconventional Machining processes.
4. Illustrate the chemical, electrical & mechanical machining process.
5. Develop the economic aspects of the different unconventional machining process.

UNIT – I

Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT - II

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

UNIT – III

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT - IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT – V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications. Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

Text Books:

1. Advanced Machining Processes / VK Jain / Allied publishers.
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill.

Reference Books:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers.
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International.
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press.

ME612PE: MACHINE TOOL DESIGN (Professional Elective – I)

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME612PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisites: Machine Design, Machine Tools and Metrology, Machining Science

Course Objectives: This course is designed to:

1. Implement the tool design process when designing tooling for the manufacturing of a product.
2. Apply Geometric Tolerancing principles in the designs of tooling.
3. Evaluate and select appropriate materials for tooling applications.
4. Design, develop and evaluate cutting tools and work holders for a manufactured product.
5. Design, develop and evaluate appropriate Gauging systems to define limits and specifications of a work piece during the manufacturing process.
6. Design, develop, and evaluate tooling for various joining processes.
7. Apply ANSI standards to tool design drawings and layouts.
8. Use CAD and conventional techniques in creating tooling drawings.

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

1. Understand basic motions involved in a machine tool, design machine tool structures, design and analyze systems for specified speeds and feeds, select subsystems for achieving high accuracy in machining.
2. Understand control strategies for machine tool operations and apply appropriate quality tests for quality assurance.
3. Ability enhancement for the design of various components of structures, guideways, spindles of machine tools.
4. Ability enhancement to adopt & implement the recent trends required as per the applications.

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.
Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

UNIT – V

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

Text Books:

1. Tool Design/ Donaldson/ Fifth Edition, McGraw Hill.
2. Principles of Machine Tools/ G.C. Sen and A. Bhattacharyya /New Central Book Agency.

Reference Books:

1. Design of Machine Tools / D. K Pal, S. K. Basu / Oxford.
2. Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw Hill.
3. Metal Cutting and Tool Design/ Ranganath B.J./ Vikas Publishers.
4. Fundamentals of Tool Design/ ASTME, PHI.
5. Tooling Data/ Joshi P.H./ Wheeler Publishing.

ME613PE: PRODUCTION PLANNING AND CONTROL (Professional Elective – I)

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME613PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisites: Management Science & Productivity

Course Objectives:

1. Understand the importance of Production planning & control. Learning way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.
2. To provide the students with an understanding of the basics of elements of PPC and types of production systems.
3. To know the basic Techniques and their application which are used in project management and to grasp basic knowledge about Materials Management, inventory control and MRP.
4. To expose to Aggregate planning, its methods and Routing.
5. Gain knowledge in fundamental concepts in the field of standard Scheduling methods, Dispatching and follow up.

Course Outcomes:

1. Define and understand concepts of PPC and types of production systems
2. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.
3. State techniques and their methodology in project management, Material Management, inventory control and MRP and JIT.
4. Appreciate and distinguish the importance of Aggregate planning and its methods and know about Routing.
5. Differentiate the concepts of Scheduling methods, Dispatching and follow up.

UNIT – I

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

Forecasting – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – II

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP

II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

UNIT – III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV

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

UNIT – V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.

Text Books:

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

Reference Books:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications.

ME600OE: QUANTITATIVE ANALYSIS FOR BUSINESS DECISIONS (Open Elective – I)

B.Tech. III Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME600OE	Core	3	0	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: NIL				Total Classes: 60		

Course Objectives:

1. Understand the problem, identifying decision variables, objective and constraints.
2. Formulation of Optimization Problem by constructing Objective Function and Constraints functions.
3. Learn to select appropriate Optimization Technique for the formulated Optimization Problem.
4. Understood the procedure involved in the selected Optimization Technique.
5. Solve the Optimization Model with the selected Optimization Technique.

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

1. Familiar with issues that would crop up in business.
2. Understanding the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique.
3. Able to formulate Mathematical Model to resolve the issue.
4. Able to select technique for solving the formulated Mathematical Model.
5. Able to analyze the results obtained through the selected technique for implementation.

UNIT – I

Introduction and Linear Programming: Nature and Scope of O.R.–Analyzing and Defining the Problem, Developing A Model, Types of models, Typical Applications of Operations Research; Linear Programming: Graphical Method, Simplex Method; Solution methodology of Simplex algorithm, Artificial variables; Duality Principle, Definition of the Dual Problem, Primal - Dual Relationships.

UNIT – II

Transportation and Assignment Models: Definition and Application of the Transportation Model, Solution of the Transportation Problem, the Assignment Model, & Variants of assignment problems. Traveling Salesman Problem.

UNIT – III

Replacement Model: Replacement of Capital Cost items when money's worth is not considered, Replacement of Capital Cost items when money's worth is considered, Group replacement of low-cost items.

UNIT – IV

Game Theory and Decision Analysis: Introduction – Two Person Zero-Sum Games, Pure Strategies, Games with Saddle Point, Mixed strategies, Rules of Dominance, Solution Methods of Games without Saddle point – Algebraic, arithmetic methods. Decision Analysis: Introduction to Decision Theory, Steps In the Decision Making, the Different environments In Which Decisions Are Made, Criteria For Decision Making Under Risk and Uncertainty, The Expected Value Criterion With Continuously Distributed Random Variables, Decision Trees, Graphic Displays of the Decision Making Process.

UNIT – V

Queuing Theory and Simulation: Basic Elements of the Queuing Model, Poisson Arrivals and Exponential Service times; Different Queuing models with FCFS Queue discipline: Single service station and infinite population, Single service station and finite population, Multi service station models with infinite population. **Simulation**: Nature and Scope, Applications, Types of simulation, Role of Random Numbers, Inventory Example, Queuing Examples, Simulation Languages.

Text Books:

1. Operations Research: Theory and Applications/ J. K. Sharma: / Macmillan, 2008.
2. Operations Research/ Er. Prem Kumar Gupta & Dr. D. S. Hira / S. Chana, 2016.

Reference Books:

1. Introduction To Operations Research; Hillier/Lieberman/ TMH, 2008.
2. Render: Quantitative Analysis for Management, Pearson, 2009.
3. Quantitative Analysis for Business Decisions / Sridharabhat/ HPH, 2009.
4. Operations Research / R. Panneerselvam/ PHI, 2008.
5. Operations Research: An Introduction / Hamdy, A. Taha/ PHI, 2007.
6. Quantitative Techniques/ Selvaraj/ Excel, 2009.
7. Quantitative Techniques for Decision Making / Gupta and Khanna/ PHI, 2009.
8. Operations Research/ Ravindran, Phillips, Solberg/ Wiley, 2009.
9. Quantitative Methods for Business/ Anderson, Sweeney, Williams/ 10/e, Cengage, 2008.

ME605PC: HEAT TRANSFER LAB

B.Tech. III Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME605PC	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 30				Total Classes: 30		

Prerequisite: *Thermodynamics*

Course Objectives:

1. To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications.
2. To define the fundamental concepts to students in the area of heat transfer and its applications.
3. To recognize the practical significance of various parameters those are involved in different modes of heat transfer.
4. Analyze different methods to calculate the heat transfer coefficient in various heat transfer problems.
5. To apply the knowledge of heat transfer in an effective manner for different applications.

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

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

List of Experiments: Minimum twelve experiments from the following:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere.
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin.
6. Experiment on Transient Heat Conduction.
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection.
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.

11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus.

ME606PC: CAD & CAM LAB

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME606PC	**Core**	-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

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

Course Objectives:

1. To make the students understand and interpret drawings of machine components
2. To prepare assembly drawings both manually and using standard CAD packages
3. To gain practical experience in handling 2D drafting and 3D modelling software systems.
4. To study the features of CNC Machine Tool.
5. To expose the students to different applications of simulation and analysis tools.

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

1. Recreate part drawings, sectional views and assembly drawings as per standards
2. Draw 3D and Assembly drawing using CAD software.
3. Demonstrating manual part programming with G and M codes using CAM.
4. Analyze the stress and strain induced in plates, brackets, beams and heat transfer problems.
5. Calculate the natural frequency and mode shape analysis of 2D components and beams.

List of Experiments: Note: conduct any TEN exercises from the list given below:

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.

10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.

EN608HS: ADVANCED COMMUNICATIONS SKILLS LAB

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
EN608HS	**HSMC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

1.INTRODUCTION:

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

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

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

2.OBJECTIVES:

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

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

3.SYLLABUS:

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

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

4.MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

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

5.SUGGESTED SOFTWARE:

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

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

Text Books:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

Reference Books:

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

*MC107ES: ENVIRONMENTAL SCIENCE

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MC107ES	**MC**	3	0	-	0	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations.

Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development.

UNIT – I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT – II

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT – III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT – IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air**

Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT – V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio- economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text Books:

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

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

*MC108: BUSINESS ENGLISH

B.Tech. III Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MC108	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		2	0	-	0	30	70	100
Contact Classes: 30	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:30**		

Prerequisite: Knowledge of functional English, basics in grammar, understanding of LSRW skills

Course Objectives:

The course aims to illustrate the significance of communication in professional life and emphasize the need for continuous learning in the context of globalization.

Course Outcomes: Students should be able to

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately in formal and informal situations.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills to perform effectively in personal and professional contexts.

UNIT – I: COMMUNICATION

Reading: Goal of Reading, General Strategies for Reading Comprehension, Previewing, Predicting, Identifying the main Idea, Questioning, Making Inferences, Visualizing

Listening: A conversation on phone, Listening to a travel anecdote

Writing: Filling in an application form, Writing emails

Speaking: Breaking the Ice, JAM sessions

Vocabulary: Word Formation: Homophones, Homonyms, Homographs

UNIT – II: DEVELOPMENT AND TRAINING

Reading: Reading between the Lines, Reading and answering a quiz

Listening: Listening to an Interview on Radio, A conversation between colleagues

Writing: Letters- responding to an invitation, letter of enquiry, letter of apology

Speaking: Role Play: How to make decisions, Giving the summary of an article, Descriptions

Vocabulary: Synonyms and Antonyms, One-word substitutes

UNIT – III: CORPORATE CULTURE

Reading: Reading beyond the lines, An article on the power of customers' opinions online

Listening: Working in Teams, Talking about Meetings

Writing: A memo asking for suggestions, Minutes of the meetings

Speaking: Discussion- How to make work place more ecofriendly?

Vocabulary: Technical or business vocabulary, emails and website terms

UNIT – IV: BEING PERSUASIVE

Reading: Reading for Negative Facts, The art of agreeing and disagreeing

Listening: What makes people persuasive, People negotiating a sale at a trade fair

Writing: A survey report, Completing a business report

Speaking: Things that are important when making a presentation, short presentations

Vocabulary: Cohesive Devices or Linkers, Collocations

UNIT – V: THINKING GLOBALLY

Reading: Thinking outside the box, Reading and comparing two articles, Ways of using social media

Listening: Thinking Globally, Social Media and Customers, Netiquette

Writing: Mail for a Job application

Speaking: How to use social media for your professional enhancement

Vocabulary: Avoiding Clichés, Idioms and Phrases

Reference Books:

1. New International Business English Updated Edition Workbook, Cambridge University Press.
2. Swan, M. (2016). Practical English Usage. Oxford University Press.
3. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
4. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
5. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
6. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
7. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

Web References:

1. www.elt.oup.com/learning resources
2. www.cambridgeenglishonline.org
3. www.eslcafe.com

4. www.bbc.co.uk/worldservice/learningenglish
5. www.manythings.org

E-Text Books:

The secret to perfecting your grammar - Bloomsbury International

*MC611EC: ARTIFICIAL INTELLIGENCE

B.Tech. III Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
MC611EC	MC	3	0	-	0	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Course Objectives: To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning. Study of Markov Models enable the student ready to step into applied AI.

UNIT – I

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents **Basic Search Strategies**: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

UNIT – II

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation, Minimax Search, Alpha-Beta Pruning

Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem.

UNIT – III

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Non- monotonic Reasoning, Other Knowledge Representation Schemes

Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks.

UNIT – IV

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston's Learning Program, Decision Trees.

UNIT – V

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, Knowledge Acquisition.

Text Books:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice- Hall, 2010.

Reference Books:

6. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.
7. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

Web References:

https://nptel.ac.in/courses/106/102/106102220/

E-Text Books:

https://cse.iitkgp.ac.in/~pallab/ai.slides/lec1.pdf
https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf

ME701PC: REFRIGERATION & AIR CONDITIONING

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME701PC	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermodynamics

Course Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

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

1. To Differentiate between different types of refrigeration systems.
2. Applications & analysis of Conventional Refrigeration cycle.
3. Understanding of various components of Refrigeration cycles.
4. To Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters.
5. To Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.

UNIT – I

Introduction to Refrigeration: - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.

Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air craft's- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

UNIT – II

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

UNIT – III

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

UNIT – IV

Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system

-Li – Br system. Principle of operation Three Fluid absorption system, salient features. Steam Jet Refrigeration System Working Principle and Basic Components

Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

UNIT – V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP. Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers.

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

Text Books:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill.
2. Refrigeration and Air-Conditioning / RC Aora / PHI.

Reference Books:

1. Principles of Refrigeration - Dossat / Pearson.
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill.

ME711PE: ADDITIVE MANUFACTURING (PE - II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME711PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Manufacturing Processes, Engineering Materials

Course Objectives:

1. To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and 3-D printing, its advantages and limitations.
2. To classify various types of Additive Manufacturing Processes and know their working principle, advantages, limitations etc.
3. To have a holistic view of various applications of these technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc.
4. Apply various liquid and solid based RPT systems.
5. Recognize various STL formats and slicing methods and tessellation.

Course Outcomes:

1. Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.
2. Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
3. Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
4. Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
5. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

UNIT – I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

UNIT – II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT – III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT – IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT – V

RP Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Books:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications.
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer.

Reference Books:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates.
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME.

ME712PE: AUTOMATION IN MANUFACTURING (PE – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME712PE/MT821PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. To know about the Automation and types of Automations in the industries.
2. To understand the different Automated flow lines in the Industries.
3. To perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts.
4. To perform a sequence of automated or mechanized assembly operations Flexible manufacturing system (FMS)—a highly automated machine cell that produces part.
5. To know product families often consists of workstations comprising CNC machine tools.

Course Outcomes:

1. Students will understand the process of automation and types.
2. Students will get exposure to workstation, which refers to the location in the factory where some well-defined task or operation is accomplished by an automated machine.
3. Worker-and-machine combination or a worker using hand tools.
4. Understand the Automated Material handling equipments and types.
5. Student gets exposure on portable power tools.

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automaton.

UNIT - II

Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT – III

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of

improving line balance, flexible assembly lines.

UNIT - IV:

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing.

Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover 3e./PE/PHI, 2009.

Reference Books:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009.
2. Automation by W. Buekinsham.

ME713PE: MEMS (PE – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME713PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Fluid Mechanics

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

1. Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. Understand the rudiments of Micro fabrication techniques.
3. Identify and understand the various sensors and actuators'.
4. Different materials used for MEMS.
5. Applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems.

1. Students will be able to apply scaling laws that are used extensively in the conceptual design of micro devices and systems. Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems.
2. Students will be able to use materials for common micro components and devices.
3. Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
4. Students will be able to understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
5. Students will be able to consider recent advancements in the field of MEMS and devices.
6. Students will be able communicate their results and findings orally via formal presentations and in writing through reports.

UNIT – I

Introduction to MEMS and Micro fabrication: MEMS Roadmap MEMS markets-MEMS foundries- Benefits of Miniaturization -Benefits of Scaling. Micro fabrication: Basic Fabrication Processes– oxidation -film deposition lithography–etching-ion implantation– diffusion.

UNIT - II:

Surface Micromachining and Bulk Micromachining: Surface Micromachining: Basic process flow– release–stiction-material choices-residual stress-Electroplating. Bulk Micromachining: LIGA-Wet Etch- based-dissolved wafer process-SOI MEMS–Scream–MEMS–RIE–DRIE.

UNIT – III

Mechanics of MEMS Materials: Stress–strain-material properties-measurement & characterization of mechanical parameters. Microstructural Elements: bending moment and strain-flexural rigidity- residual stress boundary conditions-spring combinations.

UNIT – IV

MEMS Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperature sensors Humidity sensors. Micro actuators: Electrostatic–piezoelectric–SMA–Thermoelectric- electromagnetic.

UNIT – V

Fluid Dynamics and Micro pumps: Viscosity–density-surface tension-continuity equation-Newton's second law-Navier-Stokes equation and its interpretation-flow types.

Micro fluidics: Electro kinetics electro osmosis–electrophoresis-fabrication methods-Lab ona Chip–micropumps-microvalves.

Text Books:

1. MEMS & Microsystems Design and Manufacture/ Tai-Ran Hsu/ Tata Mc Graw Hill.
2. Microelectromechanical Systems / Bhattacharyya / Cengage.

Reference Books:

1. Foundations of MEMS /Chang Liu / Pearson.
2. MEMS/ Mahalik/ Mc Graw Hill.
3. MEMS and MOEMS Technology and Applications/ PHI.
4. Microsystems Design/ Stephen D. Senturia /Springer.
5. Introductory MEMS – Fabrication and Applications/ Thomas M. Adams and Richard A Layton/ Springer.
6. Microelectronic Devices/ Dipankar Nagchaudhuri/ Pearson Education Asia.

ME721PE: POWER PLANT ENGINEERING (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME721PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: None

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

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high-pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation.

Course Outcomes: At the end of the course students are able to:

1. Understand the concept of Rankine cycle.
2. Understand working of boilers including water tube, fire tube and high pressure boilers and determine efficiencies.
3. Analyze the flow of steam through nozzles.
4. Evaluate the performance of condensers and steam turbines.
5. Evaluate the performance of gas turbines.

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

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

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT - IV

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

UNIT – V

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

Text Books:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill.
2. Power Plant Engineering / Hegde / Pearson.

Reference Books:

1. Power Plant Engineering / Gupta / PHI.
2. Power Plant Engineering / A K Raja / New age.

MT701PC/ME722PE: AUTOMOBILE ENGINEERING (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MT701PC/ME722PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. The anatomy of the automobile in general.
2. The location and importance of each part.
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles, and wheels.
4. Suspension, frame, springs, and other connections.
5. Emissions, ignition, controls, electrical systems and ventilation.

Course Outcomes:

1. Identify the different parts of the automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions.
5. Develop a strong base for understanding future developments in the automobile industry.

UNIT – I

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

UNIT – II

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

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

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

UNIT – III

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

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

UNIT - IV

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

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

UNIT – V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives

Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

Text Books:

1. Automobile Engineering / William H Crouse.
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.

Reference Books:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner.
3. Automotive Engineering / Newton Steeds & Garrett.
4. Automotive Engines / Srinivasan.
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International.

ME723PE: RENEWABLE ENERGY SOURCES (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME723PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. To explain the concepts of Non-renewable and renewable energy systems.
2. To outline utilization of renewable energy sources for both domestic and industrial applications.
3. To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.
4. At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy.
5. Understanding working principles and concepts of different renewable energy technologies.

Course Outcomes:

1. Understanding of renewable energy sources.
2. Knowledge of working principle of various energy systems.
3. Capability to carry out basic design of renewable energy systems.
4. To understand the concept of energy Conservation.
5. To get the utilization of Biogas plants and geothermal energy.

UNIT – I

Global and National Energy Scenario: Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy-concept of Hybrid systems.

UNIT – II

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

UNIT – III

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

UNIT - IV

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

UNIT – V

Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1.Small hydro Power Plant: Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.

2.Geothermal Energy: Geothermal power plants, various types, hot springs and steam ejection.

Text Books:

1. Renewable Energy Sources / Twidell, J.W. and Weir, A./ EFN Spon Ltd., 1986.
2. Non-Conventional Energy Sources / G.D Rai/ Khanna Publishers.

Reference Books:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012.
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

ME731PE: COMPUTATIONAL FLUID DYNAMICS (PE – IV)

B.Tech.IV. Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME731PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Heat Transfer and Fluid Mechanics

Course Objective:

1. To apply the principles of Heat Transfer and Fluid Mechanics to formulate governing equations for physical problems and to solve those using different numerical techniques.
2. To learn the process of creating and exploring a mesh by using any available mesh-generation software packages.
3. To learn how to set suitable boundary conditions and numerical models using any available CFD software packages.
4. To explore the post-processing facilities of the CFD code to explore the results.
5. To assess the computational results against the published experimental and numerical data.

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

1. Differentiate between different types of Partial Differential Equations and to know and understand appropriate numerical techniques.
2. Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM.
3. Understand and to appreciate the need for validation of numerical solution.
4. Understand transition from laminar to turbulent flow, effect of turbulence on time averaged Navier Stokes equations.
5. Understand and apply mixing length model, the k-e model, Reynolds stress equation model and Algebraic stress equation models.

UNIT – I

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition

Pivoting – Treatment of Banded Matrices – Thomas Algorithm Iterative Method: Gauss Seidel and Jordan Methods – Stability Criterion.

UNIT – II

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization-Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates.

UNIT – III

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems.

UNIT – IV

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations.

UNIT – V

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm.

Text Books:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications.
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill.

Reference Books:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer.

ME732PE: TURBO MACHINERY (PE – IV)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME732PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermal Engineering, Heat Transfer

Course Objectives:

1. Provide students with opportunities to apply basic flow equations.
2. Train the students to acquire the knowledge and skill of analyzing different turbo machines.
3. How to compare and chose machines for various operations.
4. Define Turbomachine & Identify the main parts of turbo machines, Classify turbo machines. and compare it with positive displacement machines.
5. Discuss the effect of Reynolds number, specific speed & dimensionless parameters and their physical significance on turbo machines.

Course Outcomes:

1. Ability to design and calculate different parameters for turbo machines.
2. Prerequisite to CFD and Industrial fluid power courses.
3. Ability to formulate design criteria.
4. Ability to understand thermodynamics and kinematics behind turbo machines.
5. Analyze the performance of turbo machinery.

UNIT – I

Introduction to Turbomachinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler‘s, Bernoulli‘s, equation and its applications, expansion and compression process, reheat factor, preheat factor.

UNIT - II

Fundamental Concepts of Axial and Radial Machines: Euler‘s equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje‘s slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT – III

Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.

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

UNIT - IV

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

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

UNIT – V

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

Text Books:

1. Principles of Turbo Machines/DG Shepherd / Macmillan.
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill.

Reference Books:

1. A Treatise on Turbo machines / G. Gopal Krishnan and D. Prithviraj/ SciTech.
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson.
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

ME733PE: FLUID POWER SYSTEMS (PE – IV)

B.Tech.IV Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME733PE	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Fluid Mechanics and Hydraulics Machinery

Course Objectives:

1. To know the concepts of hydraulics & pneumatics, components of hydraulic and pneumatic circuits and applications of hydraulics and pneumatics in automobiles.
2. Design of hydraulic and pneumatic circuits for selected industrial applications.
3. Design and understand the electro-hydraulic and electro-pneumatic circuits.
4. Electrical controls in fluid power systems.
5. Understand standard symbols, pumps, control valves, control assemblies, and actuators.

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

1. Understand the Properties of fluids, Fluids for hydraulic systems.
2. Governing laws. Distribution of fluid power, Design and analysis of typical hydraulic circuits.
3. Know accessories used in fluid power system, Filtration systems and maintenance of system.
4. Select suitable pump, motor, and other components for a specified application.
5. Design the circuit for a given application and execute the same in industry.

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling.

UNIT – V

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

Text Books:

1. Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.
2. "Fluid Power Systems: modeling, simulation and microcomputer control"/ John Watton/ Prentice Hall International.

Reference Books:

1. Fundamentals of Fluid Power Control. / John Watton/ 1 st Ed. Cambridge University Press, 2009.
2. "Fluid Power with applications"/ Anthony Esposito / Pearson Education.

ME700OE: BASIC MECHANICAL ENGINEERING (Open Elective – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME700OE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. Understanding of the basic concepts of various aspects of Mechanical Engineering, fields of application, their merits, demerits, and limitations and applications.
2. To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications.
3. Analysis of mechanisms.
4. Cam profile drawing for various followers.
5. Drawing displacement diagrams for followers with various types of motions.

Course Outcomes:

1. Understand the basic modes of heat transfer.
2. Designing a suitable mechanism depending on application
3. Selecting gear and gear train depending on application.

UNIT – I

Basic Concepts of Thermodynamics and Heat Transfer: Definitions – continuum concept – properties – point and path functions – systems – processes – thermodynamic equilibrium - laws of thermodynamic- First law applied to open and closed systems – steady and unsteady flow systems- Second law – heat engines and heat pumps – efficiency and Coefficient of Performance (COP). Heat transfer – conduction – general conduction equation in Cartesian coordinates – conduction in composite walls. Convection – free and forced convection – simple empirical correlations. Radiation – laws – black body and grey body radiation.

UNIT – II

IC Engines and Air Conditioning: I C engines – classification - construction and working - two and four stroke engines – S I and C.I. engines – powdered coal as an alternative to diesel fuel.

Air conditioning – air cycles, vapour compression cycle – vapour absorption cycle – psychrometric processes. Air cooling – methods and simple cooling load calculations. Systems applicable to mining environment.

UNIT – III

Power Transmission: Gears – nomenclature, laws of gearing, types of gears including rack and pinion, interference, gear trains, calculation of gear ratios, couplings - types, features and applications.

Basic concepts in hydraulic & pneumatic power and devices and their utilisation – simple calculations.

UNIT – IV

Kinematics of Machines: Mechanisms – basics – kinematic concepts and definitions – degree of freedom, mechanical advantage – transmission angle – description of common mechanisms – quick return mechanisms, straight line generators, dwell mechanisms, ratchets and escapements – universal joints.

Cams and followers – terminology and definitions, displacement diagrams – uniform velocity, parabolic and simple harmonic motions.

UNIT – V

Rotodynamic and Vibratory Machines: Fans and compressors – types, construction, working principle, characteristics and applications. Single stage and multistage air compressors – intercooling. Simple calculations for output and efficiency.

Vibration – Importance of free and forced vibration. Vibrators and shakers – construction, working principle, applications and limitations.

Note: HMT Data book to be permitted.

Text Books:

1. Elements of Mechanical Engineering/ S.N. Lal/ Cengage Learning.
2. Theory of Machines and Mechanisms / Shigley J.E., Pennock G.R. and Uicker J. J./ Oxford University Press, 2003.

Reference Books:

1. Rajput, R.K. Thermal Engineering, 6th Edition, Laxmi Publications, 2007.
2. Ballaney, P.L. Thermal Engineering, Khanna Publishers, 24th Edition, 2003.

ME811PE: INDUSTRIAL ROBOTICS (PE – V)

B.Tech.IV Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME811PE	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Basic principles of Kinematics and mechanics

Course Objectives:

1. To enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
2. To make the students to understand the importance of robots in various fields of engineering.
3. To expose the students to various robots and their operational details.
4. To learn robot programming and industrial applications of robots.
5. To make the understand the application of robots in manufacturing.

Course Outcomes:

Upon Completion of this course, students will be able to:

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

UNIT – I

Introduction: Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II

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

Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and

world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III

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

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion -straight line motion.

UNIT – IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools.

UNIT – V

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

Text Books:

1. Industrial Robotics / Groover M P /Mc Graw Hill.
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson.

Reference Books:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley.
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science.
3. Robotics – Fu et al / TMH Publications.

ME812PE: MECHANICAL VIBRATIONS (PE – V)

B.Tech.IV Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME812PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Engineering Mechanics

Course Objective:

1. To Understand various levels of vibrations and remedies for each of them.
2. To learn the concept of simple harmonic motion, basics of mechanical vibrations.
3. To determine a complete solution of modeled mechanical vibration problems.
4. To be able to mathematically model real-world mechanical vibration problems.
5. To compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.

Course Outcomes:

Upon Completion of this course, students will be able to:

1. Determine the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
2. Understand the causes and effects of vibration in mechanical systems.
3. Develop schematic models for physical systems and formulate governing equations of motion.
4. Understand the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds.
5. Analyze and design machine supporting structures, vibration isolators and absorbers.

UNIT – I

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

UNIT - II

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

UNIT – III

Two-degree freedom systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;

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

UNIT – IV

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

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed. **Numerical Methods:** Rayleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

UNIT – V

Sound level and subjective response to sound: Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, the decibel scale, relationship among sound power, sound intensity and sound pressure level, relationship between sound power level and sound intensity, relationship between sound intensity level and sound pressure level, sound measuring instruments.

Textbooks:

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill.
2. Principles of Vibration / Benson H. Tongue/Oxford.

Reference Books:

1. Mechanical Vibrations / SS Rao / Pearson.
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI.
3. Mechanical Vibrations/ G.K. Grover/ Nemchand & Brothers.

MM813PE: COMPOSITE MATERIALS (PE – V)

B.Tech.IV Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MM813PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. Develop understanding of the structure of ceramic materials on multiple length scales.
2. Develop knowledge of point defect generation in ceramic materials, and their impact on transport properties.
3. Enlighten the students in different types of reinforcement.
4. To describe key processing techniques for producing metal, ceramic, and polymer-matrix composites.
5. To demonstrate the relationship among synthesis, processing, and properties in composite materials.

Course Outcomes:

1. Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
2. Know various types of composite materials and their practical importance.
3. Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure.
4. Able to select matrices for composite materials in different applications.
5. Able to describe key processing methods for fabricating composites.

UNIT – I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT – II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al2O3, SiC, Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT – III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

UNIT – IV

Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques; Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT – V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

Text Books:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

Reference Books:

1. Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993.
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994.

ME821PE: INDUSTRIAL MANAGEMENT (PE – VI)

B.Tech.IV Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME821PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: None

Course Objective:

1. Understand the philosophies of management gurus.
2. Understand the various types of organization structures and their features, and Their advantages and disadvantages.
3. Understand plant location and plant layout.
4. Understand value analysis.
5. Learning various Industrial Engineering Practices like Operations Management techniques, work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques.

Course Outcomes:

1. Able to apply principles of management.
2. Able to design the organization structure.
3. Able to apply techniques for plant location, design plant layout and value analysis.
4. Able to carry out work study to find the best method for doing the work and establish standard time for a given method.
5. Able to apply various quality control techniques and sampling plans.
6. Able to do job evaluation and network analysis.

UNIT – I

Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

UNIT – II

Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures –

Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT – III

Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis-Fast diagram.

UNIT - IV:

Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives —steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart,

– Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT – V

Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. **Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

Text Books:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.

Reference Books:

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

ME822PE: PRODUCTION AND OPERATIONS MANAGEMENT (PE – VI)

B.Tech.IV Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME822PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: None

Course Objective:

1. Learn the importance of studying the subject: Production and Operations Management.
2. Learn the characteristics of various types of production systems and understand the current issues of operations Management.
3. Understand the procedure for product design & approaches for product development.
4. Learn the procedure to carry out value analysis by different methods.
5. Learn the methods for location of plant and plant layouts.
6. Understand the procedures for aggregate planning, MRP and JIT.
7. Learn the procedures for scheduling.
8. Learning the techniques for network analysis.

Course Outcomes:

1. Able to execute operations management functions.
2. Able to carry out value analysis.
3. Able to carry out aggregate planning and implement MRP Or JIT.
4. Able to schedule the jobs so as to complete them in minimum make span time.
5. Able to carry out network analysis.

UNIT – I

Operation Management – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

UNIT - II

Value engineering – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineering – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

UNIT – III

Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- MRP logic – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP – II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT-JIT Production process – benefits of JIT.

UNIT – IV

Scheduling – Policies – Types of scheduling – Forward and Backward Scheduling – Grant Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

UNIT – V

Project Management – Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature. – Total Quality Management – ISO 9000 Series Standards – Six Sigma.

Text Books:

1. Operations Management/ Chase/ TMH.
2. Production and Operations Management/ S.N. Chary/ TMH.

Reference Books:

1. "Operations Management / E.S. Buffs/ Wiley.
2. "Operations Management "Theory and Problems/Joseph G. Monks.
3. "Production Systems Management /James I. Riggs.
4. "Production and Operations Management /Panner Selvam/ PHI.
5. "Production and Operations Analysis/ Nahima.
6. Operations Management/ William J. Stevenson/ Mc Graw Hill.

ME833PE: TRIBOLOGY (PE – VI)

B.Tech.IV Year II Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME833PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Fluid mechanics, Design of machine members-II

Course Objectives:

1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. To expose the student to different types of bearings, bearing materials.
3. To understand friction characteristics and power losses in journal bearings.
4. To learn theory and concepts about different types of lubrication.
5. To select the proper grade lubricant for specific application.

Course Outcomes:

1. Understanding friction characteristics in journal bearings.
2. Knowledge about different theories of lubrication to reduce friction and wear.
3. Students will be able to identify and describe the theories of friction and the factors affecting the coefficient of friction between contacting surfaces in relative motion.
4. Students will be able to identify the lubrication modes such as hydrodynamic lubrication.
5. Students will be able to know requirements of bearing materials, Types of bearing materials.

UNIT – I

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature dependent variation, viscosity index, determination of viscosity, different viscometers used.

Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings - externally pressurized bearings. Bearing materials: General requirements of bearing materials, types of bearing materials.

Text Books:

1. Engineering Tribology/ Gwidon W. Stachowiak & Andrew W. Batchelor/Elesevier.
2. Engineering Tribology/ Prasanta Sahoo / PHI.

Reference Books:

1. Tribology – B.C. Majumdar.
2. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI.
3. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.

ME800OE: NON-CONVENTIONAL SOURCES OF ENERGY (Open Elective – III)

B.Tech.IV Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME800OE	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Thermodynamics, Fluid Mechanics and Heat Transfer

Course Objectives:

1. Understand about different types of Non-Conventional Energy Sources.
2. Understand about different equipment's used in generation of energy.
3. Understand about design and fabrication of equipment's for collection and conversion of energy.
4. Understand the basic concepts and operation of renewable energy systems.
5. To exploit renewable energy resources and effective technologies.

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

1. Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and analyze the working of solar and thermal systems.
2. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
3. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
4. Identify methods of energy storage for specific applications.

UNIT – I

Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT - II

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

UNIT – III

Bio-Mass: Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C. Engine operation, and economic aspects.

UNIT - IV

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. **Ocean Energy** – OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants, their economics.

UNIT – V

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo- electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:

1. Renewable Energy Resources / Tiwari and Ghosal / Narosa.
2. Non- conventional Energy Sources / G.D. Rai/ Khanna Publishers.
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon.

Reference Books:

1. Renewable Energy Sources / Twidell & Weir.
2. Solar Power Engineering / B.S. Magal Frank Kreith & J.F. Kreith.
3. Principles of Solar Energy / Frank Krieth & John F Kreider.
4. Non-Conventional Energy / Ashok V Desai / Wiley Eastern.
5. Non-Conventional Energy Systems / K Mittal / Wheeler.
6. Renewable Energy Technologies / Ramesh & Kumar / Narosa.