St. Martin's Engineering College

UGC Autonomous
NBA & NAAC A+ Accredited
Dhulapally, Secunderabad-500 100
www.smec.ac.in

DEPARTMENT OF MECHANICAL ENGINEERING

I YEAR I SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	MA101BS	Linear Algebra and Calculus	3	1	0	4	30	70	100
2	EP102BS	Engineering Physics	3	1	0	4	30	70	100
3	CS105ES	Programming for Problem Solving	3	1	0	4	30	70	100
4	ME106ES	Engineering Graphics	1	0	4	3	30	70	100
5	EP103BS	Engineering Physics Lab	0	0	3	1.5	30	70	100
6	CS107ES	Programming for Problem Solving Lab	0	0	3	1.5	30	70	100
		Total Credits	**10**	**3**	**10**	**18**	**180**	**420**	**600**
Mandatory Course (Noncredit)									
7	ES104BS	Environmental Science	3	0	0	-	100	0	100
8	TS109	Technical Seminar	0	0	2	-	100	0	100
		Induction Programme							

I YEAR II SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	MA201BS	Advanced Calculus	3	1	0	4	30	70	100
2	CH202BS	Engineering Chemistry	3	1	0	4	30	70	100
3	ME208ES	Engineering Mechanics	3	1	0	4	30	70	100
4	ME207ES	Engineering Workshop	1	0	3	2.5	30	70	100
5	EN203HS	Professional English	2	0	0	2	30	70	100
6	CH204BS	Engineering Chemistry Lab	0	0	3	1.5	30	70	100
7	EN205HS	English Language and Communication Skills Lab	0	0	2	1	30	70	100
		Total Credits	**12**	**3**	**8**	**19**	**210**	**490**	**700**
Mandatory Course (Noncredit)									
8	MP209	Micro Projects	0	0	2	-	100	0	100

*MC – Satisfied/Unsatisfied

DEPARTMENT OF MECHANICAL ENGINEERING
II YEAR I SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	PS301BS	Probability Statistics and Complex Variables	3	1	0	4	30	70	100
2	ME302PC	Mechanics of Solids	3	1	0	4	30	70	100
3	ME303PC	Metallurgy and Material Science	3	0	0	3	30	70	100
4	ME304PC	Kinematics of Machinery	2	1	0	3	30	70	100
5	ME305PC	Thermodynamics	3	1	0	4	30	70	100
6	ME306PC	Met & Material Science Lab	0	0	2	1	30	70	100
7	ME307PC	Mechanics of Solids Lab	0	0	2	1	30	70	100
8	ME308PC	Machine Drawing Practice	0	0	2	1	30	70	100
		Total Credits	**14**	**4**	**6**	**21**	**240**	**560**	**800**
Mandatory Course (Noncredit)									
9	CI309MC	Constitution of India	3	0	0	0	100	0	100

II YEAR II SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	ME401PC	Production Technology	3	0	0	3	30	70	100
2	ME402PC	Dynamics of Machinery	3	1	0	4	30	70	100
3	ME403PC	Thermal Engineering – I	3	1	0	4	30	70	100
4	ME404PC	Fluid Mechanics and Hydraulic Machines	3	1	0	4	30	70	100
5	EE406ES	Basic Electrical Engineering	3	0	0	3	30	70	100
6	ME406PC	Production Technology Lab	0	0	2	1	30	70	100
7	ME407PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1	30	70	100
8	ME408PC	Kinematics & Dynamics Lab	0	0	2	1	30	70	100
		Total Credits	**15**	**3**	**6**	**21**	**240**	**560**	**800**
Mandatory Course (Noncredit)									
9	GS409MC	Gender Sensitization lab	0	0	2	0	100	0	100

*MC – Satisfied/Unsatisfied

DEPARTMENT OF MECHANICAL ENGINEERING
III YEAR I SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	ME501PC	Design Of Machine Member-I	3	1	0	4	30	70	100
2	ME502PC	Thermal Engineering-II	3	0	0	3	30	70	100
3	ME503PC	Metrology and Machine Tools	3	0	0	3	30	70	100
4	ME504PC	Automobile Engineering	3	0	0	3	30	70	100
5	BE504MS	Business Economic and Financial Analysis	3	0	0	3	30	70	100
6	ME505PC	Refrigeration And Air Conditioning	3	0	0	3	30	70	100
7	ME506PC	Thermal Engineering Lab	0	0	2	1	30	70	100
8	ME507PC	Machine Tools Lab	0	0	2	1	30	70	100
9	ME508PC	Engineering Metrology Lab	0	0	2	1	30	70	100
		Total Credits	**18**	**1**	**6**	**22**	**270**	**630**	**900**
Mandatory Course (Noncredit)									
10	BS504HS	Environmental Science	3	0	0	0	100	0	100

III YEAR II SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	ME601PC	CAD/CAM	2	1	0	3	30	70	100
2	ME602PC	Design Of Machine Member-II	2	1	0	3	30	70	100
3	ME603PC	Heat Transfer	3	1	0	4	30	70	100
4	FM601MS	Fundamentals of Management	3	0	0	3	30	70	100
5		**Open Elective -I**	3	0	0	3	30	70	100
6		**Professional Elective-I**	3	0	0	3	30	70	100
8	ME605PC	Heat Transfer Lab	0	0	2	1	30	70	100
9	ME606PC	CAD/CAM Lab	0	0	2	1	30	70	100
10	EN606HS	Advanced Communication Skills Lab	0	0	2	1	30	70	100
		Total Credits	**16**	**3**	**6**	**22**	**270**	**630**	**900**
Mandatory Course (Noncredit)									
10	IP610MC	Intellectual Property Rights	3	0	0	0	100	0	100

*MC – Satisfied/Unsatisfied

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

Note: Environmental Science should be registered by lateral entry students only.

DEPARTMENT OF MECHANICAL ENGINEERING

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1	MS701MS	Operations Research	3	0	0	3	30	70	100
2		Open Elective-II	2	0	0	3	30	70	100
3		Professional Elective-II	2	1	0	3	30	70	100
4		Professional Elective-III	2	1	0	3	30	70	100
5		Professional Elective-IV	2	1	0	3	30	70	100
6	ME705PC	Industry Oriented Mini Project/ Internship	0	0	4	2	0	100	100
7	ME706PC	Seminar	0	0	2	1	100	0	100
8	ME707PR	Project Stage I	0	0	4	3	100	0	100
		Total Credits	**10**	**3**	**10**	**21**	**350**	**450**	**800**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
1		Open Elective-III	3	0	0	3	30	70	100
2		Professional Elective-V	3	0	0	3	30	70	100
3		Professional Elective-VI	3	0	0	3	30	70	100
4	ME801PR	Project Stage II	0	0	18	7	30	70	100
		Total Credits	**9**	**0**	**18**	**16**	**120**	**280**	**400**

DEPARTMENT OF MECHANICAL ENGINEERING
List of Professional Electives

Professional Elective-I

ME511PE	Finite Element Methods
ME512PE	Production Planning and Control
ME513PE	Machine Tool Design

Professional Elective-II

ME621PE	Composite Materials
ME622PE	Industrial Management
ME623PE	Production & Operations Management

Professional Elective-III

ME731PE	Engineering Tribology
ME732PE	Computational Fluid Dynamics
ME733PE	Robotics

Professional Elective-IV

ME741PE	Mechanical Vibrations
ME742PE	Power Plant Engineering
ME743PE	MEMS

Professional Elective-V

ME851PE	Intelligent Manufacturing
ME852PE	Fluid Power System
ME853PE	Renewable Energy Sources

Professional Elective-VI

ME861PE	Adative Manufacturing
ME862PE	Turbo Machinery
ME863PE	Un Conventional Machining Process

Open Electives

Open Elective-I
Un Conventional Machining Processes
Open Elective-II
Manufacturing System Engineering
Open Elective-III
Non-Conventional Source of Energy

LINEAR ALGEBRA AND CALCULUS

I B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
MA101BS	**B. Tech**	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn
1. Types of matrices and their properties.
2. Concept of a rank of the matrix which is used to know the consistency of system of linear equations.
3. Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form.
4. Determine the maxima and minima of functions of several variables by using partial differential coefficients.
5. Evaluation of improper integrals using Beta and Gamma functions.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Write the matrix representation of a set of linear equations and to analyze the solution of the system of equations.
2. Find the Eigen values and Eigen vectors, reduce the quadratic form to canonical form using orthogonal transformations.
3. Apply the Mean value theorems for the single variable functions.
4. Apply maxima and minima for functions of several variables and Lagrange's method of multipliers.
5. Evaluate the improper integrals using Beta and Gamma functions.

UNIT-I	MATRICES	Classes: 12

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	Classes:12

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	MEAN VALUE THEOREMS	Classes:12

Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series. Applications: Finding areas, volumes of revolutions of curves (Only in Cartesian coordinates)

UNIT-IV	FUNCTIONS OF SEVERAL VARIABLES	Classes: 12

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. Application: Errors and approximations.

UNIT-V	FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS	Classes: 12

First Order linear and nonlinear Partial Differential Equations, Method of separation of variables. Beta and Gamma functions, properties, relation between Beta and Gamma functions, evaluation of integrals using Beta and Gamma functions.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition.
2. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2017.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.

REFERENCE BOOKS

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.

2. B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.

WEB REFERENCES

1. https://www.efunda.com/math/gamma/index.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E -TEXT BOOKS

https://www.e-booksdirectory.com/listing.php?category=4https://www.e-booksdirectory.com/details.php?ebook=10830

MOOCS COURSE

1. https://swayam.gov.in/
2. https://swayam.gov.in/NPTEL

ENGINEERING PHYSICS

I B. TECH- I SEMESTER (R 20)							

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
EP102BS	**B.Tech**	**3**	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES:

To learn
1. The basic concepts of mechanics in a broader sense with a view today foundation for the core engineering courses.
2. The competence and understanding the concepts of Harmonic oscillations.
3. The behavior of waves in one dimension.
4. The wave nature of light through the phenomena of Interference and Diffraction.
5. The basic principles and working of laser and optical fibers.

COURSE OUTCOMES:

Upon successful completion of the course, the student will be able to
1. Understand the basic concepts of mechanics.
2. Differentiate the types of oscillations.
3. Explain the behavior of waves in one dimension and its types.
4. Get knowledge about interference and Diffraction.
5. Analyze the properties of laser and its propagation in optical fiber.

UNIT-I	INTRODUCTION TO MECHANICS	Classes: 12

Introduction to scalars and vectors, Transformation of scalars and vectors under rotation, Forces of Nature, Newton's laws and its completeness in describing particle motion, Galilean Transformation, Form invariance of Newton's second law, Solving Newton's equations of motion in polar and Cylindrical coordinates, basic concepts of constraints and friction, D' Alembert's principle.

UNIT-II	SIMPLE HARMONIC OSCILLATIONS	Classes: 12

Introduction to Simple Harmonic Motion, Motion of Simple Harmonic Oscillator, Wave equation, frequency and energy of Simple Harmonic Oscillator, Complex number notation and phasor representation of SHM, Mechanical and Electrical oscillator, Free oscillation, Damped oscillation: Critical, Heavy and Light damping, Energy decay and Quality factor, Forced oscillation: Steady state motion and power absorption by oscillator.

UNIT-III	WAVES IN ONE DIMENSION	Classes:12

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

UNIT-IV	INTERFERENCE AND DIFFRACTION	Classes: 12

Introduction to Interference, Huygens's principle, Superposition of waves, Interference of light: Wave front and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson's interferometer.

Introduction to Diffraction, Fraunhofer diffraction from a single slit and N -slits, Diffraction grating – Resolving Power, Rayleigh criterion for limit of resolution.

UNIT-V	LASER AND FIBRE OPTICS	Classes: 12

Laser: Introduction, Interaction of radiation with matter, characteristics, Principle and working of laser, Population inversion, Pumping and its methods, Construction and working: Ruby laser, He – Ne laser, Applications of lasers.
Fiber optics: Introduction, Propagation of light in optical fiber: 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 , "Engineering Mechanics", 2nd Edn., Cengage Learning, 2012
2. I. G. Main, "Vibrations and waves in physics", 3rd Edn., Cambridge University Press, 2018.
3. Ajoy Ghatak, "Optics", 5th Edn., McGraw Hill Education, 2012.

REFERENCE BOOKS:

1. M. K. Verma, "Introduction to Mechanics", Universities press, 2009.
2. H. J. Pain," The physics of vibrations and waves ", 6th Edn., Wiley, 2006
3. O. Svelto," Principles of Lasers", 5th Edn., Springer Science & Business Media, 2010.

WEB REFERENCES:

1. https://www.physicsclassroom.com/class
2. https://www.khanacademy.org/science/physics
3. https://ocw.mit.edu/courses/physics/8-03sc-physics-iii-vibrations-and-waves-fall-2016/part-i-mechanical-vibrations-and-waves/
4. https://ocw.mit.edu/courses/physics/8-03sc-physics-iii-vibrations-and-waves-fall-2016/part-iii-optics/

E -TEXT BOOKS:

1. http://www.freebookcentre.net/physics-books-download/Advances-in-Lasers-and-Electro-Optics.html
2. https://www.sciencebooksonline.info/physics/mechanics.html

MOOCS Course:

1. https://nptel.ac.in/courses/122105023/
2. https://nptel.ac.in/courses/122107035/

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PROGRAMMING FOR PROBLEM SOLVING

I B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours / Week**			**Credits**	**Maximum Marks**		
CS105ES	**B. Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able

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

UNIT-I	**INTRODUCTION TO C PROGRAMMING LANGUAGE**	**Classes: 16**

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: I/O: Simple input and output with scanf and printf, variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, type conversion

UNIT-II	**CONDITIONAL BRANCHING, LOOPS, ARRAY AND STRINGS**	**Classes: 14**

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do- while loops.
Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays.
s: Introduction to strings, handling strings as array of characters, basics tring functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings.

UNIT-III	STRUCTURE AND POINTER	Classes:10

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.
Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different datatypes

UNIT-IV	FUNCTION AND STORAGE CLASSES	Classes: 12

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
Storage classes (auto, extern, static and register)

UNIT-V	FILES AND PRE-PROCESSOR	Classes: 12

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

TEXT BOOKS

1. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI
2. Computer System & Programming in C by S Kumar & S Jain, Nano Edge Public publications, Meerut.
3. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2010, NewDelhi.

REFERENCE BOOKS

1. Computer Fundamentals and Programming in C, Reema Theraja, Oxford
2. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998,TMH
3. Theory and problem of programming with C, Byron C Gottfried,TMH

WEB REFERENCES

1. https://www.tutorialspoint.com/cprogramming/
2. https://www.tutorialspoint.com/cplusplus/
3. https://www.cprogramming.com/tutorial/c-tutorial.html

E -TEXT BOOKS

1. https://fresh2refresh.com/c-programming/
2. https://beginnersbook.com/2014/01/c-tutorial-for-beginners-with-examples/
3. https://www.sanfoundry.com/simple-c-programs/

MOOCS Course

1. nptel.ac.in/courses/106105085/4
2. https://www.quora.com/Are-IIT-NPTEL-videos-good-to-learn-basic-C-programming

ENGINEERING GRAPHICS

I B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME106ES	**B.Tech**	1	0	4	3	30	70	100

COURSE OBJECTIVES

To learn
The course aims at empowering the students with drafting skills and enhancing their visualization capacity in order to draw different views of the given object.
To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
To expose them to existing national standards related to technical drawings.
To impart knowledge about standard principles of orthographic projection of objects.
It will help students to use the techniques, skills, and modern engineering tools and communicate effectively.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to Familiarize with
the fundamentals and standards of Engineering graphics Project orthographic
projections of lines and plane surfaces.
Convert orthographic views to isometric views and vice-versa and know the basics of AutoCAD.
Preparing working drawings to communicate the ideas and information.
Know and use common drafting tools with the knowledge of drafting standards.

UNIT-I	INTRODUCTION TO ENGINEERING DRAWING	Classes: 15

Introduction to Engineering Graphics: Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloids and Involutes.

Scales: Plain & Diagonal Scales.

UNIT-II	ORTHOGRAPHIC PROJECTIONS	Classes:15

Projections of points: Principles of orthographic projections – conventions – first and third angle projections. Projection of points in all quadrants.

Projection Of Lines – lines inclined to single plane, lines inclined to both the planes.

Projection of Planes: Projection of regular planes – planes inclined to one plane, planes inclined to both planes.

UNIT-III	PROJECTION OF SOLIDS & SECTION OF SOLIDS	Classes:12

Projection of Solids: Projections of regular solids like cube, prism, pyramid, cylinder and cone. Axis inclined to both the reference planes.

Section of Solids: Sectioning of above solids in simple vertical position with the cutting planeisinclinedtotheoneplaneandperpendiculartotheother–trueshapeofsection.

UNIT-IV	DEVELOPMENT OF SURFACES & ISOMETRIC PROJECTIONS	Classes: 15

Development of Surfaces: Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views– Conventions –Plane Figures, Simple and Compound Solids.

UNIT-V	TRANSFORMATION OF PROJECTIONS & INTRODUCTION AUTO CAD	Classes: 15

Transformation of Projections: Conversion of Isometric Views to Orthographic Views. Conversion of orthographic views to isometric views – simple objects.
Introduction to Auto CAD: Introduction, Salient features of AutoCAD software, Basic Commands, construction, editing and dimensioning, two dimensional drawings.

TEXT BOOKS

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 50th edition, 2013-Charotar Publishing House, Gujarat.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. K.L.Narayana, P. Kannaiah, "Engineering Drawing", SciTech Publishers. 2nd Edition, 2013
4. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

REFERENCE BOOKS

1. Engineering Graphics / Dr. D.V. Sreekanth, Spectrum Publications-2020

2. K. V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,2015.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore,2007.
4. Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. international Publishing House, 3rd Edition, 2011.

WEB REFERENCES

1. http://freevideolectures.com/Course/3420/Engineering-Drawing
2. https://www.slideshare.net/search/slideshow?searchfrom=header&q=engineering+drawing
3. https://www.wiziq.com/tutorials/engineering-drawing
4. http://road.issn.org/issn/2344-4681-journal-of-industrial-design-and-engineering-graphics

E -TEXT BOOKS

1. http://rgpv-ed.blogspot.com/2009/09/development-of-surfaces.html
2. http://www.techdrawingtools.com/12/l1201.htm

MOOCS Course

1. https://nptel.ac.in/course.php
2. https://swayam.gov.in/explorer

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ENGINEERING PHYSICS LAB

I B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours / Week**			**Credits**	**Maximum Marks**		
EP103BS	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**3**	**1.5**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. The basic experimental skills which are very essential for an engineering student.
2. The basic concepts of oscillations through experiment and the working of electrical harmonic oscillator.
3. The behavior of waves in one dimension.
4. The wave nature of light through Interference and Diffraction.
5. The characteristics and working of laser and optical fibers.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to
1. Understand the working principle of Mechanical harmonic oscillators.
2. Know the properties of waves.
3. Understand the working principle of electrical harmonic oscillators.
4. Demonstrate the wave nature of light.
5. Illustrate the working principle of laser and optical fibers.

LIST OF EXPERIMENTS

1. Melde'sexperiment:

   To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

2. Torsional pendulum:

   To determine the rigidity modulus of the material of the given wire using Torsional pendulum.

3. Newton's rings:

   To determine the radius of curvature of the plano – convex lens by forming Newton's rings.

4. Diffraction grating:

   To determine the wavelength of given laser source.

5. Dispersive power:

   To determine the dispersive power of prism by using spectrometer.

6. Coupled Oscillator:

   To determine the spring constant by single coupled oscillator.

7. **LCR Circuit:**

   To determine quality factor and resonant frequency of LCR circuit.

8. **LASER:**

   To study the characteristics of LASER sources.

9. **Optical fibre:**

   To determine the bending losses of Optical fibres.

10. **Optical fibre:**

    To determine the Numerical aperture of a given fibre.

    NOTE: Any 8 experiments are to be performed

TEXT BOOKS

1. Dr. Y. Aparna, "Laboratory manual of Engineering Physics", VGS Techno series,2009.
2. T. Radha Krishna, V. Rajeshwar Rao, "Practical Physics for Engineering Students",S. M. Enterprises, 3rd Edn, 2009.

REFERENCE BOOKS

1. Main, I. G., Vibrations and Waves in Physics. 2nd. edition. Cambridge University Press,1984.
2. Eugene Hecht, "Optics" , 5th Edition,AdelphiUnioversity,2016.

WEB REFERENCES

1. https://lecturenotes.in/practicals/20039-lab-manual-for-engineering-physics-ep-by-rakesh-kumar-behera
2. https://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf
3. http://www.bsauniv.ac.in/UploadImages/Downloads/PHYSICS-LAB-MANUAL2017-(new-regulation).pdf
4. http://www.bvrit.ac.in/Freshman_Lab_Manuals/freshman_enginering_physics/Engineering%20Physics.pdf

E -TEXT BOOKS

1. http://www.lehman.edu/faculty/kabat/F2019-166168.pdf
2. https://www.scribd.com/doc/143091652/ENGINEERING-PHYSICS-LAB-MANUAL

MOOCS Course

1. https://nptel.ac.in/courses/115105110/
2. https://swayam.gov.in/nd1_noc19_ph09/preview

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PROGRAMMING FOR PROBLEM SOLVING LAB

I B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
CS107ES	B. Tech	0	0	3	1.5	30	70	100

COURSE OBJECTIVES

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able

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

LIST OF EXPERIMENTS

1. Write a simple program that prints the results of all the operators available in C
2. Write a simple program to convert the temperature from Fahrenheit to Celsius
3. Write a program for find the max and min from the three numbers using if else statement
4. Write a C program to find the roots of a Quadratic equation.
5. 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)
6. Write a program that finds if a given number is a prime number
7. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
8. Write a C program to generate the Fibonacci sequence of numbers.
9. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
10. Write a C program to find the minimum, maximum and average in an array of integers
11. Write a C program that uses functions to perform the following:1) Addition of Two Matrices   2) Multiplication of Two Matrices
12. 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.)

13. Toinsertasub- string into a given main string from a given position. e. ii. To delete Characters from a given position in a given string
14. WriteaCprogramthatdisplaysthepositionofacharacterchinthestringSor– 1if Sdoesn'tcontainch
15. Write a C program to count the lines, words and characters in a given text.
16. Define a structure student to store the details like Roll Number, Name, and Marks in three subjects of a student and display the same.
17. Write a C program to perform specified operation on complex numbers.
18. Write a C program to store the information about three students.
19. Write a C Program to illustrate the use of nested structures.
20. Write a C Program to perform arithmetic operations using pointers.
21. Write a C Program to display the array elements in reverse order using pointer.
22. Write a C Program to find factorial of a number using functions.
23. Write a C Program to find factorial of a number using recursive functions.
24. Write a C Program to implement call by value and call by reference.
25. Write a C Program to copy the data from one file to another
26. Write a C Program to append data to the file
27. Write a C Program to merge the two files
28. Write a C Program to display the file content on reverse order.
29. Write a C Program to count number of vowels, consonants, digits, words in a given file

TEXT BOOKS

1. TheCProgrammingLanguagebyDennisMRitchie,BrianW.Kernigham,1988,PHI Publications, 2010,NewDelhi.
2. ComputerSystem&ProgramminginCbySKumar&SJain,NanoEdge Public publications,Meerut.
3. 3 Fundamentals of Computing and C Programming, R. B. Patel,Khanna

REFERENCE BOOKS

1. Computer Fundamentals and Programming in C, ReemaTheraja,Oxford
2. InformationTechnology,DennisP.Curtin,KimFoley,Kunal Sen,Cathleen Morin,1998,TMH
3. Theory and problem of programming with C, Byron CGottfried,TMH.

TEXT BOOKS

1. https://www.tutorialspoint.com/cprogramming/
2. https://www.w3schools.in/c-tutorial/
3. https://www.cprogramming.com/tutorial/c-tutorial.html
4. www.studytonight.com/c/

REFERENCE BOOKS

1. http:///programming-with-c
2. https://developerinsider.co/best-c-programming-book-for-beginners/

REFERENCE BOOKS

1. https://nptel.ac.in/courses/106105085/4
2. https://www.coursera.org/courses?query=c%20programming

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ENVIRONMENTAL SCIENCE

I B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ES104BS	**B. Tech**	**3**	**0**	**0**	**-**	**100**	**0**	**3 100**

COURSE OBJECTIVES

To learn
1. Analyze the inter relationship between living organism and environment
2. Describe various types of natural resources available on the earth surface
3. Identify the values, threats of biodiversity, endangered and endemic species of India along with the conservation of biodiversity
4. Explain the causes, effects and control measures of various types of environmental pollutions
5. Understand the importance of environment by assessing its impact on the human world

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Differentiate between various biotic and abiotic components of ecosystem
2. Describe the various types of natural resources
3. Examine the values, threats of biodiversity, the methods of conservation, endangered and endemic species of India
4. Illustrate causes, effects, and control measures of various types of environmental pollutions
5. Understand technologies on the basis of ecological principles environmental regulations which in turn helps in sustainable development

UNIT-I	ECOSYSTEMS	Classes: 8

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.

UNIT-II	NATURAL RESOURCES	Classes: 8

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	Classes: 7

Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic, optional values and hotspots of biodiversity. Endangered and endemic species of India, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation.

UNIT-IV	ENVIRONMENTAL POLLUTION	Classes: 9

Types of pollution, Causes, effects and prevention and control measures of air, water, soil, noise and thermal pollution. Solid waste and e-waste management.

UNIT-V	ENVIRONMENTAL POLICY AND SUSTAINABLE DEVELOPEMENT	Classes: 10

Concept of sustainable development: Sustainable development goals. Threats to sustainability: Population explosion- crazy consumerism. Green building concept. Water conservation, Rainwater harvesting, watershed management. Environmental Policies and Legislations: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Forest (conservation) Act, 1980. Wildlife Protection Act.

TEXT BOOKS

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission
2. Environmental Studies by R. Rajagopalan, Oxford UniversityPress.
3. Textbook of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications
4. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi,12th Edition, 2015

REFERENCE BOOKS

1. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers
2. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Pvt. Ltd, NewDelhi
3. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHL Learning Pvt. Ltd, NewDelhi
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIAedition

WEB REFERENCES

1. https://www.britannica.com/science/ecosystem
2. https://ocw.mit.edu/resources/#EnvironmentandSustainability

E -TEXT BOOKS

1. P N Palanisamy Environmental Science ISBN:9788131773253, eISBN:97899332509771 Edition: Secondedition
2. Environmental Studies. Author, Dr. J. P. Sharma. Publisher, Laxmi Publications, 2009 ISBN, 8131806413,9788131806418.

MOOCS COURSE

1. https://nptel.ac.in/courses/122103039/38
2. https://nptel.ac.in/courses/106105151/12

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ADVANCED CALCULUS

I B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
MA201BS	**B. Tech**	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn

1. Methods of solving the differential equations of first and highe rorder
2. Evaluation of multiple integrals and their applications
3. The physical quantities involved in engineering field related to vector valued functions
4. The basic properties of vector valued functions and their applications
5. Vector point functions and scalar point functions

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Identify whether the given differential equation of first order is exact or not.
2. Solve higher order differential equation and apply the concept of differential equation to real problems.
3. Evaluate the multiple integrals and apply the concept to find areas and volumes.
4. Is able to find gradient, directional derivative, divergence and curl.
5. Evaluate the line, surface and volume integrals and converting them from one to another.

UNIT-I	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS**	**Classes: 10**

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

UNIT-II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER**	**Classes: 12**

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax}, $\sin ax$, $\cos ax$, polynomial in x^m, $e^{ax}V(x)$ and $xV(x)$, method of variation of parameters, Applications: LCR Circuit.

UNIT-III	MULTIPLE INTEGRATION	Classes:12

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)

UNIT-IV	VECTOR DIFFERENTIATION	Classes: 12

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

UNIT-V	VECTOR INTEGRATION	Classes: 12

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

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.

REFERENCE BOOKS

1. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

WEB REFERENCES

1. https://www.efunda.com/math/gamma/index.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E -TEXT BOOKS

1. https://www.e-booksdirectory.com/listing.php?category=4
2. https://www.e-booksdirectory.com/details.php?ebook=10830

MOOCS COURSE

1. https://swayam.gov.in/
2. https://swayam.gov.in/NPTEL

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ENGINEERING CHEMISTRY

I B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
CH202BS	B. Tech	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn

1. To provide basic knowledge on atomic, molecular orbitals and the bonding interaction between atoms
2. To analyze the impact of water hardness and its various methods for removal of hardness of water, numerical problems to calculate the hardness of water in a given sample
3. To discover the importance of electrical energy which originates from chemical reactions essential for industrial needs
4. Tounderstandthebasicconceptsofspectroscopyanddrugmoleculestoextrapolatetheir chemical knowledge in day to day life
5. To enable the students to understand the use of engineering materials such as polymers, lubricants and study the industrial applications in the field of engineering and technology

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Achieve the basic concepts of atomic, molecular and electronic changes related to molecular bonding and magnetism
2. Familiarize with fundamentals of treatment technologies and considerations for its design and implementation in water treatment plants
3. To extrapolate the knowledge of cell, electrode, electrolysis, electromotive force. To analyze and develop a technical solution to corrosion problems related to engineering materials
4. Acquire the significant knowledge about basic concepts of spectroscopy and synthesis of drug molecules would be known to the students
5. Comprehended and explore engineering applications of polymers and lubricants

UNIT-I	MOLECULAR STRUCTURE AND THEORIES OF BONDING	Classes: 10

Introduction to VBT, Postulates and draw backs of VBT- Atomic and Molecular orbitals, Linear Combination of Atomic Orbitals (LCAO), Introduction to Crystal Field Theory (CFT): Salient featuresofCFT-CrystalFieldSplittingoftransitionmetaliond-orbitals in tetrahedral, octahedral and square planar geometries. Applications of CFT- color and magnetic properties.

Postulates of MOT, molecular orbitals of diatomic molecules-molecular orbital energy level diagrams of N_2, O_2 and CO molecules.

UNIT-II	WATER AND ITS TREATMENT	Classes: 12

Introduction-hardness of water-causes of hardness. Types of harness: Temporary and Permanent. Expression and units of hardness. Estimation of hardness of water by complexometric method (EDTA method), Numerical problems. Boiler troubles- scales, sludges, carryover and caustic embrittlement. Internal treatment- Calgon conditioning, phosphate conditioning and colloidal conditioning. External treatment of water- Ion exchange process. Desalination of brackish water- Reverse osmosis. Potable water and its specifications. Steps involved in the treatment of water by chlorination and ozonization.

UNIT-III	ELECTROCHEMISTRY AND CORROSION	Classes: 14

Electrochemical cells- electrode potential, standard electrode potential, Galvanic cell, Nernst equation- Applications. EMF of a cell. Types of electrodes-standard hydrogen electrode, calomel and glass electrode- construction and working. Numerical problems.

Batteries - Primary (Lithium cell) and secondary batteries (Lithium ion, Lead acid storage cell)- Applications.

Corrosion: Introduction, Causes and effects of corrosion- theories of chemical and electrochemical corrosion- mechanism of electrochemical corrosion. Corrosion control methods- Cathodic protection-sacrificial anodeandim pressed current cathodic methods. Metallic coatings- Methods of preparation of surface- Hot dipping- Galvanization and tinning. Electro plating and electro less plating.

UNIT-IV	SPECTROSCOPY AND SYNTHESIS OF DRUG MOLECULES	Classes: 08

Spectroscopy- Introduction, electromagnetic spectrum, principles of UV-visible, IR spectroscopy-selection rules and applications. Basic concepts of Nuclear magnetic resonance spectroscopy, chemical shift, spin-spin splitting. Magnetic resonance imaging.

Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT-V	MATERIAL CHEMISTRY	Classes: 12

Polymers: Introduction, Classification of polymers with examples. Types of polymerization: Addition and Condensation polymerization with examples.
Plastics: Introduction, Characteristics. Thermoplastic and thermosetting plastics. Compounding and fabrication of plastics (compression and injection molding). Preparation, properties and engineering applications of PVC, Teflon and Bakelite.
Lubricants: Introduction, Characteristics, mechanism-thick film, thin film, extreme pressure lubrication, properties- flash point, fire point, cloud point, pour point, mechanical stability and their significance-applications of lubricants.

TEXT BOOKS

1. P. C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,18th edition(2018)
2. Prasanta Rath, B. Rama Devi, Ch. Venkataramana Reddy, S. Chakrovarthy, "A Text book of Engineering Chemistry", Cengage publications(2019)
3. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai & Co. Publishers., New Delhi,15th edition(2015)
4. C.N. Banwell, "Fundamentals of MolecularSpectroscopy"

REFERENCE BOOKS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013)
2. B.R.Puri,L.R.SharmaandM.S.Pathania,"PrinciplesofPhysicalChemistry",S.Nagin Chand & Company Ltd., 46th edition(2013)
3. J.D. Lee, "Concise Inorganic Chemistry", Willey Publications, 5th edition(2008)
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition(2006)
5. G. L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad(2007)

WEB REFERENCES

1. Chemistry: foundations and applications. J. J. Lagowski, editor in chief. New York, Macmillan Reference USA, c2004. 4v
2. Polymer data handbook. Edited by James E. Mark. 2nd ed. Oxford, New York, Oxford University Press, 2009
3. https://www.wyzant.com/resources/lessons/science/chemistry
4. http://www.chem1.com/acad/webtext/virtualtextbook.html

E -TEXT BOOKS

1. Krishnamurthy, N., Vallinayagam, P., Madhavan, D., Engineering Chemistry, ISBN: 9789389347005, eBook ISBN: 9789389347012, Edition: Fourth Edition
2. Vijaya sarathy, P. R., Engineering Chemistry, Print Book ISBN : 9789387472778, eBook ISBN : 9789387472785, Edition : Third Edition

MOOCS COURSE

1. https://onlinecourses-archive.nptel.ac.in
2. https://www.mooc-list.com/tags/chemistry

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ENGINEERING MECHANICS

I B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours / Week**			**Credits**	**Maximum Marks**		
ME208ES	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Determine resultant of forces acting on a body and analyze equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
5. Solve problems using work energy equations and solve problems of Mechanical vibration.

UNIT-I	**INTRODUCTION TO ENGINEERING MECHANICS**	**Classes: 15**

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.

UNIT-II	**FRICTION, CENTROID AND CENTRE OF GRAVITY**	**Classes: 15**

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction and ladder friction.
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 , MOMENT OF INERTIA OF MASSES	Classes:15

Area moment of inertia: Moment of inertia of plane sections from first principles, Theorems of oment of inertia, Moment of inertia of standard sections and composite sections.
Moment of Inertia of Masses: Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT-IV	KINEMATICS & KINETICS	Classes: 15

Kinematics: Rectilinear motion - Motion of Rigid Body under uniform and variable accelerations -motion under gravity- curvilinear motion – Projectiles - rotary motion. **Kinetics:** Analysis as a Particle and Analysis as a Rigid Body in Translation – D' Alembert's Principle - Connected bodies- Kinetics of rotating bodies.

UNIT-V	WORK, POWER, ENERGY & MECHANICAL VIBRATIONS	Classes: 15

Work, Power and Energy: Introduction**,** work-energy equation - motion of connected bodies- work done by a spring - general plane motion.
Mechanical Vibrations: Definitions, concepts - simple harmonic motion - free vibrations – Simple and compound pendulums.

TEXT BOOKS

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

REFERENCE BOOKS

1. Engineering Mechanics / Dr. D.V. Sreekanth, Spectrum Publications-2020
2. Andrew Pytel, JaanKiusalaas, "Engineering Mechanics",CengageLearning,2014.
3. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers",TMH,2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", PearsonEducation,2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", UmeshPublications,2011.

WEB REFERENCES

1. http://www.mlipsett.com/blog/
2. http://jntuh-elsdm.in/
3. https://www.sciencedirect.com/science/book/9781857180336

E -TEXT BOOKS

1. https://akuengineers.files.wordpress.com/2016/12/engineering-mechanics-rs-khurmi.pdf
2. http://clkmein.com/q2KmTm

MOOCS COURSE

1. https://nptel.ac.in/courses/112103109/
2. https://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/engg_mechanics/ui/Coursehome7.htm

ENGINEERING WORKSHOP

I B. TECH- II SEMESTER (R 20)								

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
ME207ES	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		1	0	3	2.5	30	70	100

COURSE OBJECTIVES

To learn
1. To Study of different hand operated power tools, uses and their demonstration.
2. To gain a good basic working knowledge required for the production of various engineering products.
3. To provide hands on experience about use of different engineering materials, , equipment's and processes those are common in the engineering field.
4. To develop a right attitude, team working, precision and safety at workplace.
5. It explains the construction, function, use and application of different working tools, equipment and machines.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Study and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including Fitting, Carpentry, Foundry, Tin-smithy, House Wiring and Welding.
3. Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
4. Apply basic electrical engineering knowledge for house wiring practice.

LIST OF EXPERIMENTS

TRADES FOR EXERCISES(Any two exercises from each trade)
1. Tin-Smithy – (Square Tin, Cone and Cylinder)
2. Carpentry – (T-Lap Joint, Planning Sawing & DovetailJoint)
3. Welding Practice – (Arc Welding-Butt Joint, Lap Joint&T-Joint)
4. Black Smithy – (Round to Square, S-Hook&U-Clamp)
5. Foundry – (Mould using Single Piece and SplitPattern)
6. Fitting – (V-Fit, Square Filing & Semi-circular fit)
7. House-wiring – (Two-way Switch and one-way switch inseries)
TRADES FOR DEMONSTRATION
8.Plumbing, Machine Shop, Power tools in construction, Wood turning lathe and Casting Process.
 Note: At least perform 10 Exercises out of 14 Exercises.

TEXT BOOKS

1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ ScitechPublishers.
2. Workshop Manual / Venkat Reddy/ BS Publications/SixthEdition
3. Workshop Technology byChapman
4. A Textbook Of Workshop Technology : Manufacturing Processes/J. KGUPTA

REFERENCE BOOKS

1. Engineering Work shop-R.Hanuma Naik/R. Suvarna babu-Sun Techno Publications
2. Workshop Manual / Venkat Reddy/BSP
3. Workshop Technology byHazra-Chowdhary
4. Production Engineering byR.K.Jain

WEB REFERENCES

1. https://nptel.ac.in/courses/112105126/
2. https://nptel.ac.in/downloads/112105127/
3. https://nptel.ac.in/courses/112107145/
4. https://nptel.ac.in/courses/122104015/

E -TEXT BOOKS

1. http://103.135.169.82:81/fdScript/RootOfEBooks/MED/Introduction Workshop%20Technology
2. https://www.quora.com/Download-free-mechanical-engineering-ebooks-sites

MOOCS Course

1. http://www.nits.ac.in/workshops/Workshop_on_MOOCS_26082017.pdf
2. https://www.nitttrc.ac.in/swayam/index.html

PROFESSIONAL ENGLISH

I B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours /Week**			**Credits**	**Maximum Marks**		
EN203HS	**B. Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		2	**0**	**0**	**2**	**30**	**70**	**100**

COURSE OBJECTIVES:

To enable students

1. To enhance their vocabulary and basic grammar rules for communicative competence.
2. To hone their comprehensive skills through various reading techniques.
3. To develop the professional writing with the practice of formal letters, e-mails, reports, resumes, etc.
4. To use various sentence structures effectively in formal and informal contexts.
5. To improve scientific and technical communication skills through technical vocabulary and appropriate prose texts.

COURSE OUTCOMES:

Upon successful completion of the course, the students are able to

1. Use vocabulary effectively and syntactically.
2. Translate the reading techniques and apply them in literary texts.
3. Demonstrate enhanced competence in standard Written English.
4. Develop the competence in writing professional documents.
5. Exhibit appropriate communicative approaches to suit various contexts.

UNIT-I	**THE RAMAN EFFECT**	**Classes:7**

Vocabulary: Word Formation, Use of affixes,
Grammar: Articles, Prepositions
Writing: Paragraph Writing, Organizing principles of Paragraphs in documents

UNIT-II	**THE LOST CHILD**	**Classes:9**

Vocabulary: Synonyms and Antonyms
Grammar: Noun – Pronoun Agreement and Concord
Reading: Significance & Techniques of reading; Skimming – Reading for the gist of a text;
     Scanning– Reading for specific information; Intensive; Extensive reading; SQ3R
     Technique; Reading Comprehension;
     Reading Poetry -The Road Not Taken
Writing: Narrative Writing

UNIT-III	**SATYA NADELLA'S EMAIL TO HIS EMPLOYEES**	**Classes:10**

Vocabulary: Homonyms-Homophones-Homographs
Grammar: Tenses
Writing : Significance & Effectiveness of Writing; Writing Descriptions; Letter
     writing; E-mail writing

UNIT-IV	WHAT SHOULD YOU BE EATING?	Classes:10

Vocabulary: Technical vocabulary; Words from Foreign Languages; abbreviations and
        acronyms
Grammar: Misplaced Modifiers; Redundancies and Cliches
Writing: Information Transfer, Note Making, Writing an Abstract and Report Writing

UNIT-V	HOW A CHINESE BILLIONAIRE BUILT HER FORTUNE	Classes:9

Vocabulary: Words often Confused; Idioms and Phrasal verbs, One- word Substitutes;
Grammar: Conditional Sentences; Degrees of Comparison; Simple-Complex-
        Compound Sentences and Common errors Writing:
Essay writing

TEXTBOOKS:

1. Sudarshana, N.P. and Savitha, C. (2018). English forEngineers. Cambridge UniversityPress.
2. Education for Life and Work – English Workbook prepared by English Faculty of St. Martin's EngineeringCollege.

REFERENCE BOOKS:

1. Swan, M. (2016). Practical English Usage. Oxford UniversityPress.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford UniversityPress.
3. Zinsser, William. (2001). On Writing Well. Harper ResourceBook.

WEB REFERENCES:

1. www.edufind.com
2. www.myenglishpages.com
3. http://grammar.ccc.comment.edu
4. http://owl.english.prudue.edu

E –TEXTBOOKS:

1. http://bookboon.com/en/communication-ebooks-zip
2. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandex amlespdf.pdf

MOOCS COURSE:

1. https://mooec.com/courses/grammar-guru-1
2. https://mooec.com/courses/learning-styles

ENGINEERING CHEMISTRY LABORATORY

I B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
CH204BS	B. Tech	0	0	3	1.5	30	70	100

COURSE OBJECTIVES

To learn

1. Estimationofhardnessandchloridecontentinwatertocheckitssuitabilityfordrinking purpose
2. To find the concentration of ions present in an unknown solution
3. To know the handling procedure of colorimetric and conductometric instruments
4. The fundamentals of drug synthesis
5. The measurement of physical properties like surface tension, viscosity and acid value

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Understand the total dissolved salts present in a sample of water
2. Determine the concentration of ions existing in a solution
3. Find the strength of an acid by conductometric methods
4. Acquire basic knowledge on the chemical reaction used to synthesize drug molecules like aspirin and Paracetamol
5. Select lubricants for various purposes such as to reduce the friction between two movable surfaces and to determine the surface tension of a given liquid

LIST OF EXPERIMENTS

Volumetric Analysis

1. Determination of total hardness of water by complexometric method using EDTA.
2. Determination of chloride content of water by Argentometry.
3. Determination of acid value of coconut oil.

Potentiometry

4. Determination of Fe^{2+} ions present in the given sample by Potentiometric titration.

Conductometry

5. Estimation of HCl by conductometric titration.
6. Estimation of acetic acid by conductometric titration.

Calorimetry

7. Estimation of Copper by colorimetric method.

Synthesis of Drugs

8. Synthesis of aspirin and Paracetamol.

Physical constants

9. Determination of viscosity of the given sample by using Ostwald's Viscometer.
10. Determination of surface tension of a given liquid using stalagmometer.

TEXT BOOKS

1. Senior practical physical chemistry, B. D. Khosla, A. Gulati and V. Garg (R. Chand and Co.,Delhi)
2. Prasanta Rath, B. Rama Devi, Ch. Venkataramana Reddy, S. Chakrovarthy, "A Text book of Engineering Chemistry", Cengage publications(2019)
3. An introduction to practical; chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, NewDelhi)
4. Vogel's text book of practical organic chemistry, 5editionth
5. S. S. Dhara, Text book on experiments and calculations in engineering chemistry, B.S Publications

REFERENCE BOOKS

1. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, "Vogel's Text Book of Quantitative ChemicalAnalysis"
2. O. P. Vermani & Narula, "Theory and Practice in Applied Chemistry", New Age InternationalPublishers
3. Gary D. Christian, "Analytical chemistry", 6th Edition, WileyIndia

WEB REFERENCES

1. Phillip E. Savage, Industrial & Engineering Chemistry: At the Forefront ofChemical Engineering Research since 1909, *Ind. Eng.Chem.Res.*20195811
2. Elias, AI. Sundar Manoharan S. and Raj, H. "Laboratory Experiments for General Chemistry", I.I.T. Kanpur,1997

E -TEXT BOOKS

1. Payal B Joshi, Experiments In Engineering Chemistry, Edition: First, ISBN:978-93- 85909-13-9, Publisher: I.K. International Publishing House Pvt.Ltd

2. Mohapatra, Ranjan Kumar, Engineering Chemistry With Laboratory Experiments, ISBN: 978- 81-203-5158-5, PHI Learning PrivateLimited

MOOCS COURSE

1. https://sce.ethz.ch/en/programmes-and-courses/suche-angebote.html?polycourseId=1299
2. https://www.classcentral.com/course/open2study-chemistry-building-blocks-of-the-world-1297

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

I B. TECH- II SEMESTER (R20)								
Course Code	**Programme**	**Hours /Week**			**Credits**	**Maximum Marks**		
EN205HS	**B. Tech**	L	T	P	C	CIE	SEE	Total
		0	0	2	1	30	70	100

COURSE OBJECTIVES:

To train students

1. Touseaccurateandappropriatepronunciationthroughthepracticeofphonetic sounds, symbols, word accent and intonation.
2. ToimprovetheirfluencyinspokenEnglishandneutralizetheirmothertongue influence through JAM Sessions, Role-play, etc.
3. To comprehend the speech of people of various regions through Listening practice exercises.
4. To enable students to transfer information verbally with the right usage of Body language through individual and group activities.
5. TounderstandnuancesofEnglishlanguagebypracticingvariousexercisesat Multi-media lab.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to

1. Differentiate the speech sounds in English and demonstrate accurate pronunciation.
2. Communicate with others in clear and confident manner.
3. Improve their effective and empathetic listening ability.
4. Show the zeal to participate in Public Speaking Sessions.
5. Neutralize the Mother tongue influence in day to communication.

LIST OF EXPERIMENTS:

EXERCISE: I

CALL LAB:

Introduction to Phonetics – Speech sounds - vowels and consonants

ICS LAB:

Ice-breaking Activity – Non-verbal Communication

EXERCISE: II

CALL LAB:

Minimal Pairs – Consonant Clusters – Past Tense Marker and Plural Marker Rules

ICS LAB:

Role Play – Expressions in various Situations – Making Requests and Seeking Permissions

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EXERCISE: III

CALL LAB:

Structure of Syllables – Word Accent –Stress shift–Intonation

ICS LAB:

Telephone Communication –Etiquette

EXERCISE: IV CALL LAB:

Listening Comprehension Tests

ICS LAB:

Presentations Skills & JAM Session

EXERCISE: V CALL LAB:

Mother Tongue Interference – Differences in British and American Pronunciation

ICS LAB:

Interview Skills – Mock Interviews

TEXTBOOKS:

1. ELCS Lab Manual prepared by English faculty of St. Martin's EngineeringCollege.
2. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. OxfordUniversity Press.

REFERENCE BOOKS:

1. T Balasubramanian. A Textbook of English Phonetics for
   Indian Students,Macmillan,2008
2. J Sethi et al. A Practical Course in English Pronunciation, Prentice Hall India,2005.
3. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press
   PvtLtd2011.
4. Arun Koneru, Professional Speaking Skills, Oxford UniversityPress,2016.

WEB REFERENCES:

1. https://www.asha.org/PRPSpecificTopic.aspx?folderid=8589935321&section=References
2. Argyle,MichaelF.,Alkema,Florisse,&Gilmour,Robin."Thecommunicationof friendly and
   hostile attitudes: Verbal and nonverbal signals." European Journalof Social Psychology,
   1, 385-402:1971
3. Blumer, Herbert. Symbolic interaction: Perspective and method. Engle wood
   Cliffs; NJ: PrenticeHall.1969

E –TEXTBOOKS:

1. Mc corry Laurie Kelly Mc Corry Jeff Mason, Communication Skills forthe
   Healthcare Professional, 1st edition,ISBN:1582558140, ISBN-13:9781582558141
2. RobertEOwens,Jr,LanguageDevelopment, 9^{th}edition,
   ISBN:0133810364,9780133810363

MOOCS Course:

1. https://www.coursera.org/specializations/improve-english
2. https://www.edx.org/professional-certificate/upvalenciax-upper-intermediate-english

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DEPARTMENT OF MECHANICAL ENGINEERING
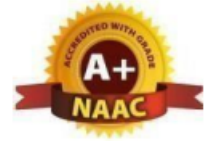## PROBABILITY STATISTICS & COMPLEX VARIABLES

II B. TECH- I SEMESTER (R20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
PS301BS	**B.Tech.**	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn
1. The ideas of random variables and various discrete and continuous probability distributions and their properties.
2. The basic ideas of statistics including measures of central tendency.
3. The statistical methods of studying data samples.
4. Differentiation and integration of complex valued functions.
5. Evaluationofintegralsusing Cauchy's integral formula and Cauchy's residue theorem.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Formulate and solve problems involving random variables
2. Understand the foundations for classical inference involving confidence intervals
3. Apply statistical methods for analyzing experimental data.
4. Analyze the complex function with reference to their analyticity, integration using Cauchy's integral theorems.
5. Analyze the complex function with reference to their analyticity, integration using Cauchy's residue theorems.

UNIT-I	RANDOM VARIABLE AND DISTRIBUTIONS		Classes: 12

Random variables: Discrete and continuous and random variables, Expectation of Random Variables, Variance of random variables, Binomial, Poisson, evaluation of statistical parameters for these distributions. Continuous random variables and their properties, distribution functions and densities, Normal distributions

UNIT-II	SAMPLING DISTRIBUTION AND ESTIMATION	Classes: 12

Sampling distribution: Population and samples, Sampling Distribution of mean, Proportions, difference of means. Estimation: Point and Interval, Bayesian estimations.

UNIT-III	TESTING OFHYPOTHESIS					Classes: 10

Procedure for testing of hypothesis, Large sample test for single proportion, difference of proportions, single mean, difference of means; Test for single mean, difference of means for small samples, test for ratio of variances for small samples.

UNIT-IV	COMPLEX VARIABLES (DIFFERENTIATION)	Classes: 10

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)	Classes: 10

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem

TEXT BOOKS

1. Ronald E. Walpole, Raymond H. Myers, Sharon L .Myers, keying Ye, Probability and statistics for engineers and scientists,9th Edition, Pearson Publications.
2. Fundamentals of Mathematical Statistics, Khanna Publications, SC Guptha and V.K Kapoor.
3. SC Gupta and VK Kapoor, Fundamentals of Mathematical statistics, Khanna publications.
4. ChurchillR.V.,"ComplexVariableanditsApplications",McGrawHill,NewYork,9thedition 2013.

REFERENCE BOOKS

1. T.T. Soong, Fundamentals of Probability And Statistics For Engineers, John Wiley & Sons Ltd, 2004.
2. Sheldon M Ross, Probability and statistics for Engineers and scientists, Academic Press.
3. Millerand Freund's, Probability and StatisticsforEngineers,8th Edition, Pearson Educations.
4. S. Ross, A First Course in Probability, 6thEd.,PearsonEducationIndia,2002

WEB REFERENCES

1. https://www.efunda.com/math/gamma/index.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E -TEXT BOOKS

1. https://www.e-booksdirectory.com/listing.php?category=4
2. https://www.e-booksdirectory.com/details.php?ebook=10830

MOOCS COURSE

1. https://swayam.gov.in/
2. https://swayam.gov.in/NPTEL

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DEPARTMENT OF MECHANICAL ENGINEERING

MECHANICS OF SOLIDS

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME302PC	**B. Tech**	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn
1. To understand basic concepts of stress, strain and their relations based on linear elasticity.
2. To discuss Material behaviors due to different types of loading
3. To understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
4. Todevelopshear-momentdiagramsofabeamandfindthemaximummoment/shearandtheir locations
5. To calculate normal and shear stresses

COURSE OUTCOMES

Upon successful completion of the course, the student is 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 a range of analytical methods;
4. Analyseandinterpretlaboratorydatarelatingtobehaviourofstructuresandthematerialsthey are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning

UNIT-I	SIMPLE STRESSES AND STRAINS	Classes: 10

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 & volumetric strain–Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT-II	SHEAR FORCE AND BENDING MOMENT	Classes: 10

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	Classes: 12

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.

Slopes and Deflections: Slope and deflection calculations of cantilever, simply supported beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.

UNIT-IV	PRINCIPAL STRESSES AND STRAINS	Classes: 10

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	TORSIONOF CIRCULAR SHAFTS	Classes: 12

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.

Thick Cylinders: Stresses in thick cylinders with internal and external pressures. Stresses in compound cylinders. Columns and struts :Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

TEXT BOOKS

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov.
3. The Art of R Programming, NormanMatloff, Edition 1, No Starch Press Publishers.
4. Strength of Materials – W.A. Nash, TMH

REFERENCE BOOKS

1. Mechanics of Solids - Dr. D.V. Sreekanth, SunRise Publications-2021.
2. Analysis of structures by Vazirani and Ratwani

3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar PublishingHouse Pvt.Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt.Ltd
7. Strength of Materials by R.K Rajput, S. Chand &Company Ltd

WEB REFERENCES

1. www.springer.com/physics/classical+continuum+physics/journal/11964
2. "Engineering Mechanics of Solids" by Popov
3. www.worldscientific.com/worldscibooks/10.1142/p187www.civil.iitb.ac.in/~sghosh/
4. CE201/

E -TEXT BOOKS

1. Mechanics of Solids,R K BANSAL ,Laxmi Publications.
2. Strength of materials ,R S Khurmi, S. Chand publications

MOOCS COURSES

1. https://web.mit.edu/emech/dontindex-build/
2. https://www.springer.com/physics/classical+continuum+physics

DEPARTMENT OF MECHANICAL ENGINEERING

METALLURGY AND MATERIAL SCIENCE

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME303PC	**B. Tech**	**3**	**0**	**0**	**3**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. The application of Disaster Concepts to Management
2. Analyzing Relationship between Development and Disasters.
3. Ability to understand Categories of Disasters and
4. realization of the responsibilities to society

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

Understand the concepts of fluid mechanics useful in mechanical Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyze engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the mechanical engineering students.

UNIT-I	CRYSTAL STRUCTURE	Classes: 8

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	Classes: 10

Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron, Iron- carbide phase diagram and microstructural aspects of ledebuarite, austenite, ferrite and cementite, cast iron.

UNIT-III	HEAT TREATMENT OF STEEL	Classes: 10

Annealing, Normalizing, Hardening, Tempering and Spheroidising Isothermal transformation diagrams for Fe-C alloys and microstructures development.

UNIT-IV	CONTINUOUS COOLING CURVES	Classes: 10

Continuous cooling curve sand interpretation of final microstructure sand properties -austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V	ALLOYS AND POLYMERS	Classes: 10

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.
Polymers and Ceramics: Polymerization, thermoplastics and thermosetting plastics, elastomers, resins. Types and applications of ceramics

TEXT BOOKS

1. Material Science & Metallurgy. P. Khanna, Dhanpat Rai Publications
2. MaterialscienceandMetallurgyforengineersKodgire,VD;Kodgire,S,VEverestPublishing House. Pune. ,c2014.

REFERENCE BOOKS

1. Metallurgy and Material Science - Dr. D.V. Sreekanth, Spectrum Publications-2021
2. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

WEB REFERENCES

1. http://www.ceramics.nist.gov/webbook/webbook.htm
2. http://materials.npl.co.uk/

E -TEXT BOOKS

1. Material Science & Metallurgy. P. Khanna, Dhanpat Rai Publications

MOOCS COURSES

1. https://www.metallurgy.utah.edu/prospective/undergraduates/careers.php
2. http://nptel.ac.in/courses/112107144/

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DEPARTMENT OF MECHANICAL ENGINEERING

KINEMATICS OF MACHINERY

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME304PC	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

UNIT-I MECHANISMS	Classes: 12

Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding,turning,rolling,screwandsphericalpairs–lowerandhigherpairs–closedandopenpairs – constrained motion – completely, partially or successfully and incompletely constrained.
Mechanism and Machines – Mobility of Mechanisms: Grubler's criterion, classification of machines–kinematicschain–inversionsofmechanism–inversionsofquadriccyclechain,single and double slider crank chains, Mechanical Advantage.

UNIT-II KINEMATICS	Classes: 10

Velocity and acceleration–Motion of link in machine–Determination of Velocity and acceleration –Graphical method–Application of relative velocity method. Plane motion of body: Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Kliens construction- Coriolis acceleration –determination of Coriolis component of acceleration.
Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.0223.

UNIT-III	MOTION MECHANISMS	Classes: 12

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	Classes: 10

Definitionsofcamandfollowers–theiruses–Typesoffollowersandcams–Terminology–Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return stroke sin the above 3cases.
Analysis of motion of followers: Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

UNIT-V	HIGHER PAIRS	Classes: 12

Laws of Friction: Friction in screw threads, pivots, collars Friction wheels and too the dgears –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
GearTrains: Introduction–Types–Simple–compound and reverted geartrains–Epicyclic geartrain. Methods of finding trainvalue or velocity ratio of Epicyclic gear trains. Selection of gearbox
- 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 HillPublishers.

REFERENCE BOOKS

1. Theory of Machines / Sadhu Singh /Pearson.
2. Theory of Machines / ThomasBevan/CBS.

WEB REFERENCES

1. https://www.slideshare.net/senthilkumar1311/kinematics-of-machinery
2. https://lecturenotes.in/notes/18655-note-for-kinematics-of-machinery-km-by-dipesh-shah
3. https://www.academia.edu/10262801/Kinematics_of_Machines_-Notes_Tutorials_Mechanisms_Kinematics_of_Machines
4. http://engineering.myindialist.com/2013/introduction-of-kinematics-of-machine/#.XWOkM3GUfIU

E -TEXT BOOKS

1. https://engineeringstudymaterial.net/ebook/theory-of-machines-rs-khurmi-jk-gupta/

2. https://drive.google.com/file/d/0BxfQqBdt-h66R0RUOTc3UkRrT1E/view

MOOCS COURSE

1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/105/112105268/

DEPARTMENT OF MECHANICAL ENGINEERING

THERMODYNAMICS

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME305PC	**B.Tech**	**3**	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. The treatment of classical Thermodynamics
2. Applications of the First law of Thermodynamics
3. Applications of Second law of Thermodynamics
4. Entropy and enthalpy concepts

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. 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
3. Perform thermodynamic analysis for various applications.
4. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

UNIT-I	INTRODUCTION: BASIC CONCEPTS	Classes: 12

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	LAWS OF THERMODYNAMICS	Classes: 14

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	Classes: 13

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. Mollie 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	GAS LAWS AND PSYCHROMETRY	Classes: 11

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables. Mixtures of perfect Gases – Mole Fraction, Mass 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.HeatsandEntropyofMixtureofperfectGasesandVapour,Atmosphericair - Psychometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapor pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychometric chart.

UNIT-V	CYCLES AND COMBUSTION	Classes: 11

Power Cycles: Otto, Diesel, Dual Combustion cycles, Stirling Cycle, Atkinson Cycle, Ericsson Cycle,LenoirCycle–DescriptionandrepresentationonP–VandT-Sdiagram,ThermalEfficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Refrigeration Cycles:Carnot cycles, Bell-Coleman, Brayton cycle –Performance Evaluation. Vapour compression cycle-performance Evaluation.

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

REFERENCE BOOKS
1.Thermodynamics / Dr. D.V. Sreekanth, Spectrum Publications-2021, 2. Engineering Thermodynamics / Chattopadhyay/ Oxford 3. Engineering Thermodynamics / Rogers /Pearson 4. Engineering Thermodynamics/Rajput/Laxmipublications

WEB REFERENCES
1.   https://nptel.ac.in/courses/112103016/ 2.   https://www.mcgoodwin.net/pages/thermodynamics.pdf 3.   http://www.darshan.ac.in/DIET/ME/SubjectDetail/3131905 4.   https://www3.nd.edu/~powers/ame.20231/notes.pdf

E -TEXT BOOKS
1. H.N.Gupta, R.C.Gupta, Arun Mittal, New Agr Publication-Second Edition, ISBN : 978-81-224-2844-5 2. Fluid Mechanics and Thermodynamics of Turbomachinery, Publisher: Elsevier Butterworth Heinemann,Print ISBN: 9780750678704,0750678704 3. Thermodynamics Foundations and Applications, By: Elias P.Gyftopoulos, Publisher: Dover Publications, Print ISBN: 9780486439327,0486439321

MOOCS COURSES
1.   https://nptel.ac.in/courses/112104113 2.   https://www.mooc-list.com/course/thermodynamique-applications-coursera

DEPARTMENT OF MECHANICAL ENGINEERING

METALLURGY AND MATERIAL SCIENCE LABORATORY

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME306PC	**B.Tech**	**0**	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

The purpose of this course is to make the students learn the concepts of Metallurgy and Material Science role in all manufacturing processes which convert raw materials in to useful products adapted to human needs.

COURSEOUTCOMES

The Primary focus of the Metallurgy and Material science program is to provide undergraduates with a fundamental knowledge based associated materials properties, and their selection and application. Upon graduation, students would have acquired and developed the necessary background and skills for successful careers in the materials –related industries. Furthermore, after completing the program, the student should be well prepared for management positions in industry or continued education toward a graduate degree.

LIST OF EXPERIMENTS

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.

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. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson,2011.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", PrenticeHall of India Private Limited, 4th Indian Reprint,2002.

WEB REFERENCES

1. http://www.ceramics.nist.gov/webbook/webbook.html
2. http://www.wwcomposites.com/
3. http://materials.npl.co.uk/
4. http://www.members.tripod.com/Mg/

E -TEXT BOOKS

1.Material Science & Metallurgy. P. Khanna, Dhanpat Rai Publications.
2.Material science and Metallurgy for engineers Kodgire, V D; Kodgire, S,
VEverest Publishing House. Pune. ,c2014.

MOOCS COURSE

1.http://nptel.ac.in/courses/112107144/
2.https://www.metallurgy.utah.edu/prospective/undergraduates/careers.php

DEPARTMENT OF MECHANICAL ENGINEERING

MECHANICS OF SOLIDS LABORATORY

II B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME307PC	B.Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

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.

The students will advance the students' development of the following broad capabilities

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Annalise 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 a range of analytical methods;
4. Analyseandinterpretlaboratorydatarelatingtobehaviorofstructuresandthematerialsthey are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning

LIST OF EXPERIMENTS

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. Test on springs
7. Izod Impact test/ Charpy Impacttest
8. Compression Test

TEXT BOOKS

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov.

REFERENCE BOOKS

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani
3. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.

WEB REFERENCES

1. www.springer.com/physics/classical+continuum+physics/journal/11964
2. "Engineering Mechanics of Solids" by Popov
3. www.worldscientific.com/worldscibooks/10.1142/p18

E -TEXT BOOKS

1. Mechanics of Solids, R K BANSAL, Laxmi Publications.
2. Strength of materials ,R S khurmi, S. Chand publications

MOOCS COURSES

1. https://www.springer.com/physics/classical+continuum+physics
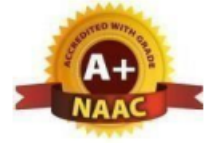2. https://web.mit.edu/emech/dontindex-build/

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DEPARTMENT OF MECHANICALENGINEERING
MACHINE DRAWING PRACTICE

II B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME308PC	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. To familiarize with the standard conventions for different materials and machine parts in working drawings.
2. Practicing the Orthographic projections and sectional views of machine elements.
3. Analyzing and practicing the methods of dimensioning the standard engineering parts and joints.
4. To prepare assembly drawing given the details of part drawings.
5. Students will be able to demonstrate an ability to design and develop the product assemblies.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Study of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components.
2. Remember Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
3. Typesofsections–selectionofsectionplanesanddrawingofsectionsandauxiliarysectional views. Parts not usually sectioned.
4. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
5. Title boxes, their size, location and details-common abbreviations and their liberal usage. Types of Drawings- working drawings for machine parts.

LIST OF EXPERIMENTS

I. Drawing of Machine Elements and simple parts
Selection of Views, additional views for the following machine elements and parts with every drawing proportion.
Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.

Keys, cotter joints and knuckle joint. Riveted joints for plates, Shaft coupling, spigot and socket pipe joint.
Journal, pivot and collar and foot step bearings.

II. Assembly Drawings:
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
Machine tool parts: Tail stock, Tool Post, Machine Vices.
Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block Simple designs of steam stop valve, spring loaded safety valve, feed check valve and air cock.
NOTE: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOKS

1. Machine Drawing by / Bhattacharyya / Oxford.
2. Machine Drawing with Auto CAD / Goutham pohit Goutam Ghosh / Pearson.
3. Machine Drawing by K.L Narayana, P. Kannaiah

REFERENCE BOOKS

1. Machine drawing / Ajeet Singh / Mc Graw Hill.
2. Machine Drawing / N.D. Bhat / Charotar.

WEB REFERENCES

1. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
2. http://home.iitk.ac.in/~anupams/ME251/EDP.pdf
3. http://web.aeromech.usyd.edu.au/ENGG1960/Documents/Week11/Engineering%20Drawings%20Lecture%20Assembly%20Drawings%202014.pdf
4. https://www.slideshare.net/gunabalans1/machine-drawing-18283689

E -TEXT BOOKS

1. http://www.uiet.co.in/downloads/20140911122818-Machine%20Drawing.pdf

MOOCS COURSES

1. https://www.mooc-list.com/tags/technical-drawing
2. https://www.edx.org/learn/drawing

DEPARTMENT OF MECHANICAL ENGINEERING

CONSTITUTION OF INDIA

II B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
CI309MC	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	**0**	**0**	**0**	**100**	**00**	**100**

COURSE OBJECTIVES

1. Sovereign -independent to conduct internal as well as external affairs
2. Socialist - preventing concentration of wealth into few hands
3. Secular - respecting all religions equally
4. Democratic- government by the people, of the people, for the people
5. Republic - Head of the state will be elected not hereditary

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. To understand the basic concepts of democracy, republicanism, constitutionalism and to know about the constitutional theories, virtues and constitutional interpretation
2. To study and analyze the quasi-federal nature of Indian Constitution and the basic function of a written constitution regarding the allocation of State power, the functions, powers and limits of the organs of state
3. To analyze elaborately regarding the emergency and amendment procedures; the need for granting of special status or special provisions to some states to know about Panchayats, Municipalities, Scheduled and Tribal areas

UNIT-I	INTRODUCTION TO INDIAN CONSTITUTION	Classes: 9

1. Meaning and importance of Constitution
2. Making of Indian Constitution
3. Salient features and the Preamble
4. Fundamental rights
5. Fundamental duties
6. Directive Principles

UNIT-II	THE AMENDMENT OF THE CONSTITUTION	Classes: 8

1. Need for Amendment
2. Types of Amendment
3. Judicial Review of Constituent Power
4. Doctrine of Basic Structure

	5. Major Amendments and their Constitutional Values	

UNIT-III	**UNION & STATE EXECUTIVE AND LEGISLATURE**	**Classes: 10**

1. Lok Sabha & Rajya Sabha (Composition, Powers &Functions)
2. President & Prime Minister (Powers, Functions, position)
3. Supreme Court-Composition, Powers &Functions
4. The President: Powers, Functions and Procedure for Impeachment
5. Judicial Review of Presidents Actions
6. Governor: Powers, Functions
7. Legislative Power of the Executive –Ordinance
8. Parliament and State Legislature
9. Privileges of Legislature
10. Council of Ministers – Prime Minister

UNIT-IV	**MAJOR FUNCTIONARIES & EMERGENCY POWERS**	**Classes: 8**

1. Union Public Service Commission
2. Election Commission
3. Planning Commission(NITI)
4. Significance of Emergency Powers
5. National Emergency – Grounds – Suspension of Fundamental Rights
6. State Emergency – Grounds – Judicial Review
7. Financial Emergency

UNIT-V	**INDIAN JUDICIARY**	**Classes: 9**

1. Supreme Court of India – Appointment of Judges –Composition
2. Jurisdiction: Original, Appellate and Writ Jurisdiction
3. Prospective Overruling and Judge - Made Laws in India (Art.141)
4. Review of Supreme Court Decision
5. High Courts – Judges -Constitution
6. Jurisdiction: Original, Appellate, Writ Jurisdiction and Supervisory Jurisdiction

TEXT BOOKS

1. H.M. Seervai: Constitutional Law of India
2. M.P. Jain: Indian Constitutional Law
3. Mahendra P. Singh: V. N. Shukla's Constitution of India
4. Granville Austin: The Indian Constitution: Cornerstone of a Nation
5. D.D. Basu: Shorter Constitution of India

REFERENCE BOOKS

1. An Introduction to the Constitution of India by Dr. Durga DasBasu
2. An Introduction to the Constitution of India by M. V.Pylee
3. Indian Constitutional Law by M.P.Jain

WEB REFERENCES

1. http://www.wdl.org/en/item/2672/
2. https://nptel.ac.in/courses/109103135/24

E -TEXT BOOKS

1. https://iasexamportal.com/ebook/the-constitution-of-india
2. https://www.india.gov.in/my-government/documents/e-books

MOOCS COURSE

1. http://nludelhi.ac.in/images/moocs/moocs-courses.pdf
2. https://www.classcentral.com/tag/constitutional-law

DEPARTMENT OF MECHANICAL ENGINEERING

PRODUCTION TECHNOLOGY

II B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
ME401PC	**B.Tech**	**3**	**0**	**0**	**3**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn

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, the student is 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	CASTING	Classes: 12

Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of molding 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 puremetal, Directional Solidification

UNIT-II	WELDING	Classes: 12

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. 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-III	HOT WORKING AND COLD WORKING	Classes: 12

Hot working, cold working, strain hardening, recovery, recrystallization 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-IV	EXTRUSION AND HIGH ENERGY RATE FORMING	Classes: 12

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.
High Energy Rate Forming Processes: Limitations, Principles of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic forming and rubber pad Forming.

UNIT-V	FORGING AND ADDTIVE MANUFACTURING TECHNOLOGY	Classes: 12

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
Additive Manufacturing: Introduction, Liquid based, powder based and deposition based layer wise Manufacturing, Applications of additive manufacturing.

TEXT BOOKS

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

REFERENCE BOOKS

1. Metal Casting / T.V Ramana Rao / NewAge
2. Production Technology / G. Thirupathi Reddy /Scitech

WEB REFERENCES

1.https://www.elsevier.com/books/production-technology/bolton/978-0-434-901739
2.https://www.elomatic.com/en/services/consulting-and-engineering/production-engineering-and-development/production-engineering-and-development-references.html
3.https://www.sanfoundry.com/best-reference-books-manufacturing-processes/

E -TEXT BOOKS

1. Production Technology by P.C Sharma, S.Chand Publications.
2.Production Technology by R.K.Jain, Khanna Publications

MOOCS COURSES

1.https://www.mooc-list.com/tags/production-engineering
2.https://businesscasestudies.co.uk/business-theory/operations/production- technology.html

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DEPARTMENT OF MECHANICAL ENGINEERING

DYNAMICS OF MACHINERY

II B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME402PC	**B. Tech**	**3**	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

The objective is to introduce some of the components mainly used in IC Engines and make analysis ofvariousforcesinvolved.Subjectdealwithtopicslikeinertiaforcesinslidercrankmechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & tensional vibration. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

COURSE OUTCOMES

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

UNIT-I	PRECESSION AND STATICE AND DYNAMIC ANALYSIS	Classes: 12

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 MOVEMENT DIAGRAGMS AND FLYWHEEL	Classes: 12

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.-. Flywheel analysis for I.C. Engines and Presses.

UNIT-III	FRICTION	Classes: 12

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	Classes: 12

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	Classes: 12

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. Whirlingof shafts – critical speed – torsional vibrations – one, two and three rotorsystems

TEXT BOOKS

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

REFERENCE BOOKS6

1. Theory of Machines and Mechanisms/Joseph E. Shigley /Oxford
2. Theory of Machines / Rao, J.S / NewAge

WEB REFERENCES

1. https://courses.lumenlearning.com/suny-osuniversityphysics/chapter/11-3-precession-of-a-gyroscope/
2. http://mech-engineeringbd.blogspot.com/2016/07/governor.html
3. http://www2.eng.cam.ac.uk/~hemh1/gyroscopes/onetofour.html
4. http://usciencecompendium.blogspot.com/2014/12/mechanical-governors-working-principle.html
5. https://www.slideshare.net/vbrayka/ppt-mech-5semdom

E -TEXT BOOKS

1. https://engineeringstudymaterial.net/ebook/theory-of-machines-rs-khurmi-jk-
2. gupta/https://drive.google.com/file/d/0BxfQqBdt-h66R0RUOTc3UkRrT1E/view

MOOCS COURSE

1.https://nptel.ac.in/courses/112/104/112104114/
2.https://nptel.ac.in/courses/112/101/112101096/

DEPARTMENT OF MECHANICAL ENGINEERING

THERMAL ENGINEERING-I

II B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME403PC	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. Laws of Thermodynamics to analyze air standard cycles
2. Evaluate the perform analysis of the major components and systems of IC engines
3. Concepts and working of Compressors
4. Concepts and applications of Gas turbines

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Evaluate the performance of IC engines
2. Understand working of compressors under the given operating conditions
3. Apply the laws of Thermodynamics to evaluate the performance of Gas turbines.

UNIT-I	INTRODUCTION:IC ENGINES	Classes: 12

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 – Carburettor 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	COMBUSTION IN IC ENGINES	Classes: 14

NormalCombustionandabnormalcombustioninSIengines–Importanceofflamespeedandeffect 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	TESING AND PERFORMANCE	Classes: 13

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.

UNIT-IV	RECIPROCATING COMPRESSROS AND ROTARY COMPRESSORS	Classes: 11

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

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

UNIT-V	DYNAMIC AND AXIAL FLOW COMPRESSORS	Classes: 11

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 Polytrophic efficiency

TEXT BOOKS

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

REFERENCE BOOKS

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

WEB REFERENCES

    1. http://webserver.dmt.upm.es/~isidoro/tc3/Thermal%20engineering.pdf
    2. https://vakantievillaveersehoek.nl/1253/thermal-engineering-pdf/
    3. https://www.sanfoundry.com/best-reference-books-applied-thermal-engineering/
    4. https://www.scribd.com/document/154313020/Applied-Thermal-Engineering.

E -TEXT BOOKS

    1. A Textbook of Thermal Engineering 15th Edition J K Gupta & R S Khurmi
    2.Introduction to Thermal Systems Engineering – Thermodynamics, Fluid Mechanics and Heat Transfer, Michael Moran, Howard Shapiro, Bruce Munson

and David DeWitt, Publisher : John Wiley and Sons
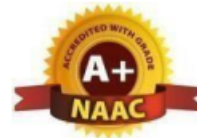
MOOCS COURSES

1. https://nptel.ac.in/courses/112107216/
2. https://easyengineering.net/me6404-thermal-engineering/

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DEPARTMENT OF MECHANICAL ENGINEERING

FLUID MECHANICS AND HYDRAULIC MACHINES

II B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME404PC	B. Tech	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn
1. To understand the basic principles of fluid mechanics
2. To identify various types off lows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
4. Toselectandanalyzeanappropriateturbinewithreferencetogivensituationinpowerplants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

UNIT-I	FLUID STATICS	Classes: 10

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	Classes: 12

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	FLEXURAL STRESSES	Classes: 12

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers(Noderivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed conduit flow: Reynolds'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	TURBO MACHINERY	Classes: 12

Basics of turbo machinery: Hydro dynamic force of jets on stationary and moving flat, Inclined, and curvedvanes, jetstriking centrally and at tip, velocity diagrams, workdone 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, characteristiccurves,governingofturbines,selectionoftypeofturbine,cavitations,surgetank,water hammer

UNIT-V	CENTRIFUGAL PUMPS	Classes: 12

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

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

Air vessels-Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels-Performance characteristic curves.

TEXT BOOKS

1. Fluid Mechanics and hydraulic machines by Rajput.
2. Hydraulics, fluid mechanics and hydraulic machinery - Modi and Seth.

REFERENCE BOOKS

1. Hydraulic Machines by Banga &Sharma, Khanna Publishers.
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

WEB REFERENCES

1. https://www.sanfoundry.com/best-reference-books-fluid-mechanics-machinery/
2. https://brijrbedu.org/FluidMechanics
3. https://www.indiamart.com/proddetail/a-textbook-of-fluid-mechanics-hydraulic-machines-9-edition-7035085912.html
4. https://qaget.info/?q=fluid+mechanics+and+hydraulic+machines+ds+kumar&spid=18pitcein4

b54pd6l82jt&sub_id=media_ping

E -TEXT BOOKS

1. Text Book of Fluid Mechanics and Hydraulic Machines - Dr. R. K. Bansal, LaxmiA
2. Textbook of Fluid Mechanics & Hydraulic Machines By R K Rajput, S Chand Publications.
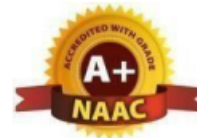
MOOCS COURSES

1. https://ocw.mit.edu/courses/mechanical-engineering/2-06-fluid-dynamics-spring-2013/
2. https://ocw.tudelft.nl/programs/master/hydraulic-engineering/

DEPARTMENT OF MECHANICAL ENGINEERING

BASIC ELECTRICAL ENGINEERING

II B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
EE406ES	**B. Tech**	3	0	0	3	30	70	100

COURSE OBJECTIVES

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. To analyze and solve electrical circuits using network laws.
2. To analyze and solve electrical circuits using theorems.
3. To understand and analyze basic Electric and Magnetic circuits.
4. To study the working principles of Electrical Machines.
5. To introduce components of Low Voltage Electrical Installations

UNIT-I	DC CIRCUITS AND AC CIRCUITS	Classes: 15

Electricalcircuitelements(R,LandC),voltageandcurrentsources,KVL&KCL,analysisofsimple circuits with dc excitation. Superposition, The venins and Nortons Theorems. Time-domain analysis of first-order RL and RC circuits

UNIT-II	A.C. CIRCUITS	Classes: 10

Representation of sinusoidal wave forms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L,C,RL,RC,RLC combinations (series and parallel),resonance in series RL-C circuit.

UNIT-III	TRANSFORMERS	Classes: 15

Ideal and practical transformer, EMF equation, operation on no load and on load, OC and SC tests, phasor diagrams equivalent circuit, losses in transformers, regulation, Efficiency and condition for maximum efficiency, Auto-transformer

UNIT-IV	ELECTRICAL MACHINES	Classes: 15

Generation of rotating magnetic fields, Construction and working of a three-phase induction Motor, Significance of torque-slip characteristics. Loss components and efficiency. Construction, working. Torque-speed characteristics of separately excited, shunt, series, compound dc motors.

UNIT-V	ELECTRICAL INSTALLATIONS	Classes: 10

Components of LT Switchgear: Switch Fuse Unit(SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules.

TEXT BOOKS

1. Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition2010,Tata
2. McGraw Hill.
3. D.C. Kulshreshtha, "Basic Electrical Engineering", McGrawHill,2009.
4. L.S.Bobrow,FundamentalsofElectricalEngineering",OxfordUniversityPress,2011
5. Electrical and Electronics Technology, E. Hughes, 10th Edition,Pearson,2010

REFERENCE BOOKS

1. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, PrenticeHall India,1989.
2. P. V. Prasad, S. Siva nagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1stEdition,2013.
3. V. D. Toro, – Electrical Engineering Fundamentals Prentice HallIndia,1989.

WEB REFERENCES

1. https://www.electrical4u.com/
2. http://www.basicsofelectricalengineering.com/
3. https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/a/ee-voltage-and-current
4. https://circuitglobe.com/

E -TEXT BOOKS

1. https://easyengineering.net/basic-electrical-engineering-by-wadhwa/
2. https://easyengineering.net/objective-electrical-technology-by-mehta/

MOOCS COURSE

1. https://nptel.ac.in/courses/108108076/1
2. https://nptel.ac.in/courses/108102146/
3. https://nptel.ac.in/courses/108108076/35

DEPARTMENT OF MECHANICAL ENGINEERING

PRODUCITON TECHNOLOGY LABORATORY

II B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	of Hours/Week			**Credits**	of Maximum Marks		
ME406PC	B. Tech	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

1. Know about the basic Physical, Chemical Properties of materials
2. Explainwhysomematerial(s)arebettertobeusedinaproductforgivendesignrequirements
3. Learn the basic operation of various manufacturing processes
4. Learn how various products are made using traditional, non-traditional, or Electronics manufacturing processes
5. Design simple process plans for parts and products
6. Understand how process conditions are set for optimization of production
7. Learn how CNC machines work
8. Write and execute CNC machining programs to cut parts on a milling machine
9. Measure a given manufactured part to evaluate its size, tolerances and surface finish
10. Design and fabricate a simple product

COURSE OUTCOMES

Understanding the properties of moulding sands and pattern making. Fabricate joints using gas weldingandarcwelding.Evaluatethequalityofweldedjoints.Basicideaofpressworkingtools and performs moulding studies on plastics.

LIST OF EXPERIMENTS

73

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

TEXT BOOKS

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

REFERENCE BOOKS

1.Metal Casting / T.V Ramana Rao / New Age
2.Production Technology / G. Thirupathi Reddy /Scitech

WEB REFERENCES

1. https://www.elsevier.com/books/production-technology/bolton/978-0-434-90173-9

2. https://www.sanfoundry.com/best-reference-books-manufacturing-processes/

E -TEXT BOOKS

1. Production Technology by P.C Sharma, S. ChandPublications
2. Production Technology by R.K Jain, KhannaPublications.

MOOCS COURSE

1. https://www.mooc-list.com/tags/production-engineering
2. https://businesscasestudies.co.uk/business-theory/operations/production-technology.html
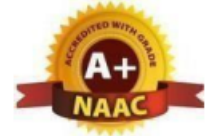
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DEPARTMENT OF MECHANICAL ENGINEERING

FLUID MECHANICS AND HYDRAULICS MACHINES LABORATORY

II B. TECH- II SEMESTER (R 20)								
Course Code	Programme	Hours/Week			Credits	Maximum Marks		
ME407PC	**B. Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. To understand the basic principles of fluid mechanics
2. To identify various types off lows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. ToanalyzeavarietyofpracticalfluidflowandmeasuringdevicesandutilizeFluidMechanics principles in design.
4. Toselectandanalyzeanappropriateturbinewithreferencetogivensituationinpowerplants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

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.
13. Hydraulic Jump

TEXT BOOKS

1. Fluid Mechanics and hydraulic machines by Rajput.
2. Hydraulics, fluid mechanics and hydraulic machinery - Modi and Seth.

REFERENCE BOOKS

1. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

WEB REFERENCES

1. https://qaget.info/?q=fluid+mechanics+and+hydraulic+machines+ds+kumar&spid=18pitcei n4b54pd6l82jt&sub_id=media_ping
2. https://qaget.info/?q=fluid+mechanics+and+hydraulic+machines+ds+kumar&spid=18pitcei n4b54pd6l82jt&sub_id=media_ping

E -TEXT BOOKS

1. Text Book of Fluid Mechanics and Hydraulic Machines - Dr. R. K. Bansal, Laxmi
2. Textbook of Fluid Mechanics & Hydraulic Machines By R K Rajput, S Chand Publications.

MOOCS COURSES

1. https://ocw.mit.edu/courses/mechanical-engineering/2-06-fluid-dynamics-spring-   2013/
2. https://ocw.tudelft.nl/programs/master/hydraulic-engineering/

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DEPARTMENT OF MECHANICAL ENGINEERING

KINEMATICS & DYNAMICS LABORATORY

II B. TECH- II SEMESTER (R 20)								

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
ME408PC	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
6. Understand the fundamentals of the theory of kinematics and dynamics of machines.
7. Study the techniques for motion of machines and their components.
8. Understand the kinematics and dynamics of mechanical elements.
9. Learn to design such elements to accomplish desired motion or tasks.
10. Use computer software packages in modern design machine.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
6. Understand types of motions.
7. Analyze forces & torques of components in linkages.
8. Understand static balancing.
9. Understand dynamic balancing.
10. Understand forward and inverse kinematics of open-loop mechanisms

LIST OF EXPERIMENTS

12. To determine the state of balance of machines for primary and secondary forces
13. To determine the frequency of tensional vibration of a given rod
14. Determine the effect of varying mass on the center of sleeve in porter andproell governor
15. Find the motion of the follower if the given profile of the cam
16. The balance masses statically and dynamically for single rotating mass systems
17. Determine the critical speed of a given shaft for different n-conditions
18. For a simple pendulum determine time period and its natural frequency
19. For a compound pendulum determine time period and its natural frequency
20. Determine the effect of gyroscope for different motions
21. Determine time period, amplitude and frequency of undamped free longitudinal Vibration of single degree spring mass systems.
22. Determine time period, amplitude and frequency of damped free longitudinal Vibration of single degree spring mass systems.

TEXT BOOKS
4.   Theory of Machines and Mechanics/JOSEPHE. SHIGLEY/Oxford. 5.   Theory of Machines / S.S. Rattan/ Mc Graw Hill Publishers. 6.   Theory of Machines / Sadhu Singh/Pearson.

REFERENCE BOOKS
3. Theory of Machines / ThomasBevan/CBS. 4. Theory of Machines / Rao.J.S / NewAge.

WEB REFERENCES
1.   https://www.sanfoundry.com/best-reference-books-kinematics-dynamics- 2.   machines/http://engineering.myindialist.com/2013/introduction-of-kinematics-of-machines/#.XXCnmvAzbIV 3.   https://link.springer.com/chapter/10.1007/978-1-4020-9485- 4.   9_1http://www.darshan.ac.in/DIET/ME/SubjectDetail/3131906

E -TEXT BOOKS
1.   http://www.freebookcentre.net/Physics/Dynamics-Books-Download.html

MOOCS COURSES
1.   https://www.mooc-list.com/course/mechanics-kinematics-and-dynamics-edx 2.https://www.edx.org/course/mechanics-kinematics-and-dynamics-3

DEPARTMENT OF MECHANICAL ENGINEERING

GENDER SENSITIZATION

II B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
GS409MC	B. Tech	0	0	2	0	100	0	100

COURSE OBJECTIVES

1. To develop students' sensibility with regard to issues of gender in contemporary India.
2. To provide a critical perspective on the socialization of men and women.
3. To introduce students to information about some key biological aspects of genders.
4. To expose the students to debates on the politics and economics of work.
5. To help students reflect critically on gender violence.
6. To expose students to more egalitarian interactions between men and women.

COURSE OUTCOMES

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
3. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
4. Students will acquire insight into the gendered division of labor and its relation to politics and economics.
5. Men and women students and professionals will be better equipped to work and live together as equals.
6. Students will develop a sense of appreciation of women in all walks of life.
7. Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence

UNIT-I	UNDERSTANDING GENDER	Classes: 4

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT-II	GENDER ROLES AND RELATIONS	Classes: 4

TwoorMany?-Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond theBinary

UNIT-III	GENDER AND LABOUR	Classes: 5

Division and Valuation of Labor-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work.- Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT-IV	GENDER BASED VIOLANCE	Classes: 5

The Concept of Violence-Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No!-Sexual Harassment, not Eve-teasing-Coping with Everyday Harassment- Further Reading:"*Chupulu"*.
Domestic Violence: Speaking Out Is Home a Safe Place? –When Women Unite [Film].Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT-V	GENDER AND CULTURE	Classes: 4

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks- The Brave Heart.
Note: Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book,Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender Sensitization"

TEXT BOOKS

1. Towards a World of Equals: A Bilingual Textbook on Gender" written by A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi, Hyderabad,Telangana State in the year 2015.

REFERENCE BOOKS

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books,2012
2. Abdulali Sohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

WEB REFERENCES

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2. Hedman, Birgitta, Francesca Perucci and Pehr Sundström (1996). Engendering Statistic: A Tool for Change. Stockholm: Statistics Sweden.
3. Milek, Anne, Stork Christoph and Alison Gillwald (2011) Engendering communication: a perspective on ICT access and usage in Africa, Info, vol. 13 No. 3, pp.125-141. Bingley, United Kingdom: Emerald GroupPublishing.
4. Hedman, Birgitta, Francesca Perucci and PehrSundström (1996). Engendering Statistic: A Tool for Change. Stockholm: StatisticsSweden.

E -TEXT BOOKS

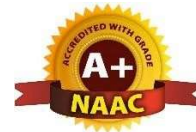1. Gender Sensitisation Hardcover – 2012 by Dr. Tanuja Trivedi.

MOOCS COURSE

1. https://www.mooc-list.com › tags ›gender-equality
2. https://www.udemy.com › course ›gender-equality-and-sexual-diversity
3. https://www.edx.org › learn ›gender-studies

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DEPARTMENT OF MECHANICAL ENGINEERING

DESIGN OF MACHINE MEMBER-I

III B. TECH- I SEMESTER (R20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME501PC	**B.Tech.**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn

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

COURSE OUTCOMES

Upon successful completion of the course, the student can 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
3. machine members and fatigue loading.
4. Design based on strength and rigidity and analyze the stresses and
5. strains induced in a machine element.

UNIT-I	INTRODUCTION	Classes: 12

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	Classes: 12

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	Classes: 10

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	Classes: 10

Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

UNIT-V	SHAFTS	Classes: 10

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 .

TEXT BOOKS

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

WEB REFERENCES

1.https://india.oup.com/product/design-of-machine-elements-9780199477647?
2.https://books.google.co.in/books/about/Design_of_Machine_Elements.html?id=M1y4_cfXy 0AC

E -TEXT BOOKS

1. https://easyengineering.net/a-textbook-of-machine-design-by-r-s-khurmi/
2. http://www.musaliarcollege.com/e-Books/ME/Machine%20Elements%20in%20Mechanical%20Design.pdf

MOOCS COURSE

1. https://nptel.ac.in/courses/112/105/112105124/
2. https://www.coursera.org/learn/machine-design1

DEPARTMENT OF MECHANICAL ENGINEERING

THERMAL ENGINEERING-II

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME502PC	B.Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

To learn

  1.To apply the laws of Thermodynamics

  2.To analyze steam and gas turbine cycles and to perform analysis of the major components of steam and gas turbine plants and their applications.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Develop state – space diagrams based on the schematic diagrams of process flow of steamand gas turbine plants
2. Apply the laws of Thermodynamics to analyze thermodynamic cycles
3. Differentiate between vapor 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 todo the analysis of these components

UNIT-I	STEAM POWER PLANT	Classes: 10

Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperatureof 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	Classes: 10

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 undercooling - Wilson line.

UNIT-III	STEAM TURBINES	Classes: 12

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	Classes: 10

Requirements of steam condensing plant – Classification of condensers –Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources andits 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	Classes: 12

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

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/ Saravana muttoo, Cohen, Rogers/ Pearson

2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI

3. Thermal Engineering/ Rajput/ Lakshmi Publications

WEB REFERENCES

1.www.springer.com 2.www.thermalengineering.org

3.www.ansys.com

E -TEXT BOOKS
1.https://www.pdfdrive.com/thermal-engineering-books.html 2. http://gtu-info.com/Subject/3341902/TEI/THERMAL-ENGINEERING-I/Books 3.https://www.phindia.com/Books
MOOCS COURSES
1.https://www.mooc-list.com/course/thermal-fluid-systems-saylororg   .
2.https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
3.https://www.edx.org/learn/mechanical-engineering

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DEPARTMENT OF MECHANICAL ENGINEERING

METROLOGY AND MACHINE TOOLS

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME503PC	B. Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

To learn

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

Upon successful completion of the course, the student is 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	Classes: 8

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. Automation. Machining Time Calculation. Merchants Circle Diagram. Problems

UNIT-II	DRILLING AND BORING MACHINES	Classes: 10

Principles of working, specifications, types, operations performed, twist drill. Types of Boring machines and applications. Shaping, Slotting, and planning machines –Principles of working – machining time calculations.

UNIT-III	MILLING MACHINES	Classes: 10

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	Classes: 10

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	Classes: 10

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

WEB REFERENCES

1.www.sciencedirect.com 2.www.mdpi.com

E -TEXT BOOKS

1.http://alvarestech.com/temp/capp/MetrologiaIndustrial2016-DMIS.pdf

2.https://www.springerprofessional.de/en/optical-sensors-for-machine-tool-metrology/17055224
MOOCS COURSES
1.https://www.edx.org/course/introduction-to-computer-numerical-control
2.https://onlinecourses.nptel.ac.in/noc20_me16/preview
3.https://mitwpu.edu.in/wp-content/upload

DEPARTMENT OF MECHANICAL ENGINEERING

AUTOMOBILE ENGINEERING

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME504PC	B. Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

The student will be made to learn
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

Upon successful completion of the course, the student is able to
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	Classes: 12

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 CRDI and TDI Systems.

UNIT-II	COOLING SYSTEM	Classes: 12

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	Classes: 12

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, synchromesh 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	Classes: 10

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 toe in, centre point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT-V	EMISSIONS FROM AUTOMOBILES	Classes: 10

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

WEB REFERENCES
1. https://guides.unitec.ac.nz/automotive/websites 2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118354179 3. https://us.sagepub.com/en-us/nam/journal/proceedings-institution-mechanical-engineers-part-d-journal-automobile-engineering
E -TEXT BOOKS
1. https://books.google.co.in/books/about/A_Text_Book_of_Automobile_Engineering.html?id=nBVefxD_0agC 2. https://www.engineeringbookspdf.com/automobile-engineering/ 3. https://easyengineering.net/automobilebooks/
MOOCS COURSES
1. https://www.classcentral.com/course/swayam-fundamentals-of-automotive-systems-17616 2. www.nptel.ac.in 3. www.coursera.org

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DEPARTMENT OF MECHANICAL ENGINEERING

BUSINESS ECONOMIC AND FINANCIAL ANALYSIS

III/I B. TECH (R20)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BE504MS	**B. Tech**	L	T	P	C	CIE	SEE	Total
		3	0	0	3	30	70	100

COURSE OBJECTIVES

To learn
1. To learn the basic Business types, impact of the Economy on Business.
   and firms specifically. To analyze the Business from the Financial Perspective.
2. To Plan production and cost concepts for maximizing profit.
3. To Construct financial statement in accordance with generally accepted accounting principles
4. To Analyze the Financial performance of business through Ratios
5. To Estimate investment proposals through Capital Budgeting Methods

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Understand Business with the use of economic theories and business structure
2. Learn Production and cost concepts for maximizing profit
3. Construct financial statement in accordance with generally accepted accounting principles.
4. Analyze the Financial performance of business through Ratios.

UNIT-I	INTRODUCTION TO BUSINESS AND ECONOMICS	Classes: 10

Business: Characteristic features of Business, Features and evaluation of Private Enterprises and Public Enterprises.
Economics: Significance of Economics, types, Concepts and Importance of National Income, Inflation, Nature and Scope of Business Economics.
Demand Analysis: Demand Definition, Types of Demand, Demand Function, Law of Demand, Elasticity of Demand, Types of Elasticity of Demand, Demand Forecasting Methods.

UNIT-II	THEORY OF PRODUCTION AND COST ANALYSIS	Classes:8

Theory of Production: Factors of Production, Production Function, Production Function with one variable input, Production function with two variable inputs (ISO Quants and ISO Costs), Scale of Production with Law of Returns, Cobb-Douglas Production Function.
Cost Analysis: Types of Costs, Short run and Long run Cost Functions, Break Even Analysis.

UNIT-III	MARKET STRUCTURES, PRICING	Classes: 8

Market Structures, Pricing: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly and Monopolistic Competition, Types of Pricing.

UNIT-IV	FINANCIAL ACCOUNTING & FINANCIAL ANALYSIS THROUGH RATIOS	Classes: 12

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Capital Structure Ratios and Profitability Ratios (simple problems), Cash Flow Statement (simple problems) and Funds Flow Statement (simple problems)

UNIT-V	CAPITAL BUDGETING	Classes: 8

Capital, significance, Types of Capital, Methods and sources of raising finance.

Nature of Capital Budgeting, features of Capital Budgeting proposals, Methods of Capital Budgeting: Pay Back Period Method (PBP), Accounting Rate of Return (ARR), Net Present Value Method (NPV) Simple problems.

TEXT BOOKS

1. S K Agarwal, Business Economics, S Chand Publications, 2018
2. Dr. A. R. Aryasri, Business Economics and Financial Analysis, McGraw Hill Education, First Edition 2020.
3. Charles T Horngren, Gary L. Sundem, John A Elliott, Donna R Philbrick, Introduction to Financial Accounting, Pearson Education, 11th Edition, 2017.

REFERENCE BOOKS

1. K. Sudha, K. Sathish, A. Sarveswarareddy, Business Economics and Financial Analysis-M/S Spectrum Publications, First Edition 2021.
2. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
3. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
4. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.

WEB REFERENCES

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2. https://nptel.ac.in/courses/110106050/39
3. https://nptel.ac.in/courses/110106050/38

E -TEXT BOOKS

1. https://www.sciencedirect.com/book/9780750644549/business-economics
2. http://www.freebookcentre.net/Business/Economics-Books.html

MOOCS COURSE

1. https://nptel.ac.in/courses/110106050/
2. https://nptel.ac.in/courses/110106050/11

DEPARTMENT OF MECHANICAL ENGINEERING

REFRIGERATION AND AIR CONDITIONING

III B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME505PC	**B.Tech**	L	T	P	C	CIE	SEE	Total
		3	0	0	3	30	70	100

COURSE OBJECTIVES

1.To apply the principles of Thermodynamics

2.To analyze different types of refrigeration and air conditioning systems

3.To understand the functionality of the major components.

COURSE OUTCOMES

1.At the end of the course, the student should be able to Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems.

2.Thermodynamically analyze refrigeration and air conditioning systems and evaluate performance parameters.

3.Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.

UNIT-I	INTRODUCTION TO REFRIGERATION	Classes: 12

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

UNIT-II	VAPOUR COMPRESSION REFRIGERATION	Classes: 14

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	Classes: 13

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 Zoetrope's.

UNIT-IV	VAPOR ABSORPTION SYSTEM	Classes: 11

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	Classes: 11

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 / Anantha narayanan / Mc Graw Hill

WEB REFERENCES

1. https://nptel.ac.in/courses/112/105/112105129/
2. https://www.technicalbookspdf.com/mechanical-engineering/refrigeration-and-air- conditioning/page/2/
3. https://nptel.ac.in/courses/112/105/112105128/
4. https://www.technicalbookspdf.com/refrigeration-and-air-conditioning-iit-kharahpur/

E -TEXT BOOKS

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2. https://mhebooklibrary.com/doi/book/10.1036/9780071487412
3. https://palmbeachstate.libguides.com/HVAC/books
4. https://eduinformer.com/refrigeration-and-air-conditioning-books/

5.https://www.technicalbookspdf.com/refrigeration-and-air-conditioning-iit-kharahpur/
98

MOOCS COURSES
1   https://www.classcentral.com/course/swayam-refrigeration-and-air-conditioning-14268
2   https://onlinecourses.nptel.ac.in/noc19_me58/preview
3   https://www.udemy.com/topic/hvac/
4   https://www.mooclab.club/threads/hvac-heat-ventilation-and-air-conditioners- courses-laundry-courses.12457/
5   https://www.coursera.org/lecture/thermodynamics-intro/05-05- refrigeration-and- heat-pump-cycles-nI1vG

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DEPARTMENT OF MECHANICAL ENGINEERING

THERMAL ENGINEERING LABORATORY

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME506PC	B.Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

To understand the working principles of IC Engines, Compressors.

COURSE OUTCOMES

1. Students can able to understand working principle of SI Engines
2. Students gain the knowledge of CI and SI Engines
3. Students can gain the knowledge of Performance Test on Engines, Compressors
4. Students can gain the knowledge of Boilers

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.

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/ Saravana muttoo, Cohen, Rogers/ Pearson
2. Fundamentals of Engineering Thermodynamics / Ratha krishnan/ PHI
3. Thermal Engineering/ Rajput/ Lakshmi Publications

WEB REFERENCES
1.www.springer.com
2.www.thermalengineering.org3.www.ansys.com

E -TEXT BOOKS
1.https://www.pdfdrive.com/thermal-engineering-books.html
2.http://gtu-info.com/Subject/3341902/TEI/THERMAL-ENGINEERING-I/Books
3.https://www.phindia.com/Books

MOOCS COURSE
1.https://www.mooc-list.com/course/thermal-fluid-systems-saylororg
2.https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
3.https://www.edx.org/learn/mechanical-engineering

DEPARTMENT OF MECHANICAL ENGINEERING

MACHINE TOOLS LABORATORY

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME507PC	B.Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

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

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Gain the knowledge of operations on Lathe, Drilling machine
2. Gain the knowledge of operations on Shaping, Milling and Grinding machines
3. Gain the knowledge of machining operations and machining time calculations.

LIST OF EXPERIMENTS

1. Step turning on lathe machine
2. Taper turning on lathe machine
3. Thread cutting on lathe machine
4. Knurling on lathe machine
5. Measurement of cutting forces on lathe
6. Machining of holes using Drilling machines.
7. Machining of holes using boring
8. Gear cutting on the Milling machine
9. Grinding of Tool angles using Cylindrical Grinding.
10. Grinding of Tool angles using Surface Grinding
11. Machining of Flat Surface on a Shaping Machine
12. Groove Formation in the workpiece on a Slotting Machine

Note: Perform any 10 out of the 12Exercises.

TEXT BOOKSn

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 CentralBook Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey BoothroydMcGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor & Kulkarni/ Tata Mc Graw Hill

WEB REFERENCES

1.www.sciencedirect.com 2.www.mdpi.com

E -TEXT BOOKS

1.http://alvarestech.com/temp/capp/MetrologiaIndustrial2016-DMIS.pdf

2.https://www.springerprofessional.de/en/optical-sensors-for-machine-tool-metrology/17055224

MOOCS COURSES

1. https://www.edx.org/course/introduction-to-computer-numerical-control

2.https://onlinecourses.nptel.ac.in/noc20_me16/preview

3.https://mitwpu.edu.in/wp-content/upload

DEPARTMENT OF MECHANICAL ENGINEERING

ENGINEERING METROLOGY LABORATORY

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME508PC	B.Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

1. To import practical exposure to the metrology and measurement

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

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Understand the Length, Height, and internal dimensions
2. Understand the measurement of Gears
3. Gain the knowledge of Angle and Taper measurement by Sine Bar and Bevel Protractor
4. Understand the working principle of Tool makers microscope
5. Gain the knowledge of surface measurement

LIST OF EXPERIMENTS

1. Measurement of lengths, heights, diameters by using vernier calipers, micrometers.
2. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
. 3.Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
4. Angle and taper measurements by bevel protractor and sine bars.
5. Thread measurement by 2-wire method.
6. Thread measurement by 3-wire method.
7. Surface roughness measurement by Tally Surf.
8. Use of mechanical comparator
9. Flatness measurement by using Optical Flat
10.Measurement of Thread Angle, Pitch by using Tool Makers Microscope.

Note: Perform any 8 out of the 10 Exercises.

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DEPARTMENT OF MECHANICAL ENGINEERING

ENVIRONMENTAL SCIENCE

III B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
BS504HS	B.Tech	3	0	0	0	100	00	100

COURSE OBJECTIVES

To learn
1. Analyze the inter relationship between living organism and environment
2. Describe various types of natural resources available on the earth surface
3. Identify the values, threats of biodiversity, endangered and endemic species of India along with the conservation of biodiversity
4. Explain the causes, effects and control measures of various types of environmental pollutions
5. Understand the importance of environment by assessing its impact on the human world

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
1. Differentiate between various biotic and abiotic components of ecosystem
2. Describe the various types of natural resources
3. Examine the values, threats of biodiversity, the methods of conservation, endangered and endemic species of India
4. Illustrate causes, effects, and control measures of various types of environmental pollutions
5. Understand technologies on the basis of ecological principles environmental regulations which in turn helps in sustainable development

UNIT-I	ECOSYSTEMS	Classes: 8

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.

UNIT-II	NATURAL RESOURCES	Classes: 8

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	Classes: 7

Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic, optional values and hotspots of biodiversity. Endangered and endemic species of India, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ
conservation.

UNIT-IV	ENVIRONMENTAL POLLUTION	Classes: 9

Types of pollution, Causes, effects and prevention and control measures of air, water, soil, noise and thermal pollution. Solid waste and e-waste management.

UNIT-V	ENVIRONMENTAL POLICY AND SUSTAINABLE DEVELOPEMENT	Classes: 10

Concept of sustainable development: Sustainable development goals. Threats to sustainability: Population explosion- crazy consumerism. Green building concept. Water conservation, Rainwater harvesting, watershed management. Environmental Policies and Legislations: EnvironmentProtection Act, Air (Prevention and Control of Pollution) Act, Forest (conservation) Act, 1980.
Wildlife Protection Act.

TEXT BOOKS

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission
2. Environmental Studies by R. Rajagopalan, Oxford UniversityPress.
3. Textbook of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications
4. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi,12 Edition, 2015

REFERENCE BOOKS

1. Environmental Studies by Anubha Kaushik, 4 Edition, New age international publishers
2. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHLLearning Pvt. Ltd, NewDelhi
3. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008PHL Learning Pvt. Ltd, NewDelhi
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIAedition

WEB REFERENCES

1. https://www.britannica.com/science/ecosystem
2. https://ocw.mit.edu/resources/#EnvironmentandSustainability

E -TEXT BOOKS

1. P N Palanisamy Environmental Science ISBN:9788131773253, eISBN:97899332509771 Edition: Second edition
2. Environmental Studies. Author, Dr. J. P. Sharma. Publisher, Laxmi Publications, 2009 ISBN, 8131806413,9788131806418.

MOOCS COURSE

1. https://nptel.ac.in/courses/122103039/38
2. https://nptel.ac.in/courses/106105151/12

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DEPARTMENT OF MECHANICAL ENGINEERING

CAD/CAM

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME601PC	B.Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

To learn

1. To provide an overview of how computers are being used in design, development and manufacturing.

2. To understand the need for integration of CAD and CAM.

3. To understand how to model engineering components using solid modeling techniques.

4. To develop programs for CNC to manufacture industrial components.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Understand geometric transformation techniques in CAD.

2. Develop mathematical modelsto represent curves and surfaces.

3. Model engineering components using solid modeling techniques.

4. Develop programs for CNC to manufacture industrial components.

5. Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT-I	FUNDAMENTALS OF CAD/ CAM	Classes: 12

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	Classes: 12

Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization ofsurface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathologicalconditions.
Solid Modeling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT-III	NC CONTROL PRODUCTION SYSTEMS	Classes: 12

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	Classes: 12

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	Classes: 12

F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS. **Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact;Coordinate measuring machines, Machine vision.
Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS

1. CAD/CAM 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

WEB REFERENCES

1. onlinelibrary.wiley.com
2. https://www.cadcam-group.eu/references-cadcam-group
3. http://ctfm-elb.citethisforme.com/topic-ideas/engineering/CAD%20and%20CAM-16403096

E -TEXT BOOKS

1. https://www.technicalbookspdf.com/cad-cam-system/

2. https://www.cadcim.com/

MOOCS COURSES

1.https://www.coursera.org/specializations/cad-design-digital-manufacturing

2.https://ocw.mit.edu/courses/architecture/4-500-introduction-to-design-computing-fall-2008/

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DEPARTMENT OF MECHANICAL ENGINEERING
DESIGN OF MACHINE MEMBER-II

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME602PC	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

1. To gain knowledge about designing the commonly used important machine memberssuch as bearings, engine parts, springs, belts, gears etc.
2. To design the components using the data available in design data books.
3. To estimate the life of rolling bearing.
4. To gain the knowledge on different forces acting on the connecting rod and stresses developed due to these forces.

COURSE OUTCOMES

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 whichis essential in design and development of machinery in industry.

UNIT-I	SLIDING CONTACT BEARINGS	Classes: 12

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	Classes: 12

Ball and roller bearings – Static load – dynamic load – equivalent radial load– design and selectionof ball & roller bearings.

UNIT-III	ENGINE PARTS	Classes: 12

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	Classes: 12

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	Classes: 12

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

TEXT BOOKS

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

REFERENCE BOOKS6

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

WEB REFERENCES

1. https://india.oup.com/product/design-of-machine-elements-9780199477647?
2. https://books.google.co.in/books/about/Design_of_Machine_Elements.html?id=M1 y4_cfXy0AC
3. www.sciencedirect.com

E -TEXT BOOKS

1. https://easyengineering.net/a-textbook-of-machine-design-by-r-s-khurmi/
2. http://www.musaliarcollege.com/e-Books/ME/Machine%20Elements%20in%20Mechanical%20Design.pdf

MOOCS COURSE

1. https://nptel.ac.in/courses/112/105/112105124/
2. https://www.coursera.org/learn/machine-design1
3. https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/

DEPARTMENT OF MECHANICAL ENGINEERING

HEAT TRANSFER

III B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
ME603PC	**B.Tech**	**3**	**1**	**0**	**4**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn

1. To provide knowledge about application of conduction, convection and radiation
2 . To understand heat transfer concepts to different practical applications
3. To gain the knowledge of one-dimensional steady state heat transfer
4. Understand concepts of continuity, momentum and energy equations
5. To provide knowledge of Design of heat exchangers.

COURSE OUTCOMES

Upon successful completion of the course, the student is 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	Classes: 12

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 ofthe field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions OneDimensional 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	Classes: 14

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	Classes: 13

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	Classes: 11

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	Classes: 11

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 ona vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations. Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – totaland monochromatic quantities – laws of Planck, Wien, Kirchhoff, 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

1. https://www.begellhouse.com/journals/heat-transfer-research.html
2. ttps://www.tandfonline.com/toc/uhte20/current
3. https://bigladdersoftware.com/epx/docs/8-3/engineering-reference/heat-exchangers.html

E -TEXT BOOKS
1. https://ahtt.mit.edu/
2. https://www.engineeringbookspdf.com/a-heat-transfer-textbook/
3. https://app.knovel.com/web/toc.v/cid:kpHTTE0007/viewerType:toc/

MOOCS COURSES
1. https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer- fall-2015/
2. https://online-learning.tudelft.nl/courses/advanced-transport-phenomena/
3. Neptel.ac.in
4. https://edu.epfl.ch/coursebook/en/advanced-heat-transfer-ME-465

DEPARTMENT OF MECHANICAL ENGINEERING

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
FM601MS	B. Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

1. To understand the Management Concepts, applications

2. To understand practical aspects of business and development of Managerial Skills for Engineers.

COURSE OUTCOMES

1. The students understand the significance of Management in their Profession.
2. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course.
3. The students can explore the Management Practices in their domain area.

UNIT-I	INTRODUCTION TO MANAGEMENT:	Classes: 12

Evolution of Management, Nature & Scope-Functions of Management Role of Manager-levels of Management-Managerial Skills - Challenges-Planning-Planning Process Types of Plans-MBO

UNIT-II	ORGANIZATION STRUCTURE & HRM:	Classes: 12

Organization Design-Organizational Structure-Departmentation– Delegation-Centralization - Decentralization-Recentralization-Organizational Culture- Organizational climate- Organizational change Human Resource Management-HR Planning - Recruitment & Selection - Training & Development Performance appraisal - Job Satisfaction-Stress Management Practices

UNIT-III	OPERATION MANAGEMENT:	Classes: 12

Introduction to Operations Management-Principles and Types of Plant Layout-Methods of production (Job Batch and Mass production) - Method study and Work Measurement-Quality Management - TQM-Six sigma - Deming's Contribution to Quality - Inventory Management – EOQ - ABC Analysis - JIT System-Business Process Re-engineering (BPR)

UNIT-IV	MARKETING MANAGEMENT:	Classes: 12

Introduction to Marketing-Functions of Marketing-Marketing vs. Selling Marketing Mix - Marketing Strategies - Product Life Cycle - Market Segmentation -Types of Marketing - Direct Marketing-Network Marketing - Digital Marketing-Channels of Distribution - Supply Chain Management (SCM)

UNIT-V	PROJECT MANAGEMENT:	Classes: 12

Introduction to Project Management-steps in Project Management - Project Planning - Project Life Cycle-
Network Analysis-Program Evaluation & Review Technique (PERT)- Critical Path Method (CPM) -Project Cost Analysis - Project Crashing - Project Information Systems

TEXT BOOKS

1.Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

2.Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.

3.Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.

REFERENCE BOOKS6

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.

2. Industrial Engineering and Management: Including Production Management, T.R.Banga,

S.C Sharma , Khanna Publishers.

WEB REFERENCES

1.https://india.oup.com/product/design-of-machine-elements-9780199477647?
2.https://books.google.co.in/books/about/Design_of_Machine_Elements.html?id=M1 y4_cfXy0AC
3.www.sciencedirect.com

E -TEXT BOOKS

1. https://easyengineering.net/a-textbook-of-machine-design-by-r-s-khurmi/
2. http://www.musaliarcollege.com/e-Books/ME/Machine%20Elements%20in%20Mechanical%20Design.pdf

MOOCS COURSE

1.https://nptel.ac.in/courses/112/105/112105124/
2. https://www.coursera.org/learn/machine-design1
3.https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/

DEPARTMENT OF MECHANICAL ENGINEERING

OPEN ELECTIVE - I - UNCONVENTIONAL MACHINING PROCESS

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME604OE	B.Tech	3	0	0	3	30	70	100

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

Upon successful completion of the course, the student is able to

1. Understand the basic techniques of Unconventional Machining processes modeling
2. Estimate the material removal rate and cutting force, in an industrially useful manner, for Unconventional Machining processes.
3. Understand how to interpret data for process selection
4. Understand the effects of tool geometry on machining force components and surface finish

UNIT-I	INTRODUCTION	Classes: 12

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	Classes: 14

AJM, AWJM, WJM Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application andlimitations. **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	Classes: 13

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	ELECTRON BEAM MACHING ,LASER BEAM MACHINING	Classes: 11

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	PLASMA MACHINING,CHEMICAL MACHINING,ABRASIVE FLOW FINISHING	Classes: 11

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
WEB REFERENCES
1.   https://link.springer.com/book/10.1007/978-1-4471-5179-1 2.   http://home.iitk.ac.in/~jrkumar/download/Lecture-3.pdf 3.   https://www.tandfonline.com/doi/full/10.1080/21693277.2014.899934
E -TEXT BOOKS
1. https://civildatas.com/download/unconventional-machining-processes-by-senthil-kumar 2. http://www.brainkart.com/subject/Unconventional-Machining-Processes_84/
MOOCS COURSES
1. http://home.iitk.ac.in/~jrkumar/download/Unconventional%20machining%20processes_2018.pdf 2. https://www.iitg.ac.in/cet/moocs/annual%20report_03.11.2020.pdf

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE - I - FINITE ELEMENT METHODS

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME511PE	B.Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of

1. Basics of Finite Element Analysis.
2. Available material models for structural materials, soils and interfaces/joints.
3. Modelling of engineering systems and Soil–Structure Interaction (SSI).
4. Importance of interfaces and joints on the behaviour of engineering systems.
5. Implementation of material model in finite element method and applications

COURSE OUTCOMES

At the end of the course
1. The student will be able to, 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 and analyse plain stress, plainstrain, axi-symmetric and plate bending problems.
4. Implement and solve the finiteelement formulations using MATLAB

UNIT-I	INTRODUCTION TO FINITE ELEMENT METHOD	Classes: 12

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations. One Dimensional Problems: Finite element modelling 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	Classes: 14

Analysis of Trusses: Stiffness Matrix for Plane Truss and Space Truss Elements, Stress Calculations. Analysis of Beams: Element stiffness matrix for two node, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses

UNIT-III	FINITE ELEMENT MODELLING	Classes: 13

Finite element modelling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, Stresses Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four nodded Isoperimetric elements and numerical integration.

UNIT-IV	STEADY STATE HEAT TRANSFER ANALYSIS	Classes: 11

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion

UNIT-V	DYNAMIC ANALYSIS	Classes: 11

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 software's such as ANSYS, NISA, NASTRAN, etc.

TEXT BOOKS

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

WEB REFERENCES

1. http://web.mit.edu/16.810/www/16.810_L4_CAE.pdf
2. https://www.open.edu/openlearn/science-maths-technology/introduction-finite-element- analysis/content-section---references
3. https://onlinelibrary.wiley.com/doi/10.1002/9780470050118.ecse159
4. https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-20617-7_16699

E -TEXT BOOKS

1. https://soaneemrana.org/onewebmedia/TEXT%20BOOKOF%20FINITE%20ELEMENT%2 0ANALYSIS%20BY%20P.%20SESHU%20%281%29.pdf
2. http://web.mit.edu/kjb/www/Books/FEP_2nd_Edition_4th_Printing.pdf
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119107323
4. https://www.elsevier.com/books/the-finite-element-method-in-engineering/rao/978-0-12- 811768-2

MOOCS COURSES
1 https://www.coursera.org/learn/finite-element-method
2 https://www.coursera.org/courses?query=finite%20element
3 https://www.my-mooc.com/en/mooc/finite-element-method-fem-analysis-tsinghuax-70120073x-1/
4 https://www.open.edu/openlearn/science-maths-technology/introduction-finite-element

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE -I

PRODUCTION PLANNING AND CONTROL

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME512PE	B.Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES:

1.To Understand the importance of Production planning & control.
2.To learn the way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.
3.To gain the knowledge of Inventory management.
4.To gain knowledge of Scheduling
5.To know the concept of Dispatching:

COURSE OUTCOMES:

At the end of the course,
1. The student will be able to understand production systems and theircharacteristics.
2. Evaluate MRP and JIT systems against traditional inventory control systems.
3. Understand basics of variability and its role in the performance of a production system.
4. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems.
5. Understand theory of constraints for effective management of production systems.

UNIT-I	INTRODUCTION	Classes: 12

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	Classes: 14

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	Classes: 13

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	Classes: 11

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	Classes: 11

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

WEB REFERENCES

1.https://www.emerald.com/insight/content/doi/10.1108/17410380410555871/full/html

2.https://www.researchgate.net/publication/235294960_An_integrated_reference_model_for_production_planning_and_control_in_SMEs

E -TEXT BOOKS

1. http://brharnetc.edu.in/br/wp-content/uploads/2018/11/22.pdf
2. https://books.google.co.in/books/about/Production_Planning_and_Control.html?id=a5adDwAAQBAJ&redir_esc=y

MOOCS COURSES
1. https://www.udemy.com/course/production-ppc/
2. https://www.coursera.org/lecture/supply-chain-principles/manufacturing-planning-control-xVwoT

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DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE - I- MACHINE TOOL DESIGN

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME513PE	B.Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

As a result of this course, students will be able 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 gaging /gaging 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,

1. The student will be able to, Understand basic motions involvedin a machine tool.
2. Design machine tool structures.

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

UNIT-I	INTRODUCTION TO MACHINE TOOL DRIVES AND MECHANISMS	Classes: 12

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	Classes: 14

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, FeedDrives, Feed Box Design.

UNIT-III	DESIGN OF MACHINE TOOL STRUCTURES	Classes: 13

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	Classes: 11

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 Spindlesand Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

UNIT-V	DYNAMICS OF MACHINE TOOLS	Classes: 11

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

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TEXT BOOKS

1. Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw 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, Vol. I, II, III and IV / N. S. Acherkhan / MIR

WEB REFERENCES

1 https://link.springer.com/chapter/10.1007/978-3-642-48697-5_7
2 https://www.sanfoundry.com/best-reference-books-machine-shop-tool-design/
3 https://academic.oup.com/jcde/article/7/5/657/5848445

E -TEXT BOOKS

1 https://books.google.co.in/books/about/Machine_Tool_Design_Handbook.html?id=Vrlu Fvnr LKkC
2 https://www.scribd.com/book/445701861/Machine-Designers-Reference
3 http://www.jainbookdepot.com/servlet/jbgetbiblio?bno=009334
4 https://www.meripustak.com/MACHINE-TOOL-DESIGN-114167

MOOCS COURSES

1. https://www.coursera.org/learn/machine-design1
2. https://www.coursera.org/courses?query=machine%20design
3. https://www.classcentral.com/course/swayam-metal-cutting-and-machine-tools-10105
4. https://www.citdindia.org/

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DEPARTMENT OF MECHANICAL ENGINEERING

HEAT TRANSFER LAB

III B. TECH- II SEMESTER (R 20)								

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME605PC	B. Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

To enable the student to apply conduction, convection and radiation heat transfer concepts topractical 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 differentmaterials.
2. Perform transient heat conduction experiment.
3. Estimate heat transfer coefficients in forced convection, free convection, condensation andcorrelate with theoretical values.
4. Obtain variation of temperature along the length of the pin fin under forced and freeConvection.
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 of 10 Exercises need to be performed

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

Note: Perform any 10 out of the 14 Exercises.

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

WEB REFERENCES
1. https://www.begellhouse.com/journals/heat-transfer-research.html 2. ttps://www.tandfonline.com/toc/uhte20/current 3. https://bigladdersoftware.com/epx/docs/8-3/engineering-reference/heat-exchangers.html

E -TEXT BOOKS
1. https://ahtt.mit.edu/ 2. https://www.engineeringbookspdf.com/a-heat-transfer-textbook/ 3. https://app.knovel.com/web/toc.v/cid:kpHTTE0007/viewerType:toc/

MOOCS COURSE
1. https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall-a 2015/ 2. https://online-learning.tudelft.nl/courses/advanced-transport-phenomena/ 3. Neptel.ac.in 4. https://edu.epfl.ch/coursebook/en/advanced-heat-transfer-ME-465

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DEPARTMENT OF MECHANICAL ENGINEERING

CAD/CAM LABORATORY

III B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME606PC	**B.Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	**0**	**2**	**1**	**30**	**70**	**100**

COURSE OBJECTIVES

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

COURSE OUTCOMES

    1.Upon successful completion of the course, the student is able to
    2.To understand the analysis of various aspects in of manufacturing design

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 anisometric. 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 CNC Machines.
11. Development of CNC code for free form and sculptured surfaces.
12. Machining of simple components on CNC lathe and Mill by transferring CNC Code.
Note: Perform any 10 out of the 12 Exercises.

TEXT BOOKS
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
WEB REFERENCES
1.onlinelibrary.wiley.com
E -TEXT BOOKS
1.http//www:cadcam.com/
MOOCS COURSES
1.https://www.coursera.org/specializations/cad-design-digital-manufacturing 2.https://ocw.mit.edu/courses/architecture/4-500-introduction-to-design-computing-fall-2008/

DEPARTMENT OF MECHANICAL ENGINEERING

ADVANCE COMMUNICATION SKILLS LAB

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
EN606HS	B.Tech	0	0	2	1	30	70	100

COURSE OBJECTIVES

To train students

    1.To use relevant words through the practice of vocabulary and responding appropriately.

    2.To improve Reading Comprehension Skills and Techniques, to read and infer formeanings.

    3.To enable to write and improve writing skills to present different types of writing.

    4.To enable students to perform presentation skills with the right usage of Bodylanguage through seminars, posters, etc.

    5.To prepare students for placements by practicing various activates like group discussions, mock interviews, etc.

COURSE OUTCOMES

    1.Upon successful completion of the course, student will be able to

    2.Gather ideas and information to organize ideas relevantly and coherently.

    3.Participate in group discussions.

    4.Face interviews.

    5.Write project/research reports/technical reports.

    6.Make oral presentations and written presentations

LIST OF EXPERIMENTS

EXERCISE: I

Activities on Fundamentals of Inter-Personal Communication and Building Vocabulary - Starting a conversation – responding appropriately and relevantly – using paralanguage and kinesics – 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.

EXERCISE: II

Activities on Reading Comprehension – sq3r reading techniques of reading comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning,

critical reading& effective googling.

EXERCISE: III
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.

EXERCISE: IV
Activities on Presentation Skills – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ emails/ assignments, tc.

EXERCISE: V
Activities on Group Discussion and Interview Skills – Dynamics of group discussion, Intervention, summarizing, modulation of voice, body language, relevance, Leadership skills and Team building skills - Concept and process, pre-interview planning, opening strategies, answering strategies, interview through Tele-conference & video-conference and Mock Interviews.

TEXT BOOKS
1. Academic Writing: A Handbook for International students by Stephen Bailey, Routledge, 5th Edition.
2. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd 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 Press2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.

WEB REFERENCES
1.http://www.skillsyouneed.com/ips/interpersonal communication.html#ixzz3Zo3C60Js
2. http://en.wikipedia.org/wiki/Conversation
3.http://www.wikihow.com/Start-a-Conversation-When-You-Have-Nothing-to-Talk About 10 Sure-Fire Strategies to Improve Your Vocabulary
4. https://litemind.com/top-3-reasons-to-improve-your-vocabulary/

E -TEXT BOOKS
1. Mc corry Laurie Kelly Mc Corry Jeff Mason, Communication Skills fortheHealthcare Professional, 1 edition,ISBN:1582558140, ISBN-13:9781582558141
2. Robert E Owens ,Jr ,Language Development, 9thedition, ISBN:0133810364,9780133810363

MOOCS COURSES
1. https://www.coursera.org/specializations/improve-english
2. https://www.edx.org/professional-certificate/upvalenciax-upper-intermediate-english

DEPARTMENT OF MECHANICAL ENGINEERING

INTELLECTUAL PROPERTY RIGHTS

III B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
IP610MC	**B. Tech**	3	0	0	0	100	0	100

COURSE OBJECTIVES

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registrationaspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects To disseminate knowledge on trademarks and registration aspects
4. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
5. To aware about current trends in IPR and Govt. steps in fostering IPR

COURSE OUTCOMES

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
2. During their research career, information in patent documents provide useful insight onnovelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations
3. Pave the way for the students to catch up Intellectual Property(IP) as an career option
   a. R&D IP Counsel
   b. Government Jobs – Patent Examiner
   c. Private Jobs
   d. Patent agent and Trademark agent
   e. Entrepreneur

UNIT-I	INTRODUCTION TO INTELLECTUAL PROPERTY	Classes: 4

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

UNIT-II	TRADE MARKS	Classes: 4

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**	**Classes: 5**

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**	**Classes: 5**

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**	**Classes: 4**

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

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

REFERENCE BOOKS

1. Intellectual Property Rights, Neeraj Pandey, PHI
2. . Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

WEB REFERENCES

1. http://www.ipindia.nic.in/
2. https://cyber.harvard.edu/property99/protection/
3. https://www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf

E -TEXT BOOKS

1. https://www.intechopen.com/books/intellectual-property-rights/introductory-chapter-intellectual-property-rights
2. https://www.wipo.int/edocs/pubdocs/en/copyright/868/wipo_pub_868.pdf

MOOCS COURSE

1. https://www.coursera.org/courses?query=intellectual%20property
2. https://er.educause.edu/blogs/2013/4/moocs-and-intellectual-property-ownership-and-use-rights
3. https://www.edx.org/course/intellectual-property-law-and-policy-part-1

DEPARTMENT OF MECHANICAL ENGINEERING

OPERATIONS RESEARCH

IV B. TECH- I SEMESTER (R20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
MS701MS	**B.Tech.**	**3**	**0**	**0**	**3**	**30**	**70**	**100**

COURSE OBJECTIVES

1. Understand the mathematical importance of development of model in a particular optimization model for the issue and solving it.
2. Understand Transportation and Assignment problem
3. To know the concept of Theory of Games and Inventory
4. To know the concept of Dynamic programing.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Understand the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique
2. Understand concept of Theory of Games and Inventory
3. Understand Applications of Dynamic programming, shortest path problem, linear programming problem.

UNIT-I	INTRODUCTION, LINEAR PROGRAMMING	Classes: 12

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 & ASSIGNMENT PROBLEM	Classes: 12

Transportation problem - Formulation-Optimal solution, unbalanced transportation problem-Degeneracy. Assignment problem- Formulation-Optimal solution,- Variants of
Assignment problem- Formulation-Optimal solution, - Variants of Assignment problemTravelling salesman problem.

UNIT-III	SEQUENCING, REPLACEMENT	Classes: 10

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, INVENTORY	Classes: 10

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 modelswith one price break and multiple price breaks- Stochastic models _ Demand may be discretevariable or continuous variable- single period model and no setup cost.

UNIT-V	WAITING LINES, DYNAMIC PROGRAMMING	Classes: 10

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.

WEB REFERENCES

1. https://www.elsevier.com/journals/computers-and-operations-research/0305- 0548/guide-for-authors
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=90002
3. https://libguides.nps.edu/opr/reference

E -TEXT BOOKS

1. https://books.google.co.in/books/about/Operations_Research_4th_Edition.html?id=6k hDDAAAQBAJ&redir_esc=y
2. https://books.google.co.in/books/about/Operations_Research.html?id=rj6bBMVzfPsC
3. https://www.researchgate.net/publication/317606351_Operations_research_httpbookb ooncomenoperations-research-ebook
4. https://www.freetechbooks.com/operations-research-f54.html

MOOCS COURSE
1. https://www.coursera.org/courses?query=operations%20research 2. https://www.edx.org/course/operations-research-an-active-approach 3. https://orc.mit.edu/impact/moocs 4. https://www.classcentral.com/course/swayam-operations-research-14219 5. https://www.mooc-list.com/tags/operations-management

DEPARTMENT OF MECHANICAL ENGINEERING

OPEN ELECTIVE - II - MANUFACTURING SYSTEMS ENGINEERING

IV B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME721OE	B.Tech	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		2	0	0	3	30	70	100

COURSE OBJECTIVES

1. Students will gain a basic understanding of manufacturing systems and its management

2. To gain the knowledge of types of systems, current theories of manufacturing management, including leanthinking, JIT and demand driven manufacturing.

3. Students will be able to develop an understanding of the performance measurement of manufacturing systems through metrics and key performance indicators.

COURSE OUTCOMES

1. Students will recognize manufacturing systems, including job shops, flow lines,assembly lines, work cells.
2. Students will have a basic understanding of performance measurement andmanagement in modern day manufacturing systems.
3. Students will have a basic understanding of current manufacturing control theories,such as lean thinking, agile, responsive systems and JIT.
4. Students will be able to analyze manufacturing systems to improve performance of assembly lines and job shops.

UNIT-I	**INTRODUCTION TO MANUFACTURING STRATEGY**	**Classes: 10**

Introduction, overview, and components of manufacturing systems, Design, operation, and control of manufacturing systems. Competitive priorities and manufacturing strategy: Introduction, Historical perspective of manufacturing management, Competitive priorities and operational strategy, Functional area strategy and Capability, Case Study.

UNIT-II	**TYPES OF MANUFACTURING SYSTEMS**	**Classes: 12**

Types of manufacturing systems, single station cells, manual assembly lines, automated production lines, transfer lines, analysis automated assembly systems. Performance of manufacturing system - productivity, quality, reliability, agility, responsiveness, sustainability, utilization & availability, flexibility, reconfigurability, resiliency, efficiency and effectiveness of manufacturing system, metrics and key performance indicators.

UNIT-III	FACILITY DESIGN AND INVENTORY CONTROL	Classes: 12
Facility Design: Introduction and History, Product design and process selection, Capacity planning, Plant location and Plant layout. Inventory control: From EOQ to ROP,		
Independent Demand Inventory control & Economic Order Quantity (EOQ), Dynamic lot sizing, Statistical inventory control models.		

UNIT-IV	THE MRP SYSTEMS AND JIT SYSTEMS	Classes: 12
The MRP crusade: History, Need, Evolution, Dependent Demand & Material Requirement Planning (MRP), Structure of MRP system, MRP Calculations. The JIT revolution: Just-in-Time System: origin & goals, Characteristics of JIT Systems, Continuous Improvement, The Kanban System, Strategic Implications of JIT System.		

UNIT-V	PRODUCTION PLANNING AND CONTROL	Classes: 12
Production Planning and Control: Shop floor control, Production scheduling, Aggregate planning, Aggregate and workforce planning. Supply Chain Management: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.		

TEXT BOOKS
1. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.
2. N. Singh, Systems Approach to Computer Integrated Design and Manufacturing, 1st edition, Wiley India, 2011. ISBN: 978-8126530410.
3. Krajewski U and Ritzman LP, Operations Management: Strategy and Analysis, Pearson Education Pvt Ltd., Singapore, 2002.
4. Gaither N and Frazier G, Operations Management, Thomson Asia Pvt. Ltd., Singapore, 2002.
5. Chase RB, Aquilano NJ and Jacobs RF, Operations Management for Competitive Advantage, McGraw-Hill Book Company, NY, 2001

REFERENCE BOOKS
1. G. Chryssolouris, Manufacturing Systems: Theory and Practice. 2nd edition, Springer, 2006. ISBN: 978-1441920676.
2. W. J. Hopp, M. L. Spearman, Factory Physics, 3rd edition, Waveland Press, 2011.
3. E. Turban, L. Volonino, Information Technology for Management: Transforming Organizations in the Digital Economy, 7th edition, Wiley India Private Limited, 2010. ISBN: 978-8126526390.
4. R. Askin and C. Standridge, Modeling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3.
5. "Production and Operations Management" by Adam and Ebert.
6. "Operations Management" by William Stevenson.
7. "Production and Operations Management" by Pannerselvam R.
8. "Modern Production/Operations Management" by Buffa.
9. "Operations Management" by Heizer.

WEB REFERENCES

1. https://www.open.edu/openlearn/money-business/business-strategy-studies/introduction-operations-management/content-section---references
2. https://onlinelibrary.wiley.com/journal/19375956
3. https://paperpile.com/s/journal-of-operations-management-citation-style/

E -TEXT BOOKS

1. https://books.google.co.in/books/about/PRODUCTION_AND_OPERATIONS_MANAGEMENT.html?id=E252-JskGS0C&redir_esc=y
2. https://dl.acm.org/doi/book/10.5555/515995

MOOCS COURSES

1. https://www.edx.org/course/operations-management
2. https://www.mooc-list.com/tags/operations-management
3. https://www.my-mooc.com/en/mooc/operations-management-iimbx-om101-1x/
4. https://www.coursera.org/learn/wharton-operations
5. https://www.classcentral.com/course/operationsmanagement-2741

DEPARTMENT OF MECHANICAL ENGINEERING
PROFESSIONAL ELECTIVE-II- COMPOSITE MATERIALS

IV B. TECH- I SEMESTER (R 20)									
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**			
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**	
MM613PE	**B. Tech**	**2**	**1**	**0**	**3**	**30**	**70**	**100**	

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
3. transport properties.
4. To describe key processing techniques for producing metal, ceramic-, and polymer-matrix
5. composites.
6. To demonstrate the relationship among synthesis, processing, and properties in composite
7. materials.

COURSE OUTCOMES
1. Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
2. Able to explain how common fibers are produced and how the properties of the fibers are
3. 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:**	**Classes: 15**

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:**	**Classes: 10**

Fibers: Carbon, Boron, Glass, Aramid, Al_2O_3, 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**	**Classes: 15**

Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic MatrixComposites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic 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:**	**Classes: 15**

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**	**Classes: 10**

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

WEB REFERENCES

1. https://www.cs.hmc.edu/~dodds/projects/RobS05/BBBot/references.html
2. https://ieeexplore.ieee.org/document/7354021
3. https://robotframework.org/
4. https://journals.sagepub.com/doi/full/10.1177/1729881418759 424
5. https://journals.sagepub.com/doi/full/10.1177/1729881417743 738

E -TEXT BOOKS

1. https://robotiq.com/resource-center/ebooks
2. https://www.ti.com/lit/eb/ssiy006/ssiy006.pdf?ts=1605688663965&ref_url=https%253A%252F%252Fwww.google.com%252F

3.https://www.intechopen.com/books/subject/physical-sciences-engineering-and-technology-robotics

4.https://www.igi-global.com/book/advanced-robotics-intelligent-automation-manufacturing/232677

MOOCS COURSE

1. https://www.mooc-list.com/tags/robotics
2. https://www.classcentral.com/tag/robotics
3. https://www.quora.com/Which-online-courses-MOOCs-help-build-a-strong-foundation-for-robotics-AI
4. https://www.coursera.org/specializations/robotics

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DEPARTMENT OF MECHANICAL ENGINEERING
PROFESSIONAL ELECTIVE-II- INDUSTRIAL MANAGEMENT

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME621PE	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES
1. Understand the philosophies of management gurus
2. Understand the various types of organization structures and their features, and Their
3. advantages and disadvantages.
4. Learning various Industrial Engineering Practices like Operations Management techniques,
5. work study, statistical quality control techniques, Job evaluation techniques and network
6. 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
5. time for a given method
6. Able to apply various quality control techniques and sampling plans
7. Able to do job evaluation and network analysis.

UNIT-I	INTRODUCTION TO MANAGEMENT:	Classes: 15

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:	Classes: 10

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:**	**Classes: 15**

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:**	**Classes: 15**

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:**	**Classes: 10**

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.

WEB REFERENCES

1. https://www.cs.hmc.edu/~dodds/projects/RobS05/BBBot/references.html
2. https://ieeexplore.ieee.org/document/7354021
3. https://robotframework.org/
4. https://journals.sagepub.com/doi/full/10.1177/1729881418759424
5. https://journals.sagepub.com/doi/full/10.1177/1729881417743738

E -TEXT BOOKS
1 https://robotiq.com/resource-center/ebooks
2 https://www.ti.com/lit/eb/ssiy006/ssiy006.pdf?ts=1605688663965&ref_url=https%253A%252F%252Fwww.google.com%252F
3 https://www.intechopen.com/books/subject/physical-sciences-engineering-and-technology-robotics
4 https://www.igi-global.com/book/advanced-robotics-intelligent-automation-manufacturing/232677

MOOCS COURSE
1. https://www.mooc-list.com/tags/robotics
2. https://www.classcentral.com/tag/robotics
3. https://www.quora.com/Which-online-courses-MOOCs-help-build-a-strong-foundation-for-robotics-AI
4. https://www.coursera.org/specializations/robotics

DEPARTMENT OF MECHANICAL ENGINEERING
PROFESSIONAL ELECTIVE-II- PRODUCTION AND OPERATIONS MANAGEMENT

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME622PE	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES
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
3. issues of operations Management.
4. Understand the procedure for product design & approaches for product development.
5. Learn the procedure to carry out value analysis by different methods
6. Learn the methods for location of plant and plant layouts
7. Understand the procedures for aggregate planning, MRP and JIT
8. Learn the procedures for scheduling
9. 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	Classes: 15

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	Classes: 10

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	Classes: 15

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	Classes: 15

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	Classes: 10

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

WEB REFERENCES

1. https://www.cs.hmc.edu/~dodds/projects/RobS05/BBBot/references.html
2. https://ieeexplore.ieee.org/document/7354021
3. https://robotframework.org/
4. https://journals.sagepub.com/doi/full/10.1177/1729881418759424
5. https://journals.sagepub.com/doi/full/10.1177/1729881417743738

E -TEXT BOOKS

1 https://robotiq.com/resource-center/ebooks
2 https://www.ti.com/lit/eb/ssiy006/ssiy006.pdf?ts=1605688663965&ref_url=https%25 3A%252F%252Fwww.google.com%252F
3 https://www.intechopen.com/books/subject/physical-sciences-engineering-and-technology-robotics
4 https://www.igi-global.com/book/advanced-robotics-intelligent-automation-manufacturing/232677

MOOCS COURSE
1.https://www.mooc-list.com/tags/robotics 2.https://www.classcentral.com/tag/robotics 3.https://www.quora.com/Which-online-courses-MOOCs-help-build-a-strong- foundation-for-robotics-AI 4.https://www.coursera.org/specializations/robotics

DEPARTMENT OF MECHANICAL ENGINEERING
PROFESSIONAL ELECTIVE-III -ENGINEERING TRIBOLOGY

IV B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours / Week**			**Credits**	**Maximum Marks**		
ME731PE	B. Tech	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		2	**1**	**0**	**3**	**30**	**70**	**100**

COURSE OBJECTIVES

1. To expose the student to different types of bearings, bearing materials,
2. To understand friction characteristics and power losses in journal bearings.
3 To learn theory and concepts about different types of lubrication.
4. To know the concept of surface roughness measurement

COURSE OUTCOMES

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

UNIT-I	**STUDY OF VARIOUS PARAMETERS**	**Classes: 8**

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

UNIT-II	**HYDRODYNAMIC THEORY OF LUBRICATION**	**Classes: 10**

Hydrodynamic theory of lubrication: Various theories of lubrication, Petroff's 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**	**Classes: 10**

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

UNIT-IV	AIR LUBRICATED BEARING	Classes: 10

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 BEARINGS	Classes: 10

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. **Bearing materials:** General requirements of bearing materials, types of bearing materials.

TEXT BOOKS

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

REFERENCE BOOKS

1 Introduction to Tribology of Bearings – B.C. Majumdar/ S. Chand
2 Engineering Tribology Book by A. W Batchelor and G. W. Stachowiak
3 Applied tribology Book by Michael M. Khonsari

WEB REFERENCES

1 https://www.cambridge.org/core/books/engineering-tribology/90E7FFB4FC70C118E1ADDC4ED8E6D471
2 https://www.elsevier.com/books/engineering-tribology/stachowiak/978-0-12-397047-3
3 https://link.springer.com/referencework/10.1007/978-0-387-92897-5
4 https://www.sciencedirect.com/topics/engineering/tribology

E -TEXT BOOKS

1 https://www.phindia.com/Books/ShowBooks/MTI5Mw/Tribology
2 https://www.cambridge.org/core/books/fundamentals-of-engineering-tribology-with-applications/introduction/BBD72E2E3B11F7FAAF2125F24FF7DC6B
3 https://beastacademy.com/?article=tribology.friction.and.wear.of.engineering.materials&context=libpubs

MOOCS COURSES

1 https://nptel.ac.in/courses/112/102/112102014/
2 https://nptel.ac.in/courses/112/102/112102015/
3 https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-III-COMPUTATIONAL FLUID DYNAMICS

IV B. TECH- I SEMESTER (R 20)								

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME732PE	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

1.To introduce the student to widely used techniques in the numerical solution of fluid equations, issues that arise in the solution of such equations.

2.To gain the knowledge in modern trends in **CFD**.

3.Emphasis will be on '**l**earning by doing', as students will work on programming projects for assignments

COURSE OUTCOMES

Upon successful completion of the course,

1.Students are expected to learn how to formulate and solve computational problems arising in the flow of fluids.

2.They should be able to assess the accuracy of a numerical solutions by comparison to known solutions of simple test problems and by meshrefinement studies

UNIT-I	**BASIC ASPECTS OF THE GOVERNING EQUATIONS**	**Classes: 12**

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**	**Classes: 12**

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic typeof Governing Equations for different boundary conditions - Numerical treatment of 1Dand 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems and Heat conduction in curve linear coordinates

UNIT-III	**FDM**	**Classes: 12**

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**	**Classes: 10**

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**	**Classes: 10**

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

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TEXT BOOKS

1 Computational Methods for Fluid Dynamics Joel H. Ferziger, Milovan Perci

2-Computational Fluid Dynamics T.J. Chung

3-Introduction to Computational Fluid Dynamics Anil W. Date

4-Computational Fluid Dynamics Patrick J Roache

5- Computational Fluid Dynamics for Engineers 001 by Klaus A. Hoffmann and Steve T.Chiang

6- Computational Fluid Dynamics for Engineers 002 by Klaus A.Hoffmann and Steve T.Chiang

7- Computationl Fluid Mechanics and Heat Transfer by Anderson ,Pletcher,Tannehill

8- An Introduction to Computational Fluid Mechanics by Example ,Sedat Biringen , Chuen-Yen Chow

REFERENCE BOOKS

1. Computational Fluid Flow and Heat Transfer – K Muralidharan and T Sudarajan, Narosa Publishers
2. Computational Fluid Dynamics : The basics with applications – John D Anderson, McGraw Hill Publications

WEB REFERENCES

1. https://www.tandfonline.com/toc/gcfd20/current
2. https://www.simscale.com/docs/simwiki/cfd-computational-fluid-dynamics/what- is-cfd-computational-fluid-dynamics/
3. https://www.simscale.com/blog/2016/03/what-everybody-ought-to-know-about- cfd/
4. http://www.strategicbusinessinsights.com/cfd/resources.shtml

E -TEXT BOOKS

1. https://books.google.co.in/books/about/An_Introduction_to_Computational_Fluid _ D.html?id=RvBZ-UMpGzIC
2. https://www.e-booksdirectory.com/details.php?ebook=2832
3. https://www.intechopen.com/books/computational-fluid-dynamics-basic- instruments-and-applications-in-science

MOOCS COURSES

1. https://www.classcentral.com/tag/computational-fluid-dynamics
2. https://www.coursera.org/lecture/digital-thread-implementation/computational-fluid- dynamics-HXjWG
3. https://nptel.ac.in/courses/112/105/112105045/
4. https://www.udemy.com/topic/computational-fluid-dynamics/

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DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-III ROBOTICS

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME733PE	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

1   Make the students acquainted with the theoretical aspects of Robotics
2   Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
3   Make the students to understand the importance of robots in various fields of engineering.
4   Expose the students to various robots and their operational details.

COURSE OUTCOMES

1   .At the end of the course, the student will be able to understand the basic components of robots.
2. Differentiate types of robots and robot grippers.
3. Understand 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	Classes: 12

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT-II	MOTION ANALYSIS	Classes: 10

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 Manipulation.

UNIT-III	DIFFERENTIAL TRANSFORMATION	Classes: 12

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Eulerand 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 FEEDBACKCOMPONENTS	Classes: 10

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

UNIT-V	ROBOT APPLICATION IN MANUFACTURING	Classes: 12

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

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

WEB REFERENCES

1 https://link.springer.com/referencework/10.1007%2F978-94-007-7194-9
2 https://library.ship.edu/c.php?g=273370&p=2974272
3 http://robotwebtools.org/
4 https://www.december.com/info/surf/robotics.html
5 http://knowrob.org/_media/bib/tenorth11www.pdf

E -TEXT BOOKS

1 https://robotiq.com/resource-center/ebooks
2 https://www.ti.com/lit/eb/ssiy006/ssiy006.pdf?ts=1605862000973&ref_url=https%253A%252F%252Fwww.google.com%252F
3 https://www.springernature.com/in/librarians/products/ebooks/ebook-collection/intelligent-technologies-robotics
4 https://www.intechopen.com/books/subject/physical-sciences-engineering-and-technology-robotics

MOOCS COURSE

1. https://www.my-mooc.com/en/categorie/robotics
2. https://www.classcentral.com/tag/robotics
3. https://www.quora.com/Which-online-courses-MOOCs-help-build-a-strong-foundation-for-robotics-AI
4. https://www.coursera.org/specializations/robotics
5. https://www.edx.org/course/robotics-2

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-IV MECHANICAL VIBRATIONS

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME741PE	B. Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

1. Understand various levels of vibrations and remedies for each of them.
2. To gain the knowledge of Single degree and two degree freedom system
3. To know sound level and subjective response to sound
4. To know the concept of continuous system

COURSE OUTCOMES

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

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

UNIT-I	SINGLE DEGREE OF FREEDOM SYSTEMS - I	Classes: 12

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	Classes: 10

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	Classes: 12

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	Classes: 10

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	Classes: 12

Sound level and subjective response to sound: Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, the decibelscale, 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.

TEXT BOOKS

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

WEB REFERENCES

1   https://app.knovel.com/web/browse-a-subject-area.v/catid:219/cat_slug:mechanics-mechanical-engineering/subcatid:46/topic:vibration/
2   https://onlinelibrary.wiley.com/doi/abs/10.1002/3527600434.eap231
3   https://onlinelibrary.wiley.com/doi/book/10.1002/9781119384502
4   https://engineering.purdue.edu/~deadams/ME563/notes_10.pdf
5   http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection/VIBRATIONS/mechVib%20theory%20and%20applications.pdf

E -TEXT BOOKS

1   https://www.phindia.com/Books/ShoweBooks/MTI5MA/Mechanical-Vibration-Theory-of-Vibrations
2   https://techknowledgebooks.com/product/mechanical-vibration/
3   https://up-za.libguides.com/c.php?g=900179&p=6476755

MOOCS COURSE
1   https://www.classcentral.com/course/swayam-introduction-to-mechanical-vibration-7929
2   https://www.coursera.org/learn/introduction-advanced-vibrations
3   https://www.coursera.org/learn/fundamentals-waves-vibrations
4   https://www.online.colostate.edu/courses/MECH/MECH580B2.dot

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-IV-POWER PLANT ENGINEERING

IV B. TECH- I SEMESTER (R 20)								
Course Code	**Programme**	**Hours / Week**			**Credits**	**Maximum Marks**		
ME742PE	**B. Tech**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		2	**1**	**0**	**3**	**30**	**70**	**100**

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

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	SOURCES OF ENERGY	Classes: 12

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	COMBUSTION ENGINE PLANT, GAS TURBINE PLANT	Classes: 10

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	Classes: 12

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	Classes: 10

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	Classes: 12

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

WEB REFERENCES

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119535003
2. https://www.sanfoundry.com/best-reference-books-power-plant-engineering/

E -TEXT BOOKS

1.http://www.gammaexplorer.com/wp-content/uploads/2014/03/Power-Plant-Engineering.pdf
2. https://books.google.co.in/books/about/Power_Plant_Engineering.html?id=Cv9LH4ckuEwC

MOOCS COURSE

1.https://onlinecourses.nptel.ac.in/noc21_me86/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-IV MEMS

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME743PE	B. Tech	2	1	0	3	30	70	100

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
2 devices.
3 Understand the rudiments of Micro fabrication techniques.
4 identify and understand the various sensors and actuators'
5 different materials used for MEMS
6 applications of MEMS to disciplines beyond Electrical and Mechanical engineering

COURSE OUTCOMES

1 Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems.
2 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.
3 Students will be able to use materials for common micro components and devices.
4 Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
5 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.
6 Students will be able to consider recent advancements in the field of MEMS and devices.
7 Students will be able communicate their results and findings orally via formal presentations and in writing through reports.

UNIT-I	INTRODUCTION TO MEMS	Classes: 12

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**	**Classes: 10**

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

UNIT-III	**MECHANICS OF MEMS MATERIALS**	**Classes: 12**

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**	**Classes: 10**

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**	**Classes: 12**

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– micro pumps-micro valves.

TEXT BOOKS

1. Microelectromechanical Systems / Bhattacharyya / Cengage
2. Microsystems Design/ Stephen D. Senturia /Springer

REFERENCE BOOKS

1. Foundations of MEMS /Chang Liu / Pearson
2. MEMS/ Mahalik/ Mc Graw Hill

WEB REFERENCES

1 https://www.trimmer.net/mems/Links_All.html
2 https://www.trimmer.net/mems/Stroud_Dbase.html
3 https://ieeexplore.ieee.org/document/5234416
4 https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118985960.meh225

E -TEXT BOOKS

1 https://www.elsevier.com/books/wireless-mems-networks-and applications/uttamchandani/978-0-08-100449-4
2 https://guides.uflib.ufl.edu/c.php?g=147508&p=968010
3 http://www.ee.iitm.ac.in/mems/page

MOOCS COURSE

1 https://www.edx.org/course/micro-and-nanofabrication-mems
2 https://www.my-mooc.com/en/mooc/micro-nanofabrication-mems-epflx-memsx/
3 https://edu.epfl.ch/coursebook/en/mooc-micro-and-nanofabrication-mems-MICRO- 621
4 https://nptel.ac.in/courses/117/105/117105082/

DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT STAGE-I

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
ME707PR	**B.Tech**	**0**	**0**	**4**	**3**	**100**	**00**	**100**

The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Above work shall be taken up individually or in groups. *The group shall not be more than 4 students,* **OR** Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the

   following types:

   i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.

   ii. Improvement of existing machine / equipment / process.

   iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.

   iv. Computer aided design, analysis *of* components such as stress analysis.

   v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems

   vi. Energy Audit of an organization, Industrial evaluation of machine devices.

   vii. Design of a test rig for performance evaluation of machine devices.

   viii. Product design and development.

   ix. Analysis, evaluation and experimental verification of any engineering problem

   x. Quality systems and management. Total Quality Management.

   xi. Quality improvements, In-process Inspection, Online gauging.

   xii. Low cost automation, Computer Aided Automation in Manufacturing.

   xiii. Time and Motion study, Job evaluation and Merit rating

   xiv. Ergonomics and safety aspects under industrial environment

   xv. Management Information System.

   xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Two copies of Seminar Report shall be submitted to the college. The students shall present their Project Phase-I report.

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DEPARTMENT OF MECHANICAL ENGINEERING

OPEN ELECTIVE-III

NON-CONVENTIONAL SOURCES OF ENERGY

IV B. TECH- II SEMESTER (R 20)									

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
ME821OE	**B.Tech**	**3**	**0**	**0**	**3**	**30**	**70**	**100**

COURSE OBJECTIVES

To learn
1. Principles of solar radiation.
2. To know the concept of Solar Energy Storage and Applications:
3. To gain knowledge of Bio-Mass.
4. To know the concept of Ocean Energy and its applications.

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 analyse 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	SOLAR RADIATION	Classes: 12

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	APPLICATIONS OF SOLAR ENERGY, WIND ENERGY	Classes: 12

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	Classes: 12

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, OCEAN ENERGY	Classes: 12

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	ENERGY CONVERSION	Classes: 12

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermoelectric 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

WEB REFERENCES

1. https://www.researchgate.net/publication/330012031_Review_on_Non-Conventional_Energy_Resources_in_India
2. https://beeindia.gov.in/sites/default/files/4Ch12.pdf
3. https://link.springer.com/article/10.1007/s12594-018-0959-x

E -TEXT BOOKS

1. https://www.kopykitab.com/Non-conventional-Energy-Sources-Sixth-Edition-by-G-D-Rai

MOOCS COURSES

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://www.coursera.org/courses?query=renewable%20energy

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-V- INTELLIGENT MANUFACTURING

IV B. TECH- I SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME851PE	B. Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

1. Understanding of basic principles of Mechanical Engineering
2. To gain knowledge of intelligent techniques for manufacturing process optimization
3. To gain knowledge of knowledge-based group technology
4. To know the concept of intelligent robotic systems

COURSE OUTCOMES

1. To understand the fundamentals of mechanical systems.
2. To understand and appreciate significance of mechanical engineering in different Fields of engineering.

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENT TECHNIQUES	Classes: 15

Goals of AI in manufacturing, tools for AI such as Search algorithm, Mathematical optimization, Evolutionary computation, fuzzy logic, Probabilistic methods for uncertain reasoning such as Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems

UNIT-II	INDUSTRIAL PLANNING AND DECISION MAKING USING INTELLIGENT SYSTEMS	Classes: 10

Production planning using fuzzy cognitive maps, computer aided process planning, Methods for inventory space allocation and storage processes analysis, Optimization of production costs and methods finding of the best process plan, Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods.

UNIT-III	INTELLIGENT TECHNIQUES FOR MANUFACTURING PROCESS OPTIMIZATION	Classes: 15

Application of neural networks and fuzzy sets to machining and metal forming, Artificial neural network modeling of surface quality characteristics in machining processes, parametric optimization of machining processes using evolutionary optimization methods.

UNIT-IV	KNOWLEDGE BASED GROUP TECHNOLOGY	Classes: 15

Group Technology: Models and Algorithms – Visual method, Coding method, Cluster analysis method Knowledge based group technology – Group technology in automated manufacturing system, Structure of knowledge based system for group technology (KBSGT) –database, knowledge base, Clustering algorithms

UNIT-V	INTELLIGENT ROBOTIC SYSTEMS	Classes: 10

Applications of intelligent systems for mobile Robot Motion Planning, Path Planning Robot Control in Dynamic Environments, Task Based Hybrid Closure Grasping Optimization for Autonomous Robot Hand. Accurate Motion Control of Fast Mobile Robots, obstacle avoidance.

TEXT BOOKS

1. Andrew Kussiak, "Intelligent Manufacturing Systems", Prentice Hall , 1990
2. Badiru A.B., "Expert Systems Applications in Engineering and Manufacturing", Prentice-Hall, New Jersey, 1992.
3. Liu, Dikai, Wang, Lingfeng, Tan, Kay Chen (Eds.) Design and Control of Intelligent Robotic Systems, Springer-Verlag, London. ISBN 978-3-540-89932-7
4. Rao R. V. "Advanced Modeling and Optimization of Manufacturing Processes", Springer-verlag, London. ISBN 978-0-85729-014-4

REFERENCE BOOKS

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

WEB REFERENCES

1.https://www.cs.hmc.edu/~dodds/projects/RobS05/BBBot/references.html
2.https://ieeexplore.ieee.org/document/7354021
3.https://robotframework.org/
4.https://journals.sagepub.com/doi/full/10.1177/1729881418759424
https://journals.sagepub.com/doi/full/10.1177/1729881417743738

E -TEXT BOOKS

1.https://robotiq.com/resource-center/ebooks
2.https://www.ti.com/lit/eb/ssiy006/ssiy006.pdf?ts=1605688663965&ref_url=https%253A%252 F%252Fwww.google.com%252F
3.https://www.intechopen.com/books/subject/physical-sciences-engineering-and-technology- robotics
4.https://www.igi-global.com/book/advanced-robotics-intelligent-automation-manufacturing/232677

MOOCS COURSE

1.https://www.mooc-list.com/tags/robotics
2.https://www.classcentral.com/tag/robotics
3.https://www.quora.com/Which-online-courses-MOOCs-help-build-a-strong-foundation-for- robotics-AI
4.https://www.coursera.org/specializations/robotics

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DEPARTMENT OF MECHANICAL ENGINEERING
PROFESSIONAL ELECTIVE-V- FLUID POWER SYSTEM

IV B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME852PE	B. Tech	3	0	0	3	30	70	100

COURSE OBJECTIVES

1.To understand concepts and relationships surrounding force, pressure, energyand power in fluid power systems.

2.To examine concepts centering on sources of hydraulic power,rotary and linear actuators, distribution systems, hydraulic flow in pipes, and control components in fluid power systems

3.To gain knowledge of control valves and servo valves

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.

UNIT-I	INTRODUCTION	Classes: 12

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. Performan curves and parameters.

UNIT-II	HYDRAULIC ACTUATORS	Classes: 12

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 controlvalves. Flapper valve Analysis and Design.

UNIT-III	CONTROL VALVES AND SERVO VALVES	Classes: 12

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

UNIT-IV	COMPONENTS OF PNEUMATIC SYSTEMS	Classes: 12

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	TIME AND TRAVEL-STEP	Classes: 12

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

TEXT BOOKS

1. John Watton: Fundamentals of Fluid Power Control. 1 st Ed. Cambridge University Press, 2009
2. Blackburn, J. F.,G.Reethof, and J. L.Shearer, Fluid Power Control, New York: Technology Press of M. I.T. and Wiley.
3. Anthony Esposito,"Fluid Power with applications", Pearson Education.
4. Ernst, W., Oil Hydraulic Power and its Industrial Applications, New York: McGrawHill.
5. Lewis,E.E., and H.Stern, Design of Hydraulic Control Systems, New York: McGrawHill.
6. Morse,A. C., Electro hydraulic Servomechanism, New York: McGraw Hill.
7. Pippenger, J.J., and R. M. Koff, Fluid Power Control systems, New York: McGrawHill.
8. Fitch, Jr., E.C., Fluid Power Control Systems, New York: McGraw Hill.
9. Khaimovitch, "Hydraulic and Pneumatic Control of Machine Tools"
10. John Watton, "Fluid Power Systems: modeling, simulation and microcomputer control", Prentice Hall International.
11. Herbert E. Merritt: Hydraulic control systems, John Wiley and Sons Inc.

REFERENCE BOOKS6

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

WEB REFERENCES

1. http://www.menet.umn.edu/~wkdurfee/projects/ccefp/fp-chapter/fluid-pwr.pdf
2. https://www.machinedesign.com/archive/fluid-power-reference-guide-hydraulics- and-fluid-handling

E -TEXT BOOKS

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118985960.meh432

2. https://www.researchgate.net/publication/279274776_Engineering_research_in_fluid_power_a_review

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-V - RENEWABLE ENERGY SOURCES

IV B. TECH- II SEMESTER (R 20)								

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME853PE	B.Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

To learn
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 analyses the environmental and cost economics of renewable energy sources incomparison with fossil fuels.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to
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

UNIT-I	GLOBAL AND NATIONAL ENERGY SCENARIO	Classes: 12

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 Nonrenewable 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	Classes: 12

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	Classes: 12

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	Classes: 12

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	Classes: 12

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: Power for a Sustainable Future - Author: Godfrey Boyle
2. Renewable: The World-Changing Power of Alternative Energy First Edition - Author: Jeremy Shere
3. Renewable Energy: A First Course - Author: Robert Ehrlich
4. Renewable Energy: Sustainable Energy Concepts for the Energy Change - Author: Roland Wengenmayr

REFERENCE BOOKS

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

WEB REFERENCES

1. https://www.tandfonline.com/doi/full/10.1080/23311916.2016.1167990
2. https://www.elsevier.com/journals/renewable-energy/0960-1481/guide-for-authors
3. https://www.ijrer.org/ijrer/index.php/ijrer
4. https://www.loc.gov/rr/scitech/tracer-bullets/solartb.html

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-VI
ADDITIVE MANUFACTURING

IV B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME861PE	B.Tech	2	1	0	3	30	70	100

COURSE OBJECTIVES

The student will be made to learn

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.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

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 manufacturin 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 TO ADDITIVE MANUFACTURING	Classes: 12

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	Classes: 12

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 groundcuring (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 AND 3D PRINTING	Classes: 12

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	Classes: 12

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	RAPID PROTOTYPE APPLICATIONS	Classes: 12

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

WEB REFERENCES
1. https://www.journals.elsevier.com/additive-manufacturing 2. https://www.sciencedirect.com/journal/additive-manufacturing

E -TEXT BOOKS
1. http://kgut.ac.ir/useruploads/1523430527968ggi.pdf 2. https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf

MOOCS COURSES
1. https://www.classcentral.com/course/swayam-fundamentals-of-automotive-systems-17616 2. www.nptel.ac.in 3. www.coursera.org

DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-VI – TURBO MACHINERY

IV B. TECH- II SEMESTER (R 20)

Course Code	Programme	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
ME862PE	B.Tech	2	1	0	3	30	70	100

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

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

UNIT-I	INTRODUCTION	Classes: 12

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	Classes: 12

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	Classes: 12

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	Classes: 12

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	Classes: 12

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.

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DEPARTMENT OF MECHANICAL ENGINEERING

PROFESSIONAL ELECTIVE-VI

UN CONVENTIONAL MACHINING PROCESSES

IV B. TECH- II SEMESTER (R 20)									
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**			
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**	
ME863PE	**B.Tech**	**2**	**1**	**0**	**3**	**30**	**70**	**100**	

COURSE OBJECTIVES

1.To impart knowledge on the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.

2.To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.

3.To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.

COURSE OUTCOMES

1.Student will be able to evaluate and select suitable manufacturing process for machining advanced materials for wide variety of applications.

2.They will be able to differentiate between conventional processes and non- conventional processes and develop niche applications based on these processes.

UNIT-I	INTRODUCTION	Classes: 12

Introduction: Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes. Mechanical Processes: USM, Rotary Ultra Sonic Machining (RUM), AJM, WJM, AWJM processes - Process principle and mechanism of material removal; Process Parameters; Process Capabilities; Applications; Operational characteristics; Limitations.

UNIT-II	ADVANCED FINE FINISHING PROCESS	Classes: 12

Advanced Fine Finishing Process: Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto Rheological Abrasive Finishing (MRAF) - Process principle; Process equipment; Process Parameters; Process Capabilities; Applications; Limitations.

UNIT-III	ELECTRO CHEMICAL PROCESSES	Classes: 12

Chemical Processes: Process principle and details of Chemical Machining (CHM), Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes. Electro Chemical Processes: ECM - Process principle; Mechanism of material removal; Process Parameters; Process Capabilities; Applications, Tool Design, Electro Chemical Deburring (ECDE).

UNIT-IV	THERMAL PROCESSES	Classes: 11

Thermal Processes: EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal; Process parameters and characteristics; Surface finish and accuracy, Process Capabilities; Applications; Limitations.

UNIT-V	DERIVED AND HYBRID MACHINING PROCESS	Classes: 11

Derived and Hybrid: Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM), Electro Chemical Honing (ECH), Electro Chemical Discharge Machining (ECDM) - Process Parameters; Process Capabilities; Applications; Limitations, Introduction to form machining.

TEXT BOOKS

1. V. K. Jain, Advanced Machining Processes, 1st edition, Allied Publishers Pvt. Ltd, 2007. ISBN: 978-8177642940.
2. Advanced Machining Processes / VK Jain / Allied publishers
3. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

REFERENCE BOOKS

1. H. Abdel and G. El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, 1 st edition, McGraw-Hill Professional, 2005. ISBN: 978- 0071453349.
2. G.F. Benedict, Nontraditional Machining Processes, 1 st edition, Marcel Dekker Inc., 2002.
3. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
4. Advanced Methods of Machining/ J.A. McGeough/ Springer International
5. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

WEB REFERENCES

1. https://link.springer.com/book/10.1007/978-1-4471-5179-1
2. http://home.iitk.ac.in/~jrkumar/download/Lecture-3.pdf
3. https://www.tandfonline.com/doi/full/10.1080/21693277.2014.899934

E -TEXT BOOKS

1. https://civildatas.com/download/unconventional-machining-processes-by-senthil-kumar
2. http://www.brainkart.com/subject/Unconventional-Machining-Processes_84/

MOOCS COURSES

1. http://home.iitk.ac.in/~jrkumar/download/Unconventional%20machining%20processes_2018.pdf
2. https://www.iitg.ac.in/cet/moocs/annual%20report_03.11.2020.pdf

DEPARTMENT OF MECHANICAL ENGINEERING

PROJECT STAGE-II

IV B. TECH- II SEMESTER (R 20)								
Course Code	**Programme**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
ME801PR	**B.Tech**	**0**	**0**	**18**	**7**	**00**	**100**	**100**

The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment , renovation of machines, etc. Above work shall be taken up individually or in groups. *The group shall not be more than 4 students,*

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the following types:

i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design,material, manufacturing the components, assembly of components, testing and performance evaluation.

ii. Improvement of existing machine / equipment / process.

iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment,inspection gauges, measuring instruments for machine tools.

iv. Computer aided design, analysis *of* components such as stress analysis.

v. Problems related to Productivity improvements/Value Engineering/Material HandlingSystems

vi. Energy Audit of an organization, Industrial evaluation of machine devices.

vii. Design of a test rig for performance evaluation of machine devices.

viii. Product design and development.

ix. Analysis, evaluation and experimental verification of any engineering problem encountered.

x. Quality systems and management. Total Quality Management.

xi. Quality improvements, In-process Inspection, Online gauging.

xii. Low-cost automation, Computer Aided Automation in Manufacturing.

xiii. Time and Motion study, Job evaluation and Merit rating

xiv. Ergonomics and safety aspects under industrial environment

xv. Management Information System.

xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When agroup of students is doing a project, names of all the students shall be included on every certifiedreport copy.Two copies of Seminar Report shall be submitted to the college. The students shall present their Project Phase-I report. before the examiners. The oral examination, shall be based on theterm work submitted and jointly conducted by an internal and an; external examiner fromindustry, at

the end of second semester. Format of the project report should be as follows:
1. Paper: The Project report should be typed/printed on white paper of A-4 size.
2. Typing: The typing shall be with one and half spacing and on one side of the paper.
3. Binding: The Industrial Implant Report should be submitted with front and back cover in black

Hard bound, with golden embossing.
4. Margins: Left - 1.25", Right - 1". Top and Bottom 1"
5. Sequence of Pages:
1. Title page
2. Certificate form Institute
3. Completion Certificate form Industry, if sponsored.
4. Acknowledgement
5. Abstract
6. Index
7. Nomenclature and Symbols
8. Actual Content
9. Conclusion
10. References.
6. Front cover: The front cover shall have the following details in block capitals
i. Title at the top.
ii. Name of the candidate in the center, and
iii. Name of the Institute, Name of Industry, if sponsored and the year of submission on separate

lines, at the bottom.
7. Blank sheets: No blank sheets be left anywhere in the report.
8. Project Completion Certificate:
The approval sheet follows the title sheet and shall be as shown with proper
spacing.

CERTIFICATE

This is to certify that Mr. /Ms ………………………(Name)................................... has Carried out a Project entitled, …………………………………………during the courseof histraining at……………………………………………in partial fulfillment of the requirement of the B.E.
Date: (Guide)

Place:
(Examiner)
(Head of Department)