Syllabus of B-Tech

(Mechanical

Engineering)

Batch 2020-24

by

School of Mechanical Engineering

School of Mechanical Engineering

Program Structure of B. Tech. Four Year Full Time Degree

(Entry Batch 2020-24 Onwards)

1st Semester

Sl. No.	AICTE CODE	Course Code	Course Title	L	T	S/P	C
1.	BSC	MTL1025	Engineering Mathematics-I	3	0	0	3
2	ESC	ECL1010	Basic Electronics	3	0	2	4
3	BSC	PHL1012	Engineering Physics	3	0	2	4
4	ESC	CSL1022	Introduction to 'C' Programming-/Phython.	3	0	2	4
5	HSMC	LNL1411	Professional Communication Skills	2	0	2	3
7	MC		Induction Program				
8	MC	PCN1010	NSS (Non-Credit)-UGC	0	0	0	0
9		MEL1001	Introduction to Mechanical Engineering	1	0	0	NC
10	ESC		Mechanical Workshop	0	0	3	1.5
			TOTAL	17	0	13	19.5

Total Credits 19.5

2nd Semester

Sl. No.	AICTE Code	Course Code	Course Title	L	T	S/P	C
1	BSC	MTL1026	Engineering Mathematics-II	3	0	0	3
2	ESC	MEL1011	Engineering Graphics	1	0	3	2.5
3	ESC	CSL1028	Programming in PYTHON-I (PL-2)PCC	2	0	4	4
4	BSC	MEL1112	Materials Science and Engineering	3	0	2	4
5	ESC	MEL1012	Engineering Mechanics	3	1	0	4
6	MC	PCL1067	Discourse on Human Virtues – AICTE MC-HS	3	0	0	3
7		LNP1142	Language lab	0	0	2	1
			TOTAL	18	1	11	21.5

Total Credits 21.5

3rdSemester

Sl. No.	AICTE code	Course Code	Course Title	L	T	S/P	C
1	HSMC	PCL2042	Introduction to Logic- AICTE	3	0	0	3
2	PCC	MEL2015	Kinematics of Machines	3	1	0	4
3	PCC	MEL2231	Fluid Mechanics	3	1	2	5
4	PCC	MEL2014	Strength of Materials	3	1	2	5
5	PCC	MEL2211	Thermodynamics	3	0	0	3
6	PCC	MEL2013	Machine Drawing	1	0	3	2.5
7	MC	BTL2304	Environmental Studies- AICTE	3	0	0	NC
		MEC2001	Summer internship-I	0	0	2	1
			TOTAL	19	3	9	23.5
Total Credits 23.5							

4thSemester

Sl. No	AICTE code	Course Code	Course Title	L	T	S/P	C
1	PCC	MEL 2232	Fluid Machines	3	1	2	5
2	PCC	MEL 2212	Thermal Engineering	3	0	2	4
3	PCC	MEL 2113	Manufacturing Processes	3	0	2	4
4	PCC	MEL 2018	Dynamics of Machines	3	0	2	4
5	PCC	MEL 2016	Mechanics of Materials	3	1	0	4
6	PCC	MEL2017	Machine Design-I	3	1	0	4
			Total	19	0	8	25
Total Credits							25

5thSemester

Sl.No.	AICTE code	Course Code	Course Title	L	T	S/P	C
1	PCC	MEL3221	Heat and Mass Transfer	3	1	2	5
2	PCC	MEL3131	Industrial Engineering	3	0	0	3
3	PCC	MEL 3018	Machine Design - II	3	1	0	4
4	PCC	MEL 3136	Metal Cutting and Machine Tool	3	0	2	4
5	ESC	MEL3021	CAD/CAM	3	0	2	4
6	PEC		School Elective – I	3	0	0	3
8		MEC3002	Summer Internship-II	0	0	2	1
9		PCN 3079	Constitution of India	1	0	0	NC
			TOTAL	19	1	8	24
Total Credits 24							

6thSemester

Sl. No.	AICTE code	Course Code	Course Title	L	T	S/P	C
1	OEC		Open Elective-I	3	0	0	3
2	ESC	MEL3121	Metrology and Measurements	3	0	2	4
3	PCC	MEL3022	Mechanical Vibration	3	0	2	4
4	PEC		School Elective-II	3	0	0	3
5	PCC	MEL 3222	IC Engine	3	0	2	4
6	PCC	MEL3031	Automobile Engineering	2	0	2	3
			TOTAL	18	0	6	21
Total Credits 21							

7th Semester							
Sl. No.	**AICTE Code**	**Course Code**	**Course Title**	**L**	**T**	**S/P**	**C**
Passing of Comprehensive Exam, conducted in 4th Week of August, Last Week of October, is mandatory for Award of degree							
1	OEC		Open Elective-II	3	0	0	3
2			School Elective – III	3	0	0	**3**
3		MEL4223	Refrigeration and Air conditioning	3	0	2	4
4		MEC4003	Summer Internship III	0	0	0	1
5							
		MED4921	Minor Project	0	0	3	1.5
			TOTAL	15	0	7	12.5
Total Credits							12.5

8th Semester							
Sl. No.	**AICTE Code**	**Course Code**	**Course Title**	**L**	**T**	**S/P**	**C**
1			**Open Elective-III**				**NC**
2	PW	MED 4912	Major Project	0	0	20	10
Total Credits							10

LIST OF SCHOOL ELECTIVES
School Elective –I

Course Code	Course Title	L-T-P	Credits
MEE 3224	**Power Plant Engineering**	3-0-0	3
MEE 3134	**Work Study and Ergonomics**	3-0-0	3
MEE 3122	**Computer Integrated Manufacturing Systems**	3-0-0	3
MEE 3024	**Concurrent Engineering**	3-0-0	3
MEE 3032	**Industrial Automation**	3-0-0	3
MEE 3233	**Gas Dynamics and Jet Propulsion**	3-0-0	3
MEE 3033	**Control Systems**	3-0-0	3
MEE 3079	**Tribology**	3-0-0	3
MEE 2134	**Mechanical System Design**	3-0-0	3
MEE3065	**Mechatronics**	3-0-0	3

School Electives-II

Course Code	Course Title	L-T-P	Credits
MEE 3236	**Alternate Fuels**	3-0-0	3
MEE 3237	**Solar Thermal Power Engineering**	3-0-0	3
MEE 3160	**Smart Manufacturing**	3-0-0	3
MEE 3161	**Micro and Nano Machining**	3-0-0	3
MEE 3080	**Design of Composite Materials**	3-0-0	3
MEE 3081	**Modeling and Simulation of Manufacturing System**	3-0-0	3
MEE 3238	**Sustainable Energy Engineering**	3-0-0	3
MEE 4141	**Maintenance Engineering**	3-0-0	3
MEE3144	**Industry 4.0**	3-0-0	3

School Electives-III

Course Code	Course Title	L-T-P	Credits
MEE 3162	Quality Management	3-0-0	3
MEE 3163	Robotics	3-0-0	3
MEE 3164	Non Destructive Testing	3-0-0	3
MEE 4234	Computational Fluid Flow and Heat Transfer	3-0-0	3
MEE 3239	Fuel and Combustion	3-0-0	3
MEE 3240	Hydrogen and Fuel Cell	3-0-0	3
MEE 3165	Project Management	3-0-0	3
MEE 4235	Energy Management	3-0-0	3
MEE 4025	Design for Manufacturing and Assembly	3-0-0	3
MEE 4027	Product Design & Developments	3-0-0	3

Open Elective

Course Code	Course Title	L-T-P	Credits
MEL 1112	Material Science and Engineering	3-0-0	3
MEE 4027	Product Design and Development	3-0-0	3
MEE 3225 MEE 3239	Fuel Combustion and Pollution	3-0-0	3
MEE 3163	Robotics	3-0-0	3
MEE 3080	Design of Composite Materials	3-0-0	3
MEE 4143 MEE 3162	Quality Management	3-0-0	3
MEE 4141	Maintenance Engineering	3-0-0	3
MEE 3238	Sustainable Energy Engineering	3-0-0	3
MEE3144	Industry 4.0	3-0-0	3

MTL 1025			Engineering Mathematics-I				B. Tech		Sem. 1st	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hours	3.0 Hours	10	20	20	50	100

COURSE CONTENTS

Unit-I **(12 Contact periods)**

Differential Calculus: Partial differentiation, asymptotes, concavity, convexity, point of inflexion, curvature, radius of curvature, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.

Unit-II **(12 Contact periods)**

Integral Calculus: Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, centre of gravity, improper integrals, β-γ functions.

Unit-III **(12 Contact periods)**

Matrices: Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.

SUGGESTED BOOKS

1. E. Kreysig, Advanced Engineering Mathematics, Wiley 1oth edition, 2011.
2. A . K. Gupta, Engineering Mathematics, Macmillan 7th edition 2013.
3. McQuarri Macmillan, Mathematical Methods by Scientists & Engineers, 1st edition 2003.

Shanti Narayan, Differential Calculus, S Chand; 30thRevised edition, 2005

PHL 1012			Engineering Physics				B. Tech		Sem. 1st	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1.5 Hours	3.0 Hours	10	20	20	50	100

Engineering Physics

PHL 1012 **3 – 0 – 2 = 4**

UNIT I: Force and electric field due to continuous charge distribution, Field lines−Flux−Gauss's Law (differential and integral forms) and its applications, Electric potential, Work done in assembling a charge distribution. **[8]**
UNIT II: Force Law−line current, surface current and volume current densities (Equation of Continuity), Biot-Savart's law, Properties of B, Magnetic flux−Div B, Curl B, Magnetic vector potential A, Ampere's law (differential and integral forms), Faraday's laws of electromagnetic induction, displacement current, Modified Ampere's law, Four Maxwell's equations in differential and integral forms. **[10]**
UNIT III: Electromagnetic Spectrum, Brief introduction to black body radiation, Photo-electric Effect and Compton Effect, Wave particle duality (de−Broglie waves), Davisson-Germer Experiment, Concept of wave function and its physical significance, Phase and Group velocities, Uncertainty Principle. **[10]**
UNIT IV: Bohr Theory of atom (with finite and infinite nuclear mass), Derivation of time dependent and time independent Schrödinger wave equations, Expectation values and operators (momentum, energy and angular momentum operators) and commutators, Particle in a box of infinite height (One dimensional). **[10]**
UNIT V: Free electron theory−Free electron gas, Energy levels and density of states in one dimension, Band theory of solids, Classification of metals, semiconductors and insulators on the basis of band theory. **[7]**
Text Books: 1. Introduction to Electrodynamics, D. J. Griffiths, Pearson. 2. Concepts of Modern Physics , Arthur Beiser, Tata McGraw Hills 3. Introduction to Solid State Physics, Charles Kittel, Wiley

Reference Books: 1. Electromagnetics, B. B. Laud, New Age International Publisher.
2. Introduction to Solid State Physics, Charles Kittel, Wiley
3. Solid State Physics, Puri and Babbar, S. Chand (2010).
4. Perspective of Quantum Mechanics, S.P. Kuila, NCBA (2013).
5. Fundamentals of Physics, Resnick Halliday, Wiley.

Engineering Physics Lab

1. To study the measuring instruments (Vernier Calipers, Screw Gauge & Spherometer)
2. To find the angle of prism by the rotating telescope method.
3. To find the refractive index of the material of given prism using a spectrometer.
4. To determine the refractive index of the given liquid (water) using a hallow prism and spectrometer.
5. To study the Newton's interference rings and to determine the wavelength of sodium light.
6. To determine the wavelength of sodium light using a plane diffraction grating.
7. To determine the frequency of A.C. mains with a sonometer using non- magnetic wire.
8. To draw the characteristics curves of a semiconductor diodes (Si or Ge).
9. To study the V-I characteristics of a Zener diode.
10. To study the performance of a half-wave, full-wave & bridge type full-wave rectifier (without filters).
11. To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.
12. To study the Hall-effect and to calculate the Hall coefficient and charge carrier Concentration of a given sample.
13. To study the dependence of refractive index of the material of the prism on the wavelength of light; and hence'
(1) to determine the dispersive power of the material of
prism;
(2) verify the Cauchy relationship $\mu = a + b/\lambda 2$, and estimate the values of a & b
(3) plot a graph of $d\mu/d\lambda$ versus λ.
14. To determine the band gap by measuring the resistance of a thermistor at different temperatures.
15. To determine the energy band gap of a semiconductor diode (Ge) using Four probe method.
16. To study the wavelength of He-Ne laser.

Reference Books: 1. Practical Physics by G L Squires Cambridge University Press.
2. Advanced Practical Physics for Students by Worsnop and Flint.
3. B. Sc Practical Physics by C. L. Arora.
4. Practical Physics by R K Shukla.
5. B.Sc Practical Physics by Harnam Singh. 6. An Advanced Course in Practical Physics by D. Chattopadhyay, P.C. Rakshit. 7. A Text Book of Practical Physics, S.K. Ghosh, 2015, New Central Book Agency.

ECL1010			**Basic Electronics**				B. Tech		Sem. 1st	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Basic Electronics

ECL 1010 **4-0–0=4**

Introduction:- Semiconductor Classification ,Semiconductor bonds, Energy band description ,Semiconductor types, Hall effect.

Diodes:- P-N junction-I/V characteristics, diode equivalent circuits, semiconductor diodes, rectifiers-(efficiency, ripple factor),filters,clipers,clampers.

Transistors:- BJT construction, characteristics (cb,ce,cc), load line. BJT biasing. FET, JFET, MOSFET (Depletion and enhancement), FET biasing.

Transistor Modeling:- BJT small signal model, hybrid equivalent model,FET small signal model.

Amplifiers:- Single stage amplifiers, voltage gain, effect of frequency on Gain, multistage amplifier.

Other Semi-conductor devices- SCR'S , Diacs, triacs, and other thyristors, basic theory of operation, characteristics, Theory and operation of UJT,

Oscillators:- Feedback BH criteria, oscillator types, sinusoidal oscillator, Hartley oscillator,Collpitts Oscillator, Phase shift,Wein bridge oscillator, crystal oscillator.

Recommended Books:

- Basic Electronics: Devices, Circuits & IT Fundamentals, Kal, PHI
- Basic Electronics for Scientists
- Electronic Devices & Circuits: An Introduction, Mottershead,
- Electronic Devices & Circuits, Boylestad, Nashelky, PHI
- Semiconductor Devices , Nandita Dass, PHI
- Electronic Devices & Circuits, Milman & Halkias
- Electronic Devices & Circuits, Theodore Bogart, Jr

LIST OF PRACTICALS
COURSE: Basic Electronics Lab (ECP 1010)

1. To study the front panel control of Multimeter.
2. To study the front panel control of DC Multiple Power Supply.
3. To study the front panel control of Cathode Ray Oscilloscope (CRO).
4. To study the front panel control of Function Generator.
5. To determine and plot the operating characteristics of a PN junction diode.
6. To study the characteristics of Zener Diode and its application as voltage regulator.
7. To study the input / output waveforms of Half-wave rectifier using diode and find out its ripple factor and efficiency.
8. To study the input / output waveform of Full-wave Bridge rectifier using diode and find out its ripple factor and efficiency.
9. To study different Clipper circuits using PN junction diode for both positive and negative configurations.
10. To study different Clamper circuits using PN junction diode.
11. To plot and determine the characteristics of common-emitter configuration of a transistor.
12. To plot and determine the characteristics of common-base configuration of a transistor.

CSL1022			Introduction to 'C' Programming				B. Tech		Sem. 1st	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Introduction to C Programming

CSL 1022 **3 – 0 – 0= 1**

Course Contents

Introduction: Concept of problem solving, Problem definition, Program design, Techniques of Problem Solving (Flowcharting, algorithms, pseudo code), Structured programming concepts

Fundamentals: C character set, Tokens, identifiers and keywords, constants and variables, Data types, Data Type Modifiers Structure of a C Program, , Types of Statements: declarations, arithmetic statements and arithmetic operations, , Operators: Arithmetic, relational and equality, logical, assignment and compound assignment, Operators classification based on number of operands: Unary, Binary and Ternary (conditional, unary operations), operator's precedence & associativity, library functions, single character input and output, entering and writing data.

Control Statements: Statement and blocks, Decision making structures: if else and its types, Looping structures: while, for, do while, Case control structures: switch, break and continue statements, nested control structures.

Arrays: Definition, types, initialization, processing an array, 2 Dimension Arrays, Sorting, Searching, Copy, Insertion, Deletion of elements in array.

Functions and pointers: Functions definition, prototype, passing parameters, recursion, pointers, pointers and arrays, pointers and Functions,

String: Operations onString, built in functions, string and functions. User defined data types and Additional Features of C: Structures, Array of Structures, Array within Structures, Structures within Structures, Union, Enumerations, Pre-processor Directives

Recommended Books:

1. Gottfried, Byron S., "Programming with C", Tata McGraw Hill
2. Balagurusamy, E., "ANSI C", Tata McGraw-Hill
3. YashwantKanetker, "Let us C", BPB
4. C, The Complete Reference, Scholdt, TMH
5. Programming with C, S. Kaicher, Macmillan
6. C For Yourself, Asian Inst. of Tech AIT
7. Structured Programming Approach Using C, B. Forouzen, Thomas Learning

Introduction to C Programming

CSP 1022 **0 – 0 – 2 = 1**

List of experiments :

1. Write a program to know the number of bytes of data type contains
2. Write a program to display the ASCII code of a variable on the screen
3. Write a program to find the sum of digits of a 4 digit number
4. Write a program to reverse a 4 digit number
5. Write a program to swap the values of two variables with/without using third variable
6. Write a program to display if a number is even or odd
7. Write a program to display that a person is eligible for voting
8. Write a program to display greatest among two/ three numbers
9. Write a program to read number between 1-7 & display corresponding day of week
10. Write a program to read marks of five subjects and compute percentage and display grade of students based on percentage
11. Write a program to check whether the year entered is leap year or not
12. Write a program to print the relation between 2 numbers as equal to, less than or greater than
13. Write a program to read lower case character and display it in upper case
14. Write a program to convert Celsius into Fahrenheit
15. Write a program to swap the values to two variables with the help of temporary variable
16. Write a program to make a calculator
17. Write a program to print 1 to 10 in ascending and descending order on screen
18. Write a program to print sum of all even/ odd numbers between 1 to n
19. Write a program to print multiplication table of n
20. Write a program to find factorial of a number
21. Write a program to find sum of all numbers between m to n
22. Write a program to read a number and print each digit on separate line
23. Write a program to find the sum of digits of a number
24. Write a program to reverse a number
25. Write a program to find if the number is Palindrome or not
26. Write a program to read +ve numbers from user till user enters 0 & display for each number whether it is even or odd
27. Write a program to read character from user till user enters special character and display count of vowels and digits
28. Write a program to print all leap years between year m to n
29. Write a program to read a number and find if it is an Armstrong number or not
30. Write a program to print all prime number between n to m
31. Write a program using switch case to read one number and perform 1. Sum of digit 2. Reverse of number 3. Number is palindrome or not
32. Write a program using switch case to read operator and perform (+, -, /, *) operators of operands
33. Write a program to sort an array of type integer
34. Write a program to reverse an array element in the array
35. Write a program to check if the array is palindrome or not
36. Write a program to insert an element in sorted array at its right place
37. Write a program to delete all the duplicate numbers from the array
38. Write a program to read temperature recorded for the month of September. Display the highest and lowest temperature recorded
39. Write a program to read total marks of 90 students. Find the average marks scored by the class. Display the number of students having marks below average and total number of students marks equal to or above average.

40. Write a program to read n numbers in an array. Display the count of total –ve numbers, +ve numbers and total zero. Your program must derive m which should be added to all –ve numbers so as they are converted to either zero or +ve number.
41. Write a program to sum the two arrays into another array.
42. Write a program to add two matrix using multi-dimensional arrays
43. Write a program to multiply to matrix using multi-dimensional arrays
44. Write a program to find transpose of a matrix
45. Write a program to find the length of a string
46. Write a program to find the total number of vowels in the string
47. Write a program to find the number of vowels, consonants, digits and white space in string using Switch - case
48. Write a program to concatenate two strings
49. Write a program to find the total number of words in a sentence
50. Write a program to reverse a sentence
51. Write a program to remove all characters in a string except alphabet
52. Write a program to sort elements in different orders in string
53. Write a program to insert a character in a string
54. Write a program to delete a character in a string
55. Write a program to insert a word in a string
56. Write a program to search a word in a string
57. Write a program to delete a word in a string
58. Write a program to find the length of each string in a 2-dimensional array
59. Write a program to find sort each string in a 2-dimensional array
60. Write a program to display prime numbers between intervals using function
61. Write a program to check prime or Armstrong number using user-defined function
62. Write a program to check whether a number can be expressed as sum of two prime numbers using function
63. Write a program to find the sum of n natural numbers using function
64. Write a program to calculate factorial of a number using function
65. Write a program to reverse a sentence using function
66. Write a program to calculate power of a number using function
67. Write a program to convert binary number to decimal and vice-versa using function
68. Write a program to store information (name, roll and marks) of student using structure
69. Write a program to add two distances (in inch-feet) system using structure
70. Write a program to add two complex numbers by passing structure to a function
71. Write a program to calculate between two time period using structures and functions
72. Write a program to store information of 10 students using structure and display the roll no, name and total marks of each student structures and functions
73. Write a program to swap numbers of an array using call by reference
74. Write a program to find largest number in an array using function
75. Write a program to multiply two matrices by passing matrix to function

1022			Python Programming				B. Tech		Sem. 1st	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Unit-1 Introduction (9 Contact Periods)

Introduction to importance of IDEs like Spyder (Anaconda)/PyCharm for professional programming, explore Python shell as a calculator and for inputting Python expressions directly, HelloWorld program in Python script, Python keyword and Identifiers, Indentation, Comments, Data Types in. Operators in Python: comparison, arithmetic, logical, Boolean, bitwise, assignment. Python: numbers, list, tuple, strings, set, dictionary, conversion between various data types

Unit-2 Basic constructs (9 Contact Periods)

Input and Output in Python, if-else , for loop, while loop, break, pass, continue, creating Functions, functions with arguments, returning values form functions, lambda expressions, recursion, global and local variables, Importing other modules/packages and using their functions, creating random numbers/random-choice to create programs for simple guessing games like Rock –Paper-Scissors. Problems on 1D/2D/3D arrays using list. Problem solving using dictionary as look-up table.

Unit-3 Object Oriented Programming (9 Contact Periods) Basics of Object oriented programming: Class and Object. Defining variables and functions inside class. Creating objects, Inheritance, Multiple and Multi Level Inheritance, Function over-riding, the concept of composing objects of a different class in an object, problems on object composition

Unit-4 GUI creation in Python (9 Contact Periods)

GUI creation using Python's de-facto GUI package like tkinter or alternative packages like: wxPython, PyQt (PySide), Pygame, Pyglet, and PyGTK. Creating labels, buttons, entry (textbox), combobox, checkbutton, radiobutton, scrolledText (textarea), spinbox, progressbar, menubar, filedialog, tabs etc. Creating GUI simple games like Tic-Tac-Toe

SUGGESTED BOOKS:

1.Think Python 2nd Edition - How to Think Like a Computer Scientist, Allen B Downey, O'Reilly publication
2. Learn Python 3 the Hard Way, Zed A. Shaw, Pearson publication
3. Head First Programming: A Learner's Guide to Programming using the Python Language, Paul Barry David Griffiths Barry Griffiths, O'Reilly publication
4. Dive into Python 3, Mark Pilgrim, Apress publication

COURSE OUTCOMES :

After Successful Completion of this Course, students shall be able to;

1. Know the basic syntax and Data Structures in Python.
2. Think and Design solution in Object Oriented way as well as Procedural way.
3. Enjoy coding and compete at online programming sites like CodeChef, HackerEarth etc.

ESC-MEL1011			**Professional Communitaion Skill**				B. Tech		Sem. 1st	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
2	0	2	3	1 Hour	3 Hours	10	20	20	50	100

Annexure XXXX

Professional Communication I.NL 1411

Course Contents

Unit 1

General Communication

Purpose of Communication; Process of Communication; Importance of Communication; The Seven C's of the Effective Communication; Differences between Technical and General Communication. Barriers to Communication and Measures to Overcome the Barriers in Communication; Scope and Types of Communication Network; Formal and Informal Communication Network; Upward Communication; Downward Communication; Horizontal Communication; Diagonal Communication

Unit 2

Oral Communication

Speaking Skills: Kinds of Speaking Skills, Effective ways of Speaking, Public Speaking

Listening Skills: Stages of Listening Process, Strategies of Listening, Types of Listening

Professional Speaking: Interview Process, Characteristics of Job Interview, Pre Interview Preparation Techniques, Answering Strategies, Frequently asked Interview questions, Projecting a positive image and Body Language

Group Discussion: Definition, Methodology of Group Discussion, Techniques for Individual Contribution, Group Interaction Strategies, Helpful Expression and Evaluation, Practical Sessions

Unit 3

Written Communication

Email: How to write a Formal E-mail

Letter Writing Cover Letter: Format of Letter Writing: Block and Modified, etc. ; Formal and Informal Letter Writing; Formal Letter Formats; Reason for a Cover Letter to Apply for a Job; Format of Cover Letter; Different Types of Cover Letters

Resume and CVs: Contents of Good Resume; Guidelines for Writing Resume; Different Types of Resumes; Difference between CVs and Resume

Unit 4

Official Written Communication

Technical Report Writing: Difference between Business Report and Engineering Report; Characteristics of writing a good report; Guidelines for Report Writing; Steps in Report Writing; Structure of Report; Types of Reports and Different Formats. Note Making and Notice Writing: Purpose; Format; Points to remember while writing a Note and Notice. Minutes and Agendas: Difference between Minutes and Agendas; Purpose; Format; Points to remember while drafting Minutes and Agendas

Unit 5

Reading Skills

Enriching Language through Literature; Comprehension

Enhancing Vocabulary: Antonyms and Synonyms, Phrasal Verbs, One word Substitution, Homophones, Common Errors, Figure of Speech: Metaphor, Personification, Simile, Alliteration, Assonance, Paradox, Imagery, Oxymoron, Onomatopoeia.

Suggested Readings:

1. Raman, Meenakshi and Sangeeta Sharma. *Technical Communication: Principles and Practice*. Oxford University Press, 2015.
2. Choudhury, Soumitra, and Anjana Neira Dev. *Business English*. Pearson Publication, 2008.
3. Mukerjee, Hory S. *Business Communication*. New Delhi: Oxford University Press, 2013.
4. Williams, D. *Communication Skills in Practice: A Practical Guide for Health Professionals*. London, United Kingdom: J.Kingsley, 2007.
5. Pandey, O. N. *Technical Writing*. New Delhi: S.K. Kataria & Sons, 2014.

MEP 1043			Mechanical Workshop				B. Tech		Sem.1st	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
0	0	3	1.5	1 Hour	3 Hours	10	20	20	50	100

Mechanical Workshop

Carpentry shop: Tools and Equipment, Making of Various Joints, Pattern Making.

Foundry Shop: Tools and Equipments, Preparation of Moulds of Simple objects Using Single Piece, Two Piece and Match Plate Patterns.

Fitting Shop: Tools and Equipment, Practice in Chipping, Filing and Drilling, Making of V, Dovetail and Square Joints of M.S Flat.

Machine Shop: Introduction to various Lathe operations and practice on Shaping, Milling, Grinding, Drilling machines etc.

Welding Shop: Introduction to Tools and Equipments, Making of Various Joints Using Arc Welding, Gas Welding, MIG Welding, TIG Welding, Bead Formation in Horizontal, Vertical and Overhead Positions.

Sheet Metal Shop: Tools and Equipments, Making Tray, Cone, etc. with GI Sheet Metal

Smithy Shop: Tools and equipments, Making of Simple Parts like Hooks, Bolts, etc.

Recommended Books:

1. Raghuvanshi, B. S. - Workshop Technology–Vol 1, Dhanpat Rai & Sons, New Delhi.
2. Narayana, K L Kannaiah P. - Manual on Workshop Practice, Scitech Publishers, Chennai.
3. Upadhyay, R. – Manufacturing Practice, Kataria & Sons, New Delhi.
4. Swarn Singh-Workshop practice, Kataria & Sons, New Delhi.

MTL 1026			Engineering Mathematics II				B.Tech		SEm 2nd	
Version R-01							Co-requisites			
L	T	P	C	Minor Duration	Major Duration	Internal Marks (Assignment)	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hours	3 Hours	10	20	20	50	100

Engineering Mathematics II

Vector Calculus: Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties. Line & surface integrals. Green's theorem, Stokes' theorem & Gauss' theorem both in vector & Cartesian forms (statement only) with simple applications.

Unit-II

Ordinary Differential Equation(ODE): Formation of ODE, definition of order and degree of ODE and solution, ODE's of first order, method of separation of variables, homogenous and non-homogenous differential equations and their solution, exactness and integrating factor, Bernoulli's equation, linear ODE's of n^{th} order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.

Unit-III

Partial Differential Equation(PDE): Formation of (PDE), Solution of PDE by direct integration, Lagrange's linear equation, Non-linear PDE of first order, Method of separation of variables, Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates).

SUGGESTED BOOKS

1. E. Kreysig, Advanced Engineering Mathematics, Wiley 10th edition 2011.
2. Frank Ayres , Vector Analysis, Mc Graw Hills, 6th edition 2011.
3. T. Marsden and W.H. Freeman,VectorCalclus, Freeman, 6 edition 2011.
4. G. Simons, Differential Equations with Applications, TMH**,** McGraw-Hill Higher Education; 2 edition 1991.
5. S.L. Ross, Differential Equations, Wiley 3rd edition 1984.
6. R. Zalman, A Course in Ordinary and PDEs, Academic Press, 1st edition 2014.

MEL1011			**Engineering Graphics**				B. Tech		Sem. 2nd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
1	0	3	2.5	1 Hour	3 Hours	10	20	20	50	100

Engineering Graphics

Section-A

Introduction of Engineering Graphics: Drawing instruments and their uses, Orthographic Projections: Planes of projection–Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane–Straight Line inclined to both the planes–True Length and inclination of lines with reference planes–Traces of line–Projection of Planes, Projection of Solids, Isometric Drawing: Types of Projection-Orthographic, Isometric, Oblique and Perspective Projections, exercises on Isometric drawings.

Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.

Development of Surfaces: Principle, Engineering applications and Methods of development.

Section-B

Introduction: Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD system, Types of CAD software. Introduction to other drafting software suchas Mechanical Desktop and Auto Cad Electrical

Introduction to Auto CAD: Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc.

Drawing Aids and Editing Commands: Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.

Creating Text, Dimensions and Tolerances in AutoCAD: Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.

Recommended Books:

1. Ellen Filkensten-AutoCAD 2006 & AutoCAD LT2006 Bible, Wiley, New York.
2. Sham Tickoo -AutoCAD 2005,Tata McGraw Hill, New Delhi.
3. George Omura - AutoCAD, Sybex Inc.
4. Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers,Anand.
5. Narayana, K.L. and Kannaiah, P.-Engineering Graphics, Tata McGrawHill, New Delhi.
6. Gill, P.S-Engineering Drawing, S.K Kataria & Sons, New Delhi.

MEL 1112			***Materials Science & Engineering***				B. Tech		Sem. 2nd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Materials Science & Engineering

Unit I Crystallography: Review of Crystal Structure, Space Lattice, Crystal Planes and Crystal Directions, Coordination Number, Number of Atoms Per Unit Cell, Atomic Packing Factor.

Unit II Imperfection & Deformation of Metal: Crystal Imperfections, Type of Defects and Effects on Metal Properties, Deformation of Metal. Mechanism, Yield Point Phenomena, Strain Ageing, Work Hardening, Bauschinger Effect, Season Cracking, Recovery, Re-Crystallization and Grain Growth.

Unit III Solid Solution and Phase Diagram: Introduction to Single and Multiphase Solid Solutions and Types of Solid Solution, Importance and Objective of Phase Diagram Systems, Phase and Structure Constituents, Cooling Curves, Unary & Binary Phase Diagrams, Gibbs's Phase Rule, Lever Rule, Eutectic, and Eutectoid Systems, Peritectic and Peritectoid Systems. Iron Carbon Equilibrium Diagram and TTT Diagram.

Unit IV Heat Treatment: Principles, Purpose, Classification of Heat Treatment Processes, Annealing, Normalizing, Stress Relieving, Hardening, Tempering, Carburing, Nitriding, Cyaniding, Flame and Induction Hardening, Allotropic Transformation of Iron and Steel, Properties of Austentic, Ferrite, Pearlite and Martensite.

Unit V Creep Concept, Creep Curve, Mechanism, Factors, Testing and Prevention. Corrosion-Type and Prevention of Corrosion. Fracture, Failures of Metals-Failure Analysis. Fatigue-Characteristics, Mechanism and Factors Affecting Fatigue.

Unit VI Plastic. Composite and Ceramics, Powder Metallurgy Techniques.

Recommended Books

1. Elements of Material Science and Engineering Van Vlack. Wesley Pub.
2. Material Science –Narula, Narula and Gupta, New Age Publishers.
3. Material Science and Engineering- V. Raghvan, Prentice Hall of India Pvt.
4. A test Book of Material Science & Metallurgy-O.P Khana, Dhanpat Rai
5. Material Science and Engineering- an Introduction–Callister; W.D., John Wiley & Sons, Delhi.
6. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, and
7. Essentials of Materials Science & engineering–Donald R. Askeland, Pradeep P. Phale

Materials Science And Engineering Lab

The Following Practical Exercises are to be carried out:

1. To study Bravias Lattice crystal structure and crystal imperfection using ball models.
2. Study of Metallurgical Microscope
3. Preparation of specimen for microstructure studies
4. To study microstructures of metals/ alloys (ferrous and Non – ferrous) using metallurgical microscope
5. To study the effects of various heat treatments vi annealing, normalizing, quenching and tempering on low. Medium and high carbon steel samples.
6. Elemental analysis of Non – ferrous alloys (brass bronze and AL alloys)
7. Elemental analysis of steel and C.Is by spectrometer
8. Elemental analysis by atomic absorption spectrometer by inductively coupled plasma unit (ICP) for ferrous alloys, Non-ferrous alloys, ceramics, polymers
9. To determine the hardenability of a given steel by J.E.Q method
10. To study the effect of gas and are welding processes on hardness and microstructure of given steel sample.
11. To study the effects of TIG and MIG welding processes on microstructure and hardness of given metallic samples.
12. To study the effect of amount of determation by rolling on microstructure and hardness of given metallic sample

To study the wire drawing on microstructure and hardness of given metallic sample.

ESC-MEL 1012			Engineering Mechanics				B. Tech		Sem. 2nd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Engineering Mechanics

Unit I: Force and Force Systems: Coplanar, Concurrent and Non-Concurrent Force Systems, Resultant and Resolutions, Forces in Space, Vectors, Operations on Force using Vectors, Moment of Force, Varignon's Theorem, Couple and Its Properties, Resultant of a Spatial Force System.

Unit II: Equilibrium-Equilibrium of a Particle, External & Internal Forces, Equilibrium of a Rigid Body, Types of Supports, Structural Members and Beams, Reactions of Beams.

Properties of Lines, Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit III: Trusses, Frames and Mechanisms: Connected Bodies, Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non Rigid Frames, Simple Mechanisms, Space Frames.

Unit IV: Friction: Type of Friction, Characteristics of a Dry Friction, Equilibrium on Rough Inclined Place, The Wedge, The Screw Jack, Journal Bearing, Axle Friction, Thrust Bearing, Disc Friction, Clutches.

UnitV: Introduction to Dynamics, Kinematics and Kinematics of Particle in Rectilinear and Curvilinear Motions, Projectile, Kinematics and Kinematics of a Rigid Body.

Usage of D'Alembert's Principle, Work and Energy, Impulse and Momentum Principles.

Recommended Books:

1. Jurnarkar, S.B. and Shah, H.J.–Applied Mechanics, Charotar
2. Merium and Kraige–Engineering Mechanics, John Wiley & Sons.
3. Sharma, S.M.–Engineering Mechanics, Kirti Publications, Jammu.
4. Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5. Beer and E.R. Johnstons–Vector Mechanics, McGraw-Hill, New York

PCL1067/PCN7067				Discourse on Human Virtues				Pre-Requisites		
								Co-requisites		
L	T	P	C	Minor Duration	Major Duration	Assignment/Quiz	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hours	3 Hours	10	20	20	50	100

Discourse on Human Virtues

Unit I **(14 Contact Hours)**

1. What is Value Education?
2. Knowledge and Skill
3. Value and Virtue
4. Moral Agency and the Notion of Dharma
5. Freedom of Will and Determinism

Unit II **(13 Contact Hours)**

6. Understanding Human Existence: Human Being and Human Person
7. The Basic Human Aspirations: Continuous Happiness and Prosperity
8. Understanding harmony at the level of Individual, Family and Society

Unit III **(13 Contact Hours)**

9. Understanding harmony at the level of Nature
10. Cardinal Human Virtues such as Compassion, Wisdom, Justice, Tolerance, Non-violence, Service to Humanity with the help of suitable illustrations

SUGGESTED BOOKS

1. Das,Gurucharan (1990), *The Difficulty of Being Good*(Chapter 3), New Delhi: Penguin Books.
2. Frankfurt,Herry G. (1971). Freedom of the Will and the Concept of a Person. *The Journal of Philosophy*, 68 (1): 5 – 20.
3. Gaur, R.R. et. al.(2006), *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
4. Excerpts from relevant books supplied by the instructor as and when required.

PCL2042				Introduction to Logic				Pre-Requisites		
								Co-requisites		
L	T	P	C	Minor Duration	Major Duration	Assignment/Quiz	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hours	3 Hours	10	20	20	50	100

Introduction to Logic

Unit-I Propositional Logic (14 Contact Hours)

1. Arguments: Inductive and Deductive Arguments, Truth and Validity
2. Simple and Compound Statements, Truth Functionality
3. Decision Procedures, Truth Tables, Inter-definability
4. Proof Construction and Proving Invalidity

Unit-II Syllogistic Logic (12 Contact Hours)

5. Categorical Propositions and Squares of Opposition
6. Categorical Syllogisms: Moods and Figures
7. Examining Syllogisms using formal rules and Venn diagrams
8. Problem of Existential Import

Unit-III Informal Fallacies, Mill's Method and Predicate Logic (14 Contact Hours)

9. Classification of Fallacies: (a) Fallacies of Relevance, (b) Fallacies of Defective Induction, (c) Fallacies of Presumption, and (d) Fallacies of Ambiguity
10. Mills Method
11. Singular Propositions and General Propositions
12. Quantificational Symbolization, Proving Validity and Invalidity

SUGGESTED BOOKS

1. Irving M. Copi, Carl Cohen, and Kenneth McMahon, *Introduction to Logic* (14th edition), New Delhi: Pearson Education Inc., 2014.
2. Irving M. Copi, *Symbolic Logic* (V edition), New Delhi: Prentice Hall, 2006.
3. P. J. Hurley, *A Concise Introduction to Logic* (IX edition), Belmont: Thomson Wadsworth, 2006

PCC-MEL 2015			***Kinematics of Machines***				B. Tech		Sem. 3rd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Kinematics of Machines

Unit I: Introduction-Links, Mechanisms, Kinematic Pair and Chains, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain, Double Slider-Crank Chain and Their Inversions, Kinematic Pairs, Graphical (Relative Velocity Vector and Instant aneous Center Methods), Analytical Methods for Displacement, Velocity, and Acceleration of Mechanisms Including Corriolis Components.

Lower Pairs-Universal Joint, Calculation of Maximum Torque, Steering Mechanisms (Ackerman and davis Approximate Steering Mechanism), Engine Indicator, Pantograph, Straight Line Mechanisms.

Unit II: Belts, Ropes and Chains-Material, Types of Drives, Idle Pulley, Intermediate or Counter Shaft Pulley, Angle and Right Angle Drive, Quarter Turn Drive, Velocity Ratio, Crowning Shaft Pulley, Loose and Fast Pulley, Stepped or Cone Pulleys, Ratio of Tension on Tight and Slack Sides of Belts, H.P Transmitted by Belts with consideration of Creep and Slip, Centrifugal Tensions and Its Effect on H.P Transmitted, Use of Gravity, Idle, Flat, V-Beltsand Rope Materials, Length of Belt, Rope and Chain Drives.

Unit III: Cams- Types of Cams and Followers, Definitions of Connected Terms, Displacement Velocity and Acceleration Diagrams (Cam and Followers), Analytical and Graphical Design of Cam Profiles with Various Motions, Analysis of Follower Motion (Circular, Convex, Tangent Cam Profiles), Calculation of Pressure Angle. **UnitIV:** Friction Devices-Concepts of Frictions and Wear Related to Bearings and Clutches, Types of Brakes, Principle of Function of Brakes of Various Types, Braking of Front and Rear Tyres of a Vehicle, Problems to Determine Braking Capacity, Types of Dynamometers.

Unit V: Flywheels-Turning Moment and Crank Effort Diagrams for Reciprocating Machines, Fluctuations of Speed, Coefficient of Fluctuation of Speed and Energy, Determination of Flywheel Mass and Dimensions for Engines and Punching Machines

Governors-Function, Types and Characteristics of Governors, Watt, Porter and Proell Governor. Hartnell and Willson-Hartnell, Spring Loaded Governors, Sensitivity, Stability, Isochronisms And Hunting of Governors, Governor Effortand Power.

Recommended Books:

1. Rao, J.S. andDukkipati, R.V. – Mechanism and MachineTheory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. – Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R.S. and Gupta, J.K. - Theoryof Machines, Eurasia Publishing House (P) Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.-Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Rattan S.S.-Theory of Machines, Tata McGraw Hill, New Delhi.

PCC-MEL 2231			***Fluid Mechanics***				B. Tech		Sem. 3rd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	5	1 Hour	3 Hours	10	20	20	50	100

Fluid Mechanics

Unit I: Introduction-Properties of Fluids-Pressure, Force, Density, Specific Weight, Compressibility, Capillarity, Surface Tension, Dynamic and Kinematic Viscosity-Pascal's Law, Newtonian and Non-Newtonian Fluids, Fluid Statics-Measurement of Pressure-Variation, Manometry-Hydrostatic Pressure on Plane and Curved Surfaces, Centre of Pressure, Buoyancy, Floation, Stability of Submerged and Floating Bodies, Metacentric Height, Period of Oscillation.

Unit II: Kinematics of Fluid Motion, Eulerian and Lagrangian Approach, Classification and Representation of Fluid Flow, Path Line, Stream Line and Streak Line. Basic Hydrodynamics, Equation for Acceleration, Continuity Equation, Rotational and Irrotational Flow, Velocity Potential and Stream Function, Circulation and Vorticity, Vortex Flow, Energy Variation Across Stream Lines, Basic Field Flow suchas Uniform Flow, Spiral Flow, Source, Sink, Doublet, Vortex Pair, Flow Pasta Cylinder with a Circulation.

Unit III: Euler's Momentum Equation-Bernoulli's Equation and Its Limitations, Momentum and Energy Correction Factors, Pressure Variation across uniform Conduit and uniform Bend-Pressure Distribution in Irrotational Flow and in Curved Boundaries, Flow Through Orifices and Mouthpieces, Notches and Weirs, Time of Emptying a Tank, Application of Bernoulli's Theorem, Orifice Meter, Venturimeter and Pitot Tube.

Unit IV: Navier-Stoke's Equation, Body Force, Hagen-Poiseullie Equation, Boundary Layer Flow Theory, Velocity Variation, Methods of Controlling, Applications, Diffuser, Boundary Layer Separation, Wakes, Drag Force, Coefficient of Drag, Skin Friction, Pressure, Profile and Total Drag-Stream Lined Body, Bluff Body, Drag Force on a Rectangular Plate, Drag Coefficient for Flow around a Cylinder, Lift and Drag Force on an Aerofoil. **UnitV**: Flow of a Real Fluid, Effect of Viscosity on Fluid Flow, Laminar and Turbulent Flow, Boundary Layer Thickness, Displacement, Momentum and Energy Thickness, Flow Through Pipes, Laminar and Turbulent Flow in Pipes, Critical Reynolds Number, Darcy-Weisback Equation, Hydraulic Radius, Moody; S Chart-Pipes in Series and Parallel, -Siphon Losses in Pipes, Power Transmission through Pipes, Water Hammer Equivalent Pipe, Open Channel Flow, Chezy's Equation, Most Economical Cross Section.

Recommended Books:

1. Som S.K. and Biswas, G-Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, New Delhi.
2. Agrawal S.K.-Fluid Mechanics and Machinery,Tata McGraw-Hill, New
3. Kumar, D.S.-Fluid Mechanics and Fluid Power Engineering, Kataria &Sons Publishers, New Delhi.
4. Bansal R.K.-Fluid Mechanics and Hydraulic Machines, Laxmi Publications

Fluid Mechanics Lab

1. To Study the Flow Through a Variable Area Duct and Verify Bernoulli's Energy Equation.
2. To Determine the Coefficient of Discharge for an Obstruction Flow Meter (Venture Meter/Orifice Meter)
3. To Determine the Discharge Coefficient for Notches And Weirs.
4. To Study the Transition from Laminar to Turbulent Flow and to ascertain Lower Critical Reynolds Number.
5. To Determine the Hydraulic Coefficient for Flow Through an Orifice.
6. To Determine the Friction Coefficient for Pipes of Different Diameters.
7. To Determine the Head Loss in a Pipe Line Due to Sudden Expansion/ Sudden Contraction/ Bend.
8. To Determine the Velocity Distribution for Pipeline Flow with a Pitot Static Probe.

PCC-MEL 2014			***Strength of Materials***				B. Tech		Sem. 3rd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	5	1 Hour	3 Hours	10	20	20	50	100

Strength of Materials

Unit I: Simple Stresses and Strains-Concept of Stress and Strain, St. Vernants Principle, Stress and Strain Diagram, Hooke's Law, Young's Modulus, Poisson Ratio, Stress at a Point, Stress and Strains in Bars subjected to Axial Loading, Modulus of Elasticity, Stress Produced in Compound Bars subject to Axial Loading, Temperature Stresses and Strain Calculations Due To Application of Axial Loads and Variation of Temperature in Single and Compound Bars. Compound Stress and Strains, Two Dimensional System, Stress at a Point on a Plane, Principal Stresses and Principal Planes, Mohr's Circle of Stresses, Hook's Law, Principal Stresses Related to Principal Strains.

Unit II: Bending Moment and Shear Force Diagrams-S.F and B.M Definitions. BM and SF Diagrams for Cantilevers, Simply Supported Beams with or Without Overhangs and Calculation of Maximum BM and SF and the Point of Contra flexure Under A) Concentrated Loads, B) Uniformity Distributed Loads Over Whole Span or Part of Span, C) Combination of Concentrated Loads and Uniformly Distributed Loads, D) Uniformity Varying Loads, and E) Application of Moments.

Unit III: Slope and Deflection-Relationship between Moment, Slope and Deflection, Moment Are a Method; Methods of Integration; Macaulay's Method: Use of these Methods to Calculate Slope and Deflection for A) Cantilevers, B) Simply Supported Beams With or Without Overhang, C) Under Concentrated Loads, Uniformly Distributed Loads or Combination of Concentrated and Uniformly Distributed Loads.

Unit IV: Theory of Bending Stresses in Beams Due to Bending-Assumptions in Simple Bending Theory, Derivation of Formula: Its Application to Beams of Rectangular, Circular and Channel, I & T-Sections, Combined Direct and Bending Stresses in aforementioned Sections, Composite Beams.

Torsion-Derivation of Torsion Equation and its Assumptions, Applications of the Equation to Hollow and Solid Circular Shafts, Torsional Rigidity, Combined Torsion and Bending of Circular Shafts Principal Stress and Maximum Shear Stresses Under Combined Loading of Bending and Torsion, Analysis and Close-Coiled-Helical Springs.

Unit V: Columns and Struts-Failure of Columns, Euler's Formulas, Rankine-Gordon's Formula, Johnson's Emperical Formula for Axially Loaded Columns and their Applications.

Recommended Books:

1. Singer, F.P.andPytel, A.- Strengthof Materials, Harperand Row H.Kogakusha Publishers,New York
2. Popov, E.P.-Mechanics of Materials, Prentice Hall India, New Delhi
3. Bedi, D. S.- Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.-Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R.S.-Strength of Materials, Khanna Publishers, New Delhi

Strength Of Materials Lab

The Following Practical Exercises are to be carried out:

1. Tensile Tests on Ductile and Brittle Materials and to Draw Stress-Strain Curve and to Determine Various Mechanical Properties.
2. Compression Test on C.I. and to Determine Ultimate Compressive Strength.
3. Shear Tests on Different Materials and to Determine Ultimate Shear Strength.
4. Hardness Tests to Determine Hardness of Materials – Rockwell or Brinell or Vicker's Test
5. Impact Test to Determine Impact Strength.
6. Torsion Test and to Determine Torsional Strength.
7. Fatigue & Creep Tests
8. Tests on Close Coiled Helical Spring
9. Determination of Bucking Loads of Long Columns with Different End Conditions.

PCC-MEL 2211			**Thermodynamics**				B. Tech		Sem. 3rd	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Thermodynamics

Unit I: Introduction–Macroscopic and Microscopic Approaches; Thermodynamic Systems-Closed, Open and Isolated; Property, State, Path and Process; Quasi-Static Process; Temperature, Zeroth Law of Thermodynamics, Concept of Ideal Gas, Type of Thermometers, Work Transfer as a Path Function, P-dv Work in Various Quasi-Static Processes, Free Expansion, Heat Transfer as a Path Function.

First Law of Thermodynamics-Application to Closed System undergoing a Cycle, Closed System undergoing a Change of State, Different forms of Stored Energy, Enthalpy, PMM1. First Law applied to Flow Processes, Mass and Energy Balance in a Simple Steady Flow Process, Some Examples.

Second Law of Thermodynamics–Statements of Kelvin-Planck and Clausius, Refrigerator and Heat Pump, Reversibility and Irreversibility, Causes of Irreversibility, Conditions of Reversibility, Carnot Cycle, Introduction to Entropy, Temperature-Entropy Plot.

Unit II: Elements of Heat Transfer: Basic Concepts, Conduction Heat Transfer, Convection Heat Transfer, Radiation Heat Transfer, Heat Exchangers.

Unit III: Properties of Pure Substance-PV-T, PT, TS Diagram, Mollier Diagram–Mixture of Gaseous and Vapours- Mixtures of Ideal Gases–Dalton's Law-Thermodynamic. Properties of Mixture–Mixtures of Ideal Gases and Vapours-Psychrometric Principles-Psychometrics Chart-Applications. Introduction to Refrigeration–Vapour Compression Refrigeration.

Unit IV: Vapour Power & Gas Power Cycles: Simple Steam Power Cycle, Rankine Cycle, Actual Vapour Cycle Processes, Comparison of Rankine and Carnot's Cycle, Reheat and Regenerative Cycles, Ericsson Cycle, Otto Cycle, Diesel Cycle and Dual Cycle.

RecommendedBooks:

1. Nag, P.K.- Engineering thermodynamics, Tata McGraw Hill Publishers,
2. Vasandani, V.P.and Kumar, D.S.-Heat Engineering, metropolitan book
3. Kumar, D.S.-thermal science and engineering, Kataria & Sons Publishers,
4. Gupta and Prakash –Engineering thermodynamics, S.Chand Publishers,
5. Kothandaraman, C.P, and Dornkundwar, S.-thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengel and Boles Thermodynamics & Engineering Approach, Tata Mc GrawHill Publishers, New Delhi.

MEL 2232			**Fluid Machines**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	5	1 Hour	3 Hours	10	20	20	50	100

FLUID MACHINES

Unit I: Impact of Free Jets: Impulse–Momentum Principle, Jet Impingement- on a Stationary Flat Plate, Inclined Plate and a Hinged Plate, at the Center of a Stationary Vane, on a Moving Flat Plate, Inclined Plate, A Moving Vane and a Series of Vanes, Jet Striking Tangentially at the tip of a Stationary Vane and Moving Vane (s), Jet Propulsion of Ships. Problems.

Unit II: Impulse Turbines: Classification–Impulse and Reaction Turbines, Water Wheels, Component Parts, Construction, Operation and Governing Mechanism of a Pelton Wheel, Work Done, Effective Head, Available Head and Efficiency of a Pelton Wheel, Design Aspects, Speed Ratio, Flow Ratio, Jet Ratio, Number of Jets, Number of Buckets and Working Proportions, Performance Characteristics, Governing of Impulse Turbines. Problems

Unit III: Francis Turbines: Component Parts, Construction and Operation of a Francis Turbine, Governing Mechanism, Work Done by the Turbine Runner, Working Proportions and Design Parameters, Slow, Medium and Fast Runners, Degree of Reaction, Inward/Outward Flow Reaction Turbines, Performance Characteristics, Problems.

Unit IV: Propeller and Kaplan Turbines: Component Parts, Construction and Operation of a Propeller, Kaplan Turbine, Differences Between the Francis and Kaplan Turbines, Draft Tube-Its Function and Different Forms, Performance Characteristics, Governing of Reaction Turbine, Introduction to New Types of Turbine, Deriaz (Diagonal), Bulb, Tubular Turbines, Problems.

Unit V: Dimensional Analysis and Model Similitude: Dimensional Homogeneity, Rayleigh's Method and Buckingham's Π-Theorem, Model Studies And Similitude, Dimensionless Numbers and their Significance. Unit Quantities, Specific Speed and Model Relationships for Turbines, Scale Effect, Cavitations–Its Causes, Harmful Effects and Prevention, Thomas Cavitation Factor, Permissible Installation Height, Problems.

Unit VI: Centrifugal Pumps: Classification, Velocity Vector Diagrams and Work Done, Manometric Efficiency, Vane Shape, Head Capacity Relationship and Pump Losses, Pressure Rise in Impeller, Minimum Starting Speed, Design Considerations, Multi-Stage Pumps. Similarity Relations and Specific Speed, Net Positive Suction Head, Cavitation and Maximum Suction Lift, Performance Characteristics. Brief Introduction to Axial Flow, Mixed Flow and Submersible Pumps, Problems.

Unit VII: Reciprocating Pumps: Construction and Operational Details, Discharge Coefficient, Volumetric Efficiency and Slip, Work and Power Input, Effect of Acceleration and Frictionon Indicator Diagram (Pressure– Stroke Length Plot), Separation, Air Vessels and their Utility, Rate of Flow into or From the Air Vessel, Maximum Speed of the Rotating Crank, Characteristic Curves, Centrifugal Vs Reciprocating Pumps, Brief Introduction to Screw, Gear, Vane and Radial Piston Pumps, Problems.

Unit VIII: Hydraulic Systems: Function, Construction and Operation of Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift and Hydraulic Press, Fluid Coupling and Torque Converter, Hydraulic Ram, Problems.

Recommended Books:

1. Som S.K. And Biswas, G-Introduction To Fluid Mechanics And Fluid Machines, Tata Mcgraw-Hill, New Delhi.
2. Agrawal S.K.-Fluid Mechanics And Machinery, Tata Mcgraw-Hill, New Delhi.
3. Kumar, D.S.-Fluid Mechanics And Fluid Power Engineering, Kataria & Sons Publishers, New Delhi.
4. Bansal R.K.-Fluid Mechanics And Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi.
5. Ramamrutham S., Fluid Mechanics, Hydraulics And Fluid Machines, Dhanpat Rai & Sons, Delhi.

FLUID MACHINES LAB

The Following Practical Exercises are to be carried out:

1.Performance Characteristic Tests on Pelton Wheel (Load Test & Best Speed)
2.Performance Characteristic Tests on Francis Turbine (Load Test & Best Gate Opening).
3.Performance Characteristic Tests on Kaplan Turbine (Load Test & Best Gate, Vane Angle Opening).
4.Performance Characteristic Tests on Single Stage, Multi Stage Centrifugal Pumps at Constant Speed & at Variable Speed. Actual & Predicted Curves.
5.Performance Characteristic Tests on Self-Priming Pump, Jet Pump, Airlift Pump And Deep Well Pump.
6.Performance Characteristic Tests on Axial Flow Pump.
7.Performance Characteristic Tests on Hydraulic Ram.
8.Vibration Measurement and Computer Aided Fault Diagnosis of a Centrifugal/ Self-Priming /Gear/Reciprocating Pump.
9.Performance Characteristic Tests on Reciprocating Pump at Constant Speed and at Variable Speed.
10.Performance Characteristic Tests on Gear Pump.
11.Performance Characteristic Tests on Screw Pump.

PCC-MEL 2212			**Thermal Engineering**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Thermal Engineering

Unit I: Steam Generators–Classification of Boilers with Details, Merits and Demerits of Fire Tube and Water Tube Boilers, High Pressure Boilers, Boiler Mounting sand Accessories, Draught and Performance of Boilers.

Unit II: Steam Nozzles– Types of Nozzles, Steam Flow Through Nozzles, Condition for Maximum Discharge, Supersaturated Flow Through Nozzles.

Unit III: Fuels and Combustion–Types of Fuels, Calorific Value of Fuels, Combustion Equation for Hydrocarbon Fuel, Conversion of Volumetric Analysis to Mass Analysis, Determination of Excess Air Supplied. Determination of Percentage Carbon in Fuel Burning to CO And CO_2. Determination of Minimum Quantity of Air Supplied to Gaseous Fuels, Flue Gas Analysis, and Bomb Calorimeter Orsat Apparatus.

Unit IV: Compressors: Compression Processes, Work of Compression, Single-Stage Reciprocating Air Compressor, Volumetric Efficiency, Multi-Stage Compression, Rotary Compressors.

Unit V: Turbines: Impulse and Reaction Principles of Turbines, Compounding, Single and Multistage Turbines, Speed Regulations.

Unit VI: Steam Condenser: Types, Various Efficiencies, Air Leakage, Cooling Towers and Applications.

Recommended Books:

1. Nag, P.K.- Engineering Thermodynamics, Tata McGraw Hill Publishers, New Delhi.
2. Vasandani, V.P. and Kumar, D.S.-Heat Engineering, Metropolitan Book Co.
3. Kumar, D.S.-Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi.
4. Gupta And Prakash –Engineering Thermodynamics, S.Chand Publishers, New Delhi.
5. Kothandaraman, C.P, and Dornkundwar, S.-Thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengeland Boles Thermodynamics & Engineering Approach, Tata Mc Graw Hill Publishers, New Delhi.

Thermal Engineering Lab

The Following Practical Exercises are to be carried out:

1. Determination of Flash Point and Fire Point
2. Determination of Dryness Fraction of Steam
3. Flue Gas Analysis
4. Bomb Calorimeter Experiment
5. Study of Various Types of Boilers, Boiler Mountings and Accessories
6. Performance and Energy Balance Test on a Fire Tube/ Water Tube Boiler.
7. Performance of Single Stage/ Multi Stage Reciprocating Compressor
8. Study of Various Types of Turbines
9. Study of Refrigeration System, Charging and Troubleshooting
10. Determination of COP of a Refrigeration System.
11. Study of Air Conditioning System, Charging and Trouble Shooting.

PCC-MEL 2113			**Manufacturing Processes**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Manufacturing Processes

Unit I: Engineering Materials- Classification, Selection of Materials for Mechanical Design, Mechanical, Physical and Thermal Properties, Common Ferrous and Non-Ferrous Metals, Introduction to Ceramics & Composite Materials. Classification of Manufacturing Processes of Materials.

Unit II: Casting -Scope, Pattern, Pattern Allowances, Solidification, Gating and Risering, Sand Mould, Permanent Mould, Cold and Hot Chamber Die Casting, Shell Moulding, Investment Casting and Centrifugal Casting, Casting Defects and Remedies.

Unit III: Forming-Scope, Fundamentals of Forming, Hot & Cold Working Processes, Rolling, Extension, Wire Drawing, Forging, Fundamentals of Sheet Metal Operation, High Energy Rate Forming Processes.

Unit IV: Powder Metallurgy-Scope, Basic Steps, Production of Powders, Powder Characteristics, Advantages and Disadvantages.

Unit V: Welding-Scope, Classification, Fundamental of Welding, Heat Affected Zone, Welding Metallurgy and Its Effecton Performance of Weldments, Residual Stresses and Distortion of Weldments, SMAW, TIG, MIG, SAW, PAW and Gas Welding Process (Principles & Applications), Brazing and Soldering Operations.

Unit VI: Classification, Specifications, Operations and Machining Parameters of Lathe, Milling, Shaper, Drilling, Cylindrical Surface Grinder and Abrasive Wheels.

Recommended Books:

1. Kalpakjian, S.- Manufacturing Engineering and Technology, Pearson Education, Singapore
2. Hajra Choudhry, S. K.- Elements of Workshop Technology, Vol I, Media Promoters & Publishers Pvt., Ltd.
3. Jain, R. K.-A Text Book of Production Technology, Khanna Publishers, New Delhi.
4. Rao, P.N.–Manufacturing Technology (Casting, Forming and Welding), Tata McGraw Hill, New Delhi.
5. De Garmo, E.P.- Materials and Processes in Manufacturing, Prentice Hall of India, New Delhi.

PCC-MEL2018			**Dynamics of Machines**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Dynamics of Machines

Unit I: Static Force Analysis-Static Equilibrium of Mechanism, Concept of Force and Couple, Free Body Diagram, Conditions of Equilibrium, Methods of Static Force Analysis of Simple Mechanisms and Power Transmission Elements, Consideration of Frictional Forces, Determination of Forces and Couples for a Crank, Inertia of Reciprocating Parts, Dynamically Equivalent System, Analytical and Graphical Method, Inertia Force Analysis of Basic Engine Mechanism, Torque Required to Overcome Inertia and Gravitational Force of a Four Bar Linkage.

Unit II: Balancing-Balancing of Rotating Masses in One Plane and in Several Planes, Unbalanced Forces in Reciprocating Engines, Balancing of In-Line Engines, Firing Order, Radial and V-Engines, Balancing of Machines, Balancing of Linkages, Fisher's Method of Principal Vectors, Method of Linearly Independent Vectors, Balancing of Shaking Moment.

Unit III: Gears-Toothed Gears and Spur Gears, Types of Toothed Gears, Definitions: Pressure Angle, Path of Contact, Arc of Contact, Conditions for Correct Gearing, Forms of Teeth, Involute and Its Variants, Interference and Methods of Removal, Calculation of Minimum No. of Teeth on Pinion/Wheel For Involute Rack, Helical/Spiral/Bevel/Worm Gears.

Gear Trains- Types of Gear Trains, Simple, Compound and Epicyclic Gear Trains, Problems and their Applications, Estimation of Velocity Ratio of Worm and Worm Wheel.

Unit IV: Single Degree Vibration-Natural Frequency of Free Oscillations, Equivalent System, Energy Method, Single Degree Damped Systems, Forced Vibrations, Support Isolation, Measurement of Vibrations, Critical Speed of Simple Shafts; Two and Multi Degree Vibration –Two Degree Freedom Systems, Generalized Coordinates, Principal Coordinates, Coordinate Coupling, Lagrange's Equation, Vibration Absorbers, Multi Degree Freedom Systems-Calculation of Natural Frequencies by Matrix Methods, Stodola, Ralyeigh and Holzer Methods.

Unit V: Kinematic Synthesis of Mechanisms– Freudenstien's Equation, Function Generation Errors in Synthesis, Two/Three Point Synthesis, Transmission Angles, Least Square Techniques.

Recommended Books:

1. Rao, J.S. and Dukkipati, R.V.-Mechanism and Machine Theory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. – Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R.S. and Gupta, J.K. – Theory of Machines, Eurasia Publishing House (P)Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.- Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt.Ltd.,New Delhi.
5. Rattan, S.S.- Theory of Machines, Tata McGraw Hill, New Delhi.

Theory Of Machines Lab

The following practical exercises are to be carried out:

1. To Study Various Links and Mechanisms.
2. To Study and Plot Various Inversions of 4- Bar Chain and Single Slider Crank Chain.
3. To Draw Velocity Diagram of Engine Mechanism Using Graphical Method
4. To Conduct Experiments on Various Types of Governors and Plot Graphs Between Height and Equilibrium Speed of a Governor.
5. Determination of Gyroscopic Couple (Graphical Method).
6. Balancing of Rotating Masses (Graphical Method)
7. Determination of Vibration Characteristics of Free and Forced Spring Mass System with and without Damping.
8. Cam Profile Analysis (Graphical Method)
9. Determination of Gear- Train Value of Compound Gear Trains and Epicyclic Gear Trains.
10. To Study Pressure Distribution in a Full Journal Bearing.

PCC-MEL 2016			**Mechanics of Materials**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Mechanics Of Materials

Unit I: Strain Energy & Impact Loading: Definitions, Expressions for Strain Energy Stored in a Body when Load is applied (I) Gradually, (II) Suddenly and (III) with Impact, Strain Energy of Beams in Bending, Beam Deflections, Strain Energy of Shafts in Twisting, Energy Methods in Determining Spring Deflection, Castigliano's & Maxwell's Theorems.

Unit II: Theories of Elastic Failure: Various Theories of Elastic Failures with Derivations and Graphical Representations, Applications to Problems of 2- Dimensional Stress System with (I) Combined Direct Loading and Bending, and (II) Combined Torsional and Direct Loading.

Unit III Unsymmetrical Bending: Properties of Beam Cross Section, Product of Inertia, Ellipse of Inertia, Slope of Neutral Axis, Stresses & Deflections, Shear Center and Flexural Axis.

Unit IV: Thin Walled Vessels: Hoop & Longitudinal Stresses & Strains in Cylindrical & Spherical Vessels & their Derivations Under Internal Pressure, Wire Wounld Cylinders, Thick Cylinders & Spheres: Derivation of Lame's Equations, Radial & Hoop Stresses and Strains in Thick, and Compound Cylinders and Spherical Shells Subjected to Internal Fluid Pressure Only, Wire Wound Cylinders, Hub Shrunk on Solid Shaft.

Unit VI: Rotating Rims & Discs: Stresses in Uniform Rotating Rings & Discs, Rotating Discs of Uniform Strength, Stresses in (I) Rotating Rims, Neglecting the Effect of Spokes, (II) Rotating Cylinders, Hollow Cylinders & Solids Cylinders.

Unit VII; Bending of Curved Bars : Stresses in Bars of Initial Large Radius of Curvature, Bars of Initial Small Radius of Curvature, Stresses in Crane Hooks, Rings of Circular & Trapezoidal Sections, Deflection of Curved Bars & Rings, Deflection of Rings by Castigliano's Theorem, Stresses in Simple Chain Link, Deflection of Simple Chain Links, Problems.

Unit VIII: Springs: Stresses in Open Coiled Helical Spring subjected to Axial Loads and Twisting Couples, Leaf Springs, Flat Spiral Springs, Concentric Springs.

Recommended Books:

1. Popov, E. P. - Mechanics of Materials, Prentice Hall India, New Delhi
2. Singer,F.P.&Pytel,A.-Strength of Materials, Harper and Row H. Kogakusha Publishers, New York
3. Bedi, D. S. - Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.- Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R. S. - Strength of Materials, Khanna Publishers, New Delhi

PCC-MEL 2017			**Machine Design-1**				B. Tech		Sem. 4th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Machine Design

MEL 2017 **3-1-0=4**

Unit I Design For Production ; Erogonomic and Value Engineering Considerations in Design, Role of Processing in Design, Design Considerations for Casting, Forging and Machining. Variable Loading : Different Types of Fluctuating/ Variable Stresses, Fatigue Strength Considering Stress Concentration Factor, Surface Factor, Size Factor, Reliability Factor, etc., Fatigue Design for Finite and Infinite Life against Combined Variable Stresses using Goodman and Soderberg's Criterion, Fatigue Design using Miner's Equation, Design Problems on above.

Unit II Shafts: Detailed Design of Shafts for Static and Dynamic Loading, Rigidity and Deflection Consideration.

Unit III Springs: Types of Springs, Design for Helical Springs against Tension and their Uses, Compression and Fluctuating Loads, Design of Leaf Springs, Surging Phenomenon in Springs, Design Problems.

Unit IV Bearings: Design of Pivot and Collar Bearing , Selection of Ball and Roller Bearing Based on Static and Dynamic Load Carrying Capacity Using Load-Life Relationship, Selection of Bearings From Manufacturer's Catalogue, Types of Lubrication – Boundary, Mixed And Hydrodynamic Lubrication, Design of Journal Bearing using Raimondi and Boyd's Charts, Lubricants and their Properties, Selection of Suitable Lubricants, Design Problems.

Unit V: I.C. Engine Parts: Cylinder, Piston, Connecting Rod, Crank and Fly Wheel Etc.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.

PCC-MEL 3221			Heat and Mass Transfer				B. Tech		Sem. 5th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	2	5	1 Hour	3 Hours	10	20	20	50	100

Heat and Mass Transfer

Unit I: Modes of Heat Transfer, Conduction-Fourier's Law, Thermal Conductivity of Solids, Liquids and Gases, Factors influencing Thermal Conductivity, General Three Dimensional Heat Conduction Equation in Cartesian, Cylindrical and Spherical Co-ordinates, Heat Flow through Plane Walls, Cylinders and Spheres, Heat Source Systems, Plane Wall and Cylinder, Critical Thickness of Insulation, Different Types of Fins, Heat Transfer from Fins of Uniform Cross Section, Heat Flow in a Semi Infinite Solid with Sudden Change of Surface Temperature, Periodic Variation of Surface Temperature.

Unit II: Convection-Free and Forced Convection, Basic Concepts of Hydrodynamic and Thermal Boundary Layers, Similarity Conditions of Heat Transfer Processes, Equations of Motion and Energy, Application of Dimensional Analysis, Empirical Equation of Convective Heat Transfer-Reynolds Analogy, Fundamentals of Boiling Heat Transfer, Pool Boiling, Heat Transfer in Condensation, Drop Wise and Film Condensation, Emperical Equations.

Unit III: Radiation-Thermal Radiation, Monochromatic and Total Emissive Power Absorptivity, Reflectivity and Transmissivity, Black, Grey and Real Surfaces, Planck's Distribution-Law, Wien's Displacement Law, Stefan- Boltzmann's Law, Kirchhoff's Law, Heat Transfer by Radiation between Black Surface and Grey

Surfaces, Heat Transfer in Presence of Re-Radiating Surface, Electrical Network Method of Solving Radiation Problems, Radiation Shields, Shape Factors.

Unit IV: Heat Exchangers-Basic Type of Heat Exchangers, Fouling Factor, Overall Heat Transfer Co-efficient, Logarithmic Mean Temperature Difference (LMTD), Effectiveness-NTO Methods of Design of Single and Multiple Pass Heat Exchangers.

Unit V: Mass Transfer-Rate Equations, Mass Diffusion in Binary Mixtures, Evaporation in a Column, Forced Convective Mass Transfer, Heat and Mass Transfer Analogies.

Recommended Books:

1. Yadav, R.-Heat and Mass Transfer, Central Publishing House, Allahabad.
2. Sachdeva,R. C.- Fundamentals of Engineering Heat and Mass Transfer, New Age International Publishers, NewDelhi.
3. Holman J.P.- Heat and Mass Transfer, Tata McGraw Hill, New Delhi.
4. Ozisik, M. N.- Heat Transfer, McGraw Hill, New York.
5. Kothandaraman, C.P.-Fundamentals of Heat and Mass Transfer, New Age International Publishers, New Delhi.

Heat & Mass Transfer Lab

List of Experiments :

1. To Determine the Thermal Conductivity of a Metallic Rod.
2. To Determine the Thermal Conductivity of an Insulating Power.
3. To Determine the Thermal Conductivity of a Solid by Guarded Hot Plate Method.
4. To Find the Effectiveness of a Pin Fin in a Rectangular Duct Natural Convective Condition and to Plot Temperature Distribution along its Length.
5. To Find the Effectiveness of a Pin Fin in a Rectangular Duct Under Forced Convective and to Plot Temperature Distribution along its Length.
6. To Determine the Surface Heat Transfer Coefficient for a Heated Vertical Tube under Natural Convection and to Plot the Variation of Local Heat Transfer Coefficient along the Length of the Tube. Also Compare the Results with those of the Correlation.
7. To Determine Average Heat Transfer Coefficient for an Externally Heated Horizontal Pipe under Forced Convection & to Plot Reynolds and Nusselt Numbers along the Length of Pipe. Also Compare the Results with those of the Correlations.
8. To Measure the Emmisivity of the Gray Body (Plate) at Different Temperature and to Plot the Variation of Emmisivity with Surface Temperature.
9. To Find Overall Heat Transfer Coefficient and Effectiveness af a Heat Exchanger under Parallel and Counter Flow Conditions. Also Plot the Temperature Distribution in both the cases along the Length of Heat Exchanger.
10. To Verify the Stefen-Boltzmann Constant for Thermal Radiation.
11. To Demonstrate the Super Thermal Conducting Heat Pipe and Compare its working with that of the Best Conductor i.e., Copper Pipe. Also Plot Temperature Variation along the Length with Time or Three Pipes.
12. To Study the Two Phases Heat Transfer Unit.
13. To Study Cross Flow Type Heat Exchanger (Air To Air).

PCC-MEL 3131			Industrial Engineering				B. Tech		Sem. 5th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Industrial Engineering

Unit I: Introduction - Definition and Scope of Industrial Engineering, Role of an Industrial Engineer in Industry, Functions of Industrial Engineering Department and Its Organization, Qualities of an Industrial Engineer, Principles of Industrial Engineering, System and Review of Growth and Development of Industrial Engineering and Scientific Management.

Unit II: Plant Layout and Material Handling - Different Types of Layouts Viz. Product, Process and Combination Layouts, Introduction to Layouts Based on GT, JIT and Cellular Manufacturing Systems, Development of Plant Layout, Types of Material Handling Equipments, Relationship of Material Handling with Plant Layouts.

Unit III: Work Study - Use and Applications, Techniques, Human Factors in the Application of Work Study, Method Study Objectives, Basic Procedure, Various Charting Techniques, Use of Photographic Techniques, SIMO Charts, Principles of Motion Economy, Work Measurement Techniques, Time Study, Work Sampling, Predetermined Motion Time Standards (PMTS), Analytical Estimation.

Unit IV: Production Planning and Control – Functions, Forecasting Techniques, Product Design, Process Planning, Machine Loading and Scheduling, Dispatching, Progress Reporting, Corrective Action.
Inventory Control - Different Costs, Determining Economic Order Quantity, Quantity Discounts, Re-order Level, Re-order Cycle Systems, ABC, VED, FSN Models.

Unit V: Quality Control - Meaning of Quality and Quality Control, Quality of Design, Quality of Conformance and Quality of Performance, Functions of Quality Control, Introduction to Statistical Quality Control-Control Charts and Sampling Plans.

Recommended Books:

1. Khanna, O.P. - Industrial Engineering and Management, Khanna Publishers, New delhi.
2. Dalela, S. and Mansuor Ali - Industrial Engineering and Management systems, Standard Distributors and Publishers, New Delhi.
3. Ralph, M. B. - Motions and Time Standards, John Wiley, New York.
4. ILO - Introduction to Work Study, International Labor Office , Geneva.
5. Jain, K.C. and Agarwal, L. N. – Production Planning Control & Industrial Management, Khanna Publishers, New Delhi.

PCC-MEL 3019			Machine Design-II				B. Tech		Sem. 5th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1 Hour	3 Hours	10	20	20	50	100

Design Of Machine Elements

Unit I: Product Development Principles – Mechanical Properties of Materials, Simple Stresses, Torsional
Stresses, Bending Stresses, Variable Stresses in Machine Parts.
Theories of Failure: Maximum Normal Stress, Maximum Shear Stress, Maximum Principal Strain, Maximum
Strain Energy, Maximum Distortion Energy Theories, Criteria of Failure, Stress Concentration Factor, Size
Factor, Surface Factor, Load Factor, Factor of Safety, Design Stress.
Unit II: Design of Shafts and Springs: Design of Shafts Based on Bending Moment, Twisting Moment,
Combined Bending & Twisting Moments, Axial Loads in Addition to Combined Torsional and Bending
Loads,Rigidity and Stiffness.
Unit III: Couplings, Keys, Belts, Chains and Design of Rigid and Flexible Couplings, Design of Keys, Design of
Belt and Chain Drives, Selection of Belt and Chain Drives, Design of Elements Subjected to Simple Loading,
Screws Including Power Screws, Bolted Joints Including Eccentrically Loaded Joints, Clutches and Brakes.
Unit IV: Design of Welded And Riveted Joints: Types of Welded Joints, Weld Symbols and their
Representation, Strength of Welded Joints Subjected to Various Types of Loads.
Riveted Joints: Types of Joints, Design of Riveted Joints for Pressure Vessels, Design of Riveted Joints for
Structures.
.
Unit V: Design of Gears: Design of Spur, Helical, Bevel and Worm Gears, Design of Gear Box, Layout Diagram,
Speed Diagram, Fixing Number of Teeth And Module Of Gears.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Khurmi,R. S. and Gupta, J. K.- A Text Book of Machine Design, Eurasia Publishing House (P) Ltd, New Delhi.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997

MEL 3136			**Machining Processes/ Metal Cutting and Machine Tool**				**B. Tech**		**Sem. 5th**	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Machining Processes

Unit I :Mechanism of Metal Cutting: Deformation of Metal During Machining, Nomenclature of Lathe, Milling Tools, Mechanics of Chip Formation, Built-Up Edges, Mechanics of Orthogonal and Oblique Cutting, Merchant Cutting Force Circle and Shear Angle Relationship in Orthogonal Cutting, Factors Affecting Tool Forces. Cutting Speed, Feed and Depth of Cut, Surface Finish. Temperature Distribution , Tool Chip Interface. Numericals on Cutting Forces and Merchant Circle.

Unit II: Cutting Tool Materials & Cutting Fluids: Characteristics of Tool Materials, Various Types of Cutting Tool Materials, Coated Tools, Cutting Tool Selection, Purpose and Types of Cutting Fluids, Basic Actions of Cutting Fluids, Effect of Cutting Fluid on Tool Life, Selection of a Cutting Fluid.

Unit III : Tool Wear and Machinability: Types of Tool Wear, Tool Life, Factors Governing Tool Life, Machinability: Definition and Evaluation. Economics of Machining. Numericals on Tool Life.

Unit IV: Gear Manufacturing: Introduction, Methods of Manufacture, Gear Generation and Forming: Gear Cutting by Milling, Single Point Form Tool, Gear Hobbing and Shaping. Gear Finishing Operations: Gear Shaving, Gear Burnishing, Gear Grinding, Lapping.

Unit V: Non-Conventional Machining Processes: Abrasive Jet Machining: Principles, Applications, Process Parameters. Ultrasonic Machining: Principles, Applications, Analysis of Process Parameters. Electro-Chemical Machining and Grinding: Principles, Classifications, Choice of Electrolytes, Applications. Electric Discharge Machining: Principles, Selection of Tools Materials and Dielectric Fluid. Electron Beam Machining: Generation of Electron Beam, Relative Merits and Demerits. Laser Beam Machining: Principles and Applications.

Unit VI: Jigs & Fixtures: Introduction, Location and Location Devices, Clamping and Clamping Devices, Drill Jigs, Milling Fixtures.

Recommended Books: 153

1. HMT - Production Technology, Tata Mcgraw Hill, New Delhi.
2. Kalpakjian, S. - Manufacturing Engineering and Technology, Pearson Education, Singapore
3. Hajra Choudhry, S. K. - Elements of Workshop Technology, Vol II, Media Promoters & Publishers Pvt., Ltd.
4. Jain, R. K. – A Text Book of Production Technology, Khanna Publishers, New Delhi.
5. Khanna, O.P. And Lal, M.- A Textbook of Production Technology, Vol II, Dhanpat Rai & Sons, New Delhi.

Machine Tools Lab

The following practical exercises are to be carried out:

1. Practice of Lathe Operations
2. Shaping Rectangular Block or Cube
3. Milling Rectangular Block or Cube
4. T -Slot Milling
5. Spur Gear Cutting on Milling Machine
6. Practice on Cylindrical Grinding Machine
7. Surface Grinding practice
8. Grinding of a Single Point Cutting Tool
9. Tool wear and Cutting Force(s) Measurement in Turning, Drilling, Milling and Grinding Operations.

MEL 3021			CAD/CAM				B. Tech		Sem. 5th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

CAD/CAM

Unit I: Fundamentals of CAD – Introduction, Design Process, Application of Computers in Design, Benefits of CAD, Computer Hardware, Graphic Input Devices, Display Devices, Graphics Output Devices, CAD Software and Database, Software Configuration of a Graphic System, Functions of a Graphic Package, Geometric Modeling, Database Structure and Control, Graphic Standards such as GKS and IGES.
Unit II: Geometric Transformations - Mathematics Preliminaries, Matrix Representation of 2 and 3 Dimensional Transformation, Concatenation of Transformation Matrices, Application of Geometric Transformations, Representation of Curves and Surfaces: Polygon, Meshed and Ruled Surfaces, Bezier Curves, B-Spline Curves.
Unit III: Geometric Modeling - Wireframe Modeling, Solid Modeling Representation, Volumetric Properties, Surface Modeling, Concept of Hidden-Line Removal and Shading, Kinematics Analysis and Simulation.
Unit IV: CNC Machine Tools - Development Of CNC Technology, Principles, Features, Advantages, Economic Benefits, Applications, CNC, DNC Concept, Classification of CNC Machines, Types of Control, CNC Controllers, Characteristics, Interpolators.
Unit V: Drives and Controls - Spindle Drives, Feed Drives, Open Loop and Closed Loop Control, Axis Measuring Systems. Tooling and Maintenance Of CNC Machine Tools.
Unit VI: CNC Programming - Coordinate System, Structure of a Part Program, G & M Codes, Manual Part Programming for Fanuc, Heidenhain, Numeric Control Systems, APT Part Programming, Programming Exercises. Computer Aided Process Planning – Retrieval, Generative and Hybrid Approaches, Advantages, Case Studies.

Recommended Books:

1. Groover, M. P. and Zimmers, E. W. - CAD/CAM, Prentice Hall of India, New Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Reddy, J. N.-An Introduction to the Finite Element Method, McGraw Hill, New York.
6. Pham, D.T. and Dimov, S.S. - Rapid Manufacturing, Springer Verlag,
7. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall

CAD/CAM LAB

SECTION - A

Exercises in Modeling and Analysis of various types of Mechanical Components and Assemblies using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA /ANSYS / NASTRAN, etc. At least 15 components and assemblies should be modeled and analyzed by the students using the above packages in the laboratory during the semester.

SECTION – B

The following practical exercises are to be carried out:

1. Study of the structure of a CNC turning centre
2. Study of the structure of a CNC machining centre
3. Part-Programming on the above CNC machines and execution of part programs for Machining given profiles (at least 10 different jobs).

(i) Manual Part Programming for CNC Machines using G and M codes, simulation of Tool Path

(ii) Computer Assisted Part Programming using APT language

4. Exposure to component modelling and CL data generation using CAD/CAM Software like Unigraphics, Pro/E, Smart CAM, etc.
5. NC code generation using CAD/CAM software - post processing for standard CNC controls like FANUC, SINUMERIC, etc.

PCN3079				Constitution of India				Pre Requisites		
L	T	P	C	Minor Duration	Major Duration	Assignment/Quiz	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
1	0	0	0	1.5 Hours	3 Hours	10	20	20	50	100

Constitution of India

Unit-I **(9 Contact Hours)**

1. Historical Background
2. Preamble
3. States and Union territories
4. Citizenship
5. Fundamental Rights (FR)

Unit-II **(9 Contact Hours)**

6. Fundamental Duties (FD)
7. Directive Principles of State Policies (DPSP)
8. Relation between FR, FD and DPSP
9. Centre State Relationship
10. President, Vice President, Prime Minister and other important officials - I

Unit-III **(9 Contact Hours)**

11. President, Vice President, Prime Minister and other important officials - II
12. Hindi as an official language
13. Panchayats and Self Governance
14. Emergency Provisions
15. Amending the Constitution

Suggested Readings:

1. Basu, Durga Das (1984). *Introduction to the Constitution of India* (10th ed.). South Asia Books.
2. Constitution of India online access - https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf

MEL3121			Metrology and Measurements				B. Tech		Sem. 6th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Metrology And Measurements

Unit I: Linear Measurements- Vernier Scale and Micrometer, Vernier Height Gauge and Depth Guage; Comparators - Types, Relative Merits and Limitations; Angular Measurements-Sine Bar, Clinometer, Angle Guage; Concept and Measurement Of Straightness and Flatness by Interferometry; Surface Roughness - Specifications and Measurement by Talysurf, Measurements for Internal and External Threads; Measurements for Gears.

Unit II: Static and Dynamic Characteristics of Instruments, Zero, First and Second Order Systems and their Response to Step, Ramp and Sinusoidal Input Signals, Sources of Errors, Systematic and Random Errors; Statistical Analysis of Test-Data, Probable Error and Probability Tables, Ejection of Test Data; Curve Fitting, Error Propagation.

Unit III: Review of Electro-Mechanical Sensors and Transducers - Variable Resistance, Inductance and Capacitive Pick Ups, Photo Cells and Piezo-Electric Transducers, Resistance Strain Guages and Application of these Elements for Measurement of Position/Dispmlacement, Speed/Velocity/ Acceleration, Force and Liquid Level.

Unit IV: Pressure and Flow Measurement - Bourdon Tube, Diaphragm and Bellows, Vaccum Measurement - Mcleod Guage, Thermal Conductivity Guage and Ionisation Guage; Ultra-Sonic Flow Meters and Hot Wire Anemometer. Temperature Measurement - Thermal Expansion Methods, Thermo-Electric Sensors - Common Thermo Couples, Resistance Thermometers and Thermistors, Optical and Total Radiation Pyrometers. Speed, Force, Torque and Shaft Power Measurement - Mechanical Tachometers, Vibration Reed Tachometer and Stroboscope; Proving Ring, Hydraulic and Pneumatic Load Cells, Torque On Rotating Shafts; Absorption, Transmission and Driving Dynamometers.

Recommended Books:

1. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
2. Holman, J. P.- Experimental Methods for Engineers, McGraw Hill, New York.
3. Doebelin, E.O.-Measurement System: Application and Design, McGraw Hill, New York.
4. Jain, R. K. – Mechanical and Industrial Measurement, Khanna Publishers, New Delhi.
5. Jain, R. K. - Engineering Metrology, Khanna Publishers, New Delhi.

Mechanical Vibration

Metrology And Measurements Lab

The following practical exercises are to be carried out:

1. Measurement with the help of Vernier Caliper and Micrometer
2. Measurement of an angle with the help of SineBar
3. Measurement of Surface Roughness
4. Measurement of Gear Elements using Profile Projector
5. Three Wire Method to determine Effective Diameter of External Threads
6. Measurement of Thread Elements by Tool Makers Microscope
7. Calibration of a Pressure Guage with the help of a dead weight Guage Tester
8. Use of Stroboscope for Measurement of Speed of a Shaft
9. Use of Pitot type to plot velocity profile of a fluid through a circular duct
10. Preparation of a Thermocouple, its calibration and application for Temperature Measurement
11. Measurement of

- Pressure.
- Temperature.
- Flow.
- Strain.
- Weight.
- Cutting forces by piezoelectric Dynamometer.
- Hardness by Micro Hardness Tester

MEL 3022			Mechanical Vibrations				B. Tech		Sem. 6th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Mechanical Vibrations

Unit I: Introduction - Periodic Motion, Harmonic Motion, Period, Frequency, Amplitude and Phase Angle of Vibratory Motion, Vector Representation, Dispmlacement, Velocity and Acceleration in Harmonic Motion, Superposition of Simple Harmonic Motions, Non- Harmonic Motions, Harmonic Analysis.

Unit II: Systems Having Single Degree of Freedom- Free Vibrations of Systems without Damping, Equilibrium and Energy Methods For Determining Natural Frequency, Rayleigh Method, Equivalent Systems; Free Vibrations of Systems with Viscous, Coulomb and Structural Damping. Forced Vibration of Systems with Viscous Damping, Simple Cases of Translent Excitation- Undamped Systems.

Unit III: Systems with Two Degrees of Freedom - Free Undamped Vibrations, Static and Dynamic Coupling, Principal Modes of Vibration, Undamped Dynamic Vibration Absorbers.

Multi Degree Freedom Systems - Calculation of Natural Frequencies by Matrix Methods, Stodola , Ralyeigh and Holzer Methods, Simple Geared Systems, Dunkerley's Method.

Unit IV: Vibration Measuring Instruments - Principle of Frequency, Dispmlacement, Velocity and Acceleration Measuring Instruments, Amplitude and Phase Shift Response.

Unit V: Whirling of Shafts - Whirling of Light Flexible Shaft with a Single Disc at the Centre of its Length with and without Damping, Critical Speeds of a Shaft Having Multiple Discs.

Recommended Books:

1. Dukkipati, R. V. and Srinivas, J. - Advanced Mechanical Vibrations, Narosa Publishing House, New Delhi.
2. Den Hartog, J.P. - Mechanical Vibrations, Dover Publications.
3. Thomson, W.T. - Theory of Vibrations with Applications, CBS Publishers,
4. Rao, S.S. - Mechanical Vibrations, Addison-Wesley, New York.
5. Rao, J. S. and Gupta, K. – Theory and Practice of Mechanical Vibrations, Tata McGraw Hill, New Delhi.

Mechanical Vibrations Lab

1. To Study Undamped Free Vibrations of Equivalent Spring Mass System and to Determine the Natural Frequency of Vibrations
2. To Study the Free Vibration of System for Different Damper Settings. Draw Decay Curve and Determine the Log Decrement and Damping Factor. Also find the Natural Frequency
3. To Study the Torsional Vibration of a Single Rotor Shaft System and to Determine the Natural Frequency.
4. To Determine the Radius of Gyration of Given Bar Using Bifilar Suspension.
5. To Verify DunkerLey's Rule
6. To Study the Forced Vibration of System with Damping. Load Magnification Factor Vs. Frequency and Phase Angle Vs Frequency Curves. Also Determine the Damping Factor.
7. To Study the Pressure Distribution of A Journal Bearing Using A Journal Bearing Apparatus.
8. To Determine the Rate of Wear of A Metallic Pin from The Plot of Displacement Vs Time Curves Using Friction and Wear Monitor Apparatus.
9. To Determine Abrasion Index of a Material using Dry Abrasion Test Rig.
10. To Evaluate the Load Wear Index and yield Point of a Lubricant with the Help of a Four Ball Stream Pressure Tester.
11. To Determine the Two Frequencies of Tensional Spring Type Double Pendulum & Compare them with Theoretical Values.
12. To Determine the Radius of Gyration of A Compound Pendulum.
13. To Determine the Radius of Gyration of Disc using Trifilar Suspension.

MEL3222			Internal Combustion Engine				B. Tech		Sem. 6th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Internal Combustion Engine

Unit I: Introduction - Classification & Nomenclature, Application of Internal Combustion (I.C.) Engines, Thermodynamic Analysis of Carnot, Sterling, Ericson, Otto, Diesel, and Dual Cycles. Working of 4 Stroke Petrol & Diesel Engines, Valve Timing Diagrams, Working of 2-Stroke Petrol & Diesel Engines (with Valve Timing Diagrams), Comparison of Two Stroke & Four Stroke Engines, Fuel Air Cycles and Analysis, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

Unit II: I.C. Engine Fuels- Types of Fuels, Solid, Liquid and Gaseous Fuels, Chemical Structure of Petroleum, Petroleum Refining Process, Important Qualities of S.I. & C.I. Engine Fuels and Their Rating, Combustion of Fuels, Calorific Valves of Fuels, Theoretical Determination of CV of Fuel, Combustion Equation for Hydrocarbon Fuels, Determination of Minimum Air Required for Combustion, Volumetric Analysis, Mass Analysis. 155 Fuel Supply System and Fuel Pumps, Properties of Air Fuel Mixture, A Simple Carburetor and Its Working, Approximate Analysis of Simple Carburetor, Actual Air Fuel Ratio of Single Jet Carburetor, Exact Analysis of Single Jet Carburetor, Ideal Requirements from a Carburetor, Different Modern Carburetors, Introduction to Fuel Injection Systems for C.I. Engines, Fuel Filters.

Unit III: Combustion in S.I. Engines - Stages of Combination in S.I. Engine, Flame Font Propagation, Flame Speed, Ignition Lag and Factors Affecting the Lag, Abnormal Combustion and Knocking, Control and Measurement of Knock, Rating of S.I. Engine Fuels and Anti Knock Agents, Combustion Chambers of S.I. Engines

Unit IV: Supercharging - Purpose of Supercharging, Type of Superchargers, Analysis of Superchargers, Performance of Superchargers, Arrangement of Supercharger and Its Installation, Turbo Charged Engines, Supercharging of S.I. & C.I. Engines, Limitations of Supercharging.

Unit V: Measurement and Testing - Measurement of Friction Horse Power, Brake Horse Power, Indicated Horse Power, Measurement of Speed, Air Consumption, Fuel Consumption, Heat Carried by Cooling Water, Heat Carried by the Exhaust Gases, Heat Balance Sheet, Governing of I.C. Engines, Performance Characteristics of I.C. Engines.

Recommended Books:

1. Ganesan, V. - Internal Combustion Engines, Prentice Hall of India, New Delhi.
2. Domkundwar - A Course in Internal Combustion Engines, Dhanpat Rai & Sons, New Delhi.
3. Kumar, D. S. - Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi
4. Vasandani, V. P. and Kumar, D. S. - Heat Engineering, Metropolitan book Co.
Kothandaraman, C.P. and Dornkundwar, S. – Thermal Engineering, Dhanpat Rai & Sons, New Delhi

I.C. Engines Lab

The Following Practical Exercises are to be carried out:

1. Study of I.C. Engines, Components and Loading Devices
2. Study of Various Circuits of a Carburetor Fitted on Indian Make Vehicle
3. Valve Timing and Port Timing Diagrams
4. Performance Test on a 4-Stroke Diesel Engine.
5. Heat Balance Test on a 4-Stroke Diesel Engine.
6. Determination of Brake Power, Indicated Power, Friction Power and Mechanical Efficiency af a MultiCylinder Petrol Engine Running at Constant Speed (Morse Test).
7. Performance af a Diesel/ Semi Diesel Engine from No Load to Full Load (At Constant Speed) for a Single Cylinder/ Multi- Cylinder Engine in terms of Brake Power, Indicated Power, Mechanical Efficiency and SFC (Specific Fuel Consumption) and further obtain Power Consumption Curves and Draw the Heat Balance Sheet.

MEL4031			Automobile Engineering				B. Tech		Sem. 6th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
2	0	2	3	1 Hour	3 Hours	10	20	20	50	100

Automobile Engineering

Unit I Introduction To Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety Considerations; Safety Features of Latest Vehicle; Future Trends in Automobiles.
Unit II Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi Plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.
Unit III Power Transmission : Requirements of Transmission System; General Arrangement of Power Transmission System; Object of the Gear Box; Different Types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- Mesh Gear Boxes; Epi-Cyclic Gear Box, Freewheel Unit. Overdrive Unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer Cases.
Unit IV Drive Lines, Universal Joint, Differential and Drive Axles: Effect of Driving Thrust and Torque Reactions; Hotchkiss Drive, Torque Tube Drive and Radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of Load Coming on Rear Axles, Full Floating, Three Quarter Floating and Semi Floating Rear Axles.
Unit V Suspension Systems: Need of Suspension System, Types of Suspension; Factors Influencing Ride Comfort, Suspension Spring; Constructional Details and Characteristics of Leaf Springs.
Unit VI Steering System : Front Wheel Geometry & Wheel Alignment Viz. Caster, Camber, King Pin Inclination, Toe-In/Toe-Out; Conditions For True Rolling Motions of Wheels During Steering; Different Types of Steering Gear Boxes; Steering Linkages and Layout; Power Steering – Rack & Pinion Power Steering Gear, Electronics Steering.
Unit VII Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and Constructional Details of Drum Brakes, Disc Brakes; Brake Actuating Systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors Affecting Brake Performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & Their Constructional Details, Wheel Balancing, Tyre Rotation; Types of Tyre Wear & Their Causes.
Unit VIII Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the Automobiles, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC)
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Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose Construction & Operation of Lead Acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Recommended Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
3. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
4. Automotive Technology – H.M. Sethi, TMH, New Delhi.
5. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
6. Automotive Mechanics – Joseph Heitner, EWP.
7. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
8. The Motor Vehicle – Newton steeds Garrett, Butter Worths

AUTOMOBILE ENGINEERING LAB

1. To study and prepare report on the constructional details, working principles and operation of the automotive Engine Systems & Sub-System.
2. To study and prepare report on the constructional details, working principles and operation of the Fuels Supply systems.
3. To study and prepare report on the constructional details, working principles and operation of the automotive clutches.
4. To study and prepare report on the constructional details, working principles and operation of the automotive Transmission Systems.
5. To study and prepare report on the constructional details, working principles and operation of the automotive Drive Lines & Differentials.
6. To study and prepare report on the constructional details, working principles and operation of the automotive Suspension Systems.
7. To study and prepare report on the constructional details, working principles and operation of the automotive Steering Systems.
8. To study and prepare report on the constructional details, working principles and operation of the automotive Tyres & Wheels.
9. To study and prepare report on the constructional details, working principles and operation of the automotive Break System.
10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

MEL 4223			Refrigeration & Air Conditioning				B. Tech		Sem. 7th	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	2	4	1 Hour	3 Hours	10	20	20	50	100

Refrigeration & Air Conditioning

Unit I: Introduction, Refrigeration Cycle, Departure of Actual Vapour Compression Cycle from Theoretical Cycle, Compressor Volumetric Efficiency, Analysis of Actual Cycle, Effect of Suction and Discharge Pressure, Subcooling and Super Heating on Performance, Compound Vapour Compression System With Intercooling for Single and Multiple Evaporators, Cascading, Manufacturing of Dry Ice, Leak Detection, Charging of Refrigerants.

Unit II: Aqua-Amonia Absorption Refrigeration System, Lithium Bromide-Water Absorption System, Electrolux System, Properties of Aqua-Ammonia Solution, Heat of Solution, Enthalpy Concentration Diagram.
Actual Air Refrigeration Cycle, Air Craft Cooling, Liquefaction of Gases, Minimum Work Cycle, Engineering Application of Cryogenics.

Unit III: Refrigerants - Introduction, Classification of Refrigerants, Required Properties of An Ideal Refrigerant, Important Refrigerants, Secondary Refrigerants, Antifreeze Solutions, Selection of Refrigerant.

Unit IV: Air Conditioning - Industrial and Comfort Air Conditioning, Physiologica1 Principle, Comfort Indices, Comfort Chart, Ventilation Requirements.
Psychrometry, Air Washer, Evaporative Cooling, Humidifier Efficiency, Cooling Tower,Performance Cooling and Dehumidification by Chilled Water Spray and Cooling Coils Equivalent by Pass Factor, Chemical Dehumidification, Sensible Heat Factor and Apparatus Dew Points

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Unit V: Equipment - Description of Refrigeration and Air Conditioning Equipment, Compressors, Condensers, Evaporators, Air Washer and Expansion Devices. Central Air Conditioning Plants.
Applications - Manufacturing of Ice, Cold Storage and Food Freezing, Air Conditioning of Building.

Recommended Books:

1. Jordan Priester - Refrigeration and Air Conditioning, Prentice Hall of India,
2. Stoecker, W. F. and Jones, J. W. - Refrigeration And Air Conditioning, Tata McGraw Hill, New Delhi.
3. Arora, C. P. - Refrigeration and Air Conditioning, Tata McGraw Hill, New
4. Prasad, M. - Refrigeration and Air Conditioning, New Age International,
5. Arora, C. P. and Domkundwar - Refrigeration and Air Conditioning, Dhanpat Rai & Sons, New Delhi.

Refrigeration & Air Conditioning Lab

1. Study & Performance of basic Vapour Compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on Vapour Absorption Apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of Cooling Tower.
7. To study various components in Room Air Conditioner.
8. To find RH of atmosphere air by using slings Psychometric and Psychometric.
9. To find performance of a Refrigeration Test Rig system by using different expansion devices.
10. To study different control devices of a Refrigeration System.
11. To study various Compressors.
12. To find the performance parameters of Ice Plant.

PW-MED 4912			Major Project				B. Tech	Sem. 8th
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	External Marks	Total Marks
0	0	20	10	-	-	50	50	100

Major Project

Team Formation For Designing, Manufacturing and Operating A Selected Product, Formulating Project
Management Procedures. Need Identification, Assessment of Alternative Designs, Selection of Design for
Development, Defining Design and Performance Specification and Testing Procedure. Detailed Mechanical,
Thermal and Manufacturing- Related Design of Systems, Assemblies, Sub- Assemblies and Components
Culminating in Engineering Drawings and Material Specifications; Preparing Bill of Materials and Identification
of Standard Components and Bought-Out Parts using Engineering Drawings, The Process Sheets are Developed
based on Available Materials, Machine Tools and other Fabrication Facilities. Materials and Standard Components are Procured and Manufacturing is carried out. After Inspection, Parts are Accepted. Assembly
Procedure is Finalized and the Machine is Assembled. Acceptance Tests are carried out vis-a-vis Specifications
From Phase-I. Functioning Product is Displayed at an Open House. Professional Quality Documentation of All
Designs, Data, Drawings, and Results, Change History, Overall Assessment, etc. Is Mandatory along with a
Final Presentation.

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List of Electives:

School Elective-I

MEE 3224			**Power Plant Engineering**				**B. Tech**		**School Elective –I**	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Power Plant Engineering

Unit I: Basics of Steam Power Plant - Various Components of Steam Power Plant, Layout, Types of Firing, Stokers, Pulverized Coal Burners and Fluidized Bed Combustion. Coal Handling System - Trippers, Plough Feeders, Crushers, Gravimetric Feeders, Pulverizers, Ash Handling - Hydraulic & Pneumatic, Forced Draft and Induced Draft Fans, Primary Air Fans.
Unit II: Components of a Steam Power Plant - High Pressure and Superficial Boilers, Feed Pump, Economizer, Superheater, Desuperheater, Regenerator, Condensers, Deaerators, Cooling Towers.
Unit III: Nuclear and Gas Turbine Power Plant - Basic Nuclear Physics and Nuclear Reaction Related to Nuclear Reactors, Nuclear Materials, Radiation Shielding, Waste Disposal. Gas Turbine Power Plant - Application, Components and Layouts, Open and Closed Cycles Plants, Combined Gas Turbine and Steam Power Plants.
Unit IV: Hydro and Diesel Power Plant - Hydro Electric Power Plants, Layout, Selection of Water Turbine, Various Hydro Electric Power Plants and Their Applications, Diesel Engine Power Plant - Component and Layout.
Unit V: Power Plant Economics and Environmental Hazards - Load Curve, Fixed and Operating Costs, Economics of Different Types of Power Plants, Environmental Hazards of Various Power Plants, CO, SOx, NOx ,Particulates, Trace Metals.

Recommended Books:

1. Vopat and Stortzki - Power Station Engineering and Economy, Tata McGraw Hill, New Delhi.
2. Arora and Domkundwar - Power Plant Engineering, Dhanpat Rai & Sons, New Delhi.
3. Nag, P. K. - Plant Engineering, Tata McGraw Hill, New Delhi.
4. Nagpal - Power Plant Engineering, Khanna Publishers, New Delhi.
5. Wakil, M.M.E.I. - Power Plant Technology, McGraw Hill, New York.

MEE 3134			Work Study and Ergonomics				B. Tech		School Elective –I	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

WORK Study & Ergonomics

Unit I: Work Study - Areas of Application of Work Study in Industry; Method Study and Work Measurements
and their Inter-Relationship, Reaction of Management and Labor to Work Study, Role of Work Study in Improving Plant Productivity and Safety.
Unit II: Method Study - Objectives and Procedure for Methods Analysis, Select, Record, Examine, Develop,Define, Install and Maintain; Recording Techniques, Micro Motion and Macro-Motion Study, Principles of Motion Economy, Normal Work Areas and Work Place Design.
Unit III: Work Measurement - Objectives, Work Measurement Techniques - Time Study, Work Sampling, PreDetermined Motion Time Standards (PMTS), Etc., Determination of Time Standards, Observed Time, Basic Time, Normal Time, Rating Factors, Allowances, Standard Time.
Unit IV: Introduction to Ergonomics - Historical Development of Human Factors Engineering, Importance of Ergonomics Workplace Improvement and Preventing Workplace Injuries.
Unit V: Human-Machine Interface - The Man-Machine System, Machine as a System Component, Reaction Time, Muscular Performance, Static Work. Types of Displays - Quantitative, Qualitative, Representative and Alpha-Numeric, Efficiency of Each Type, Pedal Design, Design of Tools and Controls, Stress in Human Body and its Consequences, Human Anthropometry - Measurement, Instrumentation, Adjustments in Measurement, Anthropometric Data for Indian Workers, Uses of Anthropometric Data, Computer-Aided Man-Machine System Design. 160

Recommended Books:

1. Shan, H. S. - Work Study and Ergonomics , Dhanpat Rai & Sons, New Delhi.
2. Dalela, S. and Saurabh -Work study and Ergonomics, Standard Publishers Distributors, New Delhi.
3. Bridger, R. S.- Introduction to Ergonomics ,Mcgraw Hill, New York.
4. Hicks - Industrial Engineering & Management, Tata McGraw Hill, New Delhi.
5. ILO - Introduction to Work Study, International Labor Office, Geneva.

MEE 3122			Computer Integrated Manufacturing Systems				B. Tech		School Elective –I	
L	T	S/P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Computer Integrated Manufacturing Systems

Unit I: Introduction - Production Systems Facilities, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles and Strategies; Manufacturing Operations, Production Concepts and Mathematical Models, Cost of Manufacturing Operations.
Unit II: Group Technology and Cellular Manufacturing, Parts Classification and Coding, Production Flow Analysis, Cellular Manufacturing. Industrial Robotics: Robot Anatomy and Related Attributes, Robot Control Systems, Robot Applications.
Unit III: Definition and Broad Characteristics of Flexible Manufacturing Cells, Systems, Flexible Transfer Lines, Place of Flexible Manufacturing Systems in CIM, Economics and Technological Justification for FMS, Design and Planning, Role of Associated Technologies such as GT, JIT and Simulation, Operation and Evaluation, Scheduling Problems, FMS Hardware, Control Aspects of FMS, Flexible Machining Cells.
Unit IV: Introduction to Material Handling, Material Transport Systems, Storage Systems-Conventional / Automated Storage Systems, Automatic Identification Methods.
Unit V: Shop Floor Control – Functions, Order Release, Order Scheduling, Order Progress, Factory Data Collection Systems, Corrective Actions.

Recommended Books:

1. Groover, M. P.-Automation Production Systems and Computer Integrated Manufacturing, Pearson
Education Asia, Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall International, UK.
4. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
5. Craig, J. J. - Introduction to Robotics: Mechanics and Control, Addison-Wesley, New York.

MEE 3024			Concurrent Engineering				B. Tech		School Elective –I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Concurrent Engineering

Unit I: Historical Background of Concurrent Engineering (CE), Sequential and Concurrent Processes; Definition and Framework of CE; Decomposition of Product Development Stages, CE Team, Implementation of CE; Role of Information Technology in CE; Examples Of CE Applications.
Unit II: Concurrent Engineering Tools – Design For Manufacture and Assembly (DFMA), Design For Quality (DFQ), Design For Cost (DFC), Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA), Design of Experiments, Taguchi's Methods, Quality Function Deployment (QFD), Simulation, etc.
Unit III: Integration of Design and Manufacturing, Design Evaluation for Manufacturing Cost, Design Process Optimization for CE, Role of CAD/CAM and Automation in CE, Virtual Reality Tools and Techniques for Product Development and Interactive Modeling and Visualization, Rapid Prototyping. Design For Manufacturing (DFM) - Case Studies; Design For Reliability, Maintainability And Reparability and their implication on CE.
Unit IV: CE Application to Composite Structures - Structural Design using Composite Materials, Mechanical Properties and Design Parameters of Composite Materials, Composite Manufacturing Processes with emphasis on Manufacturing Time, Quality and Cost; Case Studie(s) on Design for Manufacturing of Composite Structural Elements.
Unit V: Submission of a Report: Real Industrial World Case Studies.

Recommended Books:

1. Biren Prasad - Concurrent Engineering Fundamentals, Vol. I & II, Prentice Hall, New Jersey.
2. Andrew Kusiak - Concurrent Engineering, Automation, Tools and Techniques, John Wiley & Sons, New
York.
3. Backhouse, C.J. and Brookes - Concurrent Engineering, Gower Publishing House.
4. Karandikar, H. and Mistree, F. - Designing a Composite Material Pressure Vessel for Manufacturing: A Case
Study in Concurrent Engineering, Engineering Optimization, Vol 18, pp. 235-262., 1992.
5. Moustapha, I. - Concurrent Engineering in Product Design and Development, New Age International, New
Delhi.

MEE 3032			Industrial Automation				B. Tech		School Elective –I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Industrial Automation

Unit I: Concept and Scope of Automation, Socio Economic Consideration, Low Cost Automation, Fluid Power Control - Fluid Power Control Elements and Standard Graphical Symbols. Construction and Performance of Fluid Power Generators, Hydraulic and Pneumatic Cylinders- Construction, Design and Mounting; Hydraulic and Pneumatic Valves for Pressure, Flow and Direction Control, Servo Valves and Simple Servo Systems with Mechanical Feedback, Governing Differential Equation and Its Solution for Step Position Input, Basic Hydraulic
and Pneumatic Circuits.

Unit II: Pneumatic Logic Circuits - Design of Pneumatic Logic Circuits for a given Time Dispmlacement Diagram or Sequence of Operations.

Unit III: Fluidics - Boolean Algebra, Truth Tables, Conda Effect, Fluidic Elements – Their Construction Working and Performance Characteristics, Elementary Fluidic Circuits.

Unit IV: Transfer Devices and Feeders – Classification, Construction Details and Application of Transfer Devices and Feeders (Vibratory Bowl Feeder, Reciprocating Tube and Centrifugal Hopper Feeder).

Unit V: Electrical and Electronic Controls - Introduction to Electrical and Electronic Controls such as Electromagnetic Controllers - Transducers and Sensors, Microprocessors, Programmable Logic Controllers
(PLC); Integration of Mechanical Systems with Electrical, Electronic and Computer Systems.

Recommended Books:

1. Anthony Esposito - Fluid Power with Applications, Prentice Hall of India, New Delhi.
2. Majumdar, S. R. - Pneumatic Control, Tata McGraw Hill, New Delhi.
3. Deb, S. R. - Robotics and Flexible Automation, Tata McGraw Hill, New Delhi.
4. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
5. Kuo, B.C. - Automatic Control Systems, Prentice Hall, New Jersey.

MEE 3233			Gas Dynamics and Jet Propulsion				B. Tech		School Elective –I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Gas Dynamics And Jet Propulsion

Unit – I Gas Turbines - Introduction, Classification, Applications. Gas Turbine and Its Components, Gas Turbine Power Plants. Optimum Pressure Ratio for Maximum Specific and Thermal Efficiency in Actual Gas Turbine Cycle. Effect of Operating Variables on Thermal Efficiency, Air Rate and Work Ratio.
Unit – II Combustion Chamber- Types of Combustion Chamber, Factors Affecting Combustion Chamber Design, Combustion Processes, Combustion Chamber Performance, Fuel Injection Systems. Axial Flow Turbines & Combustion Chamber- Classification, Elementary Theory, Vortex Theory, Limiting Factors in Turbine Design, Overall Turbine Performance, Design Performance of Gas Turbine Plant, Matching of Turbine Components.
Unit – III Centrifugal Compressors- Prewhirling, Adiabatic Efficiency, Performance Characteristics, Pressure Coefficient and Slip Factor, Losses, Surging, Compressor Design Calculations, Mach Number.
Unit – IV Axial Flow Compressors- Principles of Operation, Simple Design Method, Blade Design, Calculation of Stage, Overall Performance, Compressor Characteristics, Mach Number, Reynolds Number.
Unit – V Jet Propulsion- Turbo Jet, Turbo Prop, Ram Jet, Rocket Engines Thrust Power, Propulsive Efficiency and Thermal Efficiency, Jet Propulsion Performance, Specifying Thrust and Specific Fuel Consumption in each case For Turbo Jet and Turbo Propulsion Units.

References:

- Gas Turbine Theory, Sarvanamatto, Cohen H, Rogers, Longmans Green.
- Turbines, Compressors and Fans, S M Yahya, Tata McGraw Hill book Co., New Delhi.
- Steam and Gas Turbines, R Yadav.

MEE 3033			Control Systems				B. Tech		School Elective –I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Control Systems

EMEE 3033 **3-0-0=3**

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems

Mathematical Models of Physical Systems: Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, Mechanical, Thermal, Hydraulic and pneumatic systems, Analogies, Block diagrams and signal flow graphs.

Components: AC and DC servomotors and tachogenerators, Potentiometers, Synchros, Stepper motors.

Analysis: Time and frequency domain analysis, Transient and frequency response of first and second order systems, Correlationship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins, M and N circles, Nichols charts

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors, Introduction to PLCs, their hardware and ladder diagram programme.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

MEE 3079			Tribology				B. Tech		School Elective – I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Tribology

MEE 3079 **3-0-0 = 3**

Introduction to tribology:

Historical background, practical importance, and subsequent use in the field. Lubricants: Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.
Friction and Wear Origin, friction theories, measurement methods, friction of metals and non-metals. Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.
Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D. Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and it'ssignificance; partial bearings, end leakages in journal bearing, numerical examples on full journal bearings only.
Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing,center of pressure, numerical examples.
Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples.
Bearing Materials: Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials.
Introduction to Surface engineering: Concept and scope of surface engineering. Surface modification – transformation hardening, surface melting, thermo chemical processes. Surface Coating – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance.

TEXTBOOKS:

1."Introduction to Tribology", B. Bhushan, John Wiley & Sons, Inc., New York, 2002

2. "Engineering Tribology", Prasanta Sahoo, PHI Learning Private Ltd, New Delhi, 2011.

3."Engineering Tribology", J. A. Williams, Oxford Univ. Press, 2005.

REFERENCES:

1. "Introduction to Tribology in bearings", B. C. Majumdar, Wheeler Publishing.

2. "Tribology, Friction and Wear of Engineering Material", I. M.Hutchings, Edward Arnold, London,1992.

MEE 2134			Mechanical System Design				B. Tech		School Elective –I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Mechanical System Design

Unit-I : Introduction to Mechanical Systematic Design Approach, Need,,Need Analysis. Conceptual Design,Phases of a Design Process at Conceptual Design Stage. Problem Identification in a Design Approach,Concept Hunt, etc.

Unit–II Functional Tree, Function Structure, Physical Reliability, Economical and Social Criteria, Possible Solutions, Concept of Embodiment Design , Preliminary Design Layouts, Selecting Best Preliminary Layouts, Design Optimization.

Unit-III Design Modeling, Reliability, Maintainability, Safety, Meterial Selection, Value Engineering, Experimental Design, Design and Patent. Detailed Design, Final Design, Complete Detail Drawing Check All Documents, Documentation Solution, etc.

Unit-IV Role of Artificial Intelligence in Mechanical Engineering: Introduction to Artificial Intelligence, Computer Programming and Development of Algorithms, Programming of Various Algorithms, Expert Systems, Expert System Packages,Concept of Knowledge Base, Artificial Neutral Network (ANN) and Varoius Optimization Techniques, Solution of Mechanical Design Problems using Artificial Intelligence Techniques to Shafts, Bearings, Gears, Clutches, Brakes, Hydraulic System. Pneumatic System, etc.

References :

1. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
2. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
3. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
4. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.
5. Some **Research Papers** relevant to the Subject area may also be referred.

MEE 3065			Mechatronics				B. Tech		School Elective – I	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Mechatronics

UNIT – I: Introduction: Definition – Trends – Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) – Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM. Signal Conditioning : Introduction – Hardware – Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors – Amplifying signals using OP amps – Software – Digital Signal Processing – Low pass , high pass , notch filtering

UNIT – II: Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring. Electronic Interface Subsystems : TTL, CMOS interfacing – Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's – Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation – Power Supply – Bipolar transistors / mosfets

UNIT – III: Electromechanical Drives : Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4-quadrant servo drives , PWM's – Pulse Width Modulation – Variable Frequency Drives, Vector Drives – Drive System load calculation. Microcontrollers Overview : 8051 Microcontroller , micro processor structure – Digital Interfacing – Analog Interfacing – Digital to Analog Convertors – Analog to Digital Convertors – Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

TEXT BOOKS:

- Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
- Introduction to Mechatronics / Appukuttan /Oxford

REFERENCE BOOKS:

- Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
- "Designing Intelligent Machines". open University, London.

School Electives-II

MEE 3236				Alternate Fuels			B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Alternate Fuels

1 Introduction:
Working process of I.C. Engine. Study of various parameters related to properties of different types of fuel (Rating of fuel, Ignition quality, volatility, calculations of Air / Fuel ratio, Calorific Value) as input and output in terms of results (Fuel efficiency, Fuel requirement, Engine efficiency and Engine life). Sources of fossil fuel, scope of availability of fossil fuel in future.

2 Need for Alternative Fuels:
Effects of constituents of Exhaust gas emission on environmental condition of earth (N2 , CO2, CO, NOx, SO2, O2) Pollution created by Exhaust gas emission in atmosphere. Green house effect, Factors affecting green house effect. Study of Global Carbon Budget, Carbon foot print and Carbon credit calculations. Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production.

3 Alcohol:
Sources of Methanol and Ethanol, methods of it's production. Properties of methanol & ethanol as engine fuels, Use of alcohols in S.I. and C.I. engines, performance of blending methanol with gasoline. Emulsification of alcohol and diesel. Dual fuel systems. Improvement / Change in emission characteristics with respect to % blending of Alcohol.

4 Bio Diesels:
Base materials used for production of Bio Diesel (Karanji oil, Neemoil, Sunflower oil, Soyabeen oil, Musturd oil, Palm oil, Jatropha seeds). Process of separation of Bio Diesel. Properties Diesel blended with vegetable oil, and difference in performance of Engine.

5 Hydrogen:
Hydrogen as a substitute fuel. Study Properties, Sources and methods of Production of Hydrogen, Storage and Transportation of hydrogen. Also, the economics of Application and Advantages of hydrogen (Liquid hydrogen) as fuel for IC engine/ hydrogen car. Layout of a hydrogen car.
Fuel Cells: Concept of fuel cells based on usage of Hydrogen and Methanol. Power rating, and performance. Heat dissipation, Layout of fuel cell vehicle.

6 Biogas:
Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine.
LPG & CNG: Properties of LPG & CNG as engine fuels, fuel metering systems, combustion characteristics, effect on performance, emission, cost and safety.

7 Solar Power:
Solar cells for energy collection. Storage batteries, layout of solar powered automobiles. Advantages and limitations.

8 Electric & Hybrid Vehicles:
Layout of an electric vehicles, advantages & limitations. Systems components, electronic controlled systems, high energy and power density batteries. Types of hybrid vehicles.

9 Vegetable Oils:
Various Vegetable oils for Engines – Esterification – Performance and emission characteristics.

Text & Reference Books:

- Alternate Fuels by Dr. S. Thipse, Jaico Publications
- "Automotive Emission Control" by Crouse, AND Anglin – McGraw Hill.
- "Alternative Fuels Guidebook" by Bechtold R..

- SAE Paper nos. 840367, 841333, 841334.
- “Internal Combustion Engines” by Ganeshan – Tata McGraw Hill.
- “Internal Combustion Engines” by Heywood John.
- The properties and performance of modern alternative fuels” – SAE Paper no. 841210.

MEE 3237			Solar Thermal Power Engineering				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Solar Thermal Power Engineering

UNIT I - ENERGY RESOURCES AND SOLAR SPECTRUM

World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance - Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Physics of the Sun - Energy balance of the earth, energy flux, solar constant for earth, green house effect.

UNIT II - SOLAR RADIATION AND MEASUREMENT

Solar radiation on the earth surface - Extraterrestrial radiation characteristics, Terrestrial radiation, solar insolation, spectral energy distribution of solar radiation. Depletion of solar radiation - Absorption, scattering. Beam radiation, diffuse and Global radiation. Measurement of solar radiation – Pyranometer, Pyrheliometer, Sunshine recorder. Solar time - Local apparent time (LAT), equation of time (E).

UNIT III - SOLAR RADIATION GEOMETRY AND CALCULATIONS (15 hours)

Solar radiation geometry - Earth-Sun angles – Solar angles. Calculation of angle of incidence - Surface facing due south, horizontal, inclined surface and vertical surface.

Solar day length – Sun path diagram – Shadow determination. Estimation of Sunshine hours at different places in India. Calculation of total solar radiation on horizontal and tilted surfaces. Prediction of solar radiation availability.

UNIT IV - SOLAR THERMAL ENERGY CONVERSION (15 hours)

Thermodynamic cycles – Carnot – Organic, reheat, regeneration and supercritical Rankine cycles - Brayton cycle – Stirling cycle – Binary cycles – Combined cycles. Solar thermal power plants - Parabolic trough system, distributed collector, hybrid solar-gas power plants, solar pond based electric-power plant, central tower receiver
power plant.

UNIT V - SOLAR ELECTRICAL ENERGY CONVERSION (15 hours)

Solar photovoltaic energy conversion - Principles - Physics and operation of solar cells. Classification of solar PV systems, Solar cell energy conversion efficiency, I-V characteristics, effect of variation of solar insolation and temperature, losses. Solar PV power plants.

REFERENCES

1. Foster .R, Ghassemi M., Cota A., "*Solar Energy"*, CRC Press, 2010.
2. Duffie .J.A, Beckman W.A. "*Solar Engineering of Thermal Processes"*, 3rd ed., Wiley, 2006.
3. De Vos .A, "*Thermodynamics of Solar Energy Conversion"*, Wiley-VCH, 2008.
4. Garg .H.P, Prakash .J, "*Solar Energy Fundamentals and Applications"*, Tata McGraw-Hill, 2005.
5. Kalogirou .S, "*Solar Energy Engineering",* Processes and Systems, Elsevier, 2009.
6. Petela .R, "*Engineering Thermodynamics of Thermal Radiation for Solar Power"*, McGraw-Hill Co., 2010.
7. Yogi Goswami .D, Frank Kreith, Jan F. Kreider, "*Principles of Solar Engineering"*, Second Edition, Taylor & Francis, 2003.
8. Andrews .J, Jelley .N, "*Energy Science"*, Oxford University Press, 2010.

MEE 3160			Smart Manufacturing				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Unit-I

Concepts of Smart Manufacturing: Definition and key characteristics of smart manufacturing**, C**orporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing. Minimizing Six big losses in manufacturing with Industry 4.0, and their benefits

Unit-II

Smart Machines and Smart Sensors: Concept andFunctions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine,**Smart sensors;** smart sensors ecosystem, need, benefits and applications of sensorsinindustry,Sensing for Manufacturing Process in IIoT, Block Diagram of aIoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces

Unit-III

Architecture of Cyber- Physical system (CPS): Functions of CPS, 5C Architecture; Smart Connection Level, Data-to- Information Level, Cyber Level, Cognition Level, Configuration Level. Design of PHM based CPS systems. Comparison of today's factory and Industry 4.0 factory by the implementation of 5C CPS architecture

Unit-IV

Digital Twin: Introduction, applications of digital twins, impact zones of digital twins in manufacturing (factories/plants and OEMs), advantages of digital twins, basic steps of digital twin technology

Machine Learning (ML) and Artificial Intelligence (AI) in Manufacturing: Introduction, benefits and applicationsof ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML

Predictive Maintenance: Introduction of predictive maintenance, difference between preventive and predictive maintenance, working and various components of predictive maintenance, benefits and tools of predictive maintenance. Common approaches to IoT predictive maintenance; Rule-based (condition monitoring) and AI (artificial intelligence) based predictive maintenance.

Augmented Reality in Maintenance (Electrical & Mechanical)

Unit-V

IoT connectivity for Industry 4.0: Industrial communication requirement and its infrastructure, an overview of different types of networks, mesh network in industrial IoT, IoT protocols and the internet, TCP/IP (transmission control protocol/internet protocol) model, IoT connectivity standards: common protocols, application layer protocols, internet/network layer protocols, physical layer IoT protocols, choosing the right IoT connectivity protocol

Reference Books

1. Industry 4.0 The Industrial Internet of Things by Alasdair Gilchrist, Apress

2. Industrial Internet of Things, Cyber Manufacturing System by Sabina Jeschke, Christian Brecher, Houbing Song Danda B. Rawat, Springer

Course Outcomes:

On successful completion of this course, the students should be able to:

- Have a knowledge of smart manufacturing systems' components and can handle it more effectively.in context of Industry 4.0
- After understanding the Architecture of Cyber- Physical system (CPS) they can make machines more oriented towards Industry 4.0, which increases productivity
- Overall brief description of associatedtechnologies of smart manufacturing systems enhance their workability knowledge in the industries
- After understanding IoTconnectivity for Industry 4.0 they are able to make a system Taylor made as per requirement of the industry
- Eventually knowledge of smart manufacturing systems enhances their employability opportunities as a whole

MEE 3161			Micro and Nano Machining				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Micro and Nano Machining

Unit I

Introduction to Precision engineering, macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications , Introduction to Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Nanofinishing – finishing operations. Laser technology in micro manufacturingPractical Lasers, application of technology fundamentals, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology, Carbon Nano-tubes – properties and structures, Molecular Logic Gates and Nano level Biosensors – applications

Unit II

Introduction to mechanical micromachining, Micro drilling – process, tools and applications, Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications, Micro milling and Micro grinding – process, tools and applications, Micro extrusion- process and applications, micro bending with Laser, Nano- Plastic forming.

Unit III

Introduction to Non-conventional micro-nano manufacturing, Process, principle and applications – Abrasive Jet Micro Machining, WAJMM, Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications, Micro ECM, Micro LBM - Process principle, description and applications, Focused ion beams - Principle and applications.

Unit IV

Introduction to Micro and Nano Finishing Processes, Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications, Elastic Emission Machining (EEM) – machine description, applications, Ion Beam Machining (IBM) – principle, mechanism of material removal, applications, Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications.

Unit V

Introduction to Micro Fabrication: basics, flowchart, basic chip making process, Introduction to Nanofabrication, Nanofabrication using soft lithography – principle, applications, Manipulative techniques – process principle, applications, Introduction to Carbon nano materials – CN Tubes, CN Tubes – properties and applications, Diamond - Properties and applications, CVD Diamond Technology, LIGA Process.

Unit VI

Laser Micro welding – description and applications, Defects, Electron Beam Micro-welding – description and applications, Introduction to micro and nano measurement, defining the scale, uncertainty. Scanning Electron Microscopy – description, principle, Optical Microscopy – description, application, Scanning Probe Microscopy, scanning tunneling microscopydescription, application.

References:

1. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
3. Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
4. V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012.

MEE 3080			Design of Composite Materials				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Design of Composite Materials

Introduction to Composite Materials Constituents, Material forms Processing, Applications Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices –Characteristics of fibers and matrices.

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina – Transformation Matrix, Transformed Stiffness.

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations– Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina, Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

Modification of Hooke's Law due to thermal properties-Modification of Laminate Constitutive Equations. Orthotropic Lamina - special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates - Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

Books:

1. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.

2. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.

3. Hyer, M.W., "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw-Hill, 1998.

4. Mechanics of Composite Materials, Autar K. Kaw, 2nd ed., CRC Press, 2006

5. Engineering Mechanics of Composite Materials, I. M. Daniel, O. Ishai, Oxford University Press, 2006.

MEE 3081			Simulation, Modelling & Analysis				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Simulation, Modelling & Analysis

Introduction to Modeling: Concept of System, Continious and Discrete System, Types of Models, Steps in Simulation Study; Statistical Models in Simulation: Discrete, Continuous, Poisson and Empirical Distributions, OutPut Data Analysis for a Single System, Comparing Alternative System Configuration Statistical Procedures for Comparing Real World Observations with Simulation OutPut Data, Generations of Arriving Processes, Verification and Validation of Simulation Models; MotnteCarlo Simulation and Its Applications in Queing Models and Inventory Models; Simulation of Manufacturing and Material Handling Systems; Case Studies on Simulation Packages.

Recommended Books:

1. Averill, M. Law - Simulation Modelling and Analysis, Mc-Graw Hill.

2. Banks, Jerry – Discrete Event System Simulation, Pearson Education.

3. G. Govdan – Simulation and Modeling – PHI

MEE 3238			Sustainable Energy Engineering				B. Tech		School Elective – II	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

SUSTAINABLE ENERGY SYSTEMS

UNIT I RENEWABLE ENERGY (RE) SOURCES

Environmental consequences of Fosil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Sting of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR PV AND THERMAL SYSTEMS

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells,

Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

UNIT IV BIOMASS ENERGY

Introduction-Bio mass resources –Energy from Bio mass: conversion proceses-Biomas Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell :Principle of working- various types – construction and applications. Energy Storage System- Hybrid Energy Systems.

Text Books:

1. Nonconventional Energy Resources ShobhNath Singh Pearson 1st Edition, 2015

Reference Books:

1. Nonconventional Energy Resources B.H. Khan McGraw Hill 3 rd Edition,
2. Renewable Energy; Power for a sustainable Future Godfrey Boyle Oxford 3rd Edition, 2012
3. Renewable Energy Sources: Their Impact on global Warming and Pollution TasneemAbbasi S.A. Abbasi PHI 1st Edition, 2011

MEE 4141			Maintenance Engineering				B. Tech		School Elective – II / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Maintenance Engineering

Unit-I : Introduction

Fundamentals of Maintenance Engineering, Maintenance Engineering, Its Importance in Material & Energy Conservation, Inventory Control, Productivity, Safety, Pollution Control, etc. Safety Regulations, Pollution Problems, Human Reliability, Total Quality Management (TQM), Total Productivity Maintenance (TPM), Environmental Issues in Maintenance, ISO 9000.

Unit-II Maintenance Management

Types of Maintenance Strategies, Planned and Unplanned Maintenance, Breakdown, Preventive & Predictive Maintenance, Comparison, Advantages & Disadvantages, Computer Aided Maintenance, Maintenance Scheduling, Spare Part Management, Inventory Control, Organization of Maintenance Department.

Unit-III Tribology In Maintenance

Friction Wear and Lubrication, Friction & Wear Mechanisms, Prevention of Wear, Types of Lubrication Mechanisms, Lubrication Processes. Lubricants- Types, General and Special Purpose, Additives, Testing of Lubricants, Degradation of Lubricants, Seal & Packing.

Unit-IV Machine Health Monitoring

Condition Based Maintenance, Signature Analysis, Oil Analysis, Vibration, Noise and Thermal Signatures, OnLine & Off Line Techniques, Instrumentation & Equipment Used in Machine Health Monitoring,Instrumentation In Maintenance, Signal Processing, Data Acquisition and Analysis, Application of Intelligent Systems, Data Base Design.

Unit-V Reliability, Availability & Maintainability (RAM) Analysis

Introduction to RAM Failure Mechanism, Failure Data Analysis, Failure Distribution, Reliability of Repairable and

Non-Repairable Systems, Improvement in Reliability, Reliability Testing, Reliability Prediction, Utilization Factor, System Reliability by Monte Carlo Simulation Technique.

References :

1 Gopal Krishnan and Banerji, Maintenance & Spare parts Management,
2 Mishra and Pathak, Maintenance Engineering and 164 Management, PHI
3 S.K. Shrivastava, Industrial Maintenance Management.
4 CNR Rao, Handbook of Condition Monitoring,.
5 Higgins, Maintenance Engineering Hand Book.

MEE3144			Industry 4.0				B. Tech		School Elective – II / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Industry 4.0

Learning Objectives This course is designed to offer learners an introduction to Industry 4.0, its applications in the business world. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.
Learning Outcomes 1. Understand the journey of Industry 4.0 and its drivers, enablers and roadmap. 2. Appreciate the smartness in smart factories, smart manufacturing, smart products, smart services and smart cities, 3. Able to understand various technologies associated with industry 4.0. 4. Understand the opportunities, challenges and future skills required for Industry 4.0.
Module 1: Introduction to Industry 4.0 The various Industrial Revolutions, Internet of Things (IoT) & Industrial Internet of Things, Overview on Technologies of Industry 4.0. Comparison of Industry 4.0 Factory and Today's Factory
Module 2: Drivers and Enablers Drivers, Enablers, Reference Architecture and Standards
Module 3: Convergence of Automation & IoT Smart Manufacturing**;** key characteristics, challenges, stages. Smart Machines; Characteristics, Technologies, interfaces, augmented reality. Cyber physical system (CPS).
IIoT; smart factory connectivity, key ingredients, Digital Twins, Predictive Maintenance
Module 4: Data Exchange With Machines Communication Protocols; OPC-UA, MQTT, Ethernet/IP, ProfiiNet, EtherCat IT infrastructure, databases, Cloud Computing Basics, Cloud Computing and Industry 4.0
Module 5: Smart Manufacturing Applications and Opportunities Internet of things & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics. Opportunities, Challenges, and skills for workers in the Industry 4.0, Supply Chain Management, Readiness of Industry.

Reference Books;
1 The Fourth Industrial Revolution by Klaus Schwab 2 The Industries of Future by Alec Ross 3. A course on “Industry 4.0: How to Revolutnize your business” on edx

School Electives-III

MEE 3162			Quality Management				B. Tech		School Elective – III / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Total Quality management

UNIT – I Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT -II Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT- III Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

TEXT BOOK:

- Total Quality Management / Joel E. Ross/Taylor and Franscis Limited
- Total Quality Management/P. N. Mukherjee/PHI

REFERENCE BOOKS:

- Beyond TQM / Robert L.Flood
- Statistical Quality Control / E.L. Grant.
- Total Quality Management:A Practical Approach/H. Lal
- Quality Management/Kanishka Bedi/Oxford University Press/2011
- Total Engineering Quality Management/Sunil Sharma/Macmillan

MEE 3163			Robotics				B. Tech		School Elective – III / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Robotics

UNIT-I

Introduction: Definitions, Types of Robots, Application of Robots, Representing Position and Orientation, Representing Pose in 2-Dimensions, Representing Pose in 3-Dimensions, Representing Orientation in 3-Dimensions, Combining Translation and Orientation.

UNIT-II

Time and Motion: Trajectories, Smooth One-Dimensional Trajectories, Multi-Dimensional Case, Multi-Segment Trajectories, Interpolation of Orientation in 3D, Cartesian Motion, Time Varying Coordinate Frames, Rotating Coordinate Frame, Incremental Motion, Inertial Navigation Systems. Mobile Robot Vehicles, Mobility, Car-like Mobile Robots, moving to a Point, following a Line, Following a Path. Navigation: Reactive Navigation, Braitenberg Vehicles, Simple Automata, Map-Based Planning, Distance Transform, Voronoi Roadmap Method, Probabilistic Roadmap Method, Localization, Dead Reckoning, Modeling the Vehicle, Estimating Pose, using a Map, Creating a Map, Localization and Mapping, Monte-Carlo Localization.

UNIT-III

Robot Arm Kinematics: Describing a Robot Arm, Forward Kinematics, a 2-Link Robot, A 6- Axis Robot, Inverse Kinematics, Closed-Form Solution, Numerical Solution, Under-Actuated Manipulator, Redundant Manipulator, Trajectories, Joint-Space Motion, Cartesian Motion, Motion through a Singularity.Installing ROS, Understanding the ROS File system level, Packages, Stacks, Messages, Services, Understanding the ROS Computation Graph level, Nodes, Topics, Services, Messages, Bags, Master, Parameter Server, creating workspace, Creating & Building an ROS package, Creating & Building the node, Visualization of images.

UNIT-I

Robot Programming: Using Sensors and Actuators with ROS, SCORBOT structure, joint movements, work envelop, motors, encoders, micro switch, transmission, gripper, SCORBOT programming, IS-14533: 2005 Manipulating industrial robots -Performance criteria related test methods, Mobile Robot Programming, Industrial Robot Programming.

Recommended Books

1. Peter Corke Robotics, 'Vision and Control: Fundamental Algorithms in MATLAB', Springer Tracts in Advanced Robotics, Vol. 73, **2011**.

2. Aaron Martinez & Enrique Fernández, 'Learning ROS for Robotics Programming', Packt Publishing, **2013**.

MEE 3164			Non Destructive Testing				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Non Destructive Testing

Unit – I:

Visual Testing Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes– light sources and special lighting – computer enhanced system – Employer defined applications, metallic materials including raw materials and welds – Inspection objectives, inspection checkpoints, sampling plan, inspection pattern etc – classification of indications for acceptance criteria - Codes, Standards and Specifications (ASME,ASTM,AWS etc.)

Unit – II:

Liquid Penetrant Testing

Principles – types and properties of liquid penetrants – developers – advantages and limitations of various methods - Preparation of test materials – Application of penetrants to parts, removal of excess penetrants, post cleaning – Control and measurement of penetrant process variables – selection of penetrant method – solvent removable, water washable, post emulsifiable – Units and lighting for penetrant testing – Interpretation and evaluation of test results - dye penetrant process, applicable codes and standards.

Unit – III:

Magnetic Particle Testing

Theory of magnetism – ferromagnetic, paramagnetic materials – characteristics of magnetic fields – magnetic hysteresis – magnetization by means of direct and alternating current – surface strength characteristics – Depth of penetration factors – Circular and longitudinal magnetization techniques, current calculation –– field produced by a current in a coil, shape and size of coils, field strength, Magnetic Bharkhausen Noise Analysis (MBN) – advantages and limitations

Unit – IV:

Magnetic Particle Testing Equipments

Selecting the method of magnetization, inspection materials, wet and dry particles – portable, mobile and stationary equipment – capabilities of equipments – magnetic particle inspection of castings and welding – Dry continuous method, wet residual method – Interpretation and evaluation of test indications – Principles and methods of demagnetization – Residual magnetism – applicable codes and standards.

Unit – V:

Eddy Current Testing Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents – eddy current sensing elements, probes, type of coil arrangement – absolute, differential, lift off, operation, applications, advantages, limitations – Through encircling coils, type of arrangements –absolute, differential fill factor, operation, application, advantages, limitations - Factors affecting sensing elements and coil impedance - test part and test system -Signal to noise ratio – equipment's, reference samples, calibration, inspection of tubes, cylinders,
steel bars, welded tubing, plates and pipes, Remote Field Sensing - Interpretation/Evaluation – Applicable codes and standards.

Text Books:

1. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989)

2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata

McGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, Treatise on non-destructive testing and evaluation, Navbharath Enterprises, Vol.3, (1983).

Reference Books:

1. C. Hellier, Handbook of Non-Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
2. J. Thomas Schmidt, K. Skeie and P. Maclntire, ASNT Non Destructive Testing Handbook: Magnetic Particle Testing, American Society for Nondestructive Testing, American Society for Metals, 2nd edition (1989).
3. V. S. Cecco, G. V. Drunen and F. L. Sharp, Eddy current Manual: Test method, Vol.1, Chalk River Nuclear Laboratories (1983).
4. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).
5. N. A. Tracy, P. O. Moore, Non-Destructive Testing Handbook: Liquid Penetrant Testing, Vol. 2, American Society for Nondestructive Testing, 3rd edition (1999).

MEE 4234			Computational Fluid Flow and Heat Transfer				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Computational Fluid Flow And Heat Transfer

Unit I: Introduction - Mathematical Description of Fluid Flow and Heat Transfer; Conservation Equations for
Mass, Momentum, Energy and Chemical Species, Finite Difference Method, Finite Volume Method, Finite Element Method, Governing Equations and Boundary Conditions, Derivation of Finite Difference Equations.
Unit II: Solution Methods of Elliptical Equations – Finite Difference Formulations, Interactive Solution Methods,
Direct Method With Gaussian Elimination.Parabolic Equations-Explicit Schemes and Von Neumann Stability
Analysis, Implicit Schemes, Alternating Direction Implicit Schemes, Approximate Factorization, Fractional Step
Methods, Direct Method with Tridiagonal Matrix Algorithm.
Unit III: Hyperbolic Equations - Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Multi
Step Methods, Nonlinear Problems, Second Order One-Dimensional Wave Equations.Burgers Equations - Explicit and Implicit Schemes, Runge-Kutta Method. Formulations of Incompressible Viscous Flows - Formulations of Incompressible Viscous Flows by Finite Difference Methods, Pressure Correction Methods,
Vortex Methods.
Unit IV: Treatment of Compressible Flows - Potential Equation, Euler Equations, Navier-Stokes System of Equations, Flow Field-Dependent Variation Methods, Boundary Conditions, Example Problems.
Finite Volume Method - Finite Volume Method Via Finite Difference Method, Formulations For Two and ThreeDimensional Problems.
Unit V: Standard Variational Methods - Linear Fluid Flow Problems, Steady State Problems, Transient Problems.
Recommended Books:
1. Chung, T. J. - Computational Fluid Dynamics, Cambridge University Press.
2. Frank Chorlton - Text Book of Fluid Dynamics, CBS Publishers, New Delhi.
3. Patankar, S. V. - Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation.
4. Anderson, D. A., Tannehill J. C. and Pletcher, R. H. - Computational Fluid Mechanics and Heat Transfer,
Hemisphere Publishing Corporation.
5. H. K. Versteeg and W. Malalasekara, An Introduction to Computational Fluid Dynamics, Longman Publishers.

MEE 3239			Fuel and Combustion				B. Tech		School Elective – III / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Fuel and Combustion

Chapter-1

Working of two stroke & four stroke - Petrol and Diesel Engines (Review Only) - valve timing diagrams - Fuels - Chemical structure- qualities, ratings of fuels - Alternative fuels, Alcohol, vegetable oils, biogas. Types of Engines - Wankel E/n, Stirling E/n, Stratified charge e/n, VCR E/n, free piston E/n. Fuel air cycle (actual) for petrol and diesel engines - variation of specific heats - heat losses - Dissociation

Chapter-2

Carburation - Air fuel mixture requirements - stoichiometry and excess air calculations - types of carburetors - Fuel injection systems- classifications - fuel injection pump - nozzle - direct and indirect injection - Injection in S. I. Engine - M. P. F. I. System - Ignition system - Battery & Magneto type - firing order - Ignition timing and spark advance - Lubrication systems - types - properties of lubricants - additives for lubricants - Heat rejection and cooling - Theory of engine heat transfer - types of cooling system - Air and liquid system - Super charging & turbo charging.

Chapter 3

Combustion in S. I. E/n - Ignition limits - stages of combustion - combustion quality - Ignition lag - Flame propagation - Abnormal combustion - detonation - effects - Theory, chemistry and control - flash point, fire point & viscosity index - combustion chamber design considerations.

Chapter 4

Combustion in C. I. Engines - Air Fuel ratio in C. I. Engines - Ignition Lag - diesel knock - Controlling Methods - Various stages of combustion - vaporization of fuel droplets and spray formation - Air motion - Swirl - combustion chamber - design considerations.

Chapter 5

Pollutant formation and control in S. I. And C. I. Engine, Nox, CO, Unburned hydro Carbon and particulate - Exhaust gas treatment - catalytic converter - Thermal reaction - Particulate Trap. Engine operating characteristics - Testing of I. C. Engines - Indicated power - Brake power - Volumetric Efficiency - Heat balance Test - Morse Test - Measurement of exhaust smoke and exhaust emission.

References

1. Internal Combustion Engine Fundamentals - John B. Heywood
2. Internal Combustion Engine and Air Pollution -Obert E. F.
3. Internal Combustion Engine - Lichty L. C.
4. Internal Combustion Engine - V. Genesan
5. A course in internal combustion Engine - Mathur and Sharma.

MEE 3240			Hydrogen and Fuel cell				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Hydrogen and Fuel cell

Introduction of hydrogen energy systems: Properties of hydrogen as fuel, Hydrogen pathways introduction-current uses, general introduction to infrastructure requirement for hydrogen production, storage, dispensing and utilization, and hydrogen production plants.
Hydrogen production processes: Thermal-Steam reformation, thermo chemical water splitting, gasification-pyrolysis, nuclear thermal catalytic and partial oxidation methods. Electrochemical-Electrolysis, photo electro chemical, Biological-Anaerobic digestion, fermentation micro-organism, PM based electrolyser.
Hydrogen storage: Physical and chemical properties, general storage methods, compressed storage-composite cylinders, glass micro sphere storage, zeolites, metal hydride storage, chemical hydride storage and cryogenic storage, carbon based materials for hydrogen storage.
Hydrogen utilization: Overview of hydrogen utilization, IC Engines, gas turbines, hydrogen burners, power plant, domestic cooking gas, marine applications, hydrogen dual fuel engines.
Fuel cells: History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell, Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC, microbial fuel cells, relative merits and demerits.
Applications of fuel cells: Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space, economic and environmental analysis on usage of hydrogen and fuel cell. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines.
Hydrogen safety: Hydrogen safety aspects, backfire, pre-ignition, hydrogen emission NOx control techniques and strategies, Hydrogen powered vehicles.

Recommended Books:

1. Sorenson B, Hydrogen and Fuel Cells: Emerging Technologies and Applications, Bent Sorenson, Academic Press (2005).
2. Hordeski MF, Hydrogen and Fuel Cells: Advances in Transportation and Power, The Fairmont Press, Inc. (2009)
3. Busby RL, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Books (2005).

MEE 3165			PROJECT MANAGMENT				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

PROJECT MANAGMENT

Project management concept, establishing the project and goals; organizing human resource and contracting; organizing systems and procedures for implementation; project direction, coordination and control, project management performance; project management case studies, project management information system; computer based project management; future of project management.

Development of Project Network:

Time estimation, determination of critical path (CPM) Event slacks and floats, choice of schedule in view of resource constraints. Programme evaluation review technique (PERT) examples. Illustrations & case studies.

Misc. Topics:

Introduction to MRP? ERP, TQM and E-commerce etc.

REFERENCE:

1. Project management-Kerzner, CBS.
2. Essentials of project management-Dennis Lock, Groover,
3. Projects-planning, analysis, selection, impletation & review -P, Chandra,TMH
4. Project management Basic-R.L.Kimmons, Dekker.
5. System analysis & Project management - Cleland & kind McGraw hill.
6. Practical Project management - RG Ghattas & Sandra L. Mckec, Pearson Education Asia.

MEE 4235			Energy Management				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Energy Management

Unit 1:- Importance of energy management. Energy auditing :(methodology, analysis of past trends plant data),laws of thermodynamics, measurements, portable and on line measurements.
Unit 2:- Energy economics – Discount rate, pay back period, internal rate of return, life cycle costing.Steam
systems:Boiler – efficiency testing, steam distribution and use steam traps, condensate recovery, flash steam
utilisation.Thermal insulation.
Unit 3:- Electrical systems: Demand control, power factor correction, Motor drives- motor efficiency testing,
energy efficient motors, motor speed control.Varaible speed drives. Lighting-lighting levels, fixtures, daylighting, timers, energy efficient windows.
Unit 4:- Energy conservation in pumps, Fans (flow control), compressed air systems, Refrigeration and air conditioning systems.Waste heat recovery: recuprators, heat wheels, heat pipes, heta pumps.
Unit 5:- Cogeneration – concept, options (steam/ gas turbines/diesel engine based), selection criteria, control
strategy.

Texts/Recommended Books:

1. Hand book on Energy Audit and Management, Amit kumar Tyagi, TERI Press.
2. L.C.Witte, P.S.Schimdt, D.R.Brown, Industrial Energy Management and Utilisation, Hemisphere Publ,Washington, 1988.
3. Practical hand book on Energy Conservation in Buildings, Indian Building Congress, Nabhi Publication.
4. The Efficient use of Energy, Ed: I.G.C.Dryden, Butterworths, London, 1982.
5. Energy Management Handbook, Ed: WQ.C.Turner, Wiley, New York, 1982.

MEE 4025			Design for Manufacturing and Assembly				B. Tech		School Elective – III	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Design For Manufacturing And Assembly

Unit I: Effect of Materials & Manufacturing Processes on Design - Major Phases in Design & Manufacture, Effect of Material Properties on Design, Effect of Manufacturing Process on Design, Material Selection Process, Cost Per Unit Property & Weighed Properties Methods.
Unit II: Tolerancing - Tolerance Specification & Representation of Various Tolerances, their Significance in Assembly, Material Tolerances for Assembly Line -True Position Tolerancing, Cumulative Effect of Tolerances in Assembly, Interchangeability and Selective Assembly in Manufacturing, Process Capability & Its Significance with Ref. to Tolerancing, Achieving Larger Machining Tolerances.
Datum Features - Functional Datum, Datum for Manufacturing, Changing the Datum, etc.
Unit III: Design Considerations - Design of Components with Casting Considerations, Pattern, Mould, and Parting Line, Cored Holes and Machine Holes, Identifying the Possible and Probable Parting Line, Castings Requiring Special Sand Cores, Designing of Obviate Sand Cores. Component Design - Component Design with Machining Considerations(Design for Turning ComponentsMilling, Drilling and other Related Processes Including Finish-Machining Operations). 163
Unit IV: Design of Gauges - Design of Gauges for Checking Components In Assembly with emphasis on Various Types of Limit Gauges For Both Hole and Shaft.
Unit V: Case Studies - Related to Above Topics and (I) Redesign to Suit Manufacture of Typical Assemblies (II) Tolerance Design of a Typical Assembly (III) Design to Minimize Cost of A Product (IV) Computer Aided DFMA

Recommended Books:

1. Harry Peck, Design for Manufacture, Pitman Publications.
2. Boothroyd, G., Dewhurst, P. and Knight, W. - Product Design for Manufacture and Assembly, Mercel Dekker, New York.
3. Dieter -Machine Design, McGraw Hill, New York.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.

MEE 4027			Product Design and Development				B. Tech		School Elective – III / Open Elective	
L	**T**	**S/P**	**C**	**Minor Duration**	**Major Duration**	**Internal Marks**	**Minor-I Marks**	**Minor-II Marks**	**Major Marks**	**Total Marks**
3	0	0	3	1 Hour	3 Hours	10	20	20	50	100

Product Design And Development

Unit-I: Product Design – Traditional and Modern Design Processes, Innovation, Creation and Diffusion Techniques, and Functional, Technological, Ecological, Ligiale Evaluation of New Product Ideas.
Unit-II: Product Modeling and Reverse Engineering-Wireframe, Surface, and Solid Modeling Techniques,
Reverse Engineering
Unit- III: Product Data Exchange-Neutral File Format such as DXF, IGES, STEP, Concurrent EngineeringConcept Design For X, DFM, DFA, DFR, DFQ
Unit-IV: Rapid Protyping Methods-Liquid Based RP Methods Such As SLA, SGC, and SCS, Solid Based RP
Methods such as FDM, And LOM, Powder Based RP Methods such as SLS, 3DP, And BPM

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab &R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P.Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce &Co., New York
4 Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.