Autonomous Programme Structure (Modified) of
F. Y. B. Tech. (Common to All Programmes)
A. Y.: 2019-2020

F. Y. B. Tech. Semester –I

Course Code	Course Title	Teaching Scheme Hours / Week			Examination Scheme			Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Practical / Oral		
BS 1101	Engg. Mathematics - I	3	1	0	50	50	0	100	4
BS 1102	Physics - I	2	1	0	50	50	0	100	3
BS 1103	Chemistry- I	2	1	0	50	50	0	100	3
ES 1101	Basic Electrical and Electronics Engg. - I	3	0	0	50	50	0	100	3
ES 1102	Fundamentals of Programming Language - I	1	0	0	25	0	0	25	1
ES 1103	Engg. Graphics	2	0	0	25	25	0	50	2
ES 1104	Environmental Studies	2	1	0	50	50	0	100	3
BS 1104	Physics and Chemistry Lab - I	0	0	2	25	0	0	25	1
ES 1105	Basic Electrical and Electronics Engg. Lab - I	0	0	2	0	0	25	25	1
ES 1106	Fundamentals of Programming Language - I	0	0	2	0	0	25	25	1
ES 1107	Engg. Graphics Lab	0	0	2	0	0	25	25	1
NC 1101	Value Education	1	0	0	0	0	0	0	0
	Total	**16**	**4**	**8**	**325**	**275**	**75**	**675**	**23**
	Grand Total	**28**			**675**			**675**	**23**

MKSSS's Cummins College of Engineer, Karvenagar, Pune-411052

DEAN ACADEMICS
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

Principal
MKSSS's Cummins College of Engg. For Women, Karvenagar, Pune-52.

APPROVED BY
Governing Body Members
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

BS1101 ENGINEERING MATHEMATICS - I

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hrs/Week	In-Semester : 50 Marks
Tutorial: 1 Hr/Week	End-Semester: 50 Marks
Credits: 4	

Course Objectives:

Mathematics is a necessary path to scientific knowledge which opens new perspective of mental activity. Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyze and solve engineering problems in their respective areas.

Course Outcomes:

1. Solve the system of Linear equations by using the matrix method and apply it to check Linear Dependence, Independence of the vectors.
2. Calculate eigen values, eigen vectors and apply it to diagonalize a matrix.
3. Analyze roots of algebraic equations by applying De Moivre's theorem and analyze the function of complex numbers .
4. Compute power series expansions by using higher order derivatives.
5. Calculate partial derivatives and use to analyze maxima, minima of a given function.

Unit – I: Matrices **(07)**

Matrices, Rank of the matrix, Echelon Form, Normal form, Inverse of the matrix,System of Linear Equations, Linear Dependence and Independence, Linear

Transformations, Rotation and Translation Matrices.

Unit – II: Applications of matrices **(06)**

Eigen Values, Eigen Vectors , Cayley Hamilton Theorem , Diagonalization and applications in finding powers of matrix.

Unit–III: Complex numbers and its applications **(08)**

Argand diagrams, De moivre's theorem and its applications, Hyperbolic Functions, Separation of real and imaginary parts of functions of complex numbers, Inverse Hyperbolic Functions, Logarithm of Complex Numbers.

Unit – IV: Differential calculus **(05)**

Successive Differentiation, Method of finding nth order derivative of functions, Leibnitz theorem, Taylor's series, Maclaurin's Series.

Unit – V: Partial Differentiation **(07)**

Partial Differentiation, chain rule, composite functions, Euler's theorem on homogeneous functions,Total derivatives .

Unit – VI: Jacobian and its applications **(08)**

Jacobian, Chain rule, Partial derivatives using Jacobian, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

Text Books:

1. B.S. Grewal, **'Higher engineering Mathematics'**, *Khanna publishers, Delhi(*40th edition),(2008).
2. B. V. Ramana, **'Higher Engineering Mathematics ',** *Tata McGraw Hill Publications* (2007)
3. Erwin Kreyszig ,**'Advanced Engineering Mathematics'** *Wiley Eastern Ltd.*(8th Student Edition)(2004).

Reference Books:

1. C.R.Wylie, L.C. Barrette, **'Advanced Engineering Mathematics',** *McGraw Hill Publi-*

*cations, New Delhi.(*6th edition)(2003)
2. Peter V. O'neil,'**Advanced Engineering Mathematics'** ,Thomson Brooks / Cole, *Singapore (*5th edition) (2007).

BS1102 PHYSICS – I

Teaching Scheme

Lectures: 2 Hrs per week

Tutorial: 1 Hr per week

Credits: 3

Examination Scheme:

In-Semester : 50 Marks

End-Semester: 50 Marks

Course Objective:

1. To introduce undergraduate students Of engineering to the principles, notions, basic physical ideas, mathematical relations and applications of Classical Physics, specifically pertaining to the theories of Electromagnetic Radiation, Optics, Special Relativity
2. To point out some of the contexts in which Classical Physics fails to account for certain experimental observation thereby requiring Quantum Physics to take over

Course Outcomes:

By taking this course, the learner will be able to –

1: **Use** the laws of Electrostatics and Electromagnetic Radiation to determine the electric field dueto static and dynamic charge distributions.
2: Apply the laws of physical optics in situations involving interference, diffraction and polarization patterns.
3: Justify the use of the principles of special relativity in situations involving elementary particles.
4: Judge the relevance of quantum mechanical principles and methods in finding out interferometric behavior and allowed energy states of particles with arbitrary spins.

Unit – I: Electromagnetic Radiation and Interference: (4)

Expression for the electric field beyond Coulomb's law; The dipole radiator; Physics of interference – Two dipole radiator

Unit – II: Diffraction and Polarization: (4)

The resultant amplitude due to *n* equal oscillators; Diffraction Grating; The electric vector of light; Birefringence; Polarisers

Unit – III: Capacitance and Dielectrics: (4)

Electrostatic energy; Capacitance of a Parallel-Plate Capacitor; The dielectric constant; The polarization vector

Unit – IV: Special Relativity: (4)

The Lorentz transformation; Slowing of clocks; Contraction of length; Relativistic energy

Unit – V: Quantum Behaviour – I: Particles and Waves: (4)

Experiments with bullets, waves and electrons; The uncertainty principle

Unit – VI: Quantum Behaviour – I: The Magnetism of Matter: (4)

The Precession of atomic magnets; Angular momentum in Quantum Mechanics; The magnetic energy of atoms; Quantized magnetic states

Text Book:

R. P. Feynman, R. B. Leighton and M. Sands, **'The Feynman Lectures on Physics'**, *Pearson Education* (2006)

Reference Books:

1. J. Walker, D. Halliday, R, Resnick, **'Principles of Physics'**, Wiley *Student Edition* (10th Edition)

2. H. Young and Roger Freedman, **'University Physics'**, Pearson Addison Wesley (12th Edition)

BS1103 CHEMISTRY- I

Teaching Scheme: **Examination Scheme:**

Lectures: 2 Hrs/Week In-Semester: **50** Marks

Tutorial: 1 Hr/Week End-Semester: **50** Marks

Credits: 3

Course Objectives:

The Chemistry course is designed such that the learners develop a sound background of fundamental concepts and principles relevant in the engineering context. The course facilitates undergraduates to learn bonding theories, methods of analysis and evaluate role of chemical substances. They analyze chemical processes related to engineering applications. Also the course inculcates basic problem solving skills involving chemistry principles.

Course Outcomes:

1. State laws, formulae, definitions and properties.
2. Comprehend synthesis procedures and analytical methods in qualitative and quantitative estimation.
3. Apply principles of fundamental chemistry for solving problems.
4. Analyze chemical processes for engineering applications based on chemical reactions and evaluate the role of chemical substances.
5. Critique the effect of different parameters on the properties of chemical substance.

Unit – I: Chemical Bonding **(05)**

Types of bonds - primary & secondary types with examples, hybridization based on valence bond theory, VSEPR theory, molecular orbital theory with respect to bonding in homo and hetero nuclear diatomic molecules.

Unit – II: Water Analysis and purification **(06)**

Chemical Analysis of water hardness, alkalinity and effect of hard water in boilers, Internal

treatment of boiler feed water, water softening techniques (Permutit and Ion exchange method) and membrane based processes.

Unit – III: Electro chemistry **(06)**

(a) Fundamentals of an electrochemical cell, EMF of cell, reference and indicator electrodes, conductance in solution and conductometric titration.

(b) Battery Technology

Primary & secondary cell, battery characteristics, Ni-Cd cell, Lithium-ion battery, rechargeable batteries, Fuel cell technology.

Unit – IV: Instrumental methods of Analysis-I **(04)**

Basic principles,instrumentation and applications of pHmetry, Potentiometry, Chromatography

Unit – V: Coordination Chemistry **(05)**

Introduction,Classification of ligands, naming coordination compounds, Werner and Sidgwick theory, VBT, CFT for Td and Oh complexes. Applications and comparison of VBT & CFT.

Unit – VI: Photochemistry **(04)**

Photochemical reactions, Laws of Photochemistry and quantum yield, energy transfer in photochemical reaction, applications.

Text Books:

1. Arun Bahl & G.D. Tuli,**Essentials of Physical Chemistry,***S.Chand Publications* (2014)
2. S.S. Dara **'Engineering Chemistry'** *S. Chand Publications (2010)*
3. Puri, Sharma, Kalia **'Principles of Inorganic Chemistry'**: *Milestone Publications* (2009)
4. B.S. Chauhan **'Engineering Chemistry'** :*Univ Sc Press.*(third edition)2009
5. Shashi Chawla **'A Text Book Of Engineering Chemistry'**: *Dhanpat Rai & Co.*(2015)

6. Jain and Jain '**A Text Book Of Engineering Chemistry**' *Dhanpat Rai & Co.*
7. Gurdeep Chatwal **'Instrumental methods of Chemical Analysis'** *Himalaya publ.house*

Reference Books:

1. Steven S. Zumdahl, **‘Chemistry concepts and applications’,** *Cengage learning publication* (2009)
2. Ram D. Gupta,**'Hydrogen fuel'***C.R.C.Publications*(2009)
3. Puri, Sharma, Pathania **'Principles of Physical Chemistry'** *: Vishal Publ. Co.*(2015)
4. Robert D. Braun*' **Instrumental methods of analysis'** Pharmamed press* (2010)

ES1101 Basic Electrical and Electronics Engineering - I

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hrs/Week In-Semester: 50 Marks

Credits: 3 End-Semester:50Marks

Course Objectives:

1. To make students familiar with the fundamental concepts of electric and magnetic circuits.
2. To educate the students about the realization of basic theoretical concepts & laws in real physical world.
3. To educate the students about the construction and applications of diode
4. To educate the students about the construction and applications of BJT

Course Outcomes:

After completion of course, students will be able to

1) Determine energy consumption for electro-thermal and electro-mechanical systems as well as analyze the temperature effect on resistance
2) Analyze given magnetic circuit and find circuit parameters
3) Analyze given DC circuit and calculate its parameters
4) Calculate average value and RMS value of sinusoidal and non-sinusoidal AC waveforms.
5) Analyze I-V characteristics of semiconductor diodes and transistors and design simple analog circuits using these devices

Unit – I: Introduction to electrical systems (05)

Review of basic electrical terms, Effect of temperature on resistance, Resistance temperature coefficient, insulation resistance, Work, Power and energy calculations for thermal, mechanical and electrical systems.

Unit – II: DC Networks (07)

Kirchoff's laws, Mesh and Nodal Analysis, Thevenin , Norton and Superposition Theorems, maximum power transfer therom, Network Simplifications using star-delta / delta-star transformations.

Unit – III: Electromagnetism and Magnetic Circuits (06)

Magnetic field due to electric current, Force on a current carring conductor, Electromagnetic induction, direction and magnitude of induced EMF, magnetomotive force and magnetic field strength, relative and absolute permeability, reluctance, series and parallel magnetic circuits, magnetic materials and B-H curve, self and mutual inductance, coupling coefficient,energy stored in magnetic circuits.

Unit – IV: Electrostatics and AC fundamentals (06)

A. Electrostatic field, electric flux density, electric field strength, permittivity. Capacitor and capacitance, dielectric strength and breakdown voltage, capacitors in series and parallel,composite capacitors, energy stored in capacitors, charging and discharging of capacitors and time constant

B. Generation of alternating emf, waveform terms and definitions, average value and rms values for sinusoidal and non sinusoidal currents and voltages, phasor representation of an alternating quantity

Unit – V: Diodes and rectifiers (06)

Overview of Semiconductor physics and p-n junction theory, Junction diode, construction and characteristic of p-n junction diode, zener diode, LED, photodiode, Half wave, full wave and bridge rectifiers, need of capacitor filter, rectifier operation with capacitor filter, zener diode as a voltage regulator, block diagram of Regulated power supply

Unit – VI: Junction Transistor Amplifiers (06)

Bipolar junction transistor, Construction of BJT, Types of biasing:-fixed bias and self bias circuit, BJT characteristics for-CE,CB,CC configurations, relationship between α and β, load line for a transistor, application of transistor as a switch and amplifier.

Text Books:

1. Hughes, **'Electrical and Electronic Technology'**, *pearson education*, (9^{th} edition), (2009)

Reference Books:

1. D. P. Kothari and I.J. Nagrath, '**Basic Electrical Engineering**', *McGraw-Hill*, (3^{rd} edition), (2010)
2. A. E. Fitzgerald, A.Grabiel,'**Basic Electrical engineering**',*McGraw-Hill*, (5^{th} edition), (2009)
3. Floyd, '**Electronic Devices and Circuits**', *pearson education, (*7^{th} edition),(2008)

ES 1102 Fundamentals of Programming Languages - I

Teaching Scheme:
Lectures: 1 Hr/Week
Credits: 1

Examination Scheme:
In-Semester: 25 Marks

Course Objectives:

1. Learn the fundamentals of building blocks of computer.
2. Understand how to formulate the programming language statements from description of a problem in English.
3. Understanding of decision and iteration interpretation in a programming language.
4. Understand basic building blocks of simple website.

Course Outcomes:

Students will be able to

1. Write algorithm based on given problem statement
2. Draw flow chart for a given problem statement
3. Write the code for simple problem statement
4. Debug the code snippets manually

Unit – I: Introduction to Programming (02)

Introduction to computer, Anatomy of a computer: Hardware and software, Operating system, Types of programming languages: Machine language, Assembly language, High level languages, Selection of language, Algorithm: As a program, As a flow-chart, Pseudo code

Unit – II: Writing First C Program (02)

Structure of a C program, Writing C program, Introduction to library functions in C, Files generated in C program, Comments, Indentation

Unit – III: Variables and Operations (03)

C language variables: Numeric, Character, Declaring and Initializing variables, Constants: Integer, Floating point, Character, String Operators: Arithmetic, Relational, Equality, Logical, Unary, Conditional, Bitwise, Assignment, Comma, sizeof, Operator precedence variable scope: Local and Global scope, Type casting and conversion

Unit – IV: Control flow in C Language (03)

Conditional branching statements: if statements, if-else Statement, Switch case, Iterative statements: while loop, do-while loop, for loop, Nested loops, break and continue statements

Unit – V: Arrays (02) Introduction to Arrays, Accessing Array elements, Internal representation of Arrays in C, Working with one-dimensional array, Introduction to two-dimensional arrays

Unit – VI: Introduction to Website Development (02)

Introduction to blogging and WordPress : Creating a simple website, Content creation, Pages and Blogs, Page linking, Comments, Adding contents like Multimedia, Presentations, Themes

Text Books:

1. Reema Thareja, **'Introduction to C programming',** *Oxford University Press* (2nd edition), (2015)
2. Pradeep Day, '**Computer Fundamentals and programming in C'**, *Oxford University Press*, (2nd edition) (2013)

Reference Books:

1. B Kernighan, D Ritchie, '**C programming Language'**, *Prentice Hall Software Series*, (2nd edition) (1988)

ES1103 Engineering Graphics

Teaching Scheme: **Examination Scheme:**

Lectures: 2 Hrs/Week In-Semester: 25 Marks

Credits: 2

End-Semester: 25Marks

Course Objectives:

a) To apply theory of projections and standard conventions in engineering drawing.

b) To understand the methods to draw various engineering curves.

c) To develop the visualization and interpretation skills, for the physical objects.

d) To develop free hand sketching skills.

Course Outcomes:

After completing the course students will be able to draw

a) Orthographic projections of an object.

b) Engineering curves by applying the given method.

c) Isometric views and development of surfaces of the given object.

4. Free hand sketches of simple machine elements.

Unit – I: Introduction to Engineering Drawing (02)

Layout and sizes of drawing sheets, drawing instruments, types of lines used in drawing practice, dimensioning systems, representation of tolerances, standard codes by B.I.S (SP-46).

Unit – II: Curves in Engineering Practice (05)

Construction of ellipse, parabola, hyperbola, involute, cycloid, archimedean spiral, helix on cone and cylinder.

Unit – III: Orthographic Projections (08)

Theory of projections, methods of obtaining orthographic views,sectional orthographic projections.

Unit – IV: Isometric Projections (08)

Isometric axes, Isometric scale, isometric projections and views, construction of isometric view from given orthographic views.

Unit – V: Development of lateral surfaces of solids (05)

Parallel line development, radial line development, methods to transfer points for development of prisms, pyramids, cylinder and cone.

Unit – VI: Free hand sketching (02)

Free hand sketching of front view and/or top view of standard machine elements –thread forms, hexagonal headed bolt and nut, screws, shaft and keys, spring, welded and riveted joint.

Text Books:

1. N. D. Bhatt and V. M. Panchal,**'Engineering drawing, plane and solid geometry'**, *Charotor Publication House.*

a) R. K. Dhawan,**'A text book of Engineering Drawing'**, *Pearson Education Inc*.

b) P.S. Gill, **'Engineering Graphics'**, *Kataria and sons Publications.*

c) M.L.Dabhade, **'Engineering Graphics'**, *Vision Publications.*

Reference Books:

a) Warren J. Luzzader, **'Fundamentals of Engineering Drawing'**, *Prentice Hall of India, New Delhi.*

b) Fredderock E. Giesecke, Alva Mitchell, **'Principles of Engineering Graph-**

ics',*Maxwell McMillan Publishing.*

c) Dhananjay A. Jolhe, **'Engineering Drawing'**, *Tata McGrawHill Publishing Co. Ltd.*

ES 1104 Environmental Studies

Teaching Scheme:

Lectures: 2Hrs/Week

Tutorial: 1Hr/Week

Credits: 3

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 Marks

Course Objectives:

1. It is an interdisciplinary approach to understand environment.
2. It enhances the ability to understand Environmental Problems.
3. Understand the relevance and importance of natural resources in the sustenance of life on earth and living standard.
4. To develop the ability and understand role of Individual in Environmental Protection

Course Outcomes:

A student should be able to obtain/develop:

1. Develop an understanding of environmental pollutions and hazards due to engineering/technological activities and general measures to control them.
2. Analyse the relationships between environmental laws across multiple sectors (local, state, national and international) Comprehend the importance of ecosystem and biodiversity.
3. Develop an understanding of different natural resources including renewable and non-renewable resources.

4. Identify suitable controlling measures for different types of solid wastes.

5. Improve fundamental knowledge of the inter-relationships between the built environment and natural environment.

6. Discuss an action plan for sustainable alternatives that integrate science, humanities and social perspective

Unit – I: Introduction (05)

Concept of environment and multidisciplinary nature of environmental studies:

a) Definition of Environment, multidisciplinary nature of Environmental Studies, scope, importance of Environment, Public awareness for Environment

b) Concept, Ecosystem characteristics:-Biotic abiotic, functional attributes

c) Energy flow in ecosystem: - Universal and single channel energy flow model, Nutrient Cycling:- Nitrogen cycle, carbon cycle, phosphorus cycle,

d) Concept of biodiversity

Unit – II: Integrated built environment (05)

d) Concept of integrated built environment – natural & man-made.

e) Eco-friendly materials in construction - Introduction, sources, Classification,properties and materials.

f) Principles of Building Planning: - Aspect, prospect, grouping, privacy, roominess, sanitation, orientation, circulation, elegance, economy.

g) Building bye laws (concept):- Building line, control line, set back distance, F.S.I., Built up area.

h) Concept of green building, advantages of green building, Introduction LEED rating system.

Unit – III: Renewable and Non- Renewable resources and it's Conservation (04)

f) Natural resources: Types of Renewable- Forest, water - causes of depletion, Conservation

g) Non-renewable resources, types, method of harnessing energy

Unit – IV: Environmental Pollution (05)

g) Introduction, Classification of pollution - Air and water - sources, causes, effects & remedial measures.

h) Solid waste generation, Collection of solid wastes, processing techniques, E- waste generation and methods of disposal.

i) Role of an individual in prevention of pollution.

Unit – V: Social Issues and Environment (05)

g) Unsustainable to sustainable development, urban problems related to energy, Climate change, global warming, acid rain, ozone layer depletion

h) Water conservation and Rain water harvesting

i) Introduction to Environmental Impact Assessment - Definition, introduction of methods with the help of a case study

j) Environment Protection Act, Forest Conservation Act, Public awareness.

Unit – VI: Smart City (03)

Concept and features of smart city, challenges of urbanization, selection process, strategy

Text books:

5. D.L. Manjunath, 'Environmental Studies', Pearson Education.

6. ErachBharucha, 'Text Book of Environmental Studies', UGC, Universities Press

Reference books:

5. D.K. asthana ,MeeraAsthana, ‘A Text Book Of Environmental Studies’,S.Chand.

6. Dr. J.P. Sharma, ‘Environmental Studies’,University Science Press.

7. Dr. Suresh K. Dhalmeja,‘Environmental Studies’,S.K.Kataria& Sons.

8. Anubha Kaushik, C.P.Kaushik, ‘Perspectives in Environmental Studies’,

New Age International Publishers.

9. Shah, Kale, Patki, ‘Building planning and Built environment’,

Tata McGraw Hill

10. Bukhootsow, ‘Energy policy and planning’,B- Prentice Hall of India New Delhi

BS1104 Physics and Chemistry Lab – I

Teaching Scheme	Examination Scheme
Practical: 2 Hrs/Week	In-Semester: 25
Credits: 1	

1: **Record** the observations as per the least counts of measuring instruments and carry out plotting and necessary calculations pertaining to the optical, electromagnetic and thermal systems.
2: Analyze the plotted data and experimental findings with the corresponding theoretical physical models pertaining to the optical, electromagnetic and thermal systems.
3: Analyze the sources of errors and arrive at conclusions pertaining to the behavior of optical, electromagnetic and thermal systems
4: Determine quality parameters of water such as hardness, alkalinity etc
5: Use of instrumental techniques in quantitative estimations like conductometry, pH metry, potentiometry.
6: Select appropriate quantitative analysis for estimation of different parameters of the substance.
7: Interpret the significance of a technique and specific role of reagent in qualitative and quantitative analysis.

List of Experiments:

Physics
1. Michelson Interferometer
2. Specific heat of substance
3. Hall Effect
4. Balmer Series and Emission Spectra
5. Zeeman Effect (Demo)

Chemistry
1. Qualitative & quantitative Analysis of alkali /alkaline earth metals using Flame Photometry.
2. Colorimetric verification of Beer-Lambert's law.
3. Determination of molecular weight of polymer using Ostwald Viscometer.
4. Proximate analysis of coal.

ES 1105 Basic Electrical and Electronics Engineering Lab-I

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./Week	Practical Exam: 25 marks
Credits: 1	

Course Outcomes:

After completion of course, students will be able to

1. Perform basic domestic wiring
2. Apply circuit laws to find the parameters of given electrical network
3. Build a basic regulated DC power supply
4. Analyse the performance of Transistor in CE configuration
5. Write techinical report of conducted experiment

List of experiments:

1. Study of different electrical and electronics components and instruments.
2. To perform electrical wiring to control lamps using one way and two-way switches.
3. Determination of Temperature Rise of a Medium Resistance
4. Verification of kirchoff's laws & superposition theorems
5. Verification of Thevenin's theorem.
6. Performance analysis of half wave,full wave rectifier with center tap transformer and bridge rectifier with and without filter.
7. Performance analysis of three terminal IC voltage regulator
8. Determination of frequency responce of CE amplifier.

ES 1106 Fundamentals of Programming Languages Lab - I

Teaching Scheme:
Practical: 2 Hrs/Week
Credits: 1

Examination Scheme:
Practical: 25 Marks

Course Objectives:
Familiarize students with

1. Learn basics of C programming.
2. Learn to write C program for a given logical solution.
3. Learn to make validation checks at required places.
4. Learn to apply programming concepts to solve problems.

Course Outcomes:
Students will be able to

1) Write algorithm based on given problem statement
2) Apply appropriate programming constructs
3) Write program for simple problem statement
4) Test program for different inputs

Section 1 (any 08 assignments)

1. A) Write a C program to accept the length of three sides of a triangle and to test and print the type of triangle - equilateral, isosceles, right angled or none of these.

   B) Find out area, perimeter of a given trigonometric figure
2. Write a C Program to display the table of any given number
3. Write a C Program to reverse a given number
4. Write a C Program to find whether a given number is Armstrong number or not.
5. Write a C Program to calculate Simple Interest
6. Write a C Program to convert temperature from Celsius to Fahrenheit
7. Write a C program to display all the prime numbers between 1 to n
8. Write a C program to generate a series (like Fibonacci)
9. Write a C Program to display the numbers divisible by 7 in a given range(e.g. 11 to 90)
10. Write a C Program to accept a number and convert every digit into word and display it
11. Write a C Program for finding roots of Quadratic Equation
12. Write a C Program to find the greatest possible length which can be used to measure exactly the lengths 4m 95cm, 9m and 16m 65cm (Hint HCF)

Section 2 (any 02 assignments)

1. The traffic light at three different road crossings change after every 48, 72 and 108 sec, if they all change simultaneously at 8:20:00 hrs., then at what time will they again change simultaneously? (Hint : LCM)
2. The average of 25 results is 18. The average of first twelve of them is 14 and the average of last twelve of them is 17. Find the thirteenth result. (Hint Average).
3. The taxi fare is Rs. 14 for the first kilometer and Rs. 2 for each additional kilometer. What will be the

fare for 10 kilometers?(Hint: Arithmetic Progression)

4. Roma's mathematics test had 75 problems, i.e. 10 arithmetic, 30 algebra and 35 geometry problems. Although she answered 70% of the arithmetic, 40 %of algebra and 60% of geometry problems correctly she did not pass because she got less than 60% of the questions right. How many more questions she would have needed to solve to earn 60% of passing grade?(Hint Percentage.)
5. A radio is purchased for Rs. 490/- and sold for Rs.465.50. Find the loss percentage(Hint: Profit and Loss)
6. In how many ways can a cricket 11 be chosen out of a batch of 15 players?(Hint Permutation and Combination)
7. Write a C Program to accept a number and convert every digit into word and display it

Section 3 (study assignment)

Design and develop a small application using Wordpress

Text Books:

1. Reema Thareja, **'Introduction to C programming',** *Oxford University Press* (2nd edition), (2015)
2. Pradeep Day, '**Computer Fundamentals and programming in C'**, *Oxford University Press*, (2nd edition) (2013)

Reference Books:

1. B Kernighan, D Ritchie, '**C programming Language'**, *Prentice Hall Software Series*, (2nd edition) (1988)

ES1107 Engineering Graphics Lab

Teaching Scheme:

Practical: 2 Hrs/Week

Credit: 1

Examination Scheme:

Practical: 25 Marks

Course Objectives:

Students will be able to

1. Apply theory of projections and standard conventions in engineering drawing.
2. Understand the methods to draw various engineering curves.
3. Develop the visualization and interpretation skills for the physical objects.
4. Develop free hand sketching skills.

Course Outcomes:

After completing the course students will be able to

Identify applications of engineering curves and draw the curves.

Understand and draw orthographic projections and isometric views of an object.

Draw the development of lateral surfaces of solids.

Create free hand sketches of the machine elements.

I: Introduction to Engineering Drawing (01)

Drawing sheet layouts, drawing instruments, standard codes by B.I.S (SP-46)

II: Assignments and Drawing Sheets (12)

- Engineering Curves.
- Orthographic Projections
- Isometric Projections

- Development of surfaces of solids.
- Free hand sketching.

III: Introduction to computer aided drafting package (02)

Features and applications of computer aided drafting packages, basic operations, and various commands for drawing, dimensioning, editing, saving and plotting the drawings.

NC 1201 Value Education

Teaching Scheme: **Examination Scheme:**

Lectures: 1 Hr /Week In-Semester: Nil

Tutorial: Nil End-Semester: Nil

Credits: Nil

Course Objectives:

1. To make understand importance of values in human behavior.
2. To understand adjustments required in one self and others to uphold values in society.
3. To understand importance of values in Family Life.
4. To understand ethics required by professionals in work place.

Course Outcomes:

1. Students will appreciate importance of values in all walks of life.
2. To develop women professional with strong ethics and above all be a good human being.
3. To help students to develop their own value system and action plan based on it.
4. To understand the impact of the Moral role of students in nation building and being a responsible citizen.
5. Understand effects of Global issue like Terrorism, Environment, different cultures etc.

Unit – I: Values and Self Development (03)

Value Education – Definition - relevance to present day - Concept of Human Values - self introspection - Self esteem.

Unit – II: Family values (03)

Components, structure and responsibilities of family - Neutralization of anger - Adjustability- Threats of family life - Status of women in family and society - Caring for needy and el-

derly -

Time allotment for sharing ideas and concerns.

Unit – III: Ethical values (03)

Professional ethics - Mass media ethics- Advertising ethics -Influence of ethics on family life -
psychology of children and youth – Leadership qualities - Personality development.

Unit – IV: Social values (03)

Faith, service and secularism - Social sense and commitment -Students and Politics -Social awareness, Consumer awareness, Consumer rights and responsibilities - Redressal mechanisms

Unit – V: Effect of international affairs on values of life/ Issue of Globalization (03)

Modern warfare -Terrorism. Environmental issues - mutual respect of different cultures, religions
and their beliefs.

Text Books:

1. Chakraborty, S.K., **'Values and Ethics for Organizations Theory and Practice'**, *Oxford
University Press, New Delhi*, (2001)

Reference Books:

1. T. Anchukandam and J. Kuttainimathathil (Ed) 'Grow Free Live Free', ***Krisitu Jyoti***

F. Y. B. Tech. Semester –II									
Course Code	Course Title	Teaching Scheme Hours / Week			Examination Scheme			Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Practical / Oral		
BS 1201	Engg. Mathematics - II	3	1	0	50	50	0	100	4
BS 1202	Physics - II	2	1	0	50	50	0	100	3
BS 1203	Chemistry - II	2	1	0	50	50	0	100	3
ES 1201	Basic Electrical and Electronics Engg. - II	3	0	0	50	50	0	100	3
ES 1202	Fundamentals of Programming Language - II	1	0	0	25	0	0	25	1
ES 1203	Basic Mechanical Engg.	3	0	0	50	50	0	100	3
ES 1204	Engg. Mechanics	2	1	0	50	50	0	100	3
BS 1204	Physics and Chemistry Lab - II	0	0	2	25	0	0	25	1
ES 1205	Basic Electrical and Electronics Engg. Lab - II	0	0	2	0	0	25	25	1
ES 1206	Fundamentals of Programming Language - II	0	0	2	0	0	25	25	1
ES 1207	Engg. Mechanics Lab	0	0	2	0	0	25	25	1
ES 1208	Workshop Practice – I	0	0	2	0	0	25	25	1
	Total	**16**	**4**	**10**	**350**	**300**	**100**	**750**	**25**
	Grand Total	**30**			**750**			**750**	**25**

MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

DEAN ACADEMICS
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

Principal
MKSSS's Cummins College of Engg. For Women, Karvenagar, Pune-52.

APPROVED BY
Governing Body Members
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

BS1201 Engineering Mathematics-II

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hrs/Week In-Semester: 50 Marks

Tutorial: 1 Hr /Week End-Semester: 50 Marks

Credits: 4

Course Objectives:
Mathematics is a necessary path to scientific knowledge which opens new perspective of mental activity. Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyse and solve engineering problems in their respective areas.

Course Outcomes: Students will be able to
1. Solve first order first degree DE, apply it to model and solve simple engineering problems like R-C circuit, conduction of heat etc.
2. Apply Beta, Gamma, Error function and Leibnitz's rule of DUIS to solve integration of univariate function
3. Identify the characteristics of the given function and trace the curve.
4. Integrate multivariate functions over the given region and apply the knowledge to find area, volume, mass, density etc.
5. Obtain Fourier series of given periodic function; Find nth harmonics for given data.

Course Contents:

Unit – I: First order first degree Differential Equation (07)

Definition, Order and degree of Differential Equation, Formation of differential equation, solutions of differential equation, Exact differential equation, Linear differential equation and equations reducible to these types.

Unit – II: Applications of Differential Equations (05)

Applications of differential equations to engineering problems: simple electrical circuits, applications of chemical engineering, applications of mechanical engineering and applications of physics.

Unit – III: Integral Calculus (07)

Special Functions:-Gamma Function, Beta Function, Error function. Differentiation Under integral sign (Leibnitz's rule). Curve tracing of Cartesian form, polar form.

Unit – IV: Multiple Integrals (08)
Transformation of Co-Ordinate systems Spherical, Polar and Cylindrical, Double and Triple integrals with limits, Double and Triple integrals without limits. Dirichlet's theorem.

Unit – V: Applications of Multiple Integrals (06)

Area of cartesian curves, Area of polar curves, Volume of solid, Mass of plane lamina, Mass of solid.

Unit – VI: Fourier Series and Harmonic Analysis (09)

Definition of Fourier series, Dirichlet's conditions, full range Fourier series, half range Fourier Sine series, half range Fourier Cosine Series, Practical Harmonic analysis and applications to problems in Engineering.

Text Books:

1. B.S. Grewal, 'Higher engineering Mathematics', Khanna publishers, Delhi (40th edition), 2008 .

2. B. V. Ramana, 'Higher Engineering Mathematics ',Tata McGraw Hill Publications, (2007)

Reference Books:

1. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi.(6th edition),(2003)

2. Peter V. O'neil, 'Advanced Engineering Mathematics', Thomson Brooks / Cole, Singapore (5th edition), (2007).

3. Erwin Kreyszig, 'Advanced Engineering Mathematics' ,Wiley Eastern Ltd.(8th Student Edition), (2004).

BS 1202 PHYSICS– II

Teaching Scheme:

Lectures: 2Hrs/Week

Tutorial: 1Hr/Week

Credits: 3

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 Marks

Course Objective:

The objective of this course is to provide an 'algorithmic' introduction of the basic principles of Quantum Physics to the first year students of engineering. Throughout the course, the applications of Quantum Physics will be discussed by emphasizing the laws of combining 'probability amplitudes'. This will be done through several case studies and experimental situations.

Course Outcomes:

By taking this course, the learner will be able to –

1: **Apply** the laws of combining probability amplitudes for obtaining intensity distributions of ensembles of identical microscopic systems.
2: Differentiate between domain – specific nature of probability amplitudes in elementary quantum mechanical situations.
3: Justify the use of the laws of combining probability amplitudes in situations involving photons and two – state and multi – state quantum systems.

Unit – I: Probability Amplitudes: (4)

The laws for combining amplitudes; The two-slit interference patter; Scattering from a crystal

Unit – II: Identical Particles: (4)

Bose particles and Fermi particles; Case studies involving use of the exclusion principle

Unit – III: The Dependence of Amplitudes on Time: (4)

Stationary states; Potential energy and energy conservation; The precession of a spin-half particle

Unit – IV: The Hamiltonian Matrix: (4)

Resolving state vectors; How state changes with time; Hamiltonian Matrix

Unit – V: Two-state Systems and Single Qubit Logic Gates: (4)

Experiments with bullets, waves and electrons; The uncertainty principle

Unit – VI: Band Theory of Solids and Semiconductor Physics: (4)

States for an electron in a lattice; Electrons and holes in semiconductors; The Hall effect; Rectification at a semiconductor junction; The transistor

Text Book:

R. P. Feynman, R. B. Leighton and M. Sands, **'The Feynman Lectures on Physics'**, *Pearson Education* (2006)

Reference Books:

1. J. Walker, D. Halliday, R, Resnick, **'Principles of Physics'**, Wiley *Student Edition* (10^{th} Edition)
2. H. Young and Roger Freedman, **'University Physics'**, Pearson Addison Wesley (12^{th} Edition)

BS-1203 Chemistry II

Teaching Scheme:

Lectures: 2 Hrs/Week

Tutorial: 1 Hr/Week

Examination Scheme:

In-Semester: 50 Marks

End-Semester: 50 Marks

Credits: 3

Course Objectives:

The Chemistry course is designed for the learners to develop a sound background of fundamental concepts and principles relevant in the engineering context. The course facilitates undergraduates to evaluate the role of chemical substances in different methods of preparation and analysis.They analyze chemical processes related to engineering applications. Also the course inculcates basic problem solving skills involving chemistry principles.

Course Outcomes:

By taking this course, the students will be able to

CO1: Apply spectral and analytical techniques for chemical analysis.

CO2: State laws, definitions and identify physical parameters affecting composition of systems.

CO3:Elucidate on structure and synthesis of materials.

CO4: Evaluate types, factors, mechanisms related to corrosion and its preventive methods.

CO5: Analyze materials for their properties and applications such as fuel or speciality materials.

Unit – I: Instrumental methods of Analysis II (04)

Basic principles, theory, instrumentation and applications of Uv-Vis Spectrophotometry; Flamephotometry.

Unit – II: Polymer Chemistry (07)

Basic terms, molecular weight determination, types of polymerization and its mechanism (free radical and ionic), compounding of plastics, Speciality polymers, Recycling of polymers

Unit – III: Chemistry of fuels (09)

Calorific value, Bomb & Boys' calorimeter, Proximate and Ultimate analysis of coal, Crude

oil: refining, knocking, alternate fuels, rocket propellants, Combustion: calculation of air required for combustion.

Unit – IV: Corrosion **(04)**

Dry and wet corrosion mechanism, types, factors affecting corrosion, Protection against corrosion: Cathodic and anodic protection, powder coating and metallic coatings.

Unit – V: Phase Rule **(03)**

Gibbs Phase Rule, one Component system- Water system, Sulphur system, Two component system- (Pb-silver alloy). Applications and limitations of phase rule.

Unit – VI: Nanomaterials **(03)**

Introduction to nanomaterials, synthesis by top down and bottom up methods, properties and typical applications of nanomaterials.

Text Books:

1. Arun Bahl and G.D. Tuli, **'Essentials of Physical Chemistry'**, (2014/2016)
2. S.S. Dara **'Engineering Chemistry'** *S.Chand Publications* (2010)
3. Puri, Sharma, Kalia **'Principles of Physical Chemistry'** *Milestone Publication* (2009)
4. B.S. Chauhan **'Engineering Chemistry'** *Univ Sc Press.*(2015)
5. Shashi Chawla **'A Text Book Of Engineering Chemistry'** *Dhanpat Rai & Co.* (2015)
6. S.K. Kulkarni **'Nanotechnology: principles and practices'** (2014)
7. Gurdeep Chatwal **'Instrumental methods of Chemical Analysis'** *Himalaya publishing house* (1996)

Reference Books:

1. Ram D. Gupta,**'Hydrogen as a fuel'** *C.R.C.Publication* (2009)
2. Puri,Sharma,Pathania **'Principles of Physical Chemistry'** *Vishal Publishing Co.* (2015-16)
3. **Robert D. Braun 'Instrumental methods of analysis'** ***Pharmamed press*** **(2010)**

ES 1201 Basic Electrical and Electronics Engineering – II

Teaching Scheme:
Lectures: 3 Hrs/Week
Credits: 3

Examination Scheme:
In-Semester: 50 Marks
End-Semester: 50 Marks

Pre-requisite : Semiconductor physics

Course Objectives:
1. To make students familiar with the fundamental concepts of AC circuits
2. To familiarize the students with three phase supply
3. To develop a clear understanding of operation and application of transformer
4. To make students familiar with Digital Circuits
5. To introduce Basics operational amplifier (IC 741) and its applications

Course Outcome:
Having successfully completed this course, the student will be able to:
1. Analyze and determine parameters of single phase AC circuit.
2. Quantify parameters of single phase transformer related to its operation and use .
3. Develop applications of logic gates for building combinational and sequential circuits.
4. Build simple linear and non-linear circuits using operational amplifier.
5. Analyze characteristics of different power devices and transducers.

Unit I: **AC Circuits** **(08)**
Behavior of pure R,L,C in ac circuits,Series and parallel RL, RC and RLC circuits, concept of Impedance and admittance, power triangle and power factor.Resonance in series and parallel RLC circuit, Three phase voltage generationand waveform, star and delta balanced systems. Relationship between phase and line quantities, phaser diagram, power in a three phase circuit.

Unit II : Single phase Transformers **(07)**
1 Φ transformer: concept, types, working, ideal transformer, practical transformer, equivalent circuit, phasor diagram, efficiency and regulation calculations. Introduction to three phase transformer.

Unit III: Digital Electronics **(07)**
Binary number systems and binary arithmetic, basic gates, implementation of basic gates using universal gates, Boolean algebra, standard representation of logic functions (SOP and POS forms), Introduction of Combinational logic circuits like multiplexer ,demultiplexer ,half adder and full adder, Introduction of Sequential logic circuits like flip- flops (SR, D), counters and shift registers.

Unit IV: OPAMP **(07)**
Introduction to operational amplifiers, opamp configurations, modes and parameters, Negative feedback concept and applications like comparators, summing amplifiers, integrators and differentiators.

Unit V: POWER DEVICES **(07)**

Construction, characteristics and turn on mechanism of SCR, two transistor analogy of SCR, concept of line and forced commutation. Introduction to phase control concept. Construction, characteristics of IGBT and MOSFET.

Unit VI: Transducers **(06)**

Introduction to Transducers, selection of transducers, classification of transducers. Types of transducers such as LVDT, RTD, Thermistor and strain gauge.

Text Books:-

Hughes,"Electrical & Electronic Technology", *Pearson Education, 9th Edition*

Reference Books:-

1. AP Malvino & Donald Leach,"Digital Principles and Applications", *McGraw Hill Education, 4th edition*

2. Floyd ,"Electronic Devices and Circuits", *Pearson Education India, 8th edition*

3. H.S. Kalsi "Electronic Instrumentation",*TMH publication,2nd edition*

4. Jacob Millman & C C Halkais, Chetan parikh,"Integrated Electronics", *TMH, 2nd edition*

5. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", *Tata McGraw- Hill, 3rd Edition.*

ES 1202 Fundamentals of Programming Languages - II

Teaching Scheme:
Lectures: 1 Hr/Week
Credits: 1

Examination Scheme:
In-Semester: 25 Marks

Course Objectives:
Familiarize students with

1. Understand role of functions and it's utility in programming.
2. Understand the use of pointers in memory management.
3. Understand the utility of need and utility of user defined data types.
4. Learn and explore mobile application development environment.

Course Outcomes:
Students will be able to

1. Write program using functions
2. Write code for effective memory management
3. Write code using appropriate user defined data types for various applications
4. Write code with user defined functions similar to inbuilt functions

Unit – I: Functions in C (03)
Concept of Function, Function declaration, Function definition, Function Call, Return statement, Passing parameters: Call by value, Recursion

Unit – II: Strings (02)
Introduction, Reading Strings, Writing Strings, Strings Operations: Counting characters in String, Converting into upper case and lower case, Concatenation, Appending, Comparing, Reverse

Unit – III: Introduction to Pointers in C (02)
Understanding Computer memory, Introduction to Pointers, Declaring pointer variable, Function Call by reference, Pointer and Arrays, Role of Pointers in Passing an Array to a Function, Pointers and Strings

Unit – IV: Structures (02)
Introduction to Structures: Declaring Structure and Structure Variables, Initializing Structure, Accessing members of Structure

Unit – V: Unions, Enumeration Data types (02)
Declaring Union and its members, Accessing members of Union, Enumeration Types

Unit – VI: Mobile application Development (02)
Introduction, Web apps vs. Native apps, Introduction to mobile operating System like Android / IOS / Windows, Features and architecture of Mobile Operating System, Generating GUI and views, Layouts and Application Components, Creating simple mobile application.

Text Books:

1. Reema Thareja, **'Introduction to C programming',** *Oxford University Press* (2nd edition), (2015)
2. Pradeep Day, '**Computer Fundamentals and programming in C'**, *Oxford University Press*, (2nd edition) (2013)

Reference Books:

1. B Kernighan, D Ritchie, '**C programming Language'**, *Prentice Hall Software Series*, (2nd edition) (1988)

ES1203 Basic Mechanical Engineering

Teaching Scheme:

Lectures: 3Hrs/Week

Credits: 3

ExaminatioScheme:

In-Semester: 50 Marks

End-Semester: 50 Marks

Course Objectives:

a) To provide an overview of mechanical engineering systems (Power plant, Manufacturing plant, Maintenance systems, transmission systems).

b) To enable students to understand terminology used in Mechanical engineering with its significance.

c) To make student understand concept of Mechatronics System.

Course Outcomes:

a) The student will be able to differentiate between major areas like Design, Manufacturing and Thermal in mechanical industries while addressing a problem.

b) The student will be able to select an appropriate sector while finding solution to a problem.

c) The student will be aware of avenues available while choosing career opportunities in mechanical engineering Industry.

d) Understand the underlying principle of energy conversion systems and power plants, power producing and Power absorbing devices.

e) Students will be able to identify Mechatronics System and its components.

Unit – I: Introduction to basic mechanical engineering (06)

Industry overview-Comparison between process, product and service industry. Work environment for Mechanical industries, role of a mechanical engineer, ethics, professional hazards and safety concerns in mechanical industry. Typical manufacturing method of a product.

Unit – II: Introduction to thermal engineering (08)

Thermodynamic system, properties, states, process, cycle, first law of thermodynamics, application of first law to open and closed systems,second law of thermodynamics, conceptual difference between heat engine, heat pump and refrigerator, significance of efficiency and co-efficient of performance. Numerical on appropriate topics.

Unit – III: Power producing devices and power absorbing devices (08)

Power producing devices-Internal combustion engines and turbines, power plants.

Power absorbing devices-Centrifugal pumps, reciprocating units, vapour compression refrigeration, air conditioning systems.

Energy management system-fluctuations in demand-supply of energy,need of power grid, concept of energy audit.

Unit – IV: Introduction to design engineering

Introduction to engineering materials, elements and principles of engineering design, basic procedure, Basic requirement, standards in design, aesthetic and ergonomic considerations in design.

Basic machine elements, shaft, key, coupling, bearing, clutch and brake.

Mechanical drives, belt, chain and gear.

Unit – V: Introduction to manufacturing (08)

Operation on different machine tools, lathe, Milling, Drilling.

Joining of metals, welding-gas and arc, TIG, MIG, Soldering, brazing.

Hot and cold working-Forging, rolling, extrusion.

Unit – VI: Introduction to Mechatronics (06)

Definition(S) of Mechatronics, Mechatronics system Components, Levels of Mechatronics system, Examples of Mechatronics (products and systems in manufacturing), Advantages of Mechatronics with Traditional Systems.

Text Books:

a) C.P. Aurora, '**Thermodynamics'**, *Tata McGraw Hill education*, (2001).

b) BasantAgarwal, C.M Agarwal, '**Basic Mechanical Engineering'**, *Wiley Ind. Pvt. Ltd*.

c) V B Bhandari, **'Design of Machine Elements'**, *Tata McGraw Hill*, (2nd edition), (2007).

d) S. K.HajraChoudhury, S.K.Bose, A.K.HajraChoudhury, **'Elements of workshop technology, volume I and II',** *Media promoters and publishers pvt. Ltd*(7th edition).

e) W.Bolton, '**Mechatronic-a multidisciplinary approach',** *Prentice Hall*, (4th edition), (2009).

f) Class room notes.

Reference Books:

a) Moran, Shapiro, Boettner, Bailey, '**Principles of engineering thermodynamics'**, *Wiley*, (7^{th} edition).

b) Rayner Joel, '**Basic engineering thermodynamics'**, *Addison-Wesley*, (5^{th} edition).

c) Y. A. Cengel and M. A. Boles, '**Thermodynamics, an Engineering Approach**', (4th edition).

d) S.S. Rattan, '**Theory of Machine'**, *McGraw Hill*, (4^{th} edition).

e) B.S. Raghuwanshi, '**A course in workshop technology'**, *DhanpatRai&co*.

f) Kalpakjian, Schmid, **'Manufacturing engineering and technology**', *Pearson*, (4^{th} edition).

7. Nptel course112105127/1, 112105127/2

ES 1204 Engineering Mechanics

Teaching Scheme:

Lectures: 2Hrs/Week

Tutorial: 1Hr/Week

Credits: 3

Examination Scheme:

In-Semester: **50** Marks

End-Semester: **50** Marks

Course Objectives:

1. To develop the ability of students to analyze any problem in a simple and logical manner.
2. To make the students understand the fundamental principles of mechanics which are the foundation of much of today's engineering.
3. To develop logical thinking of the students for application in engineering.
4. To provide an introduction to the basic quantities of mechanics.

Course Outcomes:

A student should be able to obtain/develop:

1. An ability to apply knowledge of mathematics, science and engineering

2. A recognition of the need for, and an ability to engage in, life-long learning.

3. Application of Newton's laws of motion

4. Knowledge of kinematic & kinetic analysis.

Unit – I: Introduction to Statics (06)

1. Fundamental concepts and principle (The parallelogram law of addition of forces, the principle of transmissibility, Newton's laws of motion**,** Newton's law of gravitation). Introduction to a force in a plane, Types of force system, resolution & composition of forces, Methods of composition to find resultant, moment of force, Varignon's theorem, couple, equivalent force couple system.
2. Introduction to force in a space, problems on resultant of concurrent force system
3. Equilibrium- Introduction to concept of equilibrium, Conditions of equilibrium, Free body diagram, equilibrium under different forces, equilibrium of concurrent parallel & general forces in a plane.

Unit – II: Introduction to type of Supports and Beam (05)

1. Types of supports (Fixed, roller, hinged support)

   Types of loads on a beam (point load, uniformly distributed load, uniformly varying load)
   Types of beams (simple beam, cantilever beam, compound beam)

2. Problems on Reactions & analysis of beams
3. Centroid- Definitions (Center of gravity of two dimensional body, center of mass, centroid), procedure to find centroid of regular plane lamina.

Unit – III: Introduction to Friction (03)

Definition and classification of friction, coefficient of static and kinetic friction ,angle of friction, angle of repose, problems on block friction and ladder friction

Unit – IV: Rectilinear Motion (05)

2) Variables in Rectilinear motion- Time, Position, Displacement, Distance travelled, Velocity, Acceleration

   Equations of motion for constant acceleration & motion under gravity, variable acceleration, relative motion based on kinematic equations.

3) Application of Newton's second law of motion for rectangular co-ordinate system (D' Alembert's principle)

Unit – V: Curvilinear Motion (05)

1) Equation of motion in rectangular components, Normal & Tangential components, Radial & Transverse components.

2) Projectile motion- Definition and derivation (time of flight, horizontal range, angle of projection, maximum height, trajectory),Projectile on horizontal plane only

Unit – VI: Work Energy Principle (04)

1. Introduction and definition of Work, power, energy, conservative & non- conservative forces, Conservation of energy, work-energy principle.

2. Problems on Work done by different forces (External force, Frictional force, Gravitational force, Spring force).

Text books:

1. A Nelson, '**Engineering Mechanics Statics and Dynamics**', *Mc Graw Hill Education.*

2. R.S. Khurmi, '**A Textbook of Engineering Mechanics**', *S. Chand & Company Ltd.*

Reference books:

- Beer & Johnson, '**Vector mechanics for engineers**', *Mc Graw hill publication.*
- I. H. Shames & G.K.M. Rao, '**Engg. Mechanics'**, *Pearson.*
- R. C. Hibbler, '**Engg. Mechanics statics & dynamics**', *Pearson publication*
- **S. Timosenko, DPT.young & J.V.Rao, 'Engineering mechanics',** ***Tata Mc Graw hill education pvt. Ltd. New delhi.***

BS 1204 Physics Chemistry Lab – II

Teaching Scheme:

Lectures: 2Hrs/Week

Tutorial: 1Hr/Week

Practical: 2 Hrs/Week

Credits: 1

Examination Scheme:

In-Semester: **25** Marks

1: **Record** the observations as per the least counts of measuring instruments and carry out plotting and necessary calculations pertaining to solid state physics, atomic and molecular system.
2: Analyze the plotted data and experimental findings with the corresponding theoretical physical models pertaining to solid state physics, atomic and molecular system.
3: Analyze the sources of error and arrive at conclusions pertaining to the behavior of solid state physics, atomic and molecular system.
4: Determine the molecular weight of a given polymer by viscometry.
5: Evaluate a solid fuel sample for its quality by proximate analysis.
6: Implement spectral analysis for a given chemical compound.

List of Experiments:

Physics

1. Michelson Interferometer
2. Specific heat of substance
3. Hall Effect
4. Balmer Series and Emission Spectra
5. Zeeman Effect (Demo)

Chemistry

1. Qualitative & quantitative Analysis of alkali /alkaline earth metals using Flame Photometry.
2. Colorimetric verification of Beer-Lambert's law.
3. Determination of molecular weight of polymer using Ostwald Viscometer.
4. Proximate analysis of coal.

ES 1205 Basic Electronics and Electrical Engineering Lab- II

Teaching Scheme: **Examination Scheme:**

Laboratory: 2 Hrs/Week End-Semester:25 Marks

Credits: 1

Pre-requisite : Instruments ,Electronics and electrical components,semiconductor physics.

Course Objectives:

3. To make students familiar with the fundamental concepts of single phase AC circuits
4. To make students familiar with three phase supply
5. To demonstrate working of single phase transformer
6. To explain combinational logic circuits
7. To introduce Basics operational amplifier (IC 741) and its applications

Course Outcome:

Having successfully completed this course, the student will be able to:

3. Apply fundamental concepts of single phase and three phase AC circuits.
4. Test performance parameters of single phase transformers.
5. Implement basic analog and digital circuits.
6. Verify characteristics of SCR and transducer.

List of Practicals:-

1. Performance analysis of L-C-R series circuit .
2. Load test on single phase transformer for determination of voltage regulation.
3. Performance analysis of 3 phase AC circuit.
4. Analysis of summing amplifier and difference amplifier using OPAMP.
5. Design and implementation of half adder and full adder circuits.
6. Illustrate effect of variation of displacement on output voltage of LVDT.
7. Verification of static characteristics of SCR.
8. Soldering Techniques (any small circuit like clippers, clamper, circuits using basic gates).

ES 1206 Fundamentals of Programming Languages Lab - II

Teaching Scheme:
Practical: 2 Hrs/Week
Credits: 1

Examination Scheme:
Practical: 25 Marks

Course Objectives:
Familiarize students with

1. Learn and acquire art of computer programming.
2. Learn advanced C programming features.
3. Learn to write C program for a given logical solution.
4. Learn to apply programming concepts to solve simple problems using arrays, functions and structures.

Course Outcomes:
Students will be able to

1. Write program using functions for given problem statement.
2. Write code using sequential memory management
3. Apply appropriate user defined data types for given statement.
4. Write program with user defined functions similar to library functions.

Section 1 (any 07 assignments)

1. Write a C program to swap 2 integers using user defined functions (call by value, call by reference).
2. Write a program in C to compute the factorial of the given positive integer using recursive function.
3. Write functions to convert feet to inches, convert inches to centimeters, and convert centimeters to meters. Write a program that prompts a user for a measurement in feet and converts and outputs this value in meters. Facts to use: 1 ft = 12 inches, 1 inch = 2.54 cm, 100 cm = 1 meter.
4. Write a menu driven program to perform following operations using Array of integers like (accept, display, print alternate number, sum of all numbers, search a number).
5. Write a program in C to sort n integers using bubble sort.
6. Write a menu driven program to perform string operations using library functions.
7. Write a menu driven program to perform string operations using user defined functions.
8. Define an integer pointer array of 10 integers. Initialize them to any integer values from the keyboard. Find the sum, average, minimum, and maximum of these 10 integers. Sort the 10 integers in descending order.
9. Write a program in C to compute addition / subtraction / multiplication of two matrices. Use functions to read, display and add / subtract / multiply the matrices.
10. For a class an examination is conducted and the results for the students of all the 5 subjects are recorded. Write C program to display the record of students. On the basis of the record compute

11. Write a menu-based program in C that uses a set of functions to perform the following operations:

    i. reading a complex number
    ii. writing a complex number
    iii. addition of two complex numbers
    iv. Iv.subtraction of two complex numbers
    v. multiplication of two complex numbers
    vi. Represent the complex number using a structure.

12. Write a C program to create an employee database using structure and perform operations such as accept, display, search by name, search by number, update a record.

Section 2 (any 02 assignments)

1. A string is provided from the user. Calculate the total number of characters in the string and the total number of vowels in the string with the number of occurrence in the string

2. College library has n books. Write C program to store the cost of books in array in ascending order.
   Books are to be arranged in descending order of their cost

3. Write a recursive function to obtain the first 25 numbers of a Fibonacci sequence. In a Fibonacci sequence the sum of two successive terms gives the third term. Following are the first few terms of the Fibonacci sequence:1 1 2 3 5 8 13 21 34 55 89

4. A factory has 3 division and stocks 4 categories of products. An inventory table is updated for each division and for each product as they are received. There are three independent suppliers of products to the factory:

   (a) Design a data format to represent each transaction

   (b) Write a program to take a transaction and update the inventory

   (c) If the cost per item is also given write a program to calculate the total inventory values.

5. Write a program that compares two given dates. To store date use structure say date that contains three members namely date, month and year. If the dates are equal then display message as "Equal" otherwise "Unequal".

6. Create a structure to specify data of customers in a bank. The data to be stored is: Account number, Name, Balance in account. Assume maximum of 200 customers in the bank.

   (a) Write a function to print the Account number and name of each customer with balance below Rs. 100.

   (b) If a customer request for withdrawal or deposit, it is given in the form: Acct. no, amount, code (1 for deposit, 0 for withdrawal) Write a program to give a message, “The balance is insufficient for the specified withdrawal”

7. An automobile company has serial number for engine parts starting from AA0 to FF9. The other characteristics of parts to be specified in a structure are: Year of manufacture, material and quantity manufactured.

Section 3 (study assignment)

Students should design and develop a small Android application for mobile.

Text Books:

1. Reema Thareja, **'Introduction to C programming',** *Oxford University Press* (2nd edition), (2015)
2. Pradeep Day, '**Computer Fundamentals and programming in C'**, *Oxford University Press*, (2nd edition) (2013)

Reference Books:

1. B Kernighan, D Ritchie, '**C programming Language'**, *Prentice Hall Software Series*, (2nd edition) (1988)

ES1207 Engineering Mechanics Lab

Teaching Scheme:

Lectures: 2 Hrs/Week

Tutorial: 1 Hr/Week

Credits: 1

Examination Scheme:

In-Semester: 25 Marks

No. of Experiments:

Part A-Experiments (any 7 experiments)

1. Verification of law of polygon of forces.
2. Verification of Varignon's theorem.
3. Verification of Lami's theorem.
4. Support reactions of simple beam.
5. To determine forces in space force system.
6. Study of Curvilinear motion.
7. Determination of coefficient of restitution.
8. To compare coefficient of friction of various pair of surfaces in contact.

Part B- Graphical analysis -(Any one)

1. To find resultant of force system.
2. To find support reactions of simple beam.

ES 1208 Workshop Practice I

Teaching Scheme:

Practical: 2 Hr/Week

Credit: 1

Examination Scheme:

Practical/Oral Examination: 25 marks

Course Objectives:

1. To provide knowledge and skill to use tools, machines, equipment, and measuring instruments, which are used in manufacturing industries.
2. To educate students for Safe handling of machines and tools in manufacturing environment

Course Outcomes:

1. The student will be able to apply concept related to workshop safety & use of measuring instruments during process of manufacturing.
2. The student will be able suitably select basic manufacturing practices for making of component.
3. The students will be able to manufacture/produce given product from raw material using different manufacturing methods.

Unit – I: Introduction to Workshop Safety and Measuring Instruments: (05)

- Safety precautions while working in shop, safety equipment's and their use.
- Brief introduction to instruments like – Steel rule, Calipers, VernierCaliper, Micrometer, etc. Least counts, common errors and care while using them, use of marking gauge, 'V'block and surface plate.
- Introduction & working of different tools used in workshop.

Unit – II: Manufacturing Practice:(Any Two Trades) (13)

- Fitting: Preparation of joints, markings, cutting and filling for making joints like V or T for making part of any component.
- Carpentry: Wood working consists of planning, marking, sawing, chiseling and grooving to make joint like lap, T, dovetail.
- Tin smithy: Making of small parts using sheet metal such as Tray, Funnel.
- Welding Joints: Introduction to use of MIG/ TIG, arc welding for making joints like Lap, Butt joint.

Unit – III: Information technology: (06)

- Identify the peripherals of computer components in a CPU and its functions
- Disassemble and assemble the PC back to working condition
- Loading of operating system.

Unit – IV: Plumbing (06)

- Hands on practice on Cutting, bending and external threading of GI pipes using Die
- Plumbing on PVC pipes.
- Different Joint preparation on GI & PVC Pipes

Text Books:

1. Choudhary, Hajara**'Elements of Workshop Technology**', Media Promotors& Publishers, (1997).
2. Raghuvanshi B.S. "Workshop Technology" Vol. I &II,DhanpatRai& Sons, (1998).
3. H.S. Bawa'Workshop Technology' Vol.-I by, TMH Publications, New Delhi, (2009).
4. Gupta and Kaushik "Workshop Technology: Vol. – I by, New Heights,(1999).

Reference Books:

1. Chapman W.A. J and Arnold E. '**Workshop Technology-part I**' Viva low priced Student, (1998).

Autonomous Program Structure

Second Year B. Tech.

Third Semester (Mechanical Engineering)

2016 Pattern

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 2101	Engineering Thermodynamics	3	1	0	50	50	0	0	100	4
ME 2102	Materials' Technology I	2	1	0	50	50	0	0	100	3
ME 2103	Manufacturing Process- I	3	0	0	50	50	0	0	100	3
ME 2104	Machine Drawing	1	0	0	25	0	0	0	25	1
ES 2101	Electrical and Electronics Engineering	3	1	0	50	50	0	0	100	4
HS 2101	Principles of Economics and Finance	3	0	0	50	50	0	0	100	3
ME 2105	Engineering Thermodynamics Lab	0	0	2	0	0	25	0	25	1
ME 2106	Materials' Technology - I Lab	0	0	2	0	0	25	0	25	1
ME 2107	Manufacturing Process- I Lab	0	0	2	0	0	0	25	25	1
ME 2108	Machine Drawing Lab	0	0	2	0	0	0	25	25	1
AC 2101	Self Expression	0	0	2	0	0	0	0	0	0
	Total	**15**	**3**	**10**	**275**	**250**	**50**	**50**	**625**	**22**
	Grand Total	**28**			**625**					

AC 2101 – Audit Course: Self Expression

1. Dance
2. Drawing / Painting / Sketching
3. English Communication Skill
4. Film Appreciation
5. Origami
6. Theater

ME 2101 - Engineering Thermodynamics

Teaching Scheme	Examination Scheme
Lecture: 3 Hrs/week	In semester: 50 marks
Tutorials: 1 Hrs/week	End semester: 50 marks
	Credits: 4

Prerequisites:

1. Engineering Physics
2. Engineering Chemistry
3. Basic Mechanical Engineering

Course Objectives:

1 To state and illustrate laws of Thermodynamics.
2 To understand the concept of entropy and availability.
3 To get conversant with properties of steam, vapor processes and various steam calorimeters.
4 To analyze the performance of various Thermodynamic cycles.

Course Outcomes:

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

1 Apply laws of thermodynamics to closed and open systems processes.
2 Calculate entropy change of thermodynamic universe.
3 Calculate energy interactions in steam processes
4 Analyse various thermodynamic cycles.
5 Determine availability of thermodynamic system

Unit 1: Laws of Thermodynamics (9 hrs)

Review of basic concepts of Thermodynamics, First law applied to closed system and open system, Second law of thermodynamics, Carnot theorem, Carnot cycle.

Unit 2: Entropy (6 hrs)

Clausius Inequality, Entropy - a system property, Evaluation of entropy change for solids, liquids and ideal gases, Principle of increase of entropy- entropy generation.

Unit 3: Properties of Pure Substances (8 hrs)

Formation of steam, Properties of steam, Laws of thermodynamics applied to steam processes, Steam calorimeters.

Unit 4: Thermodynamic Vapour Cycles (9 hrs)

Carnot cycle, Rankine cycle, Reheat and Regeneration, Vapour Compression cycle.

Unit 5: Thermodynamic Gas Cycles (6 hrs)

Otto cycle, Diesel cycle, Dual cycle, Brayton cycle, Bell Coleman cycle.

Unit 6: Exergy Analysis (4 hrs)

Exergy, Exergy analysis of closed system, Exergy analysis of open system, 2nd law efficiency.

Text Books:

1. Principles of Engineering Thermodynamics- Moran, Shapiro, Boettner, Baily Eighth Edition, Wiley
2. P. K. Nag, Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publications
3. C.P. Arora, Engineering Thermodynamics, Tata McGraw Hill
4. S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers

Reference Books:

1. Cengel and Boles, 'Thermodynamics - An Engineering Approach', 7th Edition, Tata McGraw Hill
2. Rayner Joel, "Basic Engineering Thermodynamics", Addison Wesley Longman

ME 2102 - Materials' Technology I

Teaching Scheme
Lecture: 2 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 3

Prerequisites:

1. Physics
2. Chemistry

Course Objectives:

1 To introduce material properties and behaviour that is relevant to Mechanical engineering.
2 To provide an integrated understanding of structure, properties, processing and performance

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

1 Based on principles of material science and engineering, correlate the relationship between processing-structure-property-performance of materials.
2 Apply the knowledge of engineering fundamentals and material science to define and evaluate properties relevant to mechanical engineering.
3 Evaluate structure of engineering materials
4 Cite usual types of failures in materials correlate the structure of material with common failures and write their causes.

Unit 1: Properties of Engineering Materials (8 hrs)
Classification of various properties, expressing and computing properties relevant to mechanical engineering. Study conventional destructive and non destructive testing.

Unit 2: Structure of Crystalline solids (8 hrs)
Effect of making process on internal structure, structure of crystalline solids.

Unit 3: Structure of Non crystalline solids (5 hrs)
Polymers, composites and functionally graded materials.

Unit 4: Structure property relation (9 hrs)
Effect of inter-atomic distance on properties, effect of crystalline and non crystalline structure and defects on properties, effect of grain size on properties, defects, defect tolerance, slip, twinning, work hardening, failure modes.

Text Books:

1 "Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016,Second edition.

Reference Books:

1 "Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003.
2 "Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.
3 "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004.
4 "Mechanical Metallurgy", Dieter, G.E., McGraw-Hill, 1988.
5 "Introduction to Physical Metallurgy", Avner, S.H., Tata McGraw-Hill, 1997.
6 "Material selection in mechanical design', Michael Ashby, Butterworth-Heinemann, 3/e, 2005.

ME 2103 - Manufacturing Processes-I

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 3

Prerequisites:

1. Basic Mechanical Engineering

Course Objectives:

1 To study basic production processes.
2 To study how to select appropriate production processes for a specific application.

Course Outcomes:

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

1 Compile basics of manufacturing, to compute elements of casting such as gating system, different types of casting method and their application..
2 Demonstrate different machining operation, calculation of force and time on lathe machine.
3 Use different machining operation, calculation of force and time on drilling machine.
4 Select different machining operation for machining component, calculation of force and time on milling machine.
5 Identify use of various finishing processes such as grinding, lapping and honing.

Unit 1: Manufacturing Processes (3 hrs)

Introduction, importance of manufacturing, economics and technological definition, introduction to product design process, role of mechanical engineer in classification and selection of manufacturing processes.

Unit 2: Metal Casting Processes (8 hrs)

Patterns, Types of patterns, allowances and material used for patterns, gating system, casting process. Moulding sands; properties and sand testing: Grain fineness, moisture content, clay content and permeability test. Core materials and core making. Moulding practices: Green, dry and loam sand moulding, pit and floor moulding; shell moulding; permanent moulding. Melting furnaces. Gating and Riser design fundamentals, Review of casting processes, casting design considerations, capabilities and applications of casting processes; casting defects.

Unit 3: Metal Cutting Lathes (8 hrs)

Introduction to Lathes, types of lathe machines, construction all arrangement and principal units of engine lathes, specifications of lathes, operations carried on lathe, attachment extending the processing capacities of engine lathes, Capstan and Turret lathes, Taper turning on lathe, Thread cutting on lathe using gear train and chasing dial.

Unit 4: Drilling Machines (8 hrs)

Purpose and field of application of drilling machines, Types of drilling machines, Drilling and allied operation: drilling, boring, reaming, tapping, countersinking, counterboring, spot facing; deep hole drilling, alignment tests of drilling machine. Boring Machine: Purpose and applications, Horizontal boring machines, Precision boring machines.

Unit 5: Milling Machines (8 hrs)

Purpose and types of milling machines, general purpose milling machines, different types of milling operations, milling cutters, attachments extending the processing capabilities of general purpose milling machines, Indexing, Helical milling operation and its set up.

Unit 6: Grinding Machines and Abrasives (6 hrs)

Classification of grinding machines, cylindrical grinders, internal grinders, Surface grinders, tool and cutter grinders, centerless grinders, Types of grinding wheels, wheel characteristics and wheel selection. Grinding Wheels: Types of abrasives−natural, artificial; grain size; types of bonds; grade; structure; shapes and sizes; grinding wheel designation, selection of grinding wheels, balancing of grinding wheels, truing, dressing and mounting of grinding wheels. Lapping and honing.

Text Books:

1 Principles of Modern Manufacturing, Mikell P. Groover, Wiley
2 Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall
3 Elements of Workshop Technology, Hazra Chaudhary Vol I, II

Reference Books:

1 Production Technology Vol. I and II, B. S. Raghuvanshi, Dhanpat rai and co.
2 Workshop Technology part I, II & III, W. A. J. Chapman.
3 Introduction to Manufacturing Processes, John A. Schey, McGraw-Hill.
4 Mechanical Engineers' Handbook, Volume 3: Manufacturing and Management, Myer Kutz, Wiley.
5 Manufacturing processes Vol. 1 and 2, P. N. Rao, Tata McGraw-Hill.

ME 2104 - Machine Drawing

Teaching Scheme
Lecture: 1 Hrs/week

Examination Scheme
In semester: 25 marks

Credits: 1

Prerequisites:

1. Engineering Graphics

Course Objectives:

1 To make students conversant with conventional representations of common features.
2 To make students to draw sectional views and dimensioning techniques.
3 To make students understand limits, Fits and tolerance.
4 To create Detail and Assembly drawing using CAD software.

Course Outcomes:

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

1 Interpret the machine parts and represented through IS conventions.
2 Illustrate the details of the given machine parts through sectional view and appropriate dimensional techniques.
3 Apply the tolerance from tolerance grade and demonstrate the type of fit resulting from the tolerance.
4 Acquire knowledge of CAD software to draw machine components.

Unit 1: Conventions and Standards (2 hrs)

Need of Graphical Language, Importance of Machine Drawing, Drafting equipment's (from Instruments to Current Software). Principles of Drawings: BIS Conventions, ISO standards, Importance of Title Block and Part list, Line types (Lines used in Machine Drawings).
Conventional Representations: Need and types, IS conventions of Springs, Gear, Shaft, Pipe, Bar, Washers, Knurling, array of holes, Ratchet & Pawl Angle etc.

Unit 2: Projections and Dimensioning (3 hrs)

Projections: Designation, Relative position of views.
Sectioning: Cutting Planes and Section, Hatching Lines, Half Sections, Aligned Sections, Offset Sections, Sectioning Revolved, Removed Sections, Local Sections,
Dimensioning: Principle of Dimensioning, Dimensioning of Common Features e.g. Diameter, radii, chords, arcs, angles, Countersunk, Counter drilled holes, Counter-bore holes, chamfered and Counter sunk holes on curved surfaces, Spot Faces, Chamfers, Tapered Features. Addition of Letters and symbols, special indications.

Unit 3: Screw Threads and Threaded Fasteners (2 hrs)

Introduction -Helix Thread terms and Nomenclature, Designation, Threads Form, Form of V Threads, Form of Square Threads, Conventional representations, Threaded fasteners- Bolts, Washers, Types of

Bolts, Stud. Types of Nuts, Types of Screw, Designation of Bolted Joints, Stud, Types of Nut Locking Arrangements. Foundation Bolt.

Unit 4: Limits, Fits and Tolerance (3 hrs)

Theory of Conventional Tolerancing, Tolerancing and limit systems, symbols for tolerances, deviations and fits, Method of tolerancing, Tolerance grade. Fits-System of fits, classification of fits, Selection of Fits, Method of indicating fits on drawing.

Unit 5: Geometric Dimensioning and Tolerancing (3 hrs)

Need of Geometrical Tolerance, Geometrical Characteristics of Symbols, Characteristics (such as Straightness, Flatness, Circularity, Cylindricity etc) Tolerances for Related Features such as Parallelism, Perpendicularity, Angularity, Concentricity, its symbols and interpretations.

Unit 6: Assembly drawing and details (4 hrs)

Assembly Drawings: Introduction, Types of Assembly, Importance of BOM, Assembly procedures, Assembly of Engine Parts, Assembly of Machine Tools Parts etc.

Text Books:

1 N. D. Bhatt, Machine Drawing. Charotor Publication House, Bombay.
2 Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN 81-85749-79-5.

Reference Books:

1 N. Sidheshwsr, P. Kannaiah and V. V. S. Sastry. Machine Drawing, Tata McGraw Hill, New Delhi.
2 R. K. Dhavan, Machine Drawing. S. Chand and Company.
3 Narayana, Kannaiah and Venkatareddv, Machine Drawing, New Age International.
4 N. D. Junnarkar Machine Drawing 1st print Pearson Education.
5 IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
6 IS: 696- Code of practice for general engineering drawings B.I.S. Publications.
7 IS: 2709-Guide for selection of fits, B.I.S. Publications.
8 IS:919- Recommendation for limits and fits for Engineering, B.I.S. Publications.
9 IS: 8000- Part I, II. III. TV, geometrical Tolerancing of technical drawings -- B.I.S. Publications.

ES 2101 - Electrical and Electronics Engineering

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:

1. Basic Electrical and Electronics Engineering I.
2. Basic Electrical and Electronics Engineering II.

Course Objectives:

Students should be conversant with Electrical and Electronics controls basic

1 To study Electrical drive system required to drive machines.
2 It will be prerequisite for Mechatronics.
3 To study Microcontrollers.

Course Outcomes:

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

1 Understand and interpret the working of D.C motor, various methods of speed control and its industrial application.
2 Interpret the performance and torque -slip characteristic of I.M.
3 Understand and analyze the electrical drive system.
4 Apply the knowledge of microcontrollers in automation.

Unit 1: D.C. Machines (6 hrs)

Construction, working principle of D.C. generator, emf equation of D C generator. Working principle of D.C. motor. Types of D. C. motor, back emf, torque equation for D.C. motor, characteristics of D. C. motor (series, shunt and compound), Three point starter for D.C Shunt motor, Braking of D.C. Motor, methods for speed control of D.C shunt and series motors, Industrial applications.

Unit 2: Three phase Induction Motor (6 hrs)

Constructional feature, working principle of three phase induction motors, types, torque equation, torque slip characteristics, power stages and efficiency. Types of starters, braking of induction motor, methods of speed control & Industrial applications.

Unit 3: Electrical Drives (6 hrs)

Advantages of Electrical Drives,, Parts of electrical drives, choice of electric drive ,Status of ac and dc drives, Brushless dc motor drives , stepper motor drives, synchronous motor variable speed drive.

Unit 4: Introduction to Microcontrollers (6 hrs)

Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega328p-features, architecture, port structure, sensors and actuators, data

acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements

Unit 5: Peripheral Interface - 1 (6 hrs)

Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE.

Unit 6: Peripheral Interface - 2 (6 hrs)

Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM.

Text Books:

1 Electrical Machines-D P Kothari and I J Nagrath, Tata McGraw Hill ,Third Edition
2 Electrical Machinery-S.K. Bhattacharya, TTTI Chandigad.
3 Fundamentals of Elecrical drives-G K Dubey
4 Ajay Deshmukh-Microcontrollers Theory and Applications, TATA McGraw Hill
5 Arduino microcontroller processing for everyone -Steven F Barret,Morgan and Claypool Publisher.
6 C programming with ardino - Warwick Smith Elektor Publication.

Reference Books:

1 Electrical Technology-Edward Hughes, Pearson Education.
2 Electrical Machines by Ashfaq Husain, Dhanpat Rai & Sons.
3 Electrical Technology- Vol I & Vol II- B. L.Theraja, S Chand Publication Co Ltd.
4 The 8051 Microcontrollers - Architecture, Programming and Applications by K. J. Ayala, Penram International Publishing (I) Pvt Ltd.
5 Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.
6 Getting Started With Arduino: A Beginner's Guide by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor).
7 Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media.
8 Application notes from ATMEL microcontroller data book.

Tutorials:

1 Study of AC and DC starter.
2 Verification of speed control of D.C. shunt motor by armature voltage and flux control method.
3 Load test on three phase induction motor.

4 Interfacing of LED to blink after every 1 sec.
5 Interfacing with transducer.
6 Display data using serial communication.
7 Interfacing of LCD to display the message.

HS 2101 - Principles of Economics and Finance

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 3

Prerequisites: NIL

Course Objectives:

1 To enable students to acquire knowledge and develop an understanding of basic concepts and principles of Economics & Finance.
2 To make students acquaint with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector.
3 To sensitize students to the current economic issues of the nation.
4 To develop an understanding of the role of institutions in the functioning of an economy.
5 To enhance financial literacy of engineering students.

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

1 Solve the questions of What, How and for Whom for various economics systems using the concept of Production Possibility Frontier curve.
2 Solve, with the help of Supply and Demand curves, the Equilibrium Price and Quantity for a product or service in various types of market structures.
3 Analyse the performance of different business organisations and various investments using financial ratios and time value of money concept respectively.
4 Evaluate current Fiscal and Monetary policies of the nation by understanding the objectives of Macroeconomics and the role of Indian Financial System.

Unit 1: Central Concepts Of Economics (6 hrs)

Economics as a science of choice and scarcity, Microeconomics and Macroeconomics, Positive & Normative Economics, Basic Economic Problems, Economic Systems-Market, Command and Mixed Economies, Society's Technological Possibilities, Opportunity Cost, Efficiency.

Unit 2: Basic Elements of Supply & Demand (6 hrs)

Concept of Demand- Demand Schedule & Curve, Law of Demand, Determinants of Demand, Concept of Supply- Supply schedule, Supply curve, Equilibrium of Supply and Demand, Market and Market Structures- Perfect Competition, Monopolistic Competition, Oligopoly, Duopoly and Monopoly.

Unit 3: Role and Environment of Managerial Finance (6 hrs)

Role of Finance in business, Forms of business organizations, Goals of the firm, Capital structure-Debt and equity capital, Sources of finance, Time value of money, Risk and Return.

Unit 4: Economic Analysis And Costs (6 hrs)

Cost Concepts- Fixed and Variable Cost, Marginal Cost, Average Cost, Total Cost, Opportunity Cost, Link between production and cost, Break even Analysis, Financial analysis of a business firm- Statement of Profit and Loss, Balance Sheet, Basic Ratios.

Unit 5: Overview of Macroeconomics (6 hrs)

Tools to measure economic activity- GDP, Employment rate, Inflation & Consumer Price Index, Fiscal & Monetary policy

Unit 6: Money And The Financial System (6 hrs)

Evolution of money, Role & Functions of the Financial System, Indian Financial System.

Text Books:

1 Paul A Samuelson, Economics,Indian Adaptation, Sudip Chaudhari,Anindya Sen, Mc Graw Hill (2010), 19th edition.
2 Lawrence J Gitman,Principles of Managerial Finance,Pearson.(2016), 11th edition.
3 K .K. Dewett, Modern Economic Theory,S.Chand (2005).

Reference Books:

1 Geetika, Ghosh P. & Choudhury, P.R. (2018), Managerial Economics,Mc Graw Hill Education,3rd Edition.
2 Thursen Gerald, Engineering Economics,Prentice Hall.(9th edition, 2008).
3 V. Mote, S. Paul, G. Gupta, Managerial Economics,Tata McGraw Hill.(2004).

Websites:

1 www.economicshelp.org
2 www.rbi.org
3 www.khanacademy.org

ME 2105 - Engineering Thermodynamics Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral Examination: 25 marks
Credits: 1

Course Objectives:

1 To study different types of calorimeters to determine calorific value of fuels.
2 To get conversant with various types of boilers.
3 To get conversant with boiler mountings and accessories.
4 To understand boiler performance calculations.
5 To understand performance calculations of vapor compression cycle.

Course Outcomes:

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

1 Conduct trial on calorimeters to determine calorific value of various fuels.
2 Understand different types of fire and water tube boilers.
3 Demonstrate working of various boiler mountings and accessories.
4 Calculate performance parameters of boiler.
5 Determine COP of a system working on vapor compression cycle.

Lab work to be accomplished

1. Determination of calorific value using gas calorimeter.
2. Determination of calorific value using bomb calorimeter.
3. Study of various types of boilers.
4. Study of boiler mountings.
5. Study of boiler accessories.
6. Study of various types of steam traps.
7. Determination of dryness fraction of steam.
8. Trial on boiler to determine boiler efficiency, equivalent evaporation and energy balance.
9. Industrial visit to any process industry which uses boiler and submission of detailed report.
10. Determination of COP of Vapor Compression cycle.

Text Books:

1. P. L. Ballaney, Thermal Engineering: Engineering Thermodynamics and Energy Conversion Techniques, Khanna Publishers
2. S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers.

ME 2106 - Materials' Technology-I Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral Examination: 25 marks
Credits: 1

Course Objectives:

1 To provide firsthand experience of procedures and equipment required for measuring common mechanical properties of material that are specified in component drawings.

Course Outcomes:

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

1 Inspect components and measure mechanical properties of engineering materials using equipments in the laboratory.
2 Propose testing method for mechanical properties considered in design, quality assurance and servicing of engineering components.
3 Prepare reports consisting drawings, graphs, written procedures, observations, results and conclusions.
4 Identify the phases and measure grain size of the material using metallography.
5 Demonstrate an understanding of professional, ethical and social responsibility by applying codes and standard practices on material testing.

Lab work to be accomplished

1. Introduction to Lab safety.
2. Perform Tensile test.
3. Perform Hardness tests (3).
4. Failure analysis based on demonstration of Impact test.
5. Ultrasonic flaw detection.
6. Magnetic particle test.
7. Dye penetrant test.
8. Tasks/ Activity based practical.

ME 2107 - Manufacturing Processes-I Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Practical Examination: 25 marks
Credits: 1

Course Objectives:

1 To practice lathe operations like turning, taper turning, thread cutting etc.
2 To understand various concepts related to pattern making for casting.
3 To understand joint preparation and welding phenomenon.

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

1 Plan different operations like turning, thread cutting, grooving etc. on lathe machine.
2 Analyze and estimate machining time for different operations on lathe machine.
3 Prepare pattern for sand casting.
4 Select welding joints for different applications.

Lab work to be accomplished

1. One job on plain and taper turning and screw cutting.
2. Demonstration of pattern making for sand casting.
3. One simple exercise on welding-preparing a component comprising of welded joints.
4. Demo of turning operation on plastic rod to know the difference in machining of metals and plastics (Any of the commercial plastics like Nylon-6, Nylon-66, Plyster, PET etc.)

Text Books:

1. Elements of Workshop Technology, Hazra Chaudhary Vol I, II.
2. Principles of Modern Manufacturing, Mikell P. Groover, Wiley.
3. Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.

ME 2108 - Machine Drawing Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Practical Examination: 25 marks
Credits: 1

Prerequisites:

1. Engineering Graphics

Course Objectives:

1 To make students to use the drafting software for creating drawing.
2 To make students to understand IS conventions.
3 To make students to draw assembly drawing from part drawing.
4 To make students to draw the sectional view of assembly drawing with part list.

Course Outcomes:

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

1 Draw part drawing of machine component using drafting software.
2 Represent the features of the parts using IS Conventions.
3 Construct an assembly of parts of machine components.
4 Illustrate the sectional assembly drawing using drafting software.

Lab work to be accomplished

Sheet 1: IS conventions

A2 Sheet based on various IS conventions (Manual Drawing sheet) Use CAD software to get conversant with modern tools to develop orthographic projections of simple objects studied in Engineering Graphics. Assembly Drawing and Detail Drawing.

Sheet 2 and Sheet 3: Detail and Assembly Sheet

Sheets based on one Simple Mechanical Assemblies (max. 5 parts) e.g. Plummer Block, Bench Vice, Screw Jack, Foot Valve, Pipe Vice, Machine Vice, Stuffing Box etc. Application and working of the studied assembly, Use BOM. One Full Imperial sheet of details and assembly of this assignment should be prepared on Auto-CAD.

Sheet 4 and Sheet 5: Detail and Assembly Sheet

Sheets based on one Complex Mechanical Assemblies (max. 10 parts) e.g. Tail Stock, Four Jaw Chuck, Tool Head for Shaping Machine etc. Application and working of the studied assembly, Prepare BOM. One Full Imperial sheet of details and assembly of this assignment should be prepared on Auto-CAD.

Text Books:

1. N. D. Bhatt, Machine Drawing. Charotor Publication House, Bombay.
2. Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN 81-85749-79-5.

Reference Books:

1. N. Sidheshwsr, P. Kannaiah and V. V. S. Sastry. Machine Drawing, Tata McGraw Hill, New Delhi.
2. R. K. Dhavan, Machine Drawing. S. Chand and Company
3. Narayana, Kannaiah and Venkatareddv, Machine Drawing, New Age International
4. N. D. Junnarkar Machine Drawing 1st print Pearson Education
5. IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
6. IS: 696- Code of practice for general engineering drawings B.I.S. Publications.
7. IS: 2709-Guide for selection of fits, B.I.S. Publications.
8. IS:919- Recommendation for limits and fits for Engineering, B.I.S. Publications
9. IS: 8000- Part I, II. III. TV, geometrical Tolerancing of technical drawings - B.I.S. Publications.

Autonomous Program Structure
Second Year B. Tech.
Fourth Semester (Mechanical Engineering)
2016 Pattern

Course Code	Course Title	Teaching Scheme Hours/ Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
BSME 2201	Engineering Mathematics - III	3	1	0	50	50	0	0	100	4
ME 2201	Strength of Materials	3	1	0	50	50	0	0	100	4
MM 2202	Fluid Mechanics	3	1	0	50	50	0	0	100	4
ME 2203	Manufacturing Process - II	3	0	0	50	50	0	0	100	3
ME 2204	Rigid Body Dynamics	2	0	0	25	25	0	0	50	2
ME 2205	Material's Technology - II	1	1	0	25	25	0	0	50	2
ME 2206	Fluid Mechanics Lab	0	0	2	0	0	25	0	25	1
ME 2207	Manufacturing Process – II Lab	0	0	2	0	0	0	25	25	1
ME 2208	Rigid Body Dynamics Lab	0	0	2	0	0	25	0	25	1
ME 2209	Material's Technology – II Lab	0	0	2	0	0	25	0	25	1
ME 2210	Solid Modeling Lab	0	0	2	0	0	0	25	25	1
	Total	**15**	**4**	**10**	**250**	**250**	**75**	**50**	**625**	**24**
	Grand Total	**29**			**625**					

BSME 2201 - Engineering Mathematics-III

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:

1. Engineering Mathematics I
2. Engineering Mathematics II

Course Objectives:

1 Mathematics is a necessary path to scientific knowledge which opens new perspective of mental activity.

2 Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyze and solve engineering problems in their respective areas.

Course Outcomes:

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

1 Solve Higher order Linear differential equations, Simultaneous Differential Equations. Mass Spring System.

2 Calculate Mean, Variance, Moments, Probability Distributions.

3 Calculate Divergence, Curl, Directional Derivatives, Solenoidal, Irrotational, Scalar Potential.

4 Find Line Integral, Green's Theorem, Stoke's Theorem, Gauss Divergence Theorem.

5 Apply Laplace Transform, Inverse L.T. Fourier Transform, Inverse F.T.

6 Solve Partial Differential Equations by F. Transforms.

Unit 1: Higher Order Linear Differential Equations and Applications (7 hrs)

Higher order Linear differential Equation with constant coefficients, Simultaneous Differential Equations, Applications in solving Engineering problems.

Unit 2: Statistics and Probability Distribution (6 hrs)

Variance, Standard deviation, Coefficient of variation, Moments, Skewness, Kurtosis, Binomial, Poisson, Normal distribution.

Unit 3: Vector Differentiation (6 hrs)

Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence, Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities.

Unit 4: Vector Integration (6 hrs)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's

theorem. Application to problems in Fluid Mechanics.

Unit 5: Laplace and Fourier Transforms (6 hrs)

Laplace Transform: Definition of Laplace, Inverse Laplace transform, Properties and theorems, LT of standard functions, application of LT for solving Linear Differential Equations.

Fourier Transforms: Fourier integral theorem, sine and cosine integrals, Fourier transform, Fourier Sine and Cosine transform, Inverse Fourier Transform.

Unit 6: Partial Differential Equations (4 hrs)

Basic Concepts, Types of P.D.E.(Hyperbolic, Elliptic, Parabolic) ,Method of separation of variables for solving Wave equation, One and two dimensional heat flow equations . Use of Fourier Transforms for solving of P.D.E.

Text Books:

1 B.S.Grewal, 'Higher engineering Mathematics', Khanna publishers, Delhi (40th Edition),(2008)

2 B. V. Ramana,'Higher Engineering Mathematics ', Tata McGraw Hill Publications (2007).

Reference Books:

1 Peter V. O'neil,'Advanced Engineering Mathematics, Thomson Brooks / Cole, Singapore (5th edition) (2007).

2 Michael D. Greenberg, 'Advanced Engineering Mathematics ', Prentice hall College Div., (1998).

3 C. R.Wylie, L. C. Barrette, 'Advanced Engineering Mathematics', Mc Graw Hill Publications, New Delhi.(6th edition) (2003)

4 Erwin Kreyszig ,'Advanced Engineering Mathematics' Wiley Eastern Ltd.(8th Student Edition), (2004).

5 S. C. Gupta, V.K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition) 2002.

6 N.P. Bali, M. Goyal,'Text book of Engineering Mathematics' Laxmi Publication (P) Ltd. (8^{th} edition), (2011).

ME 2201 - Strength of Material

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:

1. Engineering Mechanics

Course Objectives:

1 To gain knowledge of different types of stresses, strain and deformation induced in the mechanical components due to external loads
2 To study the distribution of various stresses in the mechanical elements such as beams, shafts etc.
3 To study Effect of component dimensions and shape on stresses and deformations

Course Outcomes:

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

1 Demonstrate fundamental knowledge about various types of loading and stresses induced.
2 Draw SFD and BMD for different types of loads and support conditions.
3 Compute and analyze stresses induced in basic mechanical components.
4 Design cross section of beam for slope and deflection in beam.
5 Analyze buckling and bending phenomenon in columns and beams respectively.

Unit 1: Simple Stresses and Strains (7 hrs)

Concept & types of Stresses and strains, Poison's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading.

Unit 2: Shear Force and Bending Moments (9 hrs)

Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contra-flexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments.

Unit 3: Bending and Shear Stresses in Beams (6 hrs)

Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with combined bending, torsion & axial loading of beams.

Unit 4: Slope and Deflection (9 hrs)

Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for Compound slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads .

Unit 5: Torsion Of Circular Members (8 hrs)

Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numerical.

Thin Cylindrical and Spherical Shells: Cylinders and Spheres due to internal pressure. Cylindrical Shell with hemispherical end.

Unit 6: Compound Stresses and Strains (6 hrs)

Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal- planes, Mohr's circle of stresses.

Text Books:

1 Strength of Materials, Subramanyam, Oxford University Press, Edition 200.
2 Mechanics of Materials, Thin Cylindrical and Spherical Shells: B.C Punmia Ashok Jain, Arun Jain, Lakshmi Publications, NewDelhi.

Reference Books:

1 Strength of Materials, Basavarajaiah and Mahadevappa Khanna Publishers, New Delhi..
2 Strength of Materials, Singer Harper and Row Publications..
3 Elements of Strength of Materials, Timoshenko and Young Affiliated East West Press.
4 Mechanics of Materials, James M. Gere (5th Edition), Thomson Learning.
5 Strength of Materials S. Ramamrutham, DhanpatRai Pvt. Ltd.
6 Mechanics of Materials S. S. Rattan, TMH Pvt. Ltd.
7 Mechanics of Structures S. B. Junnarkar, Charotar Publication.
8 Strength of Materials W. Nash, Schaum's Outline Series, McGraw Hill Publication.

ME 2202 - Fluid Mechanics

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:

1. Engineering Physics
2. Engineering Mathematics

Course Objectives:

1 Applying the mass conservation principle, to engineering problems.
2 Applying the momentum and energy equations to engineering problems.
3 Evaluating head loss in pipes and conduits.
4 Introduction to formation of boundary layer and drag and lift concepts associated with it.

Course Outcomes:

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

1 Apply mass conservation principle for the given system.
2 Understand the energy conservation principle for fluid flow.
3 Calculate the pressure drop for given system.
4 Explain the boundary layer formation on the flat plate.

Unit 1: Fluid Properties (6 hrs)

Applications of fluid mechanics, Basic tensor and vector calculus, Definition and characteristics of Fluids, Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematics Viscosity, Surface Tension, Capillarity, Compressibility, Vapor pressure. Pascal's Law, Centre of pressure, Buoyancy and flotation.

Unit 2: Fluid Kinematics (6 hrs)

Eulerian and Lagrangian fluid description, Types of flows (One , two, three dimensional , steady unsteady, uniform, non-uniform, laminar, turbulent, compressible, incompressible, rotational, Irrotational, Visualization of flow field (Stream, Path and Streak line), Fluid Acceleration and Material Derivative, vorticity in two dimensional flow, Control volume approach for solution.

Unit 3: Fluid Dynamics (8 hrs)

Flow Analysis using Control volume Approach, Continuity and Linear momentum Equation. Flow Analysis using differential Approach: Continuity and linear momentum equation. Euler equation of motion, Derivation Bernoulli's equation along and normal to Stream line, application of Bernoulli's equation to Pitot tube, Orifices and Venturi meter.

Unit 4: Internal Flow (6 hrs)

Entrance region and fully developed flow. Pressure and Shear Stress distribution for laminar flow in a pipe and plane Poiseulle flow, Fully developed Turbulent flow, Transition from laminar to turbulent, Velocity profile of Turbulent flow, Introduction to Navier - Stokes Equation and Exact Solution to Plane Poiseulle flow.

Unit 5: Flow through Pipe (6 hrs)

Energy losses through pipe, Major and Minor Darcy-Weisbach equation, Moody's diagram, Dimensional Analysis-Dimensions of physical quantities, dimensional homogeneity, Buckingham pi Theorem, important dimensionless numbers, Model analysis (Reynolds, Froude and Mach).

Unit 6: External Flow (6 hrs)

Boundary layer Structure and Thickness on Flat plate, Effect of Pressure Gradient on Boundary layer, Separation of Boundary Layer and Methods of Control, Lift and Drag concepts , Drag - Pressure and Friction, Drag Coefficient, Lift - Surface pressure Distribution and Circulation.

Text Books:

1 Munson, Okiishi, Young, 'Fluid Mechanics', 7th Ed,Wiley, 2016.
2 Cengel, Cimbala, 'Fluid mechanics', Tata Mcgraw hill publishing.

Reference Books:

1 Gupta and Gupta, 'Fluid Mechanics', 3rd Ed, New Age publications, 2016.
2 Kundu, Cohen, Dowling, 'Fluid Mechanics', Elsevier India.
3 K. Muralidhar, G. Biswas, 'Advance Fluid Mechanics', 3rd Edition, Narosa Publishing House.
4 Fox, Mcdonald, 'Fluid Mechanics', 8th Edition,Wiley.

ME 2203 - Manufacturing Processes-II

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits 3

Prerequisites:

1. Manufacturing Processes - I

Course Objectives:

1 To familiarize with the basic concepts of machining science.
2 To acquaint with various single and multipoint cutting tools designing processes.
3 To make the students understand the economics of machining process.

Course Outcomes:

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

1 Analyze principles and working of different forming processes such as sheet metal working, forging, rolling and extrusion.
2 Evaluate cutting force, power, tool life, surface finish for machining operation.
3 Select an appropriate single or multipoint cutting tool parameter.
4 Apply features and applications of non-traditional machining process.
5 Incorporate use of different locating and clamping devices for jigs and fixture design.

Unit 1: Sheet metal working and forging (8 hrs)

Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working. Forging, other deformation processes related to forging; Wire and Tube drawing; Sheet metal working processes such as blanking, piercing, bending, deep drawing, coining and embossing; defects.

Unit 2: Rolling, Extrusion, shaping process for plastic (7 hrs)

Rolling, extrusion, types and analysis. Plastic: types, plastic production processes, injection molding, compression and transfer molding, blow molding and rotational molding; defects.

Unit 3: Metal Cutting Theory (7 hrs)

Orthogonal and oblique cutting, various types of chips, Mechanics of orthogonal steady state metal cutting, shear plane and shear plane angle, Merchant's circle of forces, velocity relations. Merchant's theory & modified theory of metal cutting. Concept of specific power consumption in machining. Cutting forces measurement using dynamometers.

Cutting fluids: Function of coolant, types of coolants and cooling system. Major tool material types. Tool life and machining economics: types of tool wear Taylor's tool life equation: Components of product cost, Optimum cutting velocity for minimum cost of production and maximum production rate.

Unit 4: Design of cutting tools (6 hrs)

Design of shanks, cutting tip and chip breakers for HSS. Study of machining tool Nomenclature: Various types such as flat form tool, tangential form tool, circular form tool, constructional details and fields of application. Profile design of flat and circular form tools. Nomenclatures of Broach, Drills, Reamers,: Taps and Milling cutters.

Unit 5: Unconventional machining processes (6 hrs)

Classification according to type of energy used for machining, basic principles, machines, applications of Electrical discharge machining (EDM), Electron beam machining (EBM), Plasma arc machining (PAM), Laser beam machining (LBM), Ultrasonic machining (USM), Abrasive jet machining (AJM).

Unit 6: Basic Construction of Jig & Fixture (6 hrs)

Degrees of freedom, redundant location, fool proofing, nesting, Material used. Locators: types and their functions; locating & clamping Devices: Position, types of mechanisms and their functions. Component distortion under clamping and cutting forces. Design of simple Jig and Fixtures.

Text Books:

1 Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication.
2 Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group.

Reference Books:

1 Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press.
2 Cutting Tools, by P. H. Joshi, A. H. Wheeler Publishing Co. Ltd.
3 ASM Handbook, Vol. 16: Machining (9th Edition), by Joseph R. Davis, ASM International.
4 Metal Cutting Theory and Cutting Tool Design, by V. Arshinov and G. Alekseev, Mir publishers, Moscow, Mir Publishers.
5 Production Technology by HMT.
6 Jig and Fixture Design Manual, Erik K. Henriksen, Industrial Press.

ME 2204 - Rigid Body Dynamics

Teaching Scheme
Lecture: 2 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 25 marks
Credits: 2

Prerequisites:

1. Engineering Mathematics.
2. Engineering Mechanics.
3. Physics

Course Objectives:

1 To present the basic principles of rigid body dynamics.

2 To help develop proficiency in applying these principles to formulate and solve dynamics problems.

Course Outcomes:

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

1 Apply impulse/momentum methods to kinetics problems of particles, rigid bodies, and systems.
2 Analyze dependent motion of particles.
3 Analyze planar rigid body kinematics problems.
4 Apply Newton/Euler methods to kinetics problems.
5 Apply work/energy methods to kinetics problems of rigid bodies.

Unit 1: Kinetics of a Particle: Dependant Motion, Impulse and Momentum (4 hrs)

System of Particles - Dependent Motion, Principle of Linear Impulse and Momentum, Principle of Linear Impulse and Momentum for a System of Particles, Conservation of Linear Momentum, Central Impact.

Unit 2: Planar Kinematics of a Rigid Body (8 hrs)

Planar Rigid-Body Motion, Translation, Rotation about a Fixed Axis, Absolute Motion Analysis, Relative-Motion Analysis: Velocity, Instantaneous Centre of Zero Velocity, Relative-Motion Analysis: Acceleration, Relative-Motion Analysis using Rotating Axes (Coriolis Component of Acceleration).

Unit 3: Planar Kinetics of a Rigid Body: Force and Acceleration (5 hrs)

Moment of Inertia, Planar Kinetic Equations of Motion, Equations of Motion: Translation, Equations of Motion: Rotation about a Fixed Axis, Equations of Motion: General Plane Motion.

Unit 4: Planar Kinetics of a Rigid Body: Work and Energy (5 hrs)

Kinetic Energy, Work of a Force, Work of a Couple, Principle of Work and Energy, Conservation of

Energy

Unit 5: Planar Kinetics of a Rigid Body: Impulse and Momentum (6 hrs)

Angular Momentum, Relation Between Moment of a Force and Angular Momentum, Principle of Angular Impulse and Momentum, Linear and Angular Momentum, Principle of Impulse and Momentum, Conservation of Momentum, Eccentric Impact.

Text Books:

1 Engineering Mechanics - Dynamics, R. C. Hibbeler, 12th Edition, Pearson publication.

Reference Books:

1 Engineering Mechanics - Statics and Dynamics, A Nelson, Mc Graw Hill Education.
2 Vector Mechanics for Engineers-Dynamics, Beer and Johnson, Mc Graw Hill Education.
3 Engineering Mechanics- S. Timosenko. DPT.young & J.V.Rao- Tata Mc Graw hill education pvt. Ltd. New Delhi.

ME 2205 - Materials' Technology II

Teaching Scheme
Lecture: 1 Hrs/week
Tutorial: 1 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 25 marks
Credits: 2

Prerequisites:

1 Materials Technology I

Course Objectives:

1 To develop an understanding on modification of material properties.
2 To do material selection.

Course Outcomes:

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

1 Read binary phase diagram, predict and quantify phase transformation using phase diagrams.
2 Select method for modification of properties.
3 Analyze and translate performance requirements of a component into required mechanical properties of material reaching conclusions using first principles of engineering sciences.
4 Apply available methods for selection of material for a given application.

Unit 1: Phase diagrams (5 hrs)

Phase diagrams, cooling curves, plotting of phase diagrams, Iron-iron carbide equilibrium diagram. Non equilibrium cooling and its effects.

Unit 2: Modification of properties (5 hrs)

Strengthening mechanisms; Alloying, cold working, heat treatment methods.

Unit 3: Selection of Materials (5 hrs)

Translation of performance requirements into properties, selection of material for given application, material indices, material selection and specification.

Text Books:

1 "Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016,Second edition.

Reference Books:

1 "Material Science & Engineering." Raghvan V., Prentice Hall of India, New Delhi. 2003.
2 "Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.
3 "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004).

4 “Mechanical Metallurgy”, Dieter, G.E., McGraw-Hill, 1988
5 “Introduction to Physical Metallurgy”, Avner, S.H., Tata McGraw-Hill, 1997
6 “Material selection in mechanical design’, Michael Ashby, Butterworth-Heinemann, 3/e, 2005.

ME 2206 - Fluid Mechanics Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral Examination: 25 marks
Credits: 1

Prerequisites:

1. Engineering Physics

Course Objectives:

1 Introduction to the basics of experimental techniques in fluid mechanics.
2 To present the result in graphical form.
3 To measure pressure drop in a pipe and determine friction factor.
4 To calibrate a flow meter.

Course Outcomes:

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

1 Understand the basic experimental techniques in fluid mechanics.
2 Present the results in graphical form.
3 Measure the pressure drop in a pipe determine friction factor.
4 Understand the process of calibration of flow meters.

Lab work to be accomplished

1. Measurement of Viscosity and Sp. Gravity
2. Measurement of Pressure and velocity
3. Measurement of coefficient of orifice
4. Verification of Bernoulli's theorem
5. Calibration of Venturi/Orifice meter
6. Flow visualization using Reynolds Apparatus
7. Measurement of coefficient of friction in pipe
8. Verification of momentum equation.

Text Books:

1. Instrumentation, Measurements, and Experiments in Fluids, E. Rathakrishnan , CRC Press
2. Fluid Mechanics Measurements Taylor & Francis Inc, Richard J. Goldstein, Taylor & Francis Inc.
3. Springer Handbook of Experimental Fluid Mechanics, by Cameron Tropea (Editor), Alexander Yarin (Editor), John F. Foss (Editor).

ME 2207 - Manufacturing Processes-II Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Practical Examination: 25 marks
Credits: 1

Course Objectives:

1 To practice machining of flat surfaces on shaping and grinding machines.
2 To practice milling, boring and thread cutting operations.

Course Outcomes:

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

1 Develop assembly of different manufactured components using machine tools like lathe machine, drilling machine, milling machine etc.
2 Analyze and estimate machining time for lathe machine, drilling machine, milling machine etc.
3 Express plastic molding.
4 Demonstrate machining of non-metals.

Lab work to be accomplished

1. One composite job consisting of minimum four parts, employing operations on lathe, precision turning, screw cutting, boring etc. and involving the use of milling and grinding operations.
2. Demo of injection molding of plastic component.
3. Demo on machining of Glass Fiber Reinforcement Plastic (GFRP) composite material, Drilling and edge milling operation are to be studied (Any of the commercial available GFRP/Epoxy plates are to be used).

Text Books:

1. Elements of Workshop Technology, Hazra Chaudhary Vol I, II.
2. Principles of Modern Manufacturing, Mikell P. Groover, Wiley.
3. Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.

ME 2208 - Rigid Body Dynamics Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral Examination: 25 marks
Credits: 1

Course Objectives:

1 To present the basic principles of rigid body dynamics.
2 To help develop proficiency in applying these principles to formulate and solve dynamics problems.

Course Outcomes:

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

1 Apply impulse/momentum methods to kinetics problems of particles, rigid bodies, and systems.
2 Apply work/energy methods to kinetics problems of rigid bodies.

Lab work to be accomplished

1. Impact on rigid body
2. Moment of Inertia
3. Conservation of Momentum
4. Conservation of Energy

Lab of Assignments:

1. Three to five assignments based on the theory topics will be given during the semester.

ME 2209 - Materials' Technology-II Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral Examination: 25 marks
Credits: 1

Course Objectives:

1 To provide first-hand experience of facilities for materials property testing and treating.
2 To provide an understanding of structures in material and their relation to properties.

Course Outcomes:

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

1 Identify the phases and measure grain size of the material using metallography.
2 Provide interpretation of microstructures and prepare a laboratory report.
3 Apply correlation of science, mathematics and engineering principles to material processing and modify properties of steel by modifying microstructure using different heat treatments. 4 Understand and use methods utilized for selection of materials.

Lab work to be accomplished

1. Metallurgical microscope and metallographic preparation of specimen.
2. Study and draw microstructure of steel.
3. Study and draw microstructure of Cast iron.
4. Study and draw microstructure of Non ferrous metal and alloys.
5. Task based activity to measure, predict and achieve a certain set of mechanical properties in a material. This will involve conducting test, working on feasibilities, planning heat treatment and achieving results.
6. Study of material selection methods.

ME 2210 - Solid Modelling Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Practical Examination: 25 marks
Credits: 1

Course Objectives:

1 To develop an ability to create a 3D solid model of machine components.
2 To develop an ability to create 3D assembly model of mechanical system.
3 To demonstrate the rapid prototyping..

Course Outcomes:

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

1 Create 3D machine components by using a solid modeling software package.
2 Create 3D assemblies of mechanical systems.
3 Create manufacturing drawing with required tolerances.
4 Create parametric solid model of a machine component.

Lab work to be accomplished

1. Assignment on Solid modeling of simple and intricate machine and automobile components.
2. Assignment on parametric solid modelling of a machine component using various commands and features of software.
3. Assignment on assembly modeling.
4. Generation of production drawing of the parts and assembly with appropriate tolerances.
5. Assignment on rapid prototyping.

Text Books:

1. N. D. Junnarkar Machine Drawing 1st print Pearson Education.
2. N. D. Bhatt, Machine Drawing. Charotor Publication House, Bombay.
3. Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN 81-85749-79-5.

Autonomous Program Structure of
Third Year B. Tech.
Fifth Semester (Mechanical Engineering)
2016 Pattern

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 3101	Computer Oriented Numerical Methods	3	0	0	50	50	0	0	100	3
ME 3102	Analysis and Synthesis of Mechanisms	3	1	0	50	50	0	0	100	4
ME3103	Heat Transfer	3	1	0	50	50	0	0	100	4
OEHS 3101	Open Elective - 1	3	0	0	50	50	0	0	100	3
PEME 3101	Program Elective - 1	3	0	0	50	50	0	0	100	3
ME 3104	Computer Oriented Numerical Methods lab	0	0	2	0	0	25	0	25	1
ME 3105	Analysis and Synthesis of Mechanisms lab	0	0	2	25	0	0	0	25	1
ME 3106	Heat Transfer lab	0	0	2	0	0	0	25	25	1
PEME 3102	Program Elective - 1 lab	0	0	2	0	0	0	25	25	1
ME 3107	Manufacturing Processes - III Lab	0	0	2	0	0	25	0	25	1
AC 3101	Audit Course	0	0	2			0	0	0	0
	Total	**15**	**2**	**12**	**275**	**250**	**50**	**50**	**625**	**22**
	Grand Total	**29**			**525**		**100**			

OEHS 3101: Open Elective-1

1) Entrepreneurship Development
2) Introduction to digital marketing
3) Intellectual Property Rights
4) Project Management

PEME 3101: Program Elective - 1

PEME 3102: Program Elective - 1 lab

1) Automation and Control engineering
2) Advanced Fluid Mechanics
3) Tool Engineering
4) Non-Destructive Evaluation and Testing

AC 3101: Audit Course: Employability Skills development

ME 3101 – Computer Oriented Numerical Methods

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Engineering Mathematics

Co-requisites:
1. Heat Transfer

Course Objectives:

1	To understand numerical errors and error propagation.
2	To apply numerical methods for finding root of the equation.
3	To solve simultaneous linear algebraic equations by numerical methods.
4	To use numerical methods for curve fitting and interpolation.
5	To apply numerical methods for integration and differentiation
6	To implement numerical techniques for ordinary and partial differential equations.

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

1	understand errors and error propagation.
2	apply numerical method for finding root of the equation
3	solve simultaneous linear algebraic equations using numerical methods
4	formulate curve fitting equations and interpolating polynomials.
5	apply numerical methods for integration and differentiation
6	obtain approximate solution of ordinary and partial differential equations applying numerical techniques.

Unit 1: Roots of Equations and Errors (6 hrs)
Bisection method, Newton Raphson method, Successive approximation method
Types of errors, error propagation

Unit 2: Simultaneous Equations (8 hrs)
Gauss elimination method, LU decomposition method, Thomas algorithm for tridiagonal matrix, Jacobi iteration method, Gauss Seidel method

Unit 3: Curve Fitting and Interpolation (7 hrs)
Least square technique- straight line, quadratic equation, power equation, exponential equation
Interpolation- Newton's forward interpolation, Lagrange's Interpolation, Spline interpolation

Unit 4: Numerical Integration and Differentiation (7 hrs)
Numerical Integration: trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Gauss quadrature, double integration.
Numerical Differentiation: Basic finite difference methods

Unit 5: Ordinary and partial differential equations: (14 hrs)
Taylor series method, Euler method, Runge Kutta fourth order method, Runge Kutta 2^{nd} order method for simultaneous equations
Introduction to Finite difference method, Elliptic equation, Parabolic equation

Suggested Texts and Reference Materials:

1. Steven C Chapra, Raymond P. Canale, Numerical methods for engineers, Tata McGraw Hill
2. Steven C Chapra, Applied numerical methods with MATLAB for engineers and scientists, Tata McGraw Hill
3. Dr. B.S. Grewal, Numerical methods in Engineering and science, Khanna Publishers
4. E. Balagurusamy, Numerical methods, Tata McGraw Hill
5. Laurene Fausett, Applied Numerical analysis using MATLAB, PHI
6. P.Kandasamy, K.Thilagavathy, K.Gunavathi, Numerical Methods, S. Chand

ME 3102 - Analysis and Synthesis of Mechanisms

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:
1. Engineering Mechanics
2. Rigid Body Dynamics

Course Objectives:

1	To understand basics of planar kinematics of Rigid Bodies
2	To understand drawing velocity and acceleration diagram for simple mechanism
3	To understand how to apply concept of dynamic analysis of mechanisms
4	To understand how to construct and analyze Cam profile
5	To understand how to investigate gyroscopic principles

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

1	Identify nature of kinematic pair, chains and mechanisms
2	Synthesis and Analysis of Mechanism: velocity and acceleration of links in four bar and slider crank mechanisms
3	apply concept of dynamic analysis of mechanisms for slider crank mechanism
4	determine devices for simple motions and tasks
5	construct and analyze Cam profile
6	investigate gyroscopic principles for given applications

Unit 1: Planar Kinematics of Rigid Bodies (Review) 4 Hrs.
Review of types of motions, position, velocity and acceleration

Unit 2: Fundamentals and Types of Mechanisms 8 Hrs.
Kinematic link, Types of links, Kinematic pair, Types of constrained motions Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility),Kutzbach crieterion, Grubler's criterion, Grashoff's law, Four bar chain and its inversions, Slider crank chain and its inversions, Double slider crank chain and its inversions,
Straight line mechanisms: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism, watt mechanism
Steering gear mechanisms: Condition for correct steering, Davis and Ackermann steering gear mechanism

Unit 3: Displacement, Velocity and Acceleration Analysis of Mechanisms 9 Hrs.
Analytical and Graphical method for displacement, Position analysis of links with vector and complex algebra methods, Loop closure equation, Chase solution, input and output curves, Transmission angle

Analytical Method - Velocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods.
Graphical Method - Velocity and Acceleration polygons for simple mechanisms as well as for the mechanisms involving Coriolis component of acceleration, ICR method

Unit 4: Dynamic Analysis of Mechanisms **5 Hrs.**

Dynamic force analysis of reciprocating engine mechanism, Crank shaft torque, Introduction to T-θ diagram.

Unit 5: Dimensional Synthesis of Mechanisms: Analytical and Graphical Method **8 Hrs.**

Introduction to Synthesis of Mechanisms - Type, number and dimensional synthesis. Tasks of Dimentional synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors.

Graphical Method: Two and three position synthesis of four bar and slider crank Mechanisms

Analytical Method: Three position synthesis of four bar mechanism using Freudenstein's equation

Unit 6: Cam and Follower, Gyroscopic action **8 Hrs.**

Types of cams and followers, analysis of follower motions, Synthesis of CAM Profile (Graphical Approach), pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam

Motion of Rigid Bodies in three dimensions,Gyroscopes, Gyroscopic forces and Couples, Gyroscopic effects in Machines

Brief description of tutorial activities:

1	Planar Kinematics of Rigid Bodies (Review)
2	Fundamentals of Mechanisms
3	Mobility and Range of Movement
4	Types of Mechanisms
5	Displacement Analysis of Mechanisms: Analytical and Graphical Method
6	Velocity and Acceleration Analysis of Mechanisms: Analytical and Graphical Method
7	Dynamic Analysis of Mechanisms
8	Dimensional Synthesis of Mechanisms: Analytical and Graphical Method
9	Cam and Follower
10	Gyroscopic action

Text Book:

1 S. S. Ratan, "Theory of Machines", Tata McGraw Hill

References:

1 Asok Kumar Mallik, Amitabha Ghosh, Gunter Dittrich, "Kinematic Analysis and Synthesis of Mechanisms"

2 Thomas Bevan, "Theory of Machines" CBS Publisher and Distributors, Delhi

3 Ashok G. Ambekar, "Mechanism and Machine Theory", Prentice Hall, India

4 Sadhu Singh, "Theory of Machines", Pearson

5 Shigley J. E., and Uicker J.J., "Theory of Machines and Mechanism", McGraw Hill Inc.

6 Hall A. S., "Kinematics and Linkage Design", Prentice Hall

7 Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery", Person Education

8 Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice -Hall, India

ME 3103 – Heat Transfer

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:
1. Engineering Physics
2. Fluid Mechanics

Course Objectives:

1	To apply basic laws of heat transfer to ascertain the heat transfer rate,
2	To formulate heat conduction equation using given boundary conditions
3	To identify the requirement of extended surfaces for heat transfer enhancement
4	To ascertain the heat transfer rate in forced and natural convection
5	To predict the radiation heat transfer with the use of radiation shield for given application
6	To calculate efficiency of heat exchanger

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

1	apply laws of heat transfer to calculate the heat transfer rate in steady and transient state heat conduction in solids and insulation thickness and critical radius of insulation.
2	formulate the equation for heat conduction with heat generation applying suitable BC's
3	evaluate the requirement of extended surfaces for heat transfer and calculate the heat transfer enhancement using it.
4	Evaluate the convective heat transfer rate using appropriate correlations
5	predict the heat transfer rate in radiation mode and with the use of radiation shield
6	calculate the efficiency of heat exchanger for given set of operating conditions

Unit 1: Steady State Conduction Heat Transfer **9 Hrs.**
Modes of Heat transfer, Fourier's law of heat conduction. Steady heat conduction in 1 – D systems. Heat conduction in composite slab. Heat conduction with internal heat heat generation. Heat transfer through extended surfaces. Critical radius of insulation and insulating materials

Unit 2: Transient Heat Conduction Analysis **6 Hrs.**
Transient heat conduction in solids using lumped heat capacity analysis

Unit 3: Convection Heat Transfer **9 Hrs.**
Mechanism of convection heat transfer, Energy Equation, Forced convection over flat plate, cylinder and sphere. Concepts of thermal and velocity boundary layer, Empirical correlations. Forced Convection in a pipe, thermal Entrance region, Empirical correlations, Reynolds and Colburn's analogy. Non dimensional parameters and its significance.
Natural convection over vertical flat plate and cylinder. Non dimensional parameters and its significance.

Unit 4: Radiation Heat Transfer **8 Hrs.**
Fundamental concepts and laws of radiation, Black and Gray body radiation analysis, Radiation between two gray surfaces, Radiation shields.

Unit 5: Heat Exchangers **8 Hrs.**

Introduction and classification. Overall heat transfer coefficient. Heat exchanger analysis using LMTD and NTU method. Effectiveness of heat exchanger.

Brief description of tutorial activities:

1 Conduction
2 Convection
3 Radiation
4 Heat Exchangers

Suggested Texts and Reference Materials:

1 F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley
2 Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3 S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.

PEME 3101 Program Elective I – (A) Automation and Control Engineering

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Fluid mechanics.
2. Electronics and Electrical Engineering.

Course Objectives:

1	To familiarize with the basic concepts of industrial automation
2	To acquaint with the concept of low cost automation with pneumatic and hydraulic systems.
3	To acquaint with the concepts related to fluid power.
4	To familiarize with the elements of control systems.

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

1	Identify automation need, level, required components and process control.
2	Analyze given needs of automation to design Hydraulic circuit(s)
3	Analyze given needs of automation to design Pneumatic circuit(s).
4	Justify selected component(s)/system from given catalogue(s) for automation application under study.

Unit 1: Introduction to Automation **4 Hrs.**
Definition; Automation in production systems; Automation principles and strategies; Basic elements of an automated system; Advanced automation functions; Levels of automation; Types of automation; Benefits and Impact of Automation in Manufacturing and Process Industries, Architecture of Industrial Automation Systems

Unit 2 Hydraulic and pneumatic devices **8 Hrs.**
Hydraulic and pneumatic devices: Different types of valves: DCV,FCV,PCV, Actuators and auxiliary elements in Pneumatics and hydraulics, their applications and use of their ISO symbols

Unit 3: Hydraulic systems **8 Hrs.**
Basic hydraulic circuits involving linear and rotary actuators. Fundamental concepts of digital and servo hydraulic controls. Comparison between proportional, digital and servo hydraulic control systems.

Unit 4: Pneumatic systems **8 Hrs.**
Basic Pneumatic circuits involving linear and rotary actuators. Design of Pneumatic circuits using Cascade method and Shift register method (up to 3 cylinders). Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves with and without grouping. Design of Pneumatic circuits using PLC Control (ladder programming only and up to 3 cylinders) with applications of Timers and Counters and concept of Flag and latching.

Unit 5: Assembly line Automation **8 Hrs.**

automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing & part escapement systems Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc

Unit 6: Fundamentals of Control System **4 Hrs.**

Control system concepts, classification of control systems, mathematical representation of system equations, response characteristics of components and systems through classical solution

Suggested Texts and Reference Materials:

1 Anthony Esposito, Fluid power with applications, 7 th Edn., 2008, Prentice Hall. 2. M P.
2 Groover, Industrial Robotics: Technology, Programming and Applications, McGrawHill, 2 nd Edn., 2012, ISBN: 9780070265097
3 Automation, Production Systems, and Computer-integrated Manufacturing (3rd Edition), by Mikell P. Groover, PHI Learning Private Limited, New Delhi.
4 Pneumatic Controls, by Joji P., Wiley India Pvt. Ltd
5 Principles Of Control Systems, by U.A.Bakshi, V.U.Bakshi, Technical Publications Pune .
6 Pneumatics Basic Level, by Peter Croser, Frank Ebel, Festo Didactic GmbH & Co. Germany
7 Electropneumatics Basic Level, by G. Prede, D. Scholz, Festo Didactic GmbH & Co. Germany.
8 Introduction to Hydraulics and Pneumatics, by S.Ilango and V. Soundararajan, PHI Learning Pvt. Ltd. New Delhi
9 Vickers Industrial Hydraulics Manual (3rd Edition), Vickers Inc.; Maumee, OH. Hydraulic and Pneumatic Controls (2nd Edition), by R. Srinivasan, Vijay Nicole Imprints Pvt. Ltd. Chennai.

PEME 3101 Program Elective I – (B) Advanced Fluid Mechanics

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:

1. Engineering Physics
2. Engineering mathematics
3. Fluid Mechanics

Course Objectives:

1	To Interpret the mathematical and physical foundations of the continuum mechanics of fluids,
2	To apply the conservation laws to viscous, inviscid, incompressible flows; and boundary layer flows
3	Be able to apply the principles of fluid mechanics to solve engineering problems and to design systems or components to meet desired needs
4	To derive the generic form of N-S equation and able to deduce an analytical solution for simple fluid mechanics problems.

Course Outcomes:

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

1	Student will be able understand the concepts of continuum mechanics of fluids,
2	Student will be relate the conservation laws to different types of fluid flow conditions
3	Student will produce the solution for complex fluid mechanics problems and to design system using fundamental principles.
4	Student will derive the generic form of N-S equations and illustrate the analytical solution for simple flow problems

Unit 1: Reynolds Transport Theorem **9 Hrs.**

Brief recapitulation of some preliminary concepts of Fluid Mechanics: Fluid Kinematics , RTT, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation.

Unit 2: Navier Stokes Equation **6 Hrs.**

Dynamics of viscous flows - Derivation of Navier-Stokes equation

Unit 3: Exact Solution of N-S Equations **9 Hrs.**

Some exact solutions of Navier-Stokes equation- Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows.

Unit 4: Introduction to turbulence **8 Hrs.**

Fundamental concepts turbulence, Prandtl mixing length theory, Turbulent stresses, Turbulence modelling concept and requirement

Unit 5: Boundary Layer theory **8 Hrs.**

Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct.

Unit 6: Compressible Flow **8 Hrs.**

Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Fanno and Rayleigh curve, Mach waves, Oblique shock wave,

Suggested Texts and Reference Materials:

1 Introduction to Fluid Mechanics R. Fox and A. MacDonald, John Wiley and Sons
2 Introduction to Fluid Mechanics and Fluid Machines: S. K. Som, Gautam Biswas and Suman Chakraborty, McGraw-Hill Education
3 Fluid Mechanics and its Applications, Vijay Gupta Santosh Gupta New Age international
4 Fluid Mechanics: Pijush K. Kundu, Ira M. Cohen, David R Dowling, Academic Press

PEME 3101 Program Elective I – (C) Tool Engineering

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Materials Technology
2. Manufacturing Process

Course Objectives:

1	Student will be able to learn cutting tool nomenclature of single point cutting tool, drill, milling cutter etc.
2	Student will able to understand cutting tool parameters on which different cutting tools are designed.
3	Student will able to draw technical drawing of cutting tools with its nomenclature.

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

1	select proper material for cutting tools depending upon different machining conditions
2	Apply appropriate cutting tool parameters (viz. rack angle, clearance angle, etc.) to design of tools
3	design different cutting tools depending upon cutting forces in machining operation

Unit 1: Introduction to Tool Engineering **4 Hrs.**
Introduction,Tool Classifications, Tool Design Objectives , Tool Design in manufacturing Challenges and requirements- Standards in tool design.

Unit 2: Design of single Point cutting tools **9 Hrs.**
Cutting tool forces, Selection of different cutting tool angles, design tool on basis of bending and stiffness, design of form tools

Unit 3: Design of Milling Cutters **9 Hrs.**
Force calculation in up and down milling, selection of milling cutter depending upon applications,

Unit 4: Design of Twist Drill **9 Hrs.**
Drill nomenclature , Point angle selection, shank diameter section morse taper selection, Taps and selection of taps

Unit 5: Design of Broach **9 Hrs.**
Force Calculation, Pull /Push broach selection, chip breaker design,

Suggested Texts and Reference Materials:

1	Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2	Haslehurst M., "Manufacturing Technology", The ELBS, 1978
3	Fundamentals of tool design ASTME PHI.
4	Doyal Tool engineering

PEME 3101 Program Elective I – (D) Non Destructive Evaluation and Testing

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Materials technology 1
2. Materials technology 2
3. Basic Physics

Co-requisites:
Manufacturing Process

Course Objectives:

1	To educate on the concept of fault tolerance in components
2	The course aims to provide an insight on the applications of fundamental sciences to Non Destructive Testing (NDT)
3	To understand the capabilities of non destructive test methods.
4	The course aims to make the students aware of codes, standards

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

1	Predict the source of flaw
2	Characterise the flaw
3	Propose an appropriate method of NDT.
4	Interpret and apply codes and standards in the NDT practices

Unit 1: Origins and significance of flaws (9 hrs)
Overview of Manufacturing process related flaws. Type of flaws arising out of casting, forging, rolling, Welding, Extrusion. Definitions, Identification, risk assessment.

Unit 2: Surface and near surface Non Destructive methods (10 hrs)
Dye Penetrant test: Principle, Theory, Methods and techniques,
Basic principle and Theory of Magnetism, Magnetic particle test: Techniques, methods, Interpretation and evaluation, Magnetic particle test equipment and its calibration, field indicators.

Unit 3: Volumetric non destructive methods (10 hrs)
Ultrasonic Flaw detection: Acoustic principles, Basic principles of instrument, Methods of testing, Transducer material properties and sizes, calibration, Various scan techniques: A scan, B scan, C scan.
Radiography: X-ray and gamma ray and their properties, Image formation, image quality sharpness, accuracy. Interpretation of X ray images, Safety, health and license considerations in radiography

Unit 4: NDT practices (9 hrs)

Visual testing, Report writing and data presentation, Acquaintance with codes, standards, specification, and inspection practice.

Suggested Texts and Reference Materials:

1 ASM Metals Handbook, Vol. 17, Nondestructive Evaluation and Quality Control.
2 Baldev Raj, T JayaKumar, M. Thavasimuthu, "Practical Non Destructive testing", Narosa Publishing House, 3e
3 Subramanian C.V., "Practical Ultrasonics", Narosa Publishing house, 2008
4 ASNT Continuing education in Non destructive testing manuals, Level II.
5 ASME Section V, VIIID, I and Section IX.

ME 3104 Computer Oriented Numerical Methods Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Prerequisites:
1. Engineering Mathematics

Co - requisites:
1. Heat Transfer

Course Objectives:
1. To use numerical methods to solve problems.
2. To use mathematical solver.
3. To prepare flowcharts for numerical methods.
4. To write programs for numerical methods.

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. apply numerical methods to solve problems.
2. use Matlab solver.
3. prepare flowcharts for numerical methods.
4. write computer programs to obtain solution using numerical methods

List of Practical Activities:

Implementation of solution algorithms and write efficient Matlab code for following class of problems;

I. Finding roots of equations
II. Solving systems of algebraic equations
III. Curve fitting
IV. Interpolation
V. Numerical differentiation
VI. Numerical integration
VII. Solutions of ordinary differential equations including:
    a. Initial value problems
    b. Systems of equations
VIII. Solutions of partial differential equations including:
    a. Initial value problems
    b. Boundary condition problems

Text Book:

1. Steven C Chapra, Raymond P. Canale, Numerical methods for engineers, Tata McGraw Hill

ME 3105 Analysis and Synthesis of Mechanisms Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In semester: 25 marks
Credits: 1

Prerequisites:
1. Engineering Mechanics
2. Rigid Body Dynamics

Course Objectives:
1. To understand drawing velocity and acceleration diagram for simple mechanism
2. To understand how to apply concept of dynamic analysis of mechanisms
3. To understand how to construct and analyze Cam profile
4. To understand how to investigate gyroscopic principles

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. identify nature of kinematic pair, chains and mechanisms
2. construct and analyze velocity and acceleration of links in four bar and slider crank mechanisms
3. determine devices for simple motions and tasks
4. construct and analyze Cam profile
5. investigate gyroscopic principles for given applications

List of Experiments:

1. To draw mechanisms for practical applications
2. To Draw Straight Line Mechanisms
3. Velocity and acceleration analysis using Graphical methods - Polygon and ICR
4. Velocity and acceleration analysis using Graphical methods - polygons involving Coriolis component and Klein's construction
5. To synthesize the four bar and slider crank mechanisms using relative pole and inversion methods with three precision positions
6. To draw the cam profiles
7. To verify the cam jump phenomenon for an eccentric cam
8. To verify the gyroscopic principles
9. Introduction to software of Analysis and Synthesis of Mechanisms

Text Book:

1 S. S. Ratan, "Theory of Machines", Tata McGraw Hill

ME 3106 Heat Transfer Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In semester: 25 marks
Credits: 1

Prerequisites:
1. Engineering Mathematics
2. Engineering Physics
3. Fluid Mechanics

Co - Requisites:
1. Heat Transfer

Course Objectives:
1. To Conduct experiments involving steady state heat transfer phenomenon
2. To Analyze and process the experimental data/observations to ascertain the heat transfer To illustrate the results in the graphical form
3. To Illustrate the results in the graphical form
4. To Compare the results with available theoretical/experimental results and deduce the conclusion from it

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. Conduct experiments involving steady state heat transfer phenomenon
2. Analyze and process the experimental data/observations to ascertain the heat transfer rate
3. Illustrate the results in the graphical form to find the nature of temperature variation over time and length
4. Compare the results with available theoretical/experimental results and deduce the conclusion from it

List of Experiments:

1. Determination of Thermal Conductivity of insulating powder
2. Determination of Thermal Conductivity of metal rod
3. To study the unsteady state heat transfer
4. Determination of heat transfer coefficient in Natural Convection
5. Determination of heat transfer coefficient in Forced Convection
6. Determination of Emissivity of a Test surface
7. Determination of Stefan Boltzmann Constant
8. Determination of efficiency of heat exchanger

Text Book:
1. C P Kothandaraman S Subramanayam, Heat and Mass transfer data book, New Age International, 8th Edition, 2014.

PEME 3102 Program Elective I Lab – (A) Automation and control Engineering Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Prerequisites:
1. Basic Electronics
2. Fluid Mechanics

Course Objectives:
1. To familiarize with different valves and control systems for pneumatics/hydraulic, electro-pneumatics /electro-Hydraulic circuits
2. To familiarize with setup and execution of pneumatics/hydraulic, electro-pneumatics /electro-Hydraulic circuits on an experimental kit

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. Set up and execute Hydraulic circuit(s) using experimental kit.
2. Set up and execute Pneumatic circuit(s) using experimental kit.
3. Design Hydraulic/Pneumatic/Electro Pneumatic circuit for defined automation application.
4. Justify selected component(s)/system from manufacturer's catalogue(s) for automation application under study.

List of Experiments:

1. Study of Basic circuits using Hydraulics Trainer Kit
2. Study of Basic circuits using Pneumatics Trainer Kit
3. Study of Basic circuits using Electro Hydraulics Trainer Kit
4. Study of Basic circuits using Electro Pneumatic Trainer Kit
5. Analyze Hydraulic circuit(s) and simulate for different working conditions
6. Analyze Pneumatic circuit(s) and simulate for different working conditions
7. Design Hydraulic/Pneumatic system for suitable automation application using manufacturers catalogues
8. Report of field visit to any automation Industry/Environment.

ME 3102 Program Elective I Lab – (B) Advanced Fluid Mechanics Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Prerequisites:
1. Engineering Mathematics
2. Engineering Physics
3. Fluid Mechanics

Course Objectives:
1. To understand basics of numerical analysis
2. To analyze and process the experimental data/observations pertaining to fluid mechanics
3. To interpret the results obtained from numerical analysis
4. To Compare the results with available theoretical/experimental results and deduce the conclusion from it

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. understand basics of numerical analysis
2. To analyze and process the experimental data/observations pertaining to fluid mechanics
3. interpret the results obtained from numerical analysis
4. Compare the results with available theoretical/experimental results and deduce the conclusion from it

List of Experiments:

1. Determination of boundary layer thickness
2. Determination of shear force on plate
3. Determination of drag on airfoil
4. Determination of Cd and CL for Sphere
5. Determination of Cd and CL for Cylinder
6. Laminar flow through a pipe (Friction factor, Entry length, Velocity Profile)
7. Turbulent flow through a pipe (Friction factor, Entry length, Velocity Profile)

ME 3102 Program Elective I Lab – (C) Tool Engineering Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Prerequisites:
1. Basic Electronics
2. Fluid Mechanics

Course Objectives:
1. Student will be able to learn cutting tool nomenclature of single point cutting tool, drill, milling cutter etc.
2. To familiarize design parameters of cutting tools
3. Student will able to draw technical drawing of cutting tools with its nomenclature.

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. Select proper material for cutting tools depending upon different machining conditions
2. Select appropriate tool parameters (viz. rack angle, clearance angle, etc.)
3. Design different cutting tools depending upon cutting forces in machining operation.

List of Experiments:

1. Design and Draw Form Tool
2. Design and Draw Milling Cutter
3. Design and Draw Broach
4. Design and Draw Twist Drill
5. Design and Draw Tap
6. Experimental investigation on tool Economics

ME 3102 Program Elective I Lab – (D) Non Destructive Evaluation and Testing Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Prerequisites:
1. Materials Technology 1
2. Materials technology 2
3. Manufacturing process

Course Objectives:
1. To understand the application of the tools at hand to maximize the efficiency and quality of inspections.
2. To understand the context of NDT in the process of making safe components.
3. To conduct non destructive testing

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. Set up and calibrate non destructive testing equipment
2. Use techniques for proper examination of objects under inspection, ensuring strict adherence to safety regulations.
3. Interpret and evaluate results with respect to applicable codes, standards, and specifications.

List of Experiments:
1. Task based practical on Visual Inspection
2. Interpretations and discussions
3. Task based practical on Dye penetrant test
4. Interpretations and discussions
5. Task based practical on Magnetic particle test
6. Discussions and interpretations
7. Task based practical on Ultrasonic flaw detection
8. Discussions and interpretations

ME 3107 Manufacturing Processes III Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Course Objectives:

1. To study conventional machining operations.
2. Understand the different types of cutting of ferrous and non-ferrous metals by various methods and welding processes and characteristics.
3. Understand the concepts of unconventional machining process, types of unconventional machining process.

Course Outcomes:

Learner will be able to:

1. Select required manufacturing process for selected component.
2. Analyze and estimate machining time for lathe machine, drilling machine, milling machine etc.
3. Estimate approximate cost of assembly; prepare conferral (investiture) of manufactured assembly.
4. Understand codes used in programing for CNC machine and basics of manufacturing selected component on CNC machine.

Course Contents:

Manufacture assembly involving following operations of minimum 5 components.

1. Turning, Step turning, Taper turning, Grooving, Precision turning, Thread cutting, knurling,
2. Shaping, Drilling, Milling, Grinding, Welding or suitable joining process.
3. Use of CNC machine for precision manufacturing.

Term Work:

Manufacture any one assembly from following assembly list:

1. Press Tool Assembly.
2. Couplings.
3. Joints.
4. Wheel Support Assembly.
5. Bearing Puller.

Text Book:

1. Elements of Workshop Technology, Hazra Chaudhary Vol I, II.

Reference Books:

1. Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.
2. Workshop Technology part I, II & III, W. A. J. Chapman.
3. Introduction to Manufacturing Processes, John A. Schey, McGraw-Hill.

Autonomous Program Structure of
Third Year B. Tech.
Sixth Semester (Mechanical Engineering)
2016 Pattern

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 3201	Applied Thermodynamics	3	1	0	50	50	0	0	100	4
ME 3202	Machine Design	3	1	0	50	50	0	0	100	4
ME3203	Metrology And Quality Control	3	0	0	50	50	0	0	100	3
PEME 3201	Program Elective - II	3	0	0	50	50	0	0	100	3
PEME 3202	Program Elective - III	3	0	0	50	50	0	0	100	3
ME 3204	Applied Thermodynamics Lab	0	0	2	25	0	0	0	25	1
ME 3205	Machine Design lab	0	0	2	0	0	25	0	25	1
ME 3206	Metrology And Quality Control lab	0	0	2	0	0	0	25	25	1
PEME 3203	Program Elective - III Lab	0	0	2	0	0	25	0	25	1
ME 3207	Seminar	0	0	2	25	0	0	0	25	1
AC 3201	Audit Course	0	0	2	0	0	0	0	0	0
	Total	15	2	12	300	250	50	25	625	22
	Grand Total	29			550		75			

PEME 3201: Program Elective - II

1) Machines and mechanisms
2) Gas Turbine
3) Press Tool Design
4) Nanotechnology
5) Swayam Online Course

PEME 3202: Program Elective - III

PEME 3203: Program Elective – III lab

1) Computational Fluid Dynamics
2) Mechanics of Composite Materials
3) Piping Engineering
4) Jig and Fixture Design

AC 3102: Audit Course: Employability Skills development

ME 3201 Applied Thermodynamics

Teaching Scheme
Lecture: 3 Hrs/week
Tutorial: 1Hr/week

Examination Scheme
In Semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisite:
1. Engineering Thermodynamics
2. Fluid mechanics
3. Heat Transfer

Course Outcomes:
Students will be able to
1. comprehend combustion processes and cycles in IC engines.
2. ascertain the performance parameters of IC engines from given data.
3. evaluate isothermal and volumetric efficiency of reciprocating compressor
4. analyse refrigeration cycles and calculate COP.
5. plot psychrometric processes and perform air conditioning load calculations
6. construct velocity triangles of turbo machines.

Unit 1: IC Engines (10 Hrs)
Fuel air cycle, actual cycle, combustion in SI engine, combustion in CI engine, Testing and performance of IC engines

Unit 2: Reciprocating Air Compressors (8 Hrs)
Computation of work done, isothermal efficiency, volumetric efficiency, free air delivery, multi-staging of compressor, inter-cooling and after-cooling, capacity control of compressor

Unit 3: Refrigeration (8 Hrs)
Basic refrigeration cycles, cascade and multistage refrigeration, vapor absorption system

Unit 4: Psychrometry (8 Hrs)
Basic concepts and definitions, psychrometric chart, Analysis of various psychrometric processes

Unit 5: Introduction to Turbomachinery (6 Hrs)
Classification of turbo machines, comparison with positive displacement machines, fundamental equation governing turbo machines, velocity triangles and their analysis.

Text Books:

1. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill
2. M. L. Mathur and R. P. Sharma, A course in Internal Combustion Engines
3. S. Domkundwar, C. P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & Co.
4. Arora C. P. , Refrigeration and Air Conditioning, Tata McGraw-Hill
5. Manohar Prasad, Refrigeration and Air Conditioning , Wiley Eastern ltd

6. Manohar Prasad, V.kadambi, An introduction to energy Conversion: Turbomachinery, Volume III, New Age International (P)Ltd

References:

1. Dossat Ray J, Principles of refrigeration, Willey Eastern Ltd
2. Stockers W.F. and Jones J.W. , Refrigeration and Air Conditioning, McGraw Hill International
3. ASHRAE and ISHRAE handbooks

ME 3202 – Machine Design

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: 1 Hr/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 4

Prerequisites:

1. Engineering Mechanics
2. Rigid Body Dynamics
3. Strength of Materials
4. Machine Drawing

Course Objectives:

1. To design simple machine elements subjected to static loads.
2. To compute the torque transmission capacity by the given power screw.
3. To analyse the machine elements subjected to fluctuating loads.
4. To apply A.S.M.E. code for shaft design.
5. To calculate the size of a mechanical joint, subjected to eccentric load.
6. To determine the spring dimensions for given requirement.

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

1. design simple machine elements subjected to static loads.
2. compute the torque transmission capacity by the given power screw.
3. analyse the machine elements subjected to fluctuating loads.
4. apply A.S.M.E. code for shaft design.
5. calculate the size of a mechanical joint, subjected to eccentric load.
6. determine the spring dimensions for given requirements.

Unit I: Introduction to Design Engineering: Design considerations, design process, design synthesis, standards in design, selection of materials, and selection of manufacturing processes.

Unit II: Design against static load: Modes of failures, types of stresses, theories of failures, design of simple machine elements.

Unit III: Design against fluctuating load: Fatigue failure, endurance limit, design for infinite and finite life, for completely reversed and fluctuating loads.

Unit IV: Design of machine elements: Design of shafts, couplings, power screws, mechanical joints, and mechanical springs.

Text Book:

1 Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.

References:

1 Shigley J.E. and Mischke C.R., "Mechanical Engineering Design",McGraw Hill Publication Co. Ltd.

2 Spotts M.F. and Shoup T.E. ,“Design of Machine Elements” ,Prentice Hall International.

3 Black P.H. and O. Eugene Adams ,“Machine Design”,McGraw Hill Book Co. Inc.

4 Willium C. Orthwein,“Machine Components Design”,West Publishing Co. and Jaico Publications House.

5 Bhandari V.B ,“Design of Machine Elements”, Tata McGraw Hill Publication Co. Ltd.

6 Juvinal R.C,“Fundamentals of Machine Components Design”,John Wiley and Sons.

7 Hall A.S., Holowenko A.R. and Laughlin H.G,“Theory and Problems of Machine Design” , Schaum’s Outline Series.

ME 3203 – Metrology and Quality Control

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Basic Manufacturing Processes
2. Machine Design

Course Objectives:
1. Understand the objectives of metrology, methods of measurement, selection of measuring instruments and standards of measurement.
2. Understand the concept of tolerance, limits of size, fits, geometric and position tolerances, gauges and their design procedure.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
4. Understand the process of use of Quality Control Technique in engineering industries.
5. Understand Quality Management System.

Course Outcomes:
Upon completion of this course, the student will be able to:
1. Select suitable instrument / gauge / method to measure linear and angular dimensions.
2. Calibrate measuring instruments
3. Design inspection gauges
4. Select and apply appropriate Quality Management Tool and Quality Control Technique for clearly defined problem.
5. Apply Statistical Quality Control tool(s) to for clearly defined problem.

Unit 1: Introduction to Calibration & Geometric Form Measurement 8 Hrs.

Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision

Calibration: Concept and procedure, traceability Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT)

Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate.

Unit 2: Design of Gauges and Dedicated Metrology 9 Hrs.

Design of Gauges: Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).

Thread Metrology: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle and Pitch, Floating Carriage Micrometer (Numerical).

Gear Metrology: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications

Unit 3: Advances in Metrology **9 Hrs.**

Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes

Machine Vision Systems: vision system measurement – Multisensory systems.

Interferometer: Principle, NPL Interferometer

Laser Metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications

Unit 4: Concept of Quality and Statistical quality control **8 Hrs.**

Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old New Seven Tools, Quality Circles.

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical).

Unit 5: Acceptance Sampling and TQM **8 Hrs.**

Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)

TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications.

Quality Management System: Need for quality management system – design of quality management system - quality management system requirements – ISO 9001, TS-16949, ISO-14000, Quality Audit

References:

1 Jain R.K., Engineering Metrology, Khanna Publication.

2 I. C. Gupta, Engineering Metrology, Dhanpath Rai Publication.

3 Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.

4 Narayana K.L., Engineering Metrology, Scitech Publications (India) Pvt Limited.

5 Juran J. M., Quality Handbook, McGraw Hill Publications.

6 Grant S.P., Statistical Quality Control, Tata McGraw hill Publication.

7 ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.

8 Basterfield D. H., Quality control, Pearson Education India, 2004.

9 Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication.

10 Online Education resources: viz. NPTEL web site:
(1) nptel.ac.in/courses/112106179;
(2) www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;
(3) www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/;
(4) freevideolectures.com › Mechanical › IIT Madras
(5) nptel.ac.in/courses/112107143/37.

Resources required for course:

1 Metrology equipment

2 Standard quality tools formats published by ASQ and MCCAI.

PEME 3201 Program Elective II – (A) Machines and Mechanisms

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Engineering Mechanics
2. Rigid Body Dynamics
3. Analysis and Synthesis of Mechanisms

Course Objectives:

1. To describe the constructional and operational features of gears.
2. To compute the unbalanced forces and couples for rotating and reciprocating masses.
3. To evaluate the force components in gears.
4. To analyze the gear trains for torque and motion.
5. To explain constructional and operational features of flexible drives.
6. To determine the torque capacity of clutches and brakes.

Course Outcomes: The students will be able to

1. describe the constructional and operational features of gears.
2. compute the unbalanced forces and couples for rotating and reciprocating masses.
3. evaluate the force components in gears.
4. analyze the gear trains for torque and motion.
5. explain constructional and operational features of flexible drives.
6. determine the torque capacity of clutches and brakes.

Unit 1: Spur Gear **6 Hrs.**

Gear drives: Classification, features, selection, applications.
Spur gear: Terminology, law of gearing, tooth profile, arc of contact, contact ratio, interference and undercutting, standard gear tooth systems, force analysis.

Unit 2: Helical, Bevel, Worm and Worm Wheel **4 Hrs.**

Helical gears: Terminology, virtual number of teeth, force analysis.
Bevel Gear: Classification, terminology, formative gear, force analysis
Worm and worm wheel: Advantages and limitations, terminology, geometrical relationships, force analysis, efficiency.

Unit 3: Gear Trains **6 Hrs.**

Types of gear trains, analysis of epicyclic gear trains, holding torque – simple, compound and epicyclic gear trains, torque on sun and planetary gear train. Types of gearboxes.

Unit 4: Friction Clutches, Brakes and Dynamometer 6 Hrs.

Pivot and collar friction, plate clutches, cone clutches, centrifugal clutch, torque transmitting capacity.

Classification of brakes, shoe brakes, block brakes, band brakes, and band and block brakes, braking torque analysis. Different types of absorption and transmission type dynamometer.

Unit 5: Belt, Rope and Chain Drives 6 Hrs.

Belt drive: Materials and construction, classification, features, geometric relationships, tensions in belt, maximum power transmission, selection from manufacturer's catalogue, belt tensioning methods.
Wire Ropes: Construction of wire ropes lay of wire ropes, stresses in wire rope, selection of wire ropes, rope drum construction and design.
Chain Drives: Classification, geometric features, polygon effect, modes of failure for chain, lubrication of chains.

Unit 6: Balancing of machines and Step–Less-Regulation 8 Hrs.

Balancing: Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines.
Stepless regulation: Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, Conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives.

Text Book:

1 Ashok G. Ambekar, "Mechanism and Machine Theory", Prentice Hall, India

References:

1 S. S. Ratan, "Theory of Machines", Tata McGraw Hill
2 Thomas Bevan, "Theory of Machines" CBS Publisher and Distributors, Delhi
3 Asok Kumar Mallik, Amitabha Ghosh, Gunter Dittrich, "Kinematic Analysis and Synthesis of Mechanisms"
4 Sadhu Singh, "Theory of Machines", Pearson
5 Shigley J. E., and Uicker J.J., "Theory of Machines and Mechanism", McGraw Hill Inc.
6 Hall A. S., "Kinematics and Linkage Design", Prentice Hall
7 Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery", Person Education
8 Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice - Hall, India

PEME 3201 Program Elective II – (B) Gas Turbine

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1.Thermodynamics
2.Applied Thermodynamics
3. Fluid Mechanics

Course objectives:
1.To Interpret the fundamentals of gas laws and their applications.
2.To apply the conservation laws to components of gas turbines
3.Should be able to apply the principles of basic and applied thermodynamics to solve general equations and find the efficiency.
4.To understand the working of the various components of the system.

Course Outcomes:
1. Student will be able understand the working of gas turbine and its components
2. Student will be able to relate the velocity triangles and their applications.
3. Student will generate the solution for various combustion chamber designs.
4. Student will derive the equations for efficiency of various components.

Unit 1: Centrifugal fans Blowers and Compressors, Brayton cycle, regeneration and reheating cycle analysis.Axial flow fans and compressors.

Unit 2 : Elementary theory: Degree of reaction, simple design methods, blade design, stage performance, degree of reaction, three dimensional flow, simple design methods, blade design, calculation of stage performance, overall performance and compressibility effects.

Unit 3: Performance characteristics.Axial flow turbines: elementary theory, vortex theory, choice of blade profile, pitch and chord ,estimation of stage performance,

Unit 4: Combustion system: Forms of combustion, important factors affecting combustion chamber design, combustion processes,combustion chamber performance, practical problem.,

Unit 5: Simple gas turbines: Components,characteristic, pressure losses, methods of improving part load performance, behaviour of gas turbines, Gas turbine rotors and stresses,

Suggested texts and reference materials:

1. ”Gas Turbine Theory,” Cohen and Rogers,Longman Group .
2. ”Mechanics and Thermodynamics of Propulsion”;Hill Philip, Peterson Carl,Addison Wesly
3. ”Turbines Compressors and Fans” S M Yahya, McGraw-Hill
4. ”Gas Turbines” , V. Ganesan,McGraw-Hill

PEME 3201 Program Elective II – (C) Press Tool Design

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Manufacturing Processes-I
2. Manufacturing Processes-II
3. Manufacturing Processes-III

Co-requisites:
NIL

Course Objectives:
1 To learn different sheet metal operations and its tools.
2 To learn different types of forces in different sheet metal operations.
3 To learn different nomenclatures related to dies.

Course Outcomes:
Upon completion of this course, students will be able to:
1 apply numerical method for calculation of forces related to press tool operations.
2 solve strip layout considering various factors involved in press tool operation.
3 select type of dies for various industrial component manufacturing.
4 design different press tool dies.

Unit 1: Introduction (3 hrs)
Shearing of Sheet Metal: Common Press tool operations, Theory of shear action in metal cutting, classification of presses.

Unit 2: Sheet metal forming processes (8 hrs)
Calculation of Force Requirements in Blanking and Piercing, Die Clearances in Blanking and Piercing, Process of Bending through 'V' Die and 'Wiping' Die, Forming Dies, Drawing Dies, Drawing of Box-like Shells, Direct and Reverse Redrawing.

Unit 3: Introduction to press tools (7 hrs)
Standard Die Set, Description of Press Tools.

Unit 4: Introduction to the design of dies (7 hrs)
Design of blanking, piercing, progressive and compound dies, guidelines for the design of press tools, design of progressive dies, compound die, calculation of centre of pressure in unsymmetrically profiled components.

Unit 5: Bending, drawing and forming dies: (8 hrs)
Introduction, classification of bending and other forming dies.

Suggested Texts and Reference Materials:

1 K. Venkataraman, 'Design of jigs, fixtures and press tools', Wiley.
2 Z. Marciniak, J. L. Duncan, S. J. Hu, 'Mechanics of sheet metal forming', Butterworth Heinemann.
3 Ivana Suchy, 'Handbook of dies design', McGraw Hill.
4 Fundamentals of Tool Design - ASTME
5 Tool engineers handbook - ASTM
6 Handbook of press tools - ASTM

PEME 3201 Program Elective II – (D) Nanotechnology

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Course Objectives:

1 To understand principle of nanotechnology with tools and techniques used
2 To learn different types of nanomaterials with concern of environment and energy
3 To learn use of nanotechnology to textile and composites.

Course Outcomes:

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

1 understand principle of nanotechnology with tools and techniques used.
2 learn different types of nanomaterials with concern of environment and energy
3 earn use of nanotechnology to textile and composites.

Unit 1. Introduction:

What is a Nanometer? , What is Nanotechnology? , Richard Feynman's Idea of Nanotechnology, General purpose Technology, Why Nanotechnology, Tools and Techniques, History of Nanotechnology, Uses of Nanotechnology, Nanotechnology Hazards, Safety, Hazard and Public Policy Issues.

Unit 2. Tools & Techniques:

Basic Idea of Nanotechnology, Techniques used in Nanotechnology, Tools used in Nanotechnology, Electron Microscope, Imaging in the TEM, Drawbacks of TEM, Applications of the TEM, How a Typical SEM Functions, Differences between SEM and TEM, Sample Preparation for an Electron Microscope, Disadvantages of Electron Microscope.

Unit 3. Nanomaterial's:

What are Nanomaterials? , Properties of Nanomaterials, Method to Produce Nanomaterials, Applications of Nanomaterials, Carbon Nanomaterials, Carbone Nanocones, Fullerene, How to Produce Nanotubes, Types of Nanotubes, Properties of Carbon Nanotubes, Industrial Applications for Carbon Nanotubes, Potential Market for Carbon Nanotubes, Possible Toxicity of Carbon Nanotubes, Nanowires, Types of Nanowires, Properties of Nanowire, Application of Nanowire

Unit 4. Nanotechnology Environment and Energy:

Using Carbon Nanotube Fuel Cells to Store Hydrogen, Photovoltaic, Biomimcry, New Advances made in Hydrogen Fuel Cells, Fuel Cells Potential Applications in Space and Nanotechnology, Applications for Fuel Cells and what Improvements Nanotechnology Can Offer, Nanotechnology Catalysts Might Improve the Efficiency of Direct Methanol Fuel Cells, Nanotechnology Techniques for Improving Solid Oxide Fuel Cells (SOFC), Material Types Used for Hydrogen Storage.

Unit 5. Nanotechnology and Textiles:

The use of Nanotechnology in the Textile Industry, Commercial Potential of Nanotechnology for the Textile Industry, Methods of Apply Coating onto Fabrics, Well-known Properties Imparted by Nano

treatment, Nanotechnology Textile Developments, Innovations Seen in the Textile Industry, Smart Materials, Electro textile, Smart Textiles.

Unit 6. Nano composites:

Introduction, Designing Novel Nanocomposites, Advantages of Nano Sized Additions, Disadvantages of Nano sized Additions, Applications of Nanocomposites, Areas of Application, Clay Based Nanocomposties, Processing of Clay Based Nanocomposites.

References and books

1. Manasi Karkare, Nanotechnology: Fundamentals and Applications, I K International Publishing House 2013
2. Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Fundamentals of Nanotechnology, CRC Press
3. Horst-Günter Rubahn, Basics of Nanotechnology, Wiley, 2008

PEME 3202 Program Elective III – (A) Computational Fluid Dynamics

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites
Fluid dynamics, Heat transfer, Numerical methods

Course Objectives
To introduce students to,
1. Finite volume method (FVM) of discretization for differential equations ,
2. Development of solution of discretized equations using various methods,
3. Development of numerical codes for diffusion and convection problems,
4. CFD techniques to fluid dynamics and heat transfer problem,

Course Outcomes
Students will be able to
1. Discretize a given differential equation with FVM,
2. Write a numerical code for diffusion and convection problems,
3. Develop a Navier-Stokes equation solver,
4. Apply CFD techniques to real life industrial problems.

Unit 1. Governing equations: the continuity equation, momentum equation and energy equations, convective forms of the equations and general description, Reynolds transport theorem. Classification of partial differential equations; physical examples of elliptic, parabolic and hyperbolic equations. Mathematical nature of the flow equations & their boundary conditions.

Unit 2. Discretization Methods and Solution of Discretized Equations: The discretization concept, the structure of discretization equations, methods of deriving the discretization equations. Finite difference method, Finite volume method. Concept of consistency, accuracy, stability and Convergence. Tri-Diagonal Matrix Algorithm (TDMA), Application of TDMA Method to Two dimensional Problems. Gauss-Seidel Method.

Unit 3. Finite Volume Method for Diffusion Problems: Finite Volume Method for one dimensional steady state Diffusion, Finite Volume Method for Two Dimensional Diffusion Problems.

Unit 4. Finite Volume Method for Convection-Diffusion Problem: Steady one dimensional convection and Diffusion, Central Differencing Scheme, Properties of Discretization Schemes, Assessment of Central Differencing Schemes for Convection Diffusion Problem, Upwind Differencing Scheme Hybrid Differencing Scheme.

Unit 5. Solution Algorithms: Pressure-Velocity Coupling Steady Flow, Staggered Grid, Momentum Equations, Simple Algorithm, PISO Algorithm.

References and books
1 S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.

2 John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis
3 Versteeg, H. K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education.
4 Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995.

PEME 3202 Program Elective III – (B) Mechanics of Composite Material

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Engineering Mechanics
2. Strength of Materials
3. Engineering Metallurgy

Course Objectives:

1	To understand a perspective utilization and processing of composite materials
2	To analyze lamina of composite material at micro and macro level
3	To analyze the laminated composite material at macro level
4	To understand testing methods of composite materials to evaluate mechanical properties

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

1	Define need, utilization of class of composite material, its constitution, list its application fields and demonstrate the various fabrication process
2	Micro and macro-mechanical analysis of the composite material at lamina level
3	Analyze the laminated composite material at a macro level using classical lamination theory
4	Define testing methods of composite materials to evaluate mechanical properties

Unit 1. Introduction to composite (6 Hr)
Introduction to advanced materials and types, Definition, General Characteristics, Applications, Fibers, Types of fibers, Mechanical Properties of fibers; Matrix, Types of matrix, Polymer Matrix- Thermoset and Thermoplastic, Fillers/Additives/Modifiers of Fiber Reinforced Composites

Unit 2. Manufacturing of composites (6 Hr)
fabrication process for thermoset and thermoplastic PMC, open mould process as hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, and Closed mould process as pultrusion, performing, thermo-forming, injection molding, blow molding, Process parameters.

Unit 3. Elastic and strength Behavior of Lamina (12 Hr)
Introduction, Volume and mass fraction, density, void content, evaluation of elastic moduli, ultimate strength of unidirectional lamina

Review and definition of stress, strain and Elastic Moduli, Hooke's Law for different types of materials, Hook's law for 2D unidirectional and angular lamina, engineering constants of an angle lamina, Strength failure theories of an angle lamina

Unit 4. Elastic Behavior of Laminate (10 Hr)

Introduction to Laminate Code, Strain-displacement relations, Stress-strain relation for a laminate, force and moment resultants related to mid plane strains and curvatures, In-Plane engineering constants of a laminate, Flexural engineering constants of a laminate

Unit 5. Testing of Composites (6 Hr)

Societies for Testing Standards, Background to Mechanical Testing of Composites: Test Method of Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength, Impact Properties.

Text and Reference Books:

1 Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, Taylor & Francis Group, 2012.

2 Isaac M. Daniels, Ori Ishai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 2010

3 Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press, 2004.

4 Robert M. Jones, "Mechanics of Composite Materials" 2nd Edition, CRC Press 1998

PEME 3202 Program Elective III – (C) Piping Engineering

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Fluid Mechanics, Machine Drawing
2. MAchine Design
3. Strength of Materials

Co-requisites:
NIL

Course Objectives:
1. Student will able to learn different joint utilized in piping.
2. Student will able to learn piping layout.
3. Student will able to learn to calculate stresses in piping system.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Student will select proper joints for different piping layouts.
2. Student will draw piping layout for different applications
3. Student will calculate piping stress in different industrial applications.

Unit 1: Introduction to Piping: Introduction to phases of plant design, Role of Piping within project plan. Design Philosophy.
Process data sheets, Process flow diagram, Piping & Instrumentation diagrams, and Equipment layout. Interdisciplinary inputs/coordination.

Unit 2: Piping fundamentals: Piping elements (pipes, fittings, flanges, gasket, bolting, Valves), Pipe schedule, Pipe thickness calculations.

Pipe fittings (bends, elbow, Tees, Reducers, Stub ends, cross), Special pipe fittings, expansion joints, types of flanges, pressure temperature rating for flanges.

Unit 3: Piping Codes & Standards American Standards, Indian standards, British Standards for Piping Engineering. Selection of Design code. Unified numbering system (UNS).
Piping materials : ASME, ASTM , IS materials for piping components such as pipe, fittings, flanges, bolting, supports, expansion joints, valves etc. Selection of materials

Unit 4: Piping Drawing Piping symbols, orthographic (Plan & Elevation) drawings.
Plot Plan Development & Requirements (General guidelines) Equipment Layout Terminology, Control Point & Battery Limits.

Preparation of Equipment Layout. Piping GA Drawing Requirements and Layout Procedure. Pump GA Drawing and Layout Consideration.

Unit 5: Piping supports Fixed supports like Rest , Line guide, Line stop, Hold down, Rigid strut etc., Flexible supports like variable spring support, constant spring support, Snubber etc.

Piping Stress Analysis : Need of Stress Analysis, Procedure to carry out stress analysis, Loads on the piping system(such as sustained , thermal, hydro-test loads, water hammer, relief valve outlet), Allowable stress, Flexibility analysis, thermal load calculations, critical line list preparation , Steps involve in stress analysis of piping system, Pipe support

Suggested texts and reference materials

1 Piping Handbook, Mohinder L. Nayyar, McGraw-Hill Publication

2 Piping Design Handbook, Macetta John, M. Dekker , 1992

3 ASME code for Process Piping ,ASME B31.1

4 ASME code for Process Piping , ASME B31.3

5 ASME B16.5 , Pipe ,Flanges & Flange Fittings

6 An International Code 2007 ASME Boiler & Pressure Vessel Code, Rules For Construction of Pressure Vessels, Section II A, B, C & D

PEME 3202 Program Elective III – (D) Jig and Fixture Design

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Prerequisites:
1. Manufacturing Processes-I
2. Manufacturing Processes-II
3. Manufacturing Processes-III

Course Objectives:
1 To learn appropriate clamping method for jig or fixture.
2 To learn about locating devices and redundant location in jig or fixture.
3 To develop capability to design jigs and fixtures for lathe, milling and drilling M/C.

Course Outcomes:
Upon completion of this course, students will be able to:
1 Select appropriate clamping devices for jig or fixture.
2 Define basics of jig or fixture and choose locating devices for jig or fixture.
3 Index component and design jig for a given application.
4 Design milling fixtures for a given applications.
5 Apply knowledge of turning, grinding, boring, broaching, welding and modular fixtures for mass production applications

Unit 1: Introduction (3 hrs)
Definition of Jigs and Fixtures, Difference between jigs and fixtures, Advantages, Steps for design.

Unit 2: Design of locators (6 hrs)
General principle of degrees of freedom and constraints, foolproofing, other principles in the design of locators, various types of locators.

Unit 3: Design of clamps (6 hrs)
Principles of Clamping, Classification of Clamps.

Unit 4: Drilling Jigs (6 hrs)
Introduction, types of jigs, components of jig.

Unit 5: Design of milling fixtures (6 hrs)
Introduction, salient features of milling fixtures, classification of milling fixtures.

Unit 6: Other types of fixtures (6 hrs)
Turning, grinding, boring, broaching, welding and modular fixtures, advantages and disadvantages of modular fixtures, consideration of safety factors while designing of jig and fixtures.

Suggested Texts and Reference Materials:
1 K. Venkataraman, 'Design of jigs, fixtures and press tools', Wiley.
2 Kempster, 'Introduction to Jigs & Tool Design', Viva Books Pvt Ltd,1998.
3 D. Cyryll, G. H. Lecain, V. C. Goold, 'Tool Design', McGraw Hill, 2002.

ME 3204 Applied Thermodynamics Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Insem: 25 Marks
Credits: 1

Prerequisites:
1. Engineering Thermodynamics
2. Fluid Mechanics
3. Heat Transfer

Course Objectives:
1. To study performance parameters of IC engines.
2. To conduct trial and do performance calculations for reciprocating air compressor.
3. To evaluate performance of refrigeration cycles.
4. To analyze various psychrometric processes.
5. To verify impulse momentum principle.

Course Outcomes:
Upon completion of this lab course, the student will be able to:
1. conduct trial on IC engine and calculate performance parameters
2. conduct trial on reciprocating air compressor to ascertain volumetric and isothermal efficiency.
3. compute performance parameters of refrigeration systems.
4. perform trial on air conditioning tutor to understand different psychrometric processes
5. perform experiment to understand impulse momentum principle

List of Experiments:

1. Trial on petrol engine
2. Trial on Diesel engine.
3. Trial on vapor compression test rig
4. Trial on ice plant test rig.
5. Trial on air conditioning test rig
6. Trial on reciprocating air compressor
7. Verification of impulse momentum principle

Text Book:

1. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill
2. M. L. Mathur and R. P. Sharma, A course in Internal Combustion Engines
3. S. Domkundwar, C. P. Kothandraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai& Co
4. Arora C. P. , Refrigeration and Air Conditioning, Tata McGraw-Hill
5. Dr.Bansal R.K, Fluid mechanics and hydraulic machines, Laxmi publications

ME 3205 Machine Design Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral: 25 marks
Credits: 1

Prerequisites:
1. Engineering Mechanics
2. Rigid Body Dynamics
3. Analysis and Synthesis of Mechanisms

Course Objectives:

1. To describe the design process, materials and manufacturing aspects and theories of failures
2. To select the necessary data from relevant standards/standard guidelines.
3. To design the given assembly for the required application
4. To present the design work in the form of report and drawings.

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

1. To describe the design process, materials and manufacturing aspects and theories of failures.
2. To select the necessary data from relevant standards/standard guidelines.
3. To design the given assembly for the required application
4. To present the design work in the form of report and drawings.

A) Two design projects on assemblies: - Group of students will be designing an assembly for the given application. The design process and the calculations will be mentioned in design report. Assembly and details drawings will be prepared on drawing sheets.
B) Two Assignments: - Group of students will be preparing assignment report on given topic and presenting it in the form of powerpoint presentation.

Suggested Texts and Reference Materials:

1. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design",McGraw Hill Publication Co. Ltd
2. Spotts M.F. and Shoup T.E. ,"Design of Machine Elements" ,Prentice Hall International.
3. Black P.H. and O. Eugene Adams ,"Machine Design",McGraw Hill Book Co. Inc.
4. William C. Orthwein,"Machine Components Design",West Publishing Co. and Jaico Publications House.
5. Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.
6. Juvinal R.C,"Fundamentals of Machine Components Design",John Wiley and Sons.
7. Hall A.S., Holowenko A.R. and Laughlin H.G,"Theory and Problems of Machine Design" , Schaum's Outline Series.
8. "Design Data",P.S.G. College of Technology, Coimbatore.

ME 3206 Metrology and Quality Control Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In semester: 25 marks
Credits: 1

Course Objectives: Students are expected to –

1 **Understand** the methods of measurement and selection of measuring instruments.
2 To learn the concept of tolerance, limits of size, fits, geometric and position tolerances, gauges and their design procedure..
3 To learn the process of use of Quality Control Technique in engineering industries.

Course Outcomes:

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

1 **Select** suitable instrument / gauge / method to measure linear and angular dimensions.
2 **Calibrate** measuring instruments
3 **Select** and **apply** appropriate Quality Management Tool and Quality Control Technique for clearly defined problem.
4 **Apply** statistical quality control tool to for clearly defined problem.

List of Experiments:

Part [A] Experiment no. 1 and 6 are mandatory. Perform <u>any three from experiments</u> no. 2 to 5 & any three

1. Measurement of linear and angular dimensions using standard measuring instruments.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, MSA (Gauge R & R).
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one)
4. Verification of dimensions & geometry of given components using Mechanical comparator.
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers.
7. Determination of geometry & dimensions of given composite object / single point tool, using profile projector and tool maker's microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier, Span Micrometer/ Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

Part [B] Statistical Quality Control (SQC) (<u>Any 2 assignments</u>)

<u>Note</u> - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using Seven quality control tools for engineering application <u>USING STD. FORMATS</u>.
2. Determination of process capability from given components and plot variable control chart/attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

Text Book:

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. I. C. Gupta, Engineering Metrology, Dhanpath Rai Publication.
3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.
4. Narayana K.L., Engineering Metrology, Scitech Publications (India) Pvt Limited.
5. Juran J. M., Quality Handbook, McGraw Hill Publications.
6. Grant S.P., Statistical Quality Control, Tata McGraw hill Publication.
7. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.
8. Basterfield D. H., Quality control, Pearson Education India, 2004.
9. Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication.

PEME 3203 Program Elective III Lab – (A) Computational Fluid Dynamics

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Course Objectives
To introduce students to,
1. Finite volume method (FVM) of discretization for differential equations ,
2. Development of solution of discretized equations using various methods,
3. Development of numerical codes for diffusion and convection problems,
4. CFD techniques to fluid dynamics and heat transfer problem,

Course Outcomes
Students will be able to
1. Carry out discretization and numerical formulation of a given differential equation with FVM,
2. Write a numerical code for diffusion and convection and pressure-velocity coupling
3. Develop a Navier-Stokes equation solver
4. Apply CFD techniques to real life industrial problems using CFD softwares

Programming Assignments:

1	Development of FVM code for one dimensional steady state and unsteady conduction problem
2	Development of FVM code for two dimensional steady state conduction problem
3	Development of FVM code for steady state one dimensional Convection-Diffusion Problem using central differencing scheme
4	Development of FVM code for steady state one dimensional Convection-Diffusion Problem using upwind and other convection schemes
5	Lid Driven Cavity problem using SIMPLE algorithm on structured grid
6	Lid Driven Cavity problem using PISO algorithm unstructured grid
7	Assignment on conduction through a composite slab using Fluent
8	Assignment on Lid Driven cavity on Fluent and comparison with the code
9	Assignment on flow through a pipe using Fluent
10	Assignment on meshing of a complex geometry

PEME 3203 Program Elective III Lab – (B) Mechanics of Composite Material

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Course Objectives:

1. To understand a perspective on utilization of composite materials in structure
2. To analyze the composite material at lamina level
3. To analyze the laminated composite material
4. To understand methods of composite materials testing

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

1. Demonstrate fabrication process of unidirectional polymer composites
2. Develop program to analyze lamina made of polymer matrix composite material
3. Develop program to analyze laminate made up of polymer composites
4. Test and evaluate mechanical properties of polymer composites as per ASTM standards

Lab work to be accomplished

1 Develop Program for micro mechanical analysis of composite lamina

2 Develop Program for macro mechanical analysis of composite lamina and laminate

3 Develop program for failure analysis of composite laminate using different failure theories.

4 Manufacturing of unidirectional and multidirectional fiber reinforced polymer matrix composites

5 Tensile testing of composite lamina to find out tensile strength and tensile modulus

6 Flexural testing of composite lamina to find out flexural strength and flexural modulus

7 Izod/Charpy impact test of composite lamina to find out impact strength

Reference Book

1. Fiber-Reinforced Composites: Materials, Manufacturing, and Design, Third Edition (Mechanical Engineering). by P.K. Mallick | 19 November 2007

PEME 3203 Program Elective III Lab – (C) Piping Engineering

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Course Objectives:

1 Understand and Draw different Layouts required in piping
2 Study nature of stress and calculate stresses in pipe.
3 Three D Modeling of different equipments used in piping
4 Design optimum Piping Route

Course Outcomes:

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

1 Draw different Layouts required in piping
2 Analyze stresses in pipe.
3 Model different equipments used in piping
4 Route Piping Effectively

Lab work to be accomplished

1 Drawing Creation (P&ID, PFD, Layouts, and all fabrication Drawings)
2 PIPE STRESS ANALYSIS - CAESAR II
3 Equipment Modeling
4 Pipe Routing

PEME 3203 Program Elective III Lab – (D) Jig and Fixture Design Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
End semester: 25 marks
Credits: 1

Course Objectives:

1 To learn appropriate clamping method for jig or fixture.
2 To learn about locating devices and redundant location in jig or fixture.
3 To develop capability to design jigs and fixtures for lathe, milling and drilling M/C.

Course Outcomes:

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

1 Select appropriate clamping devices for jig or fixture.
2 Utilize locating devices jig or fixture.
3 Index component for mass production using jig or fixture.
4 Design jigs and fixtures for a given applications.

Lab work to be accomplished

1 Design of jig for machine component

2 Design of fixture for machine component

ME 3207 Seminar

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
In semester: 25 marks
Credits: 1

Course Objectives:

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presentation.

Course Outcome: With this seminar report and presentation, the student will be able to

1. identify historic points of technological advance in engineering
2. read, understand and interpret technical and non-technical information
3. source and comprehend technical literature and other credible sources of information
4. analyze sourced technical information for feasibility, viability, and sustainability
5. produce clear, well-constructed, and well-supported written engineering documents
6. demonstrate effective communication skills using various presentation techniques

Course Contents: The evaluation of the seminar report is proposed with the following stages. **Stage-I** In this stage the student is expected to deliver the following: 1. Topic selection 2. Literature review 3. State of the art related to the topic of interest
Stage-II 1. Problem statement 2. Methodology 3. Scope and objectives A review of the student's progress should be made after In-Sem examination, within a week. During this review, the student is expected to complete Stage-1 and Stage-2.
Stage-III 1. Quantification of results 2. Concluding remarks or summary
Stage-IV 1. Final report 2. Final presentation/viva.

The final presentation/viva will be assessed by an internal panel. The internal panel will consist of the seminar guide and a subject expert, approved by the HOD.

The contents of the seminar report and presentation (as mentioned in section-3 and section-4) are expected to include the following: Abstract/Summary, Introduction: Scope and Methodology, Literature review (The review should be conducted from recent research papers), Case study and References.

Autonomous Program Structure

Final Year B. Tech.

Seventh Semester (Mechanical Engineering)

2016 Pattern

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 4101	CAD/CAM and Automation	3	0	0	50	50	0	0	100	3
ME 4102	Transmission System Design	3	0	0	50	50	0	0	100	3
HS 4101	Economics for Engineers/ Advanced Entrepreneurship Development	3	0	0	50	50	0	0	100	3
OE 4101	Open Elective -I	3	0	0	50	50	0	0	100	3
ME 4103	CAD/CAM and Automation Lab	0	0	2	0	0	0	50	50	1
ME 4104	Project Phase-I	0	2	14	100	0	50	0	150	9
	Total	**12**	**2**	**16**	**300**	**200**	**50**	**50**	**600**	**22**
	Grand Total	**30**			**600**					

OE 4101: Open Elective-I

1) Automotive Technology

2) Finite Element Analysis

3) Industrial Engineering and Management

ME 4101 – CAD/CAM and Automation

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks
End semester: 50 marks
Credits: 3

Prerequisites:

1. Strength of material
2. Manufacturing process

Course Objectives:

1. To apply homogeneous transformation matrix for geometrical transformations of 2D& 3D CAD entities
2. To apply mathematical models to get different type of curve generation
3. To write G&M codes based part program of CNC lathe and milling operations
4. To analyze 1D and 2D structural problems using finite element methods
5. To demonstrate digital manufacturing methods and Define structure and mechanism of industrial robotic system

Course Outcomes:

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

1	Apply homogeneous transformation matrix for geometrical transformations of 2D& 3D CAD entities
2	Apply mathematical models to get different type of curve generation/ Model the curves, surfaces and solid geometry
3	Write G&M codes based part program of CNC lathe and milling operations
4	Analyze 1D and 2D structural problems using finite element methods
5	Demonstrate digital manufacturing methods and Define structure and mechanism of industrial robotic system

Unit 1: Computer Graphics **8 Hrs**

Transformations (2D & 3D) : Introduction, Formulation, Translation, Shear, Rotation, Scaling and reflection, Homogeneous representation, Concatenated transformation, Mapping of geometric models, Inverse transformations, Introduction to 3D transformation
Projections : Orthographic, Isometric, Perspective projections

Unit 2: Geometric Modeling **8 Hrs**

Curves – Introduction, Analytical curves (Line, circle, ellipse, parabola, hyperbola), Synthetic curves (Hermite Cubic Spline, Bezier, B-Spline Curve)
Surfaces – Introduction, Surface representation, Analytic surfaces, Synthetic Surfaces, Hermite bicubic, Bezier, B-Spline, Coons patch surface, Applications in freeform surfaces

Solids - Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry (CSG), Boolean operation for CSG

Unit 3: Computer Aided Manufacturing 6 Hrs

Introduction to Computer Aided Manufacturing (CAM), Coordinate system, Working principal of CNC Lathe, Turning Centers, Milling Machine, Steps in developing CNC part program, Tool and geometric compensations, subroutine and Do loop using canned cycle.
CNC Lathe part programming (FANUC) : Linear and circular interpolation, Canned cycles for facing, threading, grooving, etc.
*CNC Milling part programming (FANUC)***:** Linear and circular interpolation, Pocketing, contouring and drilling cycles.

Unit 4: Finite Element Analysis (FEA) 10 Hrs
Introduction : Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, meshing, p and h formulation, Advantages and disadvantages of FEM
One Dimensional Problem: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, (stepped bar, spring in series and parallel)
Trusses : Introduction, 2D Trusses, Element stiffness matrix for truss, Assembly of Global Stiffness Matrix , load vector

Unit 5: Digital Manufacturing , Robotics and Artificial Intelligence 8 Hrs

Rapid Prototyping : Introduction, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle, features, models & specification of process, application, advantages and disadvantages, Rapid Tooling and STL format, Concept of 4D Rapid Prototyping.
Introduction to Robotics: Structure of Robotic System - Point to point & continuous path robotic systems, Joints, End Effectors, Grippers - Mechanical, Magnetic and Pneumatic. Drives, Controllers, Industrial Applications
Artificial Intelligence: Introduction, need and application, problem solving through forward and backward search, introduction to machine learning and industry 4.0

Suggested Texts and Reference Materials:

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill Publishing Co. 2009
2. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
3. Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India.
4. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010
5. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
6. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

ME4102 – Transmission System Design

Teaching Scheme	Examination Scheme
Lecture: 3 Hrs/week	In semester: 50 marks
	End semester: 50 marks
	Credits: 3

Prerequisites:

1. Strength of machine elements (S.O.M.)
2. Engineering materials and their properties (Material Science and Metallurgy)
3. Principles of machine design (Machine Design)
4. Mechanical Drives (Machines and Mechanisms)

Course Objectives:

1	To analyze the forces in rigid drives during power transmission.
2	To apply the AGMA equations to design a gear pair.
3	To compute the required dynamic load rating for a bearing to select it from the manufacturer's catalog.
4	To evaluate the tensions and stresses to design a flexible drive..
5	To describe the features of transmission systems used for automotive and industrial applications.
6	To elaborate various configurations and operations of hybrid electric vehicles..

Course Outcomes:

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

1	To analyze the forces in rigid drives during power transmission.
2	To apply the AGMA equations to design a gear pair.
3	To compute the required dynamic load rating for a bearing to select it from the manufacturer's catalog.
4	To evaluate the tensions and stresses to design a flexible drive..
5	To describe the features of transmission systems used for automotive and industrial applications.
6	To elaborate various configurations and operations of hybrid electric vehicles..

Unit 1: Elements of transmission systems-I (Rigid drives-I):
Classification and selection of gears, standard tooth systems, modes of failures, terminology and force analysis, gear design based on strength (AGMA standard), dynamic load by velocity factor and Buckingham's equation.

8 Hrs

Unit 2: Elements of transmission systems-II (Rigid drives-II):
Formative gear and force analysis of helical and bevel gears, design based on strength (AGMA

standard), velocity factor and Buckingham's equation. Design of worm and worm gear based on strength and thermal considerations.
8 Hrs

Unit 3: Anti-friction Bearings and Flexible Drives :
Ball and roller bearings, magnetic bearings, ball screw systems: Modes of failures, static and dynamic load ratings, equivalent dynamic load, reliability of bearing, bearing life, load-life relationship and selection of bearings from manufacturer's catalogue. Power rating, tensions, stresses and selection from manufacturer's catalogue for flexible drives.

6 Hrs

Unit 4: Mechanical Transmission Systems:
Gear boxes for automobiles and industrial use: Constant mesh, sliding mesh, synchromesh, differential and planetary gear box, and epicyclic power train.

6 Hrs

Unit 5: Electric and Hybrid Vehicle Transmission Systems:
EV transmission configurations, transmission components, torque-speed characteristics, EV motor sizing, hybrid drive trains, sizing of components.

6 Hrs

Unit 6: Series and Parallel Electric Drive Systems:
Control strategies, sizing of major components, power ratings, traction motors, engine generator, and drive train parameters.
Design examples: GM two mode hybrid, Toyota Prius, Hyundai Ioniq Hybrid, Volkswagen Golf GTE.

6 Hrs

Suggested Texts and Reference Materials:

1. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd.
2. Spotts M.F. and Shoup T.E. ,"Design of Machine Elements" ,Prentice Hall International.
3. Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.
4. Black P.H. and O. Eugene Adams ,"Machine Design",McGraw Hill Book Co. Inc.
5. Willium C. Orthwein,"Machine Components Design",West Publishing Co. and Jaico Publications House.
6. "Design Data",P.S.G. College of Technology, Coimbatore.
7. Juvinal R.C,"Fundamentals of Machine Components Design",John Wiley and Sons.
8. Hall A.S., Holowenko A.R. and Laughlin H.G,"Theory and Problems of Machine Design" , Schaum's Outline Series.
9. Michael Nikowitz, 'Advanced Hybrid and Electric Vehicles, System Optimization and Vehicle Integration', Springer International Publishing Switzerland 2016.
10. Iqbal Husain, 'Electric and Hybrid Vehicles, Design Fundamentals', CRC PRESS.

HS 4101 -- Economics for Engineers

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Course Objectives:

1. To enable students to understand the Fundamental Economic Concepts
2. To enable students to understand the techniques of Inflation Factor
3. To Enable students to understand market structure and pricing theory.

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

1. develop the Basics of Economics to solve engineering problems
2. apply cost analysis in industry domain
3. apply economically sound decisions
4. Understand the different financial terms required in an organization

Unit 1: Introduction to Economics **8 Hrs**

Introduction To Economics- Flow In An Economy, Concept Of Engineering Economics – Engineering Efficiency, Revision of concepts like Economic Efficiency, Scope Of Engineering Economics – Element Of Costs, Marginal Revenue, Sunk Cost, Opportunity Cost, Break Even Analysis -P/V Ratio, Elementary Economic Analysis – Material Selection For Product Design Selection For A Product, Process Planning.

Unit 2: Value Engineering **8 Hrs.**

Make Or Buy Decision, Value Engineering – Function, Aims, Value Engineering Procedure. Interest Formulae And Their Applications –Time Value Of Money, Single Payment Compound Amount Factor, Single Payment Present Worth Factor, Equal Payment Series Sinking Fund Factor, Equal Payment Series

Unit 3: Cash Flow **8 Hrs.**

Methods Of Comparison Of Alternatives – Present Worth Method (Revenue Dominated Cash Flow Diagram), Future Worth Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Annual Equivalent Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Rate Of Return Method, Examples In All The Methods.

Unit 4: Replacement And Maintenance Analysis **5 Hrs.**

Replacement And Maintenance Analysis – Types Of Maintenance, Types Of Replacement Problem, Determination Of Economic Life Of An Asset, Replacement Of An Asset With A New Asset – Capital Recovery With Return And Concept Of Challenger And Defender, Simple Probabilistic Model For Items Which Fail Completely.

Unit 5: Depreciation **8 Hrs.**

Depreciation- Introduction, Straight Line Method Of Depreciation, Declining Balance Method Of Depreciation-Sum Of The Years Digits Method Of Depreciation, Sinking Fund Method Of Depreciation/ Annuity Method Of Depreciation, Service Output Method Of Depreciation-Evaluation Of Public Alternatives- Introduction, Examples,

Inflation Adjusted Decisions – Procedure To Adjust Inflation, Examples On Comparison Of Alternatives And Determination Of Economic Life Of Asset.

Suggested Texts :

1.Panneer Selvam, R, “Engineering Economics”, Prentice Hall Of India Ltd, Second Edition ,New Delhi, 2013.
2. Banga and Sharma, “Industrial Organisation and Engineering Economics”, Khanna Publishers,Twenty Fifth ,2006

Reference books :

1.Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics And Analysis” Engg. Press, Texas, 2010. 2.Degarmo, E.P., Sullivan, W.G And Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011. 3.Zahid A Khan: , “Engineering Economy”, Dorling Kindersley, 2012

OE 4101-L- Automotive Technology

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Sem: 50 marks

End Sem.: 50 Marks

Credits: 3

Pre-requisite:

1. Basic Mechanical Engineering.

Course Objectives:

1. To study layout of the vehicles.
2. To understand function of various components of automotive systems.
3. To understand use of alternative fuels for vehicle.

Course Outcomes: Students will be able to:

1. Identify different layouts of automobile vehicle and engine auxiliary systems.
2. Explain types and function of transmission systems in vehicle.
3. Identify types, function of different steering, brakes and suspension systems to solve problems using required knowledge.
4. Compile use and need of alternative fuels.
5. Discuss current emission norms and identify use of emission control systems.

Unit 1: Vehicle Structure and Engine auxiliary systems: 8 Hrs

Vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine. Electronically controlled gasoline injection system for SI engines. Electronically controlled diesel injection system, Electronic ignition system.

Unit 2: Transmission Systems: 7 Hrs

Conventional transmission system, Automatic transmission system (fluid coupling, clutch less drive, fluid flywheel – torque converter), Semi-automatic transmission, continuously variable transmission (CVT), dual clutch hybrid transmission.

Unit 3: Steering, Brakes and Suspension Systems: 7 Hrs

Steering geometry and types of steering gear box - Power Steering, Active and passive Suspension Systems, Pneumatic and Hydraulic Braking Systems, Regenerative breaking, Anti-lock Braking System (ABS) and Traction Control.

Unit 4: Electric and hybrid vehicles: **6 Hrs**

Concept of electric and hybrid vehicle, EV and HEV fundamentals, architecture and dynamics (power, torque speed relationship, performance, etc.) of EV and HEV power train, drives and energy sources in EV and HEV. Vehicles with hydrogen fuel cells.

Unit 5: Modern Energy Sources: **6 Hrs**

Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LNG), Bio-fuels, lithium-ion battery, hydrogen fuel cell in Automobiles.

Unit 6: Emission control in automobiles: **6 Hrs**

Emission and Fuel Roadmap Euro 6 / BS V norms (proposed 2020-21), Exhaust gas re-circulation (EGR), Electrostatic precipitation (Particulate matter) and Engine emission control (three way catalytic converter system SCR and particulate filter).

Text Books:

1. Kirpal Singh, Automobile Engineering Vol 1 and 2, Standard Publishers, 7th Edition, 1997.
2. M. Chris and M. A. Masrur, Hybrid Electric Vehicles, Wiley Publications, 2nd Edition, 2017.

Reference Books:

1. K. K. Jain and R. B. Asthana, Automobile Engineering, Tata McGraw Hill Publishers, New Delhi, 1999.
2. Dr. K. R. Govindan, Automobile Engineering, Anuradha Publications, Chennai, 2013.
3. Joseph Heiner, Automotive Mechanics, Litton Education Publishing Ins., New York, 1999.
4. Angelin, Automotive Mechanics, Tata McGraw Hill Pub. Comp. Ltd., 10th Edition, 2004.

OE 4101-- Finite Element Analysis

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Semester: 50 marks

End Semester: 50 Marks

Credits: 3

Pre-requisite:

1. Engineering Mathematics
2. Numerical Methods
3. Applied Mechanics

Course Objectives:

1. To carry out discretization of differential equations using finite element method
2. To perform analysis of engineering problems using finite element method
3. To understand and interpret results obtained with FEA software tools.

Course Outcomes: Students will be able to

1. Derive discretization equations from differential equations for one- and two-dimensional problems
2. Solve static and dynamic engineering problems using FEA
3. Develop numerical codes in C/C++/Matlab for simple problems.
4. Perform simulations of rweal-life problems using FEA software tools

Unit 1: Introduction: 4 Hr

Typical Application Examples, Automotive Applications, Manufacturing Process Simulation, Electrical and Electronics Engineering Applications, Aerospace Applications

Unit 2: Finite Element Formulations: 10 Hrs

Weighted Residual Method, Use of a Single Continuous Trial Function, The General Weighted Residual (WR) Statement, Weak (Variational) Form of the Weighted Residual Statement, Functional and Differential Equation Forms, Principle of Stationary Total Potential (PSTP), Rayleigh–Ritz Method, One-dimensional Bar Finite Element, One-dimensional Heat Transfer Element

Unit 3: One-dimensional Finite Element Analysis: 12 Hrs

General Form of the Total Potential for 1-d, Generic Form of Finite Element Equations, The Linear Bar Finite Element, The Quadratic Bar Element, Determination of Shape Functions, Element Matrices, Beam Element, Selection of Nodal d.o.f., Determination of Shape Functions, Element Matrices, Frame Element, One-dimensional Heat Transfer

Unit 4: Two-dimensional Finite Element Analysis: 8 Hrs

Approximation of Geometry and Field Variable, Simple Three-noded Triangular Element, Four-noded Rectangular Element, Six-noded Triangular Element, Natural Coordinates and Coordinate Transformation, Alternate Methods of Deriving Shape Functions, Natural Coordinates—Quadrilateral Elements, Natural Coordinates—Triangular Elements, 2-d Elements for Structural Mechanics, Generic Relations, Three-noded Triangular Element, Four-noded Rectangular Element

Unit 5: Dynamic Analysis Using Finite Elements: 6 Hrs

Vibration Problems, Equations of Motion Based on Weak Form, Axial Vibration of a Rod, Transverse Vibration of a Beam, Transient Vibration Analysis, Modelling of Damping, The Mode Superposition Scheme, Direct Integration Methods, Thermal Transients-Unsteady Heat Transfer in a Pin-Fin

Books:

1. Daryl L. Logan, A First Course in the Finite Element Method
2. Cook, R. D., Malkus, D. D. and Plesha, M. E., Concepts and Applications of Finite Element Analysis
3. Seshu, P., Textbook of Finite Element Analysis
4. Chandrupatla, T. R. and Belegundu, A. D., An Introduction to the Finite Element Method in Engineering

OE 4101 -- Industrial Engineering and Management

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Course objectives: The Industrial Engineering course prepares students to…

1. Understand type of organisation and calculate partial and total productivity
2. Learn the fundamental knowledge, skills, tools and techniques of methods study and work measurement.
3. Understand type of production environments, resource planning and control methods.
4. Learn basic resource scheduling techniques, human resource management and industrial safety norms.

Course Outcomes: Students will be able to…

1. Identify type of organisation and analyze partial and total productivity
2. Manage and implement different techniques of methods study and work measurement of process under consideration for improvement.
3. Analyze production environment under consideration w.r.to its resource planning and control.
4. Apply basic resource scheduling and human resource management techniques.

Unit 1: Introduction to Industrial Management and Productivity Analysis 6 Hrs

Industrial management: Functions and principles of management; Organisation: Concept, characteristics, structures and types of organisation- (formal line, military, functional, line and staff organisation);
Productivity analysis: Definition, measurement of productivity: productivity models and index (numerical); factors affecting the productivity; productivity improvement techniques;
Definition and scope of Industrial Engineering.

Unit 2: Method Study 7 Hrs

Work Study: Definition, objective and scope of work-study.
Method Study : Definition, objective and scope of method study, activity recording and exam aids, Charts to record moments in shop - operation process charts, flow process charts, travel chart, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method;
Human factors in Work-Study; **Value Engineering and Value Analysis**.

Unit 3: Work Measurements 6 Hrs

Introduction: Definition, objectives and uses; Work measurement techniques:
Time study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination(numerical);
Work sampling: Need and procedure, sample size determinations (numerical);

Unit 4: Synthetic motion studies: PMTS and MTM. Introduction to MOST (numerical).

Production Management **7 Hrs**

Production Planning and Control: Types of production systems, functions of PPC, Aggregate production planning; Master Production Schedule; ERP

Forecasting techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality; (Numerical).

Supply Chain Management: Concept, Strategies, Supply Chain Network, Push and Pull Systems, Logistics, Distribution; Order Control strategies: MTO, MTA, MTS.

Unit 5: Facility Management **6 Hrs**

Facility Layout: Factors affecting facility location; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical);

Material Handling and Inventory Control: Principles, Types of Material Handling Devices; Stores Management, Inventory costs, Types of inventory models - Deterministic and Probabilistic, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis (Numerical).

Unit 6: Project Scheduling, Human Resource and Industrial Safety **6 Hrs**

Scheduling Techniques: CPM and PERT(Numerical);

Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training; Concept of KRA (Key Result Areas); Performance Appraisal (Self, Superior, Peer, 360^0);

Text Books

1. Industrial Engineering and Production Management, M Mahajan, Dhanpat Rai and Co.
2. Industrial engineering and management by O. P. Khanna, Dhanpatrai publication
3. Industrial Engineering , Martend Telsang, S. Chand Publication.
4. Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication.
5. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
6. J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.

Reference Books

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008
2. Maynard's Industrial Engineering Hand Book By H.B. Maynard, KJell, McGraw Hill Education, 2001
3. Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002.

- Assignment based evaluations are designed. **This evaluation is treated as T1-Marks**. Marks will be calculated (at the end of semester) on the basis of successful completion / submission of assignments explained to you time to time on the basis of syllabus content. [Note: these assignments are part of activity based learning. Hence, students are to work in a group to complete following assignments].

ME 4103 – CAD/CAM and Automation Lab

Teaching Scheme
Lab: 2 Hrs/week

Examination Scheme
Practical: 50 marks
Credits: 1

Prerequisites:
Strength of material, Manufacturing process

Course Objectives:

1. To apply homogeneous transformation matrix for geometrical transformations of CAD entities
2. To compute stresses, strains, and deflection for bar, truss and beam problems under static loading using finite element tool
3. To incorporate manufacturing simulation tool for virtual manufacturing of lathe and milling part
4. To demonstrate 3D printing technique for preparing of prototype models

Course Outcomes:

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

1 Apply homogeneous transformation matrix for geometrical transformations of CAD entities

2 Compute stresses, strains, and deflection for bar, truss and beam problems under static loading using finite element tool

3 Incorporate manufacturing simulation tool for virtual manufacturing of lathe and milling part

4 Demonstrate 3D printing technique for preparing of prototype models

List of Practical Activities:

1. Write a Programs for transformation of different objects using MATLAB solver
2. Solve 1D bar problems for stress and deflection analysis using ANSYS
3. Solve 2D truss problems for stress and deflection analysis using ASYSS
4. Stress and deflection analysis of plate/bracket using ANSYS
5. Tool path generation of Turning components using Feature CAM tool
6. Tool path generation of Milling components using Feature CAM tool
7. Manufacture assembly components using 3D printing machine
8. Assignment of robot gripper design

Text Book:

1. Ibraim Zeid, Mastering CAD/CAM – Tata McGraw Hill Publishing Co. 2000
2. Nitin S. Gokhale, Practical Finite Element Analysis, Finite to Infinite; First edition

ME 4104 – Project Phase -I

Teaching Scheme	**Examination Scheme**
Tutorial: 2 Hrs/week	In-Sem : 100 marks
Lab : 14 Hrs./week	Oral: 50 marks
	Credits: 9

Course Outcomes:
On completion of the course, students will be able to -

1. extract desired understanding and conclusions consistent with objectives and limitations of the analysis by using mechanical engineering concepts
2. build models/prototypes to develop diverse set of design solutions
3. use appropriate procedures, tools and techniques to conduct experiments to identify various engineering roles
4. demonstrate effective communication, problem solving, conflict resolution and leadership skills considering moral & ethical principles
5. read, understand and interpret technical and non-technical information
6. produce clear, well-constructed, and well-supported written engineering documents
7. use project management tools to schedule a sustainable engineering project so it is completed on time and on budget

INSTRUCTIONS FOR DISSERTATION WRITING (Project Stage I)

1. Print the manuscript using
    a. Letter quality computer printing.
    b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
    c. Use 1.5 line spacing.
    d. Entire report shall be of 5- 7 chapters.
2. Use the paper size 8.5'' × 11'' or A4 (210 × 197 mm). Please follow the margins given below. Margin Location
    a. Top - 1'' (25.4 mm)
    b. Left - 1.5'' (37 mm)
    c. Bottom - 1.25'' (32 mm)
    d. Right - 1'' (25.4 mm)
3. The footer must include the following: Institute Name, B.Tech. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.
5. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
6. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

7. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).
8. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a. Illustrations should not be more than two per page. One could be ideal
    b. Figure No. and Title at bottom with 12 pt
    c. Legends below the title in 10 pt
    d. Leave proper margin in all sides
    e. Illustrations as far as possible should not be photo copied.
9. Photographs if any should be of glossy prints
10. Please use SI system of units only.
11. Please number the pages on the front side, centrally below the footer
12. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
13. Symbols and notations if any should be included in nomenclature section only
14. Following will be the order of report
    a. Cover page and Front page as per the specimen on separate sheet
    b. Certificate from the Institute as per the specimen on separate sheet
    c. Acknowledgements
    d. List of Figures
    e. List of Tables
    f. Nomenclature
    g. Contents
    h. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word Abstract‖ should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Two sentences each on motive, method, key-results and conclusions in Abstract

The main body of your report will contain:

1. Introduction (Times New Roman (TNR) – 14 Bold)
    a. Problem statement (TNR – 12)
    b. Objectives
    c. Scope
    d. Methodology
    e. Organization of Dissertation
2. Literature Review: Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.
3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD)
4. Experimental Validation - This chapter shall be based on your own experimental work
5. Concluding Remarks and Scope for the Future Work
6. References
7. ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

Note:

1. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3… and for subheadings 1.1, 1.2… etc and section subheadings 2.1.1, 2.1.2… etc.
2. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it.

Please follow the following procedure for references

Reference Books

[1] Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions

[1] Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 – 98.

[2] Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings

[1] Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports or Handbooks

[1] United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent

[1] Patent no, Country (in parenthesis), date of application, title, year.

Avoid Internet reference as far as possible, but if you have no other chice

[1] www.(Site) [Give full length URL]

Autonomous Program Structure

Final Year B. Tech.

Eighth Semester (Mechanical Engineering)

2016 Pattern (R0)

Course Code	Course Title	Teaching Scheme Hours/ Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 4201	Turbo Machines	3	0	0	50	50	0	0	100	3
PEME 4201	Program Elective-I	3	0	0	50	50	0	0	100	3
OE 4201	Open Elective-II	3	0	0	50	50	0	0	100	3
ME 4202	Turbo Machines Lab	0	0	2	0	0	50	0	50*	1
ME 4203	Project Phase-II	0	2	16	100	0	50	0	150	10
ME 4204	Project based Online Course**	2	0	0	50	0	0	0	50	2
	Total	**11**	**2**	**18**	**300**	**150**	**100**	**0**		
	Grand Total	**31**			**550**				**550**	**22**

**The student shall register and complete the project based online course preferably in semester-I but may complete the same till the end of semester-II.

PEME 4201: Programme Elective-I
1) Mechanical Vibrations
2) Advanced Manufacturing Processes
3) Refrigeration and Air conditioning
4) Energy Storage Management

OE 4201: Open Elective-II
1) Renewable Energy Sources
2) Operations Research

ME 4201 – Turbomachines

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Prerequisites:

1. Applied Thermodynamaics
2. Fluid Mechanics

Course Objectives:

1 Application of basic flow equations to various machines can be done by students
2 Train the students to acquire the knowledge and skill of analyzing different turbo machines.
3 Comparison and selection of machines for various operations

Course Outcomes:

Upon completion of this course, the student will be able :

1 To calculate efficiency of for impulse and reaction turbine
2 Demonstrate the different types of turbines, pumps and compressors
3 Interpret the type of turbomachines and illustrate inlet and outlet conditions with the help of velocity triangles.
4 Identify the type of turbomachines for given application

Unit 1: Introduction & Hydraulic Turbines **10 Hrs**

Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines,
Pelton wheel- Construction, principle of working, velocity diagrams and analysis, design aspects,
Reaction Water Turbines : Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction, Draft tubes: types and analysis,

Unit 2: Performance Characteristics of turbomachines **5 Hrs.**

Governing and performance characteristics, specific speed, selection of turbines, Introduction to Steam Turbines

Unit 3: Centrifugal Pumps **8 Hrs.**

Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thoma‟s cavitation factor, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, system resistance curve, selection of pumps. Cavitation, open, semi open impeller pumps

Unit 4: Centrifugal Compressor **8 Hrs.**

Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input, actual work input, dimension parameters, pre-whirl losses, surging, choking, stalling characteristics.

Unit 5: Axial Compressor **8 Hrs.**

Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, dimensionless parameters, flow through the blade rows, pressure rise across the stage, stage losses and efficiencies, Performance characteristics.

Suggested Texts and Reference Materials:

1 William W. Peng, Fundamentals of Turbomachinery, John Wiley & Sons.

2 Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill

3 S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966.

4 Karassik, Hand Book of Pumps, Tata McGraw Hills Ltd., New Delhi.

PEME4201 – Mechanical Vibrations

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Prerequisites:

1. Rigid body dynamics
2. Machines and Mechanisms
3. Machine Design

Course Objectives:

1. To determine the natural frequency of free undamped system.
2. To analyze the given systems subjected to damped vibrations.
3. To compute the amplitude and phase difference for a system subjected to forced vibrations.
4. To explain features and applications of vibration measuring devices.
5. To describe various control methods.
6. To understand basics of noise measurement and control.

Course Outcomes: The students will be able to,

1. determine the natural frequency of free undamped system.
2. analyze the given systems subjected to damped vibrations.
3. compute the amplitude and phase difference for a system subjected to forced vibrations.
4. explain features and applications of vibration measuring devices.
5. describe various control methods.
6. explain basics of noise measurement and control

Unit 1: Single Degree of Freedom Systems – Free Vibration **8 Hrs**

Fundamentals of Vibration: Elements of a vibratory system, S.H.M., degrees of freedom, modeling of a system, concept of linear and non-linear systems, equivalent spring, linear and torsional systems. **Undamped free vibrations:** Natural frequency by equilibrium and energy methods for longitudinal and torsional vibrations.

Unit 2: Damped free vibrations: **6 Hrs**

Different types of damping, free vibrations with viscous damping - over damped, critically damped and under damped systems, dry friction damping.

Unit 3: Single Degree of Freedom Systems - Forced Vibrations **6 Hrs**

Forced vibrations of longitudinal and torsional systems, simple harmonic excitation, excitation due to reciprocating and rotating unbalance, base excitation, magnification factor and phase difference, force and motion transmissibility.

Unit 4: Two Degree of Freedom Systems - Undamped Vibrations **6 Hrs**

Free vibration of spring coupled systems – longitudinal and torsional, natural frequency and mode shapes. Eigen value and Eigen vector by Matrix method, Geared systems.

Unit 5: Vibration Measurement and Control **8 Hrs**

Vibration measurement: Basics of vibration measurement, vibration measuring devices, FFT Analyzer, vibration exciters. Vibration standards.

Vibration control: Control of natural frequency, vibration isolators, and absorbers, control at source, path, receiver. Active and passive systems.

Unit 6: Introduction to Noise **6 Hrs**

Fundamentals of acoustics, decibels, sound pressure level, sound intensity, sound fields, sound reflection, absorption and transmission, pass-by-noise, noise measurement environments, noise standards.

Suggested Texts and Reference Materials:

1. Rao S. S., 'Mechanical Vibrations', Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd.
2. Grover G. K., 'Mechanical Vibrations', Nem Chand and Bros.
3. Thomson, W. T., 'Theory of Vibration with Applications', CBS Publishers and Distributors.
4. V P Singh, 'Mechanical Vibrations', Dhanpat Rai & Sons.
5. Kelly S. G., 'Mechanical Vibrations', Schaum's outlines, Tata McGraw Hill Publishing Co. Ltd.
6. Meirovitch, 'Elements of Mechanical Vibrations', McGraw Hill.
7. M.L.Munjal, 'Noise and vibration control', Cambridge University Press India Private Limited.
8. Bies, D. and Hansen, C., 'Engineering Noise Control - Theory and Practice', Taylor and Francis.

PEME 4201 Advanced Manufacturing Processes

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Semester: 50marks

End Semester: 50 Marks

Credits: 3

Pre-requisite: MP-I, MP-II.

Objectives:

1. To impart the fundamentals of various metal cutting practices, fundamentals of machine tools and processes.
2. To impart fundamental knowledge of non-traditional and MEMS machining.

Course Outcomes: Students will be able to,

1. Describe features and applications of screw thread and gear manufacturing processes.
2. Demonstrate finishing processes like polishing, burnishing, buffing.
3. Exploit use of non-traditional and MEMS machining processes to diversify and improve manufacturing technology in the region.
4. Judge the limitations and scope of machines to perform variety of operations.

Unit 1: Manufacturing and Finishing Processes for Screw Threads and Gear: 6 Hrs

Basic Introduction, thread milling, die threading, Thread rolling, Thread grinding. Gear hobbing, Hobbing technique, Gear finishing processes- gear shaving, gear lapping, gear grinding and gear burnishing. Roller burnishing process. Super finishing processes (Polishing, Buffing).

Unit 2: Non-Traditional machining processes: 8 Hrs

Introduction, Principle of ECM process, parameters of the processes, electrochemical grinding, electrochemical deburring, chemical machining. Abrasive flow machining (AFM), Magnetic abrasive finishing (MAF) – working, system, rocess variables, performance parameters and applications

Unit 3: MEMS: 6 Hrs

Introduction to MEMS, Definition and classification – applications, Bulk Micromachining, Wet and Dry Etching, Surface Micromachining, Chemical Vapor Deposition, Lithography, Wafer Bonding.

Unit 4: Advanced Metal Forming and Welding: 6 Hrs

High velocity hydro forming, High velocity mechanical forming, electromagnetic forming, High Energy Rate forming (HERF), Spinning (introduction to shear Spinning). Friction Stir Welding, Thermit welding,

Unit 5: Additive Manufacturing Processes: 6 Hrs

Introduction, principles and development in additive manufacturing technology, powder based fusion process, extrusion based system, sheet lamination process, direct write technologies.

Unit 6: E-MANUFACTURING: **6 Hrs**

Nano manufacturing techniques and micromachining, High Speed Machining and hot machining

Text Book:

1. Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Pearson (2005)

Reference Books:

1. Fundamentals of Modern Manufacturing – Materials, Processes and Systems, M. P. Groover, Wiley India, 5th Edition.
2. V. K. Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd. 2002.
3. Elements of Workshop Technology: Machine Tools (Volume – 2) by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirajhar Roy, Media promotors (2010).
4. Sheet metal forming: Processes and applications – Tayalam Atlan, ASM International USA.
5. Friction Stir welding and Processing – Rajiv S. Mishra, ASM International.
6. Additive Manufacturing Techniques – Ian Gibson, Springer.

PEME 4201 – Refrigeration and Air Conditioning

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Prerequisites:

1. Engineering Thermodynamics
2. Heat Transfer
3. Applied Thermodynamics

Course Objectives:

1	To determine the performance parameters of vapour refrigeration system.
2	To estimate thermal performance of various refrigeration and air conditioning system components.
3	To do performance calculations for multistage refrigeration system.
4	To calculate load for air conditioning system
5	To analyze air distribution system.

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

1	Understand properties and environmental issues of various refrigerants.
2	Calculate the performance parameters of vapour refrigeration system.
3	Estimate thermal performance of various refrigeration and air conditioning system components.
4	Do performance calculations for multistage refrigeration system.
5	Calculate load for air conditioning system.
6	Analyze air distribution system

Unit 1 Refrigerants **3 hrs**

Classification of refrigerants, Designation of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant: recovery reclaims, recycle and recharge.

Unit 2 Vapour Refrigeration System **7 hrs**

Review of vapour compression cycle, advanced vapour compression cycles, Review of vapour absorption system, aqua ammonia system, three fluid system (Electrolux refrigerator).

Unit 3 Thermal Design of Refrigeration and Air Conditioning System Components **8 hrs**

Compressor: characteristic curves of reciprocating and centrifugal compressors, sizing of reciprocating compressor
Evaporator: types, Performance analysis
Condenser: air-cooled condenser, shell and tube condenser and evaporative condenser.
Expansion Devices: - capillary tube, thermostatic expansion valve, electronic expansion valve, operating Characteristics
Cooling Tower: types and design of cooling towers, thermal performance

Unit 4 Multi pressure Refrigeration system 7 hrs

Review of basics of multi pressure refrigeration system, cascade system, multi evaporator system. Individual and multiple expansion valve, multistage compression.
Introduction to Cryogenics (Linde - Hampson cycle) and applications.

Unit 5 Air Conditioning Load Estimation 7 hours

Types of air conditioning systems
Review of psychometric processes, thermodynamics of human body, Concept of infiltration and ventilation, indoor air quality requirements, Ventilation for cooling (Natural ventilation and Mechanical Ventilation) Solar radiation, Cooling load temperature difference method
Concept of ECBC (Energy Conservation Building Code)

Unit 6 Air Distribution System 7 hrs

Ducts: Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, methods of duct system design: equal friction, velocity reduction, static regain method.
Air handling unit: fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, and smoke).

Suggested Texts and Reference Materials:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd
3. McQuiston, Heating Ventilating and air Conditioning: Analysis and Design, Wiley India
4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpat Rai & Company, New Delhi
5. ASHRAE Handbooks
6. Threlkeld J.L., Thermal Environmental Engineering, Prentice Hall Inc. New Delhi
7. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGraw Hill Publications

PEME 4201 Energy Storage and Management

Teaching Scheme

Lectures 3 hrs/week

Examination Scheme

In Semester- 50Marks

End Semester- 50 Marks

Credits-3

Prerequisite: Basics of electrical engineering, Engineering Thermodynamics, Economics.

Course Objective:- Students will be able to :-

1. Understand different energy systems, their economics and Management.
2. Use these knowledge to analyse and design simple energy storage system.
3. Formulate and solve equations and model containing energy storage elements
4. Understand build a simple energy storage systems and take measurements to compare measurements of different energy storage systems.
5. Understand relationship between mathematical representation of energy storage systems and corresponding real life effects.

Course Outcome:- Student will be able to demonstrate knowledge and understanding of:

1. Fundamentals of energy storage application (e.g. temporal storage needs) and principles of energy conversion
2. Principles of battery and other electro-chemical systems such as super-capacitors, fuel cells, and mechanical energy storage systems
3. Principles of energy storage and energy management systems
4. Be able to propose, analyze and size an energy storage system for a given application.
5. Compare different engineering technologies from various perspectives such as storage, efficiency and economics.

Unit 1 Mechanical Energy Storage: 6 Hrs

Potential Energy Storage , Energy Storage in Pressurized Gas, Potential Energy Storage Using Gravity, Hydroelectric Power, Pumped-Hydro Storage. Use of the Kinetic Energy in Moving Water, Kinetic Energy in Mechanical Systems**,** Linear Kinetic Energy, Rotational Kinetic Energy, Internal Structural Energy Storage, Energy Storage in Ultra-high speed Flywheel

Unit 2 Electro-chemical and Electromagnetic Storage 8 Hrs

Introduction Simple Chemical and Electrochemical and electromagnetic Reactions ,Major Types of Reaction Mechanisms in Electrochemical Cells. The Operating Voltage and the Concept of Energy Quality,The Charge Capacity The Maximum Theoretical Specific Energy, Variation of the Voltage as Batteries Discharged and Recharged, Cycling Behavior ,Self-Discharge ,Lead-Acid Batteries, Lithium ion batteries, Energy in a Parallel Plate Capacitor, Electrochemical Charge Storage Mechanisms, Electrostatic Energy Storage in the Electrical, Ultracapacitors (Energy Storage in Capacitors).

Unit 3 Hydrogen Storage **6 Hrs**

Introduction,The Production of Hydrogen ,The Steam Reforming Process,The Reaction of Steam with Carbon, Electrolytic Production of Hydrogen ,Thermal Decomposition of Water to Produce Hydrogen, Chemical Extraction of Hydrogen from Water ,Current On-Board Hydrogen Storage Alternatives ,Storage of Gaseous Hydrogen in High Pressure Tanks ,Storage of Liquid Hydrogen in Insulated Tanks ,Storage of Hydrogen as Protons in Solids; Metal Hydrides , Hydrogen fuel cell.

Unit 4 Energy Management **6 Hrs**

Need of Energy Audit, Types of energy audit, Energy audit methodology, Instruments - equipment used in energy audit. Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy and environment, Need of Renewable and energy efficiency. Electricity billing, Electrical load management and maximum demand control, Power factor Improvement and its benefit, Selection and location of capacitors, Distribution and transformer losses.

Unit 5 Energy Economics **6 Hrs**

Investment – Need of Energy Economics, Financial analysis techniques - Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options.

Unit 6 Thermal Energy Utilities **6 Hrs**

Energy performance assessment and efficiency improvement of DG Set, Heat exch-angers, Pumps, Compressors. Carbon credit calculations.

Reference and Text Books:-

1. Energy Storage by Robert A. Huggins Springer Publication
2. Energy storage (A new approach) by Ralph Zito Wiley Publication
3. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7 th Edition.
4. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition,Georgia.
5. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, Press, New Delhi, 2006
6. Energy Performance assessment for equipment and Utility Systems.-Vol. 2,3.4 BEE Govt. of India
7. www.enrgymanagertraining.com
8. http://www.bee-india.nic.in

OE 4201 -Renewable Energy Sources

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Pre-requisites:- None

Course Objectives:-

1. Students will be able to understanding basic characteristics of renewable sources of energy and technologies for their utilization.
2. Students will learn engineering approach for renewable energy projects.
3. Students will analyze energy potential of renewable sources of energy.

Course Outcome:-

1. Students will be able to Understand of different renewable sources of energy and technologies for their utilization.
2. Select engineering approach to problem solving when implementing the projects on renewable sources of energy.
3. Undertake simple analysis of energy potential of renewable sources of energy.
4. Students will be able to describe main elements of technical systems designed for utilisation of renewable sources of energy.

Unit1. Solar Energy **8 Hrs**

Solar potential, Solar radiation geometry, Solar radiation data, radiation measurement, Types of Solar Collectors, Collection efficiency, Testing of Solar collectors – IS code, Applications of Solar Energy, Solar Desalination system, Solar dryer, Concentrating collectors, line type- point type Solar Energy storage. Solar PV Principle, Photo-cell materials, Solar batteries, solar tracking system,

Unit2. Wind Energy **6 Hrs**

Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills, Operation and maintenance of wind mills, wind farms, floating wind turbine, transitional depth technology, deepwater floating technology.

Unit3. Biomass Technology **6 Hrs**

Introduction, Energy plantation, Combustion and fermentation, Biomass gasification, types of gasifire, Updraught, downdraught, crossdraught Pyrolysis, various applications of Biomass energy, Bio-fuel types, Biomass gasification boiler

Unit4. Hydro Power systems **6 Hrs**

Introduction, types and system components, discharge curve and estimation of power potential, turbines for hydro power system, pump storage system

Unit5. Waste Heat Recovery Technology **6 Hrs**

Introduction, classification, advantages and application, commercially viable waste heat recovery devices, saving potential

Unit6. Hybrid Energy Systems **6 Hrs**

Need for Hybrid systems, Range and type of hybrid systems, Case studies of Solar-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems, 2,3,4 Way Hybrid Energy System. Applications for hybrid energy system.

Reference Books:

1. Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill.
2. Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3. Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.
4. Godfrey Boyle, Renewable Energy, Power for a sustainable future, Oxford university
5. Energy Engineering by R.S. Kulkarni & Dr. S.V. Karmare.
6. Non Conventional Energy Sources by Dr. L. Umanand.
7. Introduction to Non Conventional Energy Resources by Raja, SciTech Publications.

OE 4201 Operations Research

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Semester: 50 marks

End Semester: 50 Marks

Credits: 3

Pre-Requisites: Engineering Mathematics, Theory of probability, Statistics.

Course Objectives

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes: Learner will be able to.....

1. Illustrate the need to optimally utilize the resources in various types of industries.
2. Formulate and analyze various real life industrial operations.
3. Apply Operations Research techniques to industrial operations.
4. Demonstrate cost effective strategies in various applications in industry.

Unit 1: Introduction: Operation Research **8 hrs**

Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations.
Linear Programming: Introduction, Formulation, Simplex Method (Big – M and Two Phase Methods), Dual Simplex Method (Conversion of primal to dual)
Introduction to Sensitivity Analysis.
Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty, Decision Trees.

Unit 2: Transportation Model **8 hrs**

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods like UV and Stepping Stone Method, Concept of Trans-shipment Methods as an Extension of Transportation.
Assignment Problem- Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem.

Unit 3: Theory of Games and Investment Analysis **8 hrs**

Theory of Games : Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming.
Investment Analysis: Break-Even Analysis, Payback Period Method, A (A) R Method, DCF Method, IRR Method, Introduction to Probabilistic Models.

Unit 4: Inventory Control and Replacement Analysis **8 hrs**

Inventory Control - Deterministic Models- Shortage, without shortage; Probabilistic Inventory Models, Introduction to Concept of Service level.
Replacement Analysis - Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly.

Unit 5: Queuing Theory and Sequencing models **8 hrs**

Queuing Theory - Introduction, Basis Structure, Terminology (Kendal's Notations) and Applications.
Queuing Model M/M/1: /FIFO, M/M/c.
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Sequencing models: Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines

Unit 6: Network Models **8 hrs**

Network Models: Fulkerson's rule, concept and types of floats, CPM and PERT, Introduction to crashing.
Simulation: Introduction, Monte-Carlo Simulation method, Simulation of Inventory and Queuing Problems.
Introduction to Multi Object Decision Making: Goal Programming Formulation.

Text Books

1. N. D. Vora, Quantitative Techniques.
2. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
3. J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.
4. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.

Reference Books

1. Belegundu, ― Optimization Concepts and Applications in engineering, Cambridge Uni. Press, India
2. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India
3. Ravindran, ―Engineering optimization Methods and Appliations‖, 2nd edition, Wiley, India
4. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
5. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

ME 4202 – Turbo machines Lab

Teaching Scheme

Lab: 2 Hrs/week

Examination Scheme

Oral: 50 marks

Credits: 1

Prerequisites:

1. Applied Thermodynamics
2. Fluid Mechanics

Co - requisites:

1. Turbomachines

Course Objectives:

1. To conduct experiments involving various parameters of different turbo machines
2. To calculate the output parameters of given turbomachines based on the input parameters
3. To Illustrate the characteristics in the graphical form
4. To Compare the results with available characteristic curves and deduce the conclusion from it

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

1. Conduct experiments involving different turbomachines
2. calculate the output parameters of given turbomachines based on the input parameters
3. plot the various characteristics curves
4. Compare the results with available theoretical/experimental results and deduce the conclusion from it

List of Experiments:

1. Verification of impulse moment principle
2. Study and trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and trial on any one hydraulic reaction turbine and plotting of main and operating characteristics
4. Study and trial on centrifugal pump and plotting operating characteristics
5. Study and trial of rotary compressors.
6. Visit to hydro/steam power plant and report to be submitted.
7. Performance Test on Gear (Oil) Pump Test Rig

ME 4203 – Project Phase -II

Teaching Scheme

Tutorial: 2 Hrs/week

Lab : 16 Hrs./week

Examination Scheme

In-Sem : 100 marks

Oral: 50 marks

Credits: 10

Course Outcomes:

On completion of the course, students will be able to -

1. extract desired understanding and conclusions consistent with objectives and limitations of the analysis by using mechanical engineering concepts
2. build models/prototypes to develop diverse set of design solutions
3. use appropriate procedures, tools and techniques to conduct experiments to identify various engineering roles
4. demonstrate effective communication, problem solving, conflict resolution and leadership skills considering moral & ethical principles
5. read, understand and interpret technical and non-technical information
6. produce clear, well-constructed, and well-supported written engineering documents
7. use project management tools to schedule a sustainable engineering project so it is completed on time and on budget

INSTRUCTIONS FOR DISSERTATION WRITING (Project Stage I)

1. Print the manuscript using
    a. Letter quality computer printing.
    b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
    c. Use 1.5 line spacing.
    d. Entire report shall be of 5- 7 chapters.
2. Use the paper size 8.5'' × 11'' or A4 (210 × 197 mm). Please follow the margins given below. Margin Location
    a. Top - 1'' (25.4 mm)
    b. Left - 1.5'' (37 mm)
    c. Bottom - 1.25'' (32 mm)
    d. Right - 1'' (25.4 mm)
3. The footer must include the following: Institute Name, B.Tech. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.
5. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
6. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

7. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).
8. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a. Illustrations should not be more than two per page. One could be ideal
    b. Figure No. and Title at bottom with 12 pt
    c. Legends below the title in 10 pt
    d. Leave proper margin in all sides
    e. Illustrations as far as possible should not be photo copied.
9. Photographs if any should be of glossy prints
10. Please use SI system of units only.
11. Please number the pages on the front side, centrally below the footer
12. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
13. Symbols and notations if any should be included in nomenclature section only
14. Following will be the order of report
    a. Cover page and Front page as per the specimen on separate sheet
    b. Certificate from the Institute as per the specimen on separate sheet
    c. Acknowledgements
    d. List of Figures
    e. List of Tables
    f. Nomenclature
    g. Contents
    h. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word Abstract‖ should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Two sentences each on motive, method, key-results and conclusions in Abstract

The main body of your report will contain:

1. Introduction (Times New Roman (TNR) – 14 Bold)
    a. Problem statement (TNR – 12)
    b. Objectives
    c. Scope
    d. Methodology
    e. Organization of Dissertation
2. Literature Review: Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.
3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD)
4. Experimental Validation - This chapter shall be based on your own experimental work
5. Concluding Remarks and Scope for the Future Work

6. References
7. ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

Note:

1. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3… and for subheadings 1.1, 1.2… etc and section subheadings 2.1.1, 2.1.2… etc.
2. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it.

Please follow the following procedure for references

Reference Books

[1] Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions

[1] Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 – 98.

[2] Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings

[1] Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports or Handbooks

[1] United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent

[1] Patent no, Country (in parenthesis), date of application, title, year.

Avoid Internet reference as far as possible, but if you have no other chice

[1] www.(Site) [Give full length URL]