



B. Tech.

IN

MECHANICAL ENGINEERING

FLEXIBLE CURRICULUM

(For students admitted in 2015-16)



**DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015**

TAMIL NADU, INDIA



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CURRICULUM

The total minimum credits for completing the B.Tech. programme in Mechanical Engineering is 177 [68 + 109].

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES

The structure of B.Tech. programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) are as follows:

Sl. No.	COURSE CATEGORY	Number of Courses	Number of Credits
1.	General Institute Requirement (GIR)	17	68
2.	Programme Core (PC)	20	65
3.	Essential Programme Laboratory Requirement (ELR)	10	11
4.	Elective courses a. Programme Electives (PE) b. Open Electives (OE) c. Minor (MI) A student should be allowed a minimum of 50% of the total electives of a programme from (b) and (c) if so desired by the student.	11	33
TOTAL			<u>177</u>

**(I) GENERAL INSTITUTE REQUIREMENTS**

Sl.No.	Name of the course	Number of Courses	Maximum Credits
1.	Mathematics	4	14
2.	Physics*	2	7
3.	Chemistry*	2	7
4.	Humanities	1	3
5.	Communication	2	6
6.	Energy and Environmental Engineering	1	2
7.	Professional Ethics	1	3
8.	<i>Engineering Graphics</i>	<i>1</i>	<i>3</i>
9.	<i>Engineering Practice</i>	<i>1</i>	<i>2</i>
10.	Basic Engineering	2	4
11.	Introduction to Computer Programming	1	3
12.	Branch Specific Course** (Introduction to Branch of Study)	1	2
13.	<i>Summer Internship</i>	<i>1</i>	<i>2</i>
14.	<i>Project work</i>	<i>1</i>	<i>6</i>
15.	<i>Comprehensive Viva</i>	<i>1</i>	<i>3</i>
16.	Industrial lecture	-	1
17.	NSS / NCC / NSC	-	0
	TOTAL	17 (Excluding Italics)	68

***including Lab**

**** Commence during Orientation Programme**

**I. GENERAL INSTITUTE REQUIREMENTS****1. MATHEMATICS**

Sl. No.	Course Code	Course Title	Credits
1.	MAIR11	MATHEMATICS I	4
2.	MAIR21	MATHEMATICS II	4
3.	MAIR32	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION	3
4.	MAIR41	NUMERICAL TECHNIQUES	3
Total			14

2. PHYSICS

Sl. No.	Course Code	Course Title	Credits
1.	PHIR11	PHYSICS I	3
2.	PHIR12	PHYSICS II	4
Total			7

3. CHEMISTRY

Sl. No.	Course Code	Course Title	Credits
1.	CHIR11	CHEMISTRY I	3
2.	CHIR13	CHEMISTRY II	4
Total			7

4. HUMANITIES

Sl. No.	Course Code	Course Title	Credits
1.	HSIR13	INDUSTRIAL ECONOMICS AND FOREIGN TRADE	3
Total			3

**5. COMMUNICATION**

Sl. No.	Course Code	Course Title	Credits
1.	HSIR11	ENGLISH FOR COMMUNICATION	3
2.	HSIR12	PROFESSIONAL COMMUNICATION	3
Total			6

6. ENERGY AND ENVIRONMENTAL ENGINEERING

Sl. No.	Course Code	Course Title	Credits
1.	ENIR11	ENERGY AND ENVIRONMENTAL ENGINEERING	2
Total			2

7. PROFESSIONAL ETHICS

Sl. No.	Course Code	Course Title	Credits
1.	HSIR14	PROFESSIONAL ETHICS	3
Total			3

8. ENGINEERING GRAPHICS

Sl. No.	Course Code	Course Title	Credits
1.	MEIR12	ENGINEERING GRAPHICS	3
Total			3

9. ENGINEERING PRACTICE

Sl. No.	Course Code	Course Title	Credits
2.	PRIR11	ENGINEERING PRACTICE	2
Total			2

**10. BASIC ENGINEERING**

Sl. No.	Course Code	Course Title	Credits
1.	CEIR11	BASIC CIVIL ENGINEERING	2
2.	EEIR11	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	2
Total			4

11. INTRODUCTION TO COMPUTER PROGRAMMING

Sl. No.	Course Code	Course Title	Credits
1.	CSIR11	BASICS OF PROGRAMMING (Theory & Lab)	3
Total			3

12. BRANCH SPECIFIC COURSE

Sl. No.	Course Code	Course Title	Credits
1.	MEIR15	INTRODUCTION TO MECHANICAL ENGINEERING	2
Total			2

13. SUMMER INTERNSHIP

Sl. No.	Course Code	Course Title	Credits
1.	MEIR16	INTERNSHIP / INDUSTRIAL TRAINING / ACADEMIC ATTACHMENT (2 to 3 months duration during summer vacation)	2
Total			2

The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or university abroad is also permitted instead of industrial training.

To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.

**14. PROJECT WORK**

Sl. No.	Course Code	Course Title	Credits
1.	MEIR17	PROJECT WORK	6
Total			6

15. COMPREHENSIVE VIVA

Sl. No.	Course Code	Course Title	Credits
1.	MEIR18	COMPREHENSIVE VIVA	3
Total			3

16. INDUSTRIAL LECTURE

Sl. No.	Course Code	Course Title	Credits
1.	MEIR19	INDUSTRIAL LECTURE	1
Total			1

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture.

17. NSS / NCC / NSO

Sl. No.	Course Code	Course Title	Credits
1.	SWIR11	NSS / NCC / NSO	0
Total			0

**(II) PROGRAMME CORE (PC)****[Note: (1) Number of programme core: 16 to 20 (2) Credits: 56 - 65]**

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	MEPC10	ENGINEERING MECHANICS	-NIL-	3
2.	MEPC11	ENGINEERING THERMODYNAMICS	-NIL-	4
3.	MEPC12	STRENGTH OF MATERIALS	-NIL-	3
4.	MEPC13	APPLIED ELECTRICAL AND ELECTRONICS ENGINEERING	EEIR11	4
5.	MEPC14	INSTRUMENTATION AND CONTROL ENGINEERING	-NIL-	3
6.	MEPC15	PRODUCTION TECHNOLOGY - I	-NIL-	4
7.	MEPC16	THERMAL ENGINEERING	MEPC11	3
8.	MEPC17	MECHANICS OF MACHINES - I	MEPC10	3
9.	MEPC18	FLUID MECHANICS	-NIL-	3
10.	MEPC19	PRODUCTION TECHNOLOGY - II	-NIL-	4
11.	MEPC20	ENGINEERING MATERIALS	-NIL-	4
12.	MEPC21	TURBOMACHINES	MEPC18	3
13.	MEPC22	HEAT AND MASS TRANSFER	MEPC11	3
14.	MEPC23	MECHANICS OF MACHINES - II	MEPC17	3
15.	MEPC24	ANALYSIS AND DESIGN OF MACHINE COMPONENTS	MEPC12	3
16.	MEPC25	AUTOMOBILE ENGINEERING	-NIL-	3
17.	MEPC26	DESIGN OF MECHANICAL DRIVES	MEPC12	3
18.	MEPC27	COMPUTER AIDED DESIGN AND DRAFTING	MEIR12	3
19.	MEPC28	POWER PLANT ENGINEERING	MEPC21	3
20.	MEPC29	METROLOGY AND QUALITY CONTROL	-NIL-	3
Total				65

**(III) ELECTIVES****a. PROGRAMME ELECTIVE (PE)**

[Note: Number of programme elective: at least 3 courses]

Students pursuing B.Tech. in Mechanical Engineering should take at least three courses from the Programme Electives listed below.

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	MEPE10	COMPRESSIBLE FLOW AND JET PROPULSION	MEPC18	3
2.	MEPE11	COMPUTATIONAL FLUID DYNAMICS	MEPC18	3
3.	MEPE12	ADVANCED IC ENGINES	MEPC16	3
4.	MEPE13	COMBUSTION ENGINEERING	MEPC16	3
5.	MEPE14	BIOFUELS	MEPC16	3
6.	MEPE15	REFRIGERATION AND AIR CONDITIONING	MEPC16	3
7.	MEPE16	FUNDAMENTALS OF HVAC SYSTEMS	MEPC16	3
8.	MEPE17	CRYOGENIC ENGINEERING	MEPC16	3
9.	MEPE18	NANO TECHNOLOGY	MEPC20	3
10.	MEPE19	VEHICLE DYNAMICS	MEPC25	3
11.	MEPE20	COMPUTER APPLICATIONS IN DESIGN	MEPC27	3
12.	MEPE21	DYNAMICS OF MACHINERY	MEPC23	3
13.	MEPE22	MEMS DEVICES – DESIGN AND FABRICATION	MEPC13	3
14.	MEPE23	VIBRATION ANALYSIS AND CONTROL	MEPC23	3
15.	MEPE24	OIL HYDRAULICS AND PNEUMATICS	MEPC18	3
16.	MEPE25	INDUSTRIAL ROBOTICS	MEPC13	3
17.	MEPE26	MECHATRONICS	MEPC13	3
18.	MEPE27	INDUSTRIAL TRIBOLOGY	MEPC20	3
19.	MEPE28	OPTIMIZATION IN ENGINEERING DESIGN	MAIR31, MAIR46	3

**b. OPEN ELECTIVE (OE)**

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	MEOE10	RENEWABLE ENERGY	-NIL-	3
2.	MEOE11	FINITE ELEMENT METHOD	-NIL-	3
3.	MEOE12	COMPOSITE MATERIALS	-NIL-	3
4.	MEOE13	ADVANCES IN WELDING TECHNOLOGY	-NIL-	3
5.	MEOE14	INDUSTRIAL SAFETY ENGINEERING	-NIL-	3

c. MINOR (MI)

Students who have registered for B.Tech Minor in Mechanical Engineering.

[Note: Number of Minor courses: 5 courses (Minimum)]

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	MEMI10	BASIC THERMODYNAMICS	-NIL-	3
2.	MEMI11	FUNDAMENTALS OF THERMAL ENGINEERING	-NIL-	3
3.	MEMI12	FLUID MECHANICS AND MACHINERY	-NIL-	3
4.	MEMI13	FUNDAMENTALS OF HEAT AND MASS TRANSFER	-NIL-	3
5.	MEMI14	MACHINE DESIGN	-NIL-	3
6.	MEMI15	FUNDAMENTALS OF AUTOMOTIVE TECHNOLOGY	-NIL-	3
7.	MEMI16	POWER PLANT TECHNOLOGY	-NIL-	3
8.	MEMI17	FUNDAMENTALS OF REFRIGERATION AND AIR CONDITIONING	-NIL-	3
9.	MEMI18	PRINCIPLES OF TURBOMACHINERY	-NIL-	3
10.	MEMI19	FUNDAMENTALS OF INTERNAL COMBUSTION ENGINES	-NIL-	3
11.	MEMI20	ENGINE POLLUTION AND CONTROL	-NIL-	3
12.	MEMI21	CAD/ CAM	-NIL-	3



Note : Student should be allowed a minimum of 50% of the total electives of a programme from Open electives and Minor, if so desired by the student.

(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

Sl. No.	Course Code	Course Title	Co requisites	Credits
1.	MELR10	MACHINE DRAWING	MEIR12	2
2.	MELR11	STRENGTH OF MATERIALS LABORATORY	MEPC12	1
3.	MELR12	THERMAL ENGINEERING LABORATORY	MEPC16	1
4.	MELR13	FLUID MECHANICS LABORATORY	MEPC18	1
5.	MELR14	HEAT TRANSFER, REFRIGERATION AND AIR CONDITIONING LABORATORY	MEPC22	1
6.	MELR15	DYNAMICS LABORATORY	MEPC23	1
7.	MELR16	AUTOMOBILE ENGINEERING LABORATORY	MEPC25	1
8.	MELR17	COMPUTER AIDED DESIGN LABORATORY	MEPC27	1
9.	MELR18	METROLOGY AND QUALITY CONTROL LABORATORY	MEPC29	1
10.	MELR19	MECHATRONICS LABORATORY	MEPE26	1
Total				11

NOTE: Students can register for 2 laboratory courses during one session along with regular courses (PC / PE / OE / MI).



V. ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

A student can obtain B.Tech. (Honours) degree provided the student has;

- i. Registered at least for 12 theory courses and 2 ELRs in the second year.
- ii. Consistently obtained a minimum GPA of 8.5 in the first four sessions
- iii. Continue to maintain the same GPA of 8.5 in the subsequent sessions (including the Honours courses)
- iv. Completed 3 additional theory courses specified for the Honors degree of the programme.
- v. Completed all the courses registered, in the first attempt and in four years of study.

Sl. No.	Course Code	Course Title	Co requisites	Credits
1.	MEHO10	ADVANCED HEAT TRANSFER	MEPC22	3
2.	MEHO11	ADVANCED FLUID MECHANICS	MEPC18	3
3.	MEHO12	SIMULATION OF IC ENGINES	MEPC16	3
4.	MEHO13	DESIGN AND ANALYSIS OF TURBO MACHINES	MEPC21	3
5.	MEHO14	ADVANCED ENGINEERING MATERIALS	MEPC20	3
6.	MEHO15	DESIGN OF HEAT EXCHANGERS	MEPC22	3
7.	MEHO16	DESIGN AND OPTIMIZATION OF THERMAL ENERGY SYSTEMS	MEPC16	3

**DESCRIPTION OF COURSE CODES FOR B.TECH. PROGRAMME**

Sl. No.	Type of the course	Course Code and range
1.	General Institute requirements	xxIR10 to 99
2.	Programme core	xxPC10 to 99
3.	Programme Elective	xxPE10 to 99
4.	Essential Laboratory Requirement	xxLR10 to 99
5.	Open Electives	xxOE10 to 99
6.	Minors	xxMI10 to 99
7.	Honours	xxHO10 to 99

where xx denotes the Department offering the course

DESCRIPTION OF DEPARTMENT CODES FOR B.TECH. PROGRAMME

Sl. No.	Department	Code
1.	Architecture	AR
2.	Chemical Engineering	CL
3.	Civil Engineering	CE
4.	Computer Applications	CA
5.	Computer Science and Engineering	CS
6.	Chemistry	CH
7.	Electronics and Communication Engineering	EC
8.	Electrical and Electronics Engineering	EE
9.	Energy and Environment	EN
10.	Humanities	HM
11.	Instrumentation and control Engineering	IC
12.	Mathematics	MA
13.	Mechanical Engineering	ME
14.	Metallurgical and Materials Engineering	MT
15.	Production Engineering	PR
16.	Physics	PH
17.	Management Studies (DoMS)	MB
18.	Office of Dean, Student Welfare (NSS/NSC/NSO)	SW



Flow of course for B.Tech. Mechanical Engineering Programme and the session of study for each core course is given below.

Sl. No.	Course Code	Course Title	Year of Study	Session/s
1.	HSIR11	ENGLISH FOR COMMUNICATION	I	July
2.	MAIR11	MATHEMATICS I	I	July
3.	PHIR11	PHYSICS I	I	July
4.	CHIR11	CHEMISTRY I	I	July
5.	CSIR11	BASICS OF PROGRAMMING	I	July
6.	MEIR15	INTRODUCTION TO MECHANICAL ENGINEERING	I	July
7.	CEIR11	BASIC CIVIL ENGINEERING	I	July
8.	EEIR11	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	I	January
9.	PRIR11	ENGINEERING PRACTICE	I	January
10.	HSIR12	PROFESSIONAL COMMUNICATION	I	January
11.	MAIR21	MATHEMATICS II	I	January
12.	PHIR12	PHYSICS II	I	January
13.	CHIR13	CHEMISTRY II	I	January
14.	ENIR11	ENERGY AND ENVIRONMENTAL ENGINEERING	I	January
15.	MEPC10	ENGINEERING MECHANICS	I	January
16.	MEIR12	ENGINEERING GRAPHICS	I	January
17.	SWIR11	NSS/ NCC/ NSO	I	January
18.	MAIR32	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	II	July
19.	MEPC11	ENGINEERING THERMODYNAMICS	II	July
20.	MEPC12	STRENGTH OF MATERIALS	II	July



21.	MEPC13	APPLIED ELECTRICAL AND ELECTRONICS ENGINEERING	II	July
22.	MEPC14	INSTRUMENTATION AND CONTROL ENGINEERING	II	July
23.	MEPC15	PRODUCTION TECHNOLOGY - II	II	July
24.	MELR10	MACHINE DRAWING	II	July
25.	MELR11	STRENGTH OF MATERIALS LABORATORY	II	July
26.	MAIR41	NUMERICAL TECHNIQUES	II	January
27.	MEPC16	THERMAL ENGINEERING	II	January
28.	MEPC17	MECHANICS OF MACHINES - I	II	January
29.	MEPC18	FLUID MECHANICS	II	January
30.	MEPC19	PRODUCTION TECHNOLOGY - II	II	January
31.	MEPC20	ENGINEERING MATERIALS	II	January
32.	MELR12	THERMAL ENGINEERING LABORATORY	II	January
33.	MELR13	FLUID MECHANICS LABORATORY	II	January
34.	MEPC21	TURBOMACHINES	III	July
35.	MEPC22	HEAT AND MASS TRANSFER	III	July
36.	MEPC23	MECHANICS OF MACHINES - II	III	July
37.	MEPC24	ANALYSIS AND DESIGN OF MACHINE COMPONENTS	III	July
38.		ELECTIVE-I	III	July
39.		ELECTIVE-II	III	July
40.	MELR14	HEAT TRANSFER, REFRIGERATION AND AIR CONDITIONING LABORATORY	III	July
41.	MELR15	DYNAMICS LABORATORY	III	July
42.	MEPC25	AUTOMOBILE ENGINEERING	III	January
43.	MEPC26	DESIGN OF MECHANICAL DRIVES	III	January
44.	MEPC27	COMPUTER AIDED DESIGN AND DRAFTING	III	January
45.		ELECTIVE-III	III	January



46.		ELECTIVE-IV	III	January
47.		ELECTIVE-V	III	January
48.	MELR16	AUTOMOBILE ENGINEERING LABORATORY	III	January
49.	MELR17	COMPUTER AIDED DESIGN LABORATORY	III	January
50.	MEIR16	SUMMER INTERNSHIP	III	January
51.	MEIR19	INDUSTRIAL LECTURE	III	January
52.	HSIR	PROFESSIONAL ETHICS	IV	July
53.	MEPC28	POWER PLANT ENGINEERING	IV	July
54.	MEPC29	METROLOGY AND QUALITY CONTROL	IV	July
55.		ELECTIVE-VI	IV	July
56.		ELECTIVE-VII	IV	July
57.		ELECTIVE-VIII	IV	July
58.	MELR18	METROLOGY AND QUALITY CONTROL	IV	July
59.	MELR19	MECHATRONICS LABORATORY	IV	July
60.	MEIR18	COMPREHENSIVE VIVA	IV	July
61.	HSIR13	INDUSTRIAL ECONOMICS AND FOREIGN TRADE	IV	January
62.		ELECTIVE-IX	IV	January
63.		ELECTIVE-X	IV	January
64.		ELECTIVE-XI	IV	January
65.	MEIR17	PROJECT WORK	IV	January

**SYLLABUS****I. GENERAL INSTITUTE REQUIREMENTS****1. MATHEMATICS**

Course Code	:	MAIR11
Course Title	:	MATHEMATICS I
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

To acquire fundamental knowledge and apply in engineering disciplines.

Course Content

Characteristic equation of a matrix – Eigen values and Eigen vectors – Properties of Eigen values – Diagonalization of matrix – Cayley-Hamilton Theorem (without proof) verification – Finding Inverse and Power of a matrix using it – Quadratic form – Definite and indefinite forms – Orthogonal reduction of quadratic form to canonical form.

Sequences of real numbers – Limit of a sequence – Convergent and divergent sequences – sub sequence- Cauchy's sequence – monotone convergence theorem (without proof)- Sequence with recurrence relations.

Infinite series-Convergence Tests for positive term series – Comparison, Root, Ratio and Raabe's tests - Alternating series – Leibnitz's rule – Absolute and Conditional Convergence. Riemann rearrangement theorem (without proof).

Functions of several variables – Partial derivatives and Transformation of variables – Jacobian and its Properties- Maxima and Minima of function of two variables.

Double integral – Changing the order of Integration – Change of variables from Cartesian to Polar Coordinates – Area using double integral in Cartesian and Polar Coordinates – Triple integral – Change of Variables from Cartesian to Spherical and Cylindrical Coordinates – Volume using double and triple integrals.

Reference Books:

1. Kreyszig, E., 'Advanced Engineering Mathematics', 9th edition, John Wiley Sons, 2006.
2. Grewal, B.S., 'Higher Engineering Mathematics', 42nd edition, Khanna Publications, Delhi, 2012.
3. M K Venkataraman, 'Engineering mathematics', Volume I, 2nd ed., National Publishing Co, 2003.

Course Outcome

At the end of the course student will be, to solve curriculum problems.



Course Code	:	MAIR21
Course Title	:	MATHEMATICS II
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

To learn mathematical concepts and methods

Course Content

Vector space – Subspaces – Linear dependence and independence – Spanning of a subspace – Basis and Dimension. Inner product – Inner product spaces – Orthogonal and orthonormal basis – Gram- Schmidt orthogonalization process.

Basic review of first order differential equation - Higher order linear differential equations with constant coefficients –Particular integrals for $x^n e^{ax}$, $e^{ax} \cos(bx)$, $e^{ax} \sin(bx)$ – Equation reducible to linear equations with constant coefficients using $x e^t$ - Simultaneous linear equations with constant coefficients – Method of variation of parameters – Applications – Electric circuit problems.

Gradient, Divergence and Curl – Directional Derivative – Tangent Plane and normal to surfaces – Angle between surfaces –Solenoidal and irrotational fields – Line, surface and volume integrals – Green’s Theorem, Stokes’ Theorem and Gauss Divergence Theorem (all without proof) – Verification and applications of these theorems.

Analytic functions – Cauchy – Riemann equations (Cartesian and polar) –Properties of analytic functions – Construction of analytic functions given real or imaginary part – Conformal mapping of standard elementary functions (, , $\sin z$, $\cos z$, z^+) and bilinear transformation.

Cauchy’s integral theorem, Cauchy’s integral formula and for derivatives– Taylor’s and Laurent’s expansions (without proof) – Singularities – Residues – Cauchy’s residue theorem – Contour integration involving unit circle.

Reference Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th edition, John Wiley Sons, 2006.
2. Grewal, B.S., ‘Higher Engineering Mathematics’, 42nd edition, Khanna Publications, Delhi, 2012.
3. Hsiung, C.Y. and Mao, G. Y. ‘Linear Algebra’, World Scientific Pub Co Inc., 1999.
4. Apostol, T.M. ‘Calculus’, Volume I & II, 2nd Edition, John Wiley & Sons (Asia), 2005.
5. Greenberg, M.D. ‘Advanced Engineering Mathematics’, 2nd Edition, Pearson Education Inc. (First Indian reprint), 2002.
6. Strauss. M.J, Bradley, G.L. and Smith, K.J. ‘Calculus’, 3rd Edition, Prentice Hall, 2002.
7. Venkataraman, M. K. ‘Linear Algebra’, The National Publishing Co, 1999



Course outcome

At the end of the course student will be able to solve industrially applicable problems.

Course Code	:	MAIR32
Course Title	:	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. To impart knowledge on solving ordinary differential equations and partial differential equations using Laplace transform.
2. To know to express the periodic functions such as Fourier series, Fourier transform and formation of partial differential equation in solving problems.
3. To understand to solve one dimensional and two dimensional wave and heat equation.

Course Content

Laplace Transforms of standard functions – Unit Step function, Dirac delta, function, derivatives and integrals - Inverse Laplace Transform - convolution theorem – Periodic functions - Application to ordinary differential equations and simultaneous equations with constant coefficients and integral equations.

Dirichlet conditions - Expansion of periodic functions into Fourier series - Change of interval- Fourier series for even and odd functions - Half-range expansions- RMS value of a function - Parseval's relation - Fourier series in complex form - Harmonic analysis.

Definition of Fourier Transform (finite and infinite) - Inverse Fourier Transform – Properties - Fourier Sine and Cosine transforms - Inverse Fourier Sine and Cosine transforms – Properties - Convolution theorem for Fourier Transform.

Formation of PDE - Solution of standard types of first order equations - Lagrange's linear equation - Second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution. Two-dimensional heat flow equation in steady state - Laplace equation in Cartesian and polar co ordinates - method of separation of variables - Fourier series solution.

Reference Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 6th ed. 2001.
2. Gupta, S.C., and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2002.
3. Venkataraman, M. K., Higher Mathematics for Engineering and Science, National Publishing Company, 1997.



Course Outcomes

At the end of the course student will be

1. Demonstrate the ability of using Laplace transform in solving the ordinary differential equations and partial differential equations
2. Apply the fundamental concept of Fourier series and be able to give Fourier expansions of a given function.
3. Solve various first order differential equations with their applications.
4. Illustrate the mathematical aspects that contribute to the solution of heat and wave equations.

Course Code	:	MAIR41
Course Title	:	NUMERICAL TECHNIQUES
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. To acquire knowledge on Bessel's equation, Poisson and Normal distributions, Moment generating function etc and to apply the same in solving the engineering problems.
2. To develop the basic understanding of numerical techniques for solving linear, non-linear and Ordinary Differential Equations.
3. To provide knowledge on solving Laplace equation and Poisson equation, heat flow and wave equation

Course Content

Bessel's equation – Bessel functions - Recurrence formulae - Orthogonality property-Generating function. Legendre's equation- Legendre polynomials - Rodrigue's formula-Orthogonality property - Generating function - Recurrence relations.

Moment generating function - Characteristic function – Chebyshev's inequality - Law of large numbers - Central Limit Theorem.

Solution of linear system - Gaussian elimination and Gauss-Jordan methods - LU - decomposition methods - Crout's method - Jacobi and Gauss-Seidel iterative methods - sufficient conditions for convergence - Power method to find the dominant eigenvalue and eigenvector. Newton's forward, backward and divided difference interpolation – Lagrange's interpolation – Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rules - Curve fitting - Method of least squares and group averages.

Numerical Solution of Ordinary Differential Equations- Euler's method - Euler's modified method - Taylor's method and Runge-Kutta method for simultaneous equations and 2nd order equations - Multistep methods - Milne's and Adams' methods.

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method - Solution of one dimensional wave equation.



Reference Books:

1. Gerald, C.F., and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley, 1998.
2. Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern, 1987.
3. Kandasamy, P., Thilagavathy, K., and Gunavathy, S., Numerical Methods, S.Chand & Company, 1998.

Course Outcomes

At the end of the course student will be

1. Solve linear and non-linear system of equations through numerical techniques.
2. Apply various numerical techniques to solve Laplace equation and Poisson equation, heat flow and wave equation.
3. Identify the relationship between gamma and beta functions and apply the various distributions like binomial, Poisson and normal distributions in engineering applications.

2. PHYSICS

Course Code	:	PHIR11
Course Title	:	PHYSICS I
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. To make a bridge between the physics in school and engineering courses.
2. To introduce the basic concepts of modern science like Photonics, Engineering applications of acoustics, fundamentals of crystal physics and materials science.

Course Content

Introduction to Laser-characteristics of Lasers-Spontaneous and stimulated emissions – Einstein’s coefficients – population inversion and lasing action – laser systems: Ruby laser, He-Ne Laser, semiconductor laser-applications:-Holography- CD-drive – industrial and medical applications.

Fermat’s principle and Snell’s law-optical fiber – principle and construction – acceptance cone - numerical aperture - V-Number - types of fibers, Fabrication: Double Crucible Technique, Vapour phase Oxidation Process – fiber optic communication principle – fiber optic sensors-other applications of optical fibers.

Characteristics of musical sound – loudness – Weber-Fechner law – decibel – absorption coefficient – reverberation – reverberation time – Sabine’s formula – acoustics of buildings – ultrasonics – production of ultrasonics using piezoelectric method –magnetostriction method-applications.



Crystalline and amorphous solids – lattice and unit cell – seven crystal system and Bravais lattices – symmetry operation – Miller indices – atomic radius – coordination number – packing factor calculation for sc, bcc, fcc – Bragg’s law of X-ray diffraction – Laue Method powder crystal method.

Magnetic materials: Definition of terms – classification of magnetic materials and properties – Domain theory of ferromagnetism- hard and soft magnetic materials – applications. Conductors: classical free electron theory (Lorentz –Drude theory) – electrical conductivity Superconductors: definition – Meissner effect – type I & II superconductors – BCS theory (qualitative) – high temperature superconductors – Josephson effect – quantum interference (qualitative) – SQUID – applications.

Laboratory Experiments

1. Torsional pendulum
2. Numerical aperture of an optical fiber
3. Temperature measurement – Thermocouple
4. Specific rotation of a liquid – Half Shade Polarimeter
5. Thickness of a thin wire – Air Wedge
6. Conversion of galvanometer into ammeter and voltmeter
7. Dispersive power of a prism – Spectrometer
8. Superconductivity- measurement of transition temperature
9. Absorption spectrometer
10. Brewster’s Angle measurement
11. Measurement of Young’s modulus

Reference Books:

1. M.N. Avadhanulu and P.G. Kshirsagar, ‘A text book of Engineering Physics’ S. Chand and Company, New Delhi (2009).
2. R.K. Gaur and S.L. Gupta, ‘Engineering Physics’ Dhanpat Rai Publications (P) Ltd., 8th edn., New Delhi (2001).
3. William T. Silfvast, Laser Fundamentals, 2nd edn, Cambridge University press, New York (2004)
4. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6th Edition, John Wiley and Sons, New York (2001).
5. Charls Kittel, Introduction to solid state physics, 7th Edn, Wiley, Delhi (2007)

Course Outcomes

At the end of the course student will be able to understand many modern devices and technologies based on lasers and optical fibers. Student can also appreciate various material properties which are used in engineering applications and devices.



Course Code	:	PHIR12
Course Title	:	PHYSICS II
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. To make a bridge between the physics in school and engineering courses
2. To introduce the basic concepts of modern physics like fundamentals of quantum mechanics, nuclear physics and advanced materials.
3. To introduce the concepts of NDT and Vacuum Technology

Course Content

Inadequacy of classical mechanics (black body radiation, photoelectric effect) – wave and particle duality of radiation – de Broglie concept of matter waves – electron diffraction – Heisenberg's uncertainty principle – Schrodinger's wave equation – eigenvalues and eigen functions – superposition principle – interpretation of wave function – particle confined in one dimensional infinite square well potential.

Fundamental forces - Nuclear properties and forces - Nuclear models - Shell model - Nuclear reaction - Radioactivity - types and half lives - application in determining the age of rock and fossils- Neutrons and its applications (neutron diffraction, nuclear reaction etc)- Stellar nucleosynthesis. Particle physics - classification of matter - quark model-neutrino properties and their detection.

Nanomaterials - Introduction and properties – synthesis – chemical vapour deposition – ball milling – applications. Carbon nanotubes: structure and properties – synthesis– arc method – pulsed laser deposition- applications. Liquid Crystal types – nematic, cholesteric, smectic – modes: dynamic scattering, twisted nematic – display systems. Shape memory alloys-one way and two way memory effect- pseudoelasticity-applications

Principle of ultrasonic testing – inspection methods – different types of scans – liquid penetrant testing – magnetic particle inspection – principle and types of radiography – exposure factor – attenuation of radiation – real time radiography – principle of thermography – thermographic camera – advantages and limitations of all methods.

Introduction-Exhaust pump and their characteristics-different types of pumps-rotary vane pump-roots pump-diffusion pump-turbo-molecular pump-measurement of low pressurepirani gauge-penning gauge - applications of vacuum technology - thin film deposition: thermal evaporation-sputtering.

Laboratory Experiments

1. Wavelength of sodium light – Newton's rings
2. Thermal conductivity –Lee's Disc
3. Wavelength of mercury spectrum – Spectrometer
4. Calibration of Voltmeter – Potentiometer



5. Wavelength of laser using diffraction grating
6. Field along the axis of a Circular coil
7. Non-destructive testing by ultrasonic flaw detector.
8. GM counter experiment
9. Zeeman effect experiment
10. Millikan's oil drop experiment
11. Kunds tube experiment

Reference Books:

1. M.N. Avadhanulu and P.G. Kshirsagar, 'A text book of Engineering Physics', S. Chand and Company, New Delhi 2009.
2. R.K. Gaur and S.L. Gupta, 'Engineering Physics', Dhanpat Rai Publications (P) Ltd., 8th ed., New Delhi 2001.
3. Arthur Beiser, 'Concepts of Modern Physics. Tata McGraw-Hill, New Delhi 2010.
4. C.J. Hellier, 'Hand Book of Non-destructive evaluation', McGraw-Hill, New York 2001.
5. V.V. Rao, T.B. Ghosh, K.L. Chopra, 'Vacuum Science and Technology', Allied Publishers, New Delhi 2008.
6. C.P. Poole and F.J. Owens, 'Introduction to Nanotechnology', Wiley, New Delhi 2007.
7. Peter J. Collings, 'Introduction to Liquid Crystals Chemistry and Physics', 2 nd Ed, Princeton University Press, New Jersey, 2002.
8. D. C. Lagoudas 'Shape memory alloys - modeling and engineering applications', Ed., Springer, New York 2008.

Course Outcomes

At the end of the course student will be able to get an exposure to most modern and advanced concepts in nuclear physics, nanotechnology and advanced materials. Study of basic concept of NDT is very important for a modern engineer.

3. CHEMISTRY

Course Code	:	CHIR11
Course Title	:	CHEMISTRY I
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

To introduce students to water chemistry, bonding concepts, entropy and basic organic chemistry

Course Content

Sources, hard & soft water, estimation of hardness by EDTA method, softening of water, zeolite process & demineralization by ion exchangers, boiler feed water, internal treatment methods, specifications for drinking water, BIS & WHO standards, treatment of water for domestic use, desalination - Reverse osmosis & Electrodialysis.



Basic concepts, bonding in metals, electron gas theory, physical properties of metals (electrical & thermal conductivity, opaque & lustre, malleability & ductility), Alloys substitutional alloys, interstitial alloys. Coordinate bond, EAN rule, 16 & 18 electron rule, crystal field theory, splitting of 'd' orbitals in octahedral, tetrahedral and square planar complexes.

Shape-Lewis dot structures, formal charge, VSEPR method, consequences of shape, dipole moment, valence bond theory; Intermolecular interactions-ion ion interactions, ion-dipole interactions, hydrogen bonding, dipole-dipole interactions, London / dispersion forces, relative strength of intermolecular forces; Consequences-surface tension.

Entropy as a thermodynamic quantity, entropy changes in isothermal expansion of an ideal gas, reversible and irreversible processes, physical transformations, work & free energy functions, Helmholtz and Gibbs free energy functions, Gibbs-Helmholtz equation, Gibbs-Duhem equation, Clapeyron-Clausius equation & its applications, Van't Hoff isotherm and applications.

Fuels - Classification, examples, relative merits, types of coal, determination of calorific value of solid fuels, Bomb calorimeter, theoretical oxygen requirement for combustion, proximate & ultimate analysis of coal, manufacture of metallurgical coke, flue gas analysis, problems. Lubricants - Definition, theories of lubrication, characteristics of lubricants, viscosity, viscosity index, oiliness, pour point, cloud point, flash point, fire point, additives to lubricants, Solid lubricants.

Laboratory Experiments

1. Estimation of total alkalinity in the given water sample.
2. Estimation of carbonate, non-carbonate and total hardness in the given water sample.
3. Estimation of dissolved oxygen in the given water sample.
4. Determination of the percentage of Fe in the given steel sample.
5. Estimation of Ca in limestone.
6. Estimation of Fe³⁺ by spectrophotometer.

Reference Books:

1. P.C. Jain, M. Jain, 'Engineering Chemistry', Dhanpat Rai Publishing Company, New Delhi, 2005.
2. P. Atkins, J.D. Paula, 'Physical Chemistry', Oxford University Press, 2002.
3. R.D. Madan, 'Modern Inorganic Chemistry', S. Chand & Company Ltd., New Delhi, 2012.
4. M.J. Shultz, 'Engineering Chemistry', Cengage Learning, New Delhi, 2007.

Course Outcomes

At the end of the course student will learn about quality of water, bonding theories, entropy change for various processes and basic stereo chemical aspects



Course Code	:	CHIR13
Course Title	:	CHEMISTRY II
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

To introduce the students to basic principles of electrochemistry, cell construction and evaluation, corrosion, adsorption, phase equilibrium and engineering materials of importance

Course Content

Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications, Weston standard cell, reversible and irreversible cells, concentration cell, electrode (hydrogen gas electrode) and electrolyte concentration cell, concentration cell with and without transference, fuel cells, hydrox fuel cell.

Dry corrosion and wet corrosion, mechanisms, types of corrosion, DMC, DAC, stress, inter granular, atmospheric and soil corrosion, Passivity, Polarization, over potential and its significance, Factors affecting corrosion, protection from corrosion by metallic coatings, electroplating, electroless plating and cathodic protection, Chemical conversion coatings and organic coatings- Paints, enamels.

Adsorption – types – adsorption of gases on solids – adsorption isotherm – Freundlich and Langmuir isotherms – adsorption of solutes from solutions – role of adsorbents – activated carbon in pollution abatement of air and waste water. Phase rule: Statement and explanation of the terms involved – one component water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (Pb - Ag system only) – alloys – importance, ferrous alloys – nichrome, and stainless steel, nonferrous alloys – brass and bronze – heat treatment of alloys.

Abrasives – Moh's scale of hardness – natural abrasives (diamond, corundum, emery, garnets and quartz) – synthetic abrasives (silicon carbide, boron carbide) – refractories – characteristics – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina magnesite and zirconia bricks. Cement - Important Parameters for Manufacturing Cement Clinkers. Chemical Constituents and Composition of Cement. Methods of Manufacture of Cement - Wet and Dry Processes. Additives for Cement. Properties of Cement - Setting and Hardening. Types of Portland Cement.

Concept of macromolecules-Nomenclature of polymers-Tacticity- Polymerization processes-Mechanism-Types of Polymerization-Classification of Polymers-Effect of Polymer structure on properties-Moulding of plastics into articles-Important addition and condensation polymers – synthesis and properties – Molecular mass determination of polymers- Static and dynamic methods, Light scattering and Gel Permeation Chromatography-Rubbers –Vulcanization –



Synthetic rubbers – Conducting polymers Composite materials – Reinforced composites and processing.

Laboratory Experiments

1. Corrosion rate by polarization technique
2. Conductometric titration
3. Potentiometric titration
4. pH metric titration
5. Percentage purity of bleaching powder
6. Percentage purity of washing soda
7. Determination of molecular weight of polymer by viscometry
8. Demonstration of sophisticated instruments and assignments on them

Reference Books:

1. P. C. Jain & M. Jain, 'Engineering Chemistry', Dhanpat Rai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, 'Principles of Physical Chemistry', Vishal Publishing Company, 2008.
3. F.W. Billmeyer. 'Textbook of Polymer Science', 3rd Edn, Wiley. N.Y. 1991.
4. S. S. Dara, S. S. Umare, 'A Text Book of Engineering Chemistry', S. Chand Publishing, 2011

Course Outcomes

At the end of the course student will learn the significance of electrochemistry and its application, corrosion, adsorption, engineering materials of importance and polymer.

4. HUMANITIES

Course Code	:	HSIR13
Course Title	:	INDUSTRIAL ECONOMICS AND FOREIGN TRADE
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. Give a simple yet thorough introduction into the main methods of economic analysis of industry structure and firm behaviour under various conditions of technology, competition, and organization.
2. Elaborate students' skills and abilities to use modern theoretical and empirical tools to formulate and solve economic problems.
3. Explore in details how economists approach and answer specific empirical questions.



Course Content

Demand and Supply – Forecasting techniques – Cost and Revenues.

Competitive nature of the firms – Keynesian economics – National income.

International Trade – Meaning and Benefits – Basis of International Trade – Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade – WTO – Indian EXIM Policy.

Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates – The effects of Exchange rates in Foreign Trade – Tools for hedging against Exchange rate variations – Forward, Futures and Currency options – FEMA – Determination of Foreign Exchange rate and Forecasting

Exchange Rate determination – Marketing – Product life cycle – Marketing research – Branding – Personality – Motivation – Leadership – Working in Teams.

References:

1. Adhikary Manab, Business Economics, Excel Books, 2004.
2. Dwivedi, D.N., Macro Economics Theory & Policy, Tata Mc Graw-Hill, 2005.
3. Aczel D. Amir, Soundarapandian Jayavel, Complete Business Statistics, Tata Mc Graw-Hill, 2005.
4. Robins P. Stephen, Organizational Behaviour, Prentice-Hall, 2002.
5. Apte P.G., International Financial Management, Tata McGraw Hill, 2011.
6. Jeff Madura, International Corporate Finance, Cengage Learning, 9th Edition, 2011.

Course Outcomes:

At the end of the course student will be able to

1. Analyze the risk of decision making in a firm.
2. Describe and explain the determinants of the size and structure of firms.
3. Give an overview of trade cycle, inflation, cash flow analysis and Balance sheet.
4. Explain the marketing research, product life cycle, motivation and leadership.
5. Describe the competitive nature of the firm and team working.



5. COMMUNICATION

Course Code	:	HSIR11
Course Title	:	ENGLISH FOR COMMUNICATION
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

The primary objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for academic and social needs.

Course Content

An introduction - Its role and importance in the corporate world – Tools of communication – Barriers – Levels of communication – English for Specific purposes and English for technical purposes.

Listening process & practice – Exposure to recorded & structured talks, class room lectures – Problems in comprehension & retention – Note-taking practice – Listening tests- Importance of listening in the corporate world.

Introduction of different kinds of reading materials: technical & non-technical – Different reading strategies: skimming, scanning, inferring, predicting and responding to content – Guessing from context – Note making – Vocabulary extension.

Barriers to speaking – Building self-confidence & fluency – Conversation practice- Improving responding capacity - Extempore speech practice – Speech assessment.

Effective writing practice – Vocabulary expansion - Effective sentences: role of acceptability, appropriateness, brevity & clarity in writing – Cohesion & coherence in writing –Writing of definitions, descriptions & instructions - Paragraph writing - Introduction to report writing.

Reference Books:

1. Krishna Mohan and Meenakshi Raman 'Effective English Communication', Tata McGraw Hill, New Delhi, 2000.
2. Meenakshi Raman and Sangeetha Sharma 'Technical Communication', Oxford University Press, New Delhi, 2006.
3. M. Ashraf Rizvi 'Effective Technical Communication', Tata McGraw-Hill, New Delhi, 2005.
4. Golding S.R. 'Common Errors in English Language', Macmillan, 1978.
5. Christopher Turk 'Effective Speaking', E & FN Spon, London, 1985.

Course Outcomes

At the end of the course student will be able to express themselves in a meaningful manner to different levels of people in their academic and social domains.



Course Code	:	HSIR12
Course Title	:	PROFESSIONAL COMMUNICATION
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

The primary objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for their professional needs.

Course Content

Listening Barriers to listening: Physical & psychological – Steps to overcome them – Purposive listening practice – Active listening and anticipating the speaker – Use of technology in the professional world.

Speaking Fluency & accuracy in speech – Positive thinking – Kinds of thinking -Improving self-expression – Tonal variations – Listener oriented speaking -Group discussion practice – Interpersonal Conversation -Developing persuasive speaking skills.

Reading Speed reading practice– Use of extensive readers –Trans-coding: verbal and nonverbal – Eye-reading practice – Analytical and critical reading practice- Introduction to ethics & values through case-study materials.

Writing Professional Correspondence – Formal and informal letters – Argument Writing practice – Perspectives in writing – Narrative writing -Different registers - Tone in formal writing – Summary writing practice- Introduction to reports.

Study Skills Reference Skills - Use of dictionary, thesaurus etc – Importance of contents page, cover & back pages – Bibliography.

Reference Books:

1. Shirley Taylor (1999), 'Communication for Business', Longman, New Delhi.
2. Robert Gannon (2000), 'Best Science Writing: Readings and Insights', University Press, Hyderabad.
3. Richard A. Boning (1990), 'Multiple Reading Skills', McGraw Hill, Singapore.
4. Albert J. Harris, Edward R. Sipay (1990), 'How to Increase Reading Ability', Longman.
5. David Martin (1994), 'Tough Talking', University press, Hyderabad.

Course Outcomes

At the end of the course student will be able to get knowledge of the various uses of English in their professional environment and they will be able to communicate themselves effectively in their chosen profession.



6. ENERGY AND ENVIRONMENTAL ENGINEERING

Course Code	:	ENIR11
Course Title	:	ENERGY AND ENVIRONMENTAL ENGINEERING
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. To teach the principal renewable energy systems.
2. To explore the environmental impact of various energy sources and also the effects of different types of pollutants.

Course Content

Present Energy resources in India and its sustainability - Different type of conventional Power Plant--Energy Demand Scenario in India-Advantage and Disadvantage of conventional Power Plants – Conventional vs Non-conventional power generation

Basics of Solar Energy- Solar Thermal Energy- Solar Photovoltaic- Advantages and Disadvantages-Environmental impacts and safety.

Power and energy from wind turbines- India's wind energy potential- Types of wind turbines- Off shore Wind energy- Environmental benefits and impacts.

Biomass resources-Biomass conversion Technologies- Feedstock preprocessing and treatment methods- Bioenergy program in India-Environmental benefits and impacts. Geothermal Energy resources –Ocean Thermal Energy Conversion – Tidal.

Air pollution- Sources, effects, control, air quality standards, air pollution act, air pollution measurement. Water pollution-Sources and impacts, Soil pollution-Sources and impacts, disposal of solid waste.

Greenhouse gases – effect, acid rain. Noise pollution. Pollution aspects of various power plants. Fossil fuels and impacts, Industrial and transport emissions- impacts.

Reference Books:

1. Boyle, G. 2004.' Renewable energy: Power for a sustainable future'. Oxford University press.
2. B H Khan, 'Non Conventional Energy Resources'-The McGraw –Hill Second edition.
3. G. D. Rai, 'Non conventional energy sources', Khanna Publishers, New Delhi, 2006.
4. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd Edition, Prentice Hall, 2003.
5. 'Unleashing the Potential of Renewable Energy in India' –World bank report.
6. Godfrey Boyle, Bob Everett and Janet Ramage.2010.'Energy Systems and Sustainability. Power for a sustainable future'. Oxford University press.



Course Outcomes

At the end of the course student will be introduced to the Principal renewable energy systems and explore the environmental impact of various energy sources and also the effects of different types of pollutants.

7. PROFESSIONAL ETHICS

Course Code	:	HSIR14
Course Title	:	PROFESSIONAL ETHICS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. Identify the core values that shape the ethical behavior of an engineer
2. To create an awareness on professional ethics and Human Values
3. To appreciate the rights of others

Course Content

Morals, Values and Ethics - Integrity - work Ethic - Service Learning - Civic Virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Co-operation - Commitment - Empathy - Self-Confidence - Character - Spirituality - The role of engineers in modern society - social expectations.

Sense of 'Engineering Ethics' - Variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy - Models of Professional Roles & Professionalism - theories about right action - Self-interest - customs and religion - uses of ethical theories.

Engineering as experimentation - engineers as responsible experimenters - Research ethics - Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.

Safety and risk - assessment of safety and risk - Riysis - Risk benefit analysis and reducing risk - Govt. Regulator's approach to risks - the three mile island and Chernobyl case studies & Bhopal - Threat of Nuclear power, depletion of ozone, greenery effects - Collegiality and loyalty - respect for authority - collective bargaining - Confidentiality - conflicts of interest - occupation crime - professional rights - employees' rights - Intellectual Property rights (IPR) - discrimination.

Multinational corporations - Business ethics - Environmental ethics - computer ethics - Role in Technological Development - Weapons development engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Honesty - leadership - sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India, etc.,.



Reference books:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Learning, (2000).
3. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, (1999).
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, (2003)
5. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, (2001)
6. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”, Biztantra, New Delhi, (2004)

Course Outcome

At the end of the course student will be able to

1. Understood the core values that shape the ethical behaviour of an engineer
2. Exposed awareness on professional ethics and human values.
3. Known their role in technological development

8. ENGINEERING GRAPHICS

Course Code	:	MEIR12
Course Title	:	ENGINEERING GRAPHICS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. Irrespective of engineering discipline, it has become mandatory to know the basics of Engineering graphics. The student is expected to possess the efficient drafting skill depending on the operational function in order to perform day to day activity.
2. Provide neat structure of industrial drawing
3. Enables the knowledge about position of the component and its forms Interpretation of technical graphics assemblies
4. Preparation of machine components and related parts

Course Content

Fundamentals Drawing standard - BIS, dimensioning, lettering, type of lines, scaling-conventions.

Geometrical constructions Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and hexagon – conic sections – ellipse – parabola – hyperbola - cycloid – trochoid.



Orthographic projection Introduction to orthographic projection, drawing orthographic views of objects from their isometric views - Orthographic projections of points lying in four quadrants, Orthographic projection of lines parallel and inclined to one or both planes Orthographic projection of planes inclined to one or both planes. Projections of simple solids - axis perpendicular to HP, axis perpendicular to VP and axis inclined to one or both planes.

Sectioning of solids Section planes perpendicular to one plane and parallel or inclined to other plane.

Intersection of surfaces Intersection of cylinder & cylinder, intersection of cylinder & cone, and intersection of prisms.

Development of surfaces Development of prisms, pyramids and cylindrical & conical surfaces.
Isometric and perspective projection Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection.

Computer aided drafting Introduction to computer aided drafting package to make 2-D drawings.

Reference Books:

1. Bhatt, N. D. and Panchal, V.M., 'Engineering Drawing', Pub.: Charotar Publishing House, 2010.
2. Natarajan, K. V., 'A text book of Engineering Graphics', Pub.: Dhanalakshmi Publishers, Chennai, 2006.
3. Venugopal, K. and Prabhu Raja, V., 'Engineering Drawing and Graphics + AutoCAD', Pub.: New Age International, 2009.
4. Jolhe, D. A., 'Engineering drawing', Pub.: Tata McGraw Hill, 2008
5. Shah, M. B. and Rana, B. C., 'Engineering Drawing', Pub.: Pearson Education, 2009.
6. Trymbaka Murthy, S., 'Computer Aided Engineering Drawing', Pub.: I.K. International Publishing House, 2009.

Course Outcomes

At the end of the course student will be able to visualize the engineering components. A number of chosen problems will be solved to illustrate the concepts clearly.

9. ENGINEERING PRACTICE

Course Code	:	PRIR11
Course Title	:	ENGINEERING PRACTICE
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

Introduction to the use of tools and machinery in Carpentry, Welding, Foundry, Fitting and Sheet Metal Working.



Course Content

Carpentry

Wood sizing exercise in planning, marking, sawing, chiseling and grooving to make

1. Half lap joint
2. Cross lap joint

Welding

Exercise in arc welding for making

1. Lap joint
2. Butt joint

Foundry

Preparation of sand mould for the following

1. Flange
2. Anvil

Fitting

Preparation of joints, markings, cutting and filling for making

1. V-joint
2. T-joint

Sheet metal

Making of small parts using sheet metal

1. Tray
2. Funnel

Course Outcome

At the end of the course student will be able to

1. To provide hands on exercises in common carpentry works associated with residential and industrial buildings.
2. To expose the students regarding pipe connection for pumps & turbines and to study the joint used in roofs, doors, windows and furnitures.
3. To provide hands on exercise on basic welding, machining and sheet metal works.
4. To provide exposure regarding smithy, foundry operations and in latest welding operations such as TIG, MIG, CO₂, spot welding etc.



10. BASIC ENGINEERING

Course Code	:	CEIR11
Course Title	:	BASIC CIVIL ENGINEERING
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective:

1. To give an overview of the fundamentals of the Civil Engineering fields to the students of all branches of Engineering
2. To realize the importance of the Civil Engineering Profession in fulfilling societal needs

Course Content

Properties and uses of construction materials - stones, bricks, cement, concrete and steel.

Site selection for buildings - Component of building - Foundation- Shallow and deep foundations - Brick and stone masonry - Plastering - Lintels, beams and columns - Roofs.

Roads-Classification of Rural and urban Roads- Pavement Materials-Traffic signs and road marking-Traffic Signals.

Surveying - Classification-Chain Survey-Ranging-Compass Survey-exhibition of different survey equipment.

Sources of Water - Dams- Water Supply-Quality of Water-Wastewater Treatment – Sea Water Intrusion – Recharge of Ground Water.

Reference Books:

1. Punmia, B.C, Ashok Kumar Jain, Arun Kumar Jain, 'Basic Civil Engineering', Lakshmi Publishers, 2012.
2. Satheesh Gopi, 'Basic Civil Engineering', Pearson Publishers, 2009.
3. Rangwala, S.C, 'Building materials', Charotar Publishing House, Pvt. Limited, Edition 27, 2009.
4. Palanichamy, M.S, 'Basic Civil Engineering', Tata Mc Graw Hill, 2000.
5. Lecture notes prepared by Department of Civil Engineering, NITT.

Course Outcome

1. The students will gain knowledge on site selection, construction materials, components of buildings, roads and water resources
2. A basic appreciation of multidisciplinary approach when involved in Civil Related Projects.



Course Code	:	EEIR11
Course Title	:	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. This course aims to equip the students with a basic understanding of Electrical circuits and machines for specific types of applications.
2. The course gives a comprehensive exposure to house wiring.
3. This course also equips students with an ability to understand basics of analog and digital electronics.

Course Content

DC & AC Circuits: Current, voltage, power, Kirchhoff's Laws - circuit elements R, L and C, phasor diagram, impedance, real and reactive power in single phase circuits.

DC & AC Machines: DC Motor, Induction motor, Synchronous motor, Synchronous generator and Transformers- construction, principle of operation, types and applications.

House wiring & safety: Single phase and three phase system – phase, neutral and earth, basic house wiring - tools and components, different types of wiring – staircase, florescent lamp and ceiling fan, basic safety measures at home and industry.

Analog Electronics: semiconductor devices – p-n junction diode, Zener diode, BJT, operational amplifier – principle of operation and applications – Introduction to UPS.

Digital Electronics: Introduction to numbers systems, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.

Reference Books:

1. Hughes revised by McKenzie Smith with John Hilcy and Keith Brown, 'Electrical and Electronics Technology', 8th Edition, Pearson, 2012.
2. R.J. Smith, R.C. Dorf, 'Circuits Devices and Systems', 5th Edition, John Wiley and sons, 2001.
3. P. S. Dhogal, 'Basic Electrical Engineering – Vol. I & II', 42nd Reprint, Mc Graw Hill, 2012.
4. Malvino, A. P., Leach D. P. and Gowtham Sha, 'Digital Principles and Applications', 6th Edition, Tata Mc Graw Hill, 2007.
5. Vincent Del Toro, 'Electrical Engineering Fundamental', Prentice Hall India, 2002.

Course Outcome

At the end of the course, students will be able to develop an intuitive understanding of the circuit analysis, basic concepts of electrical machines, house wiring and basics of electronics and be able to apply them in practical situation.



11. INTRODUCTION TO COMPUTER PROGRAMMING

Course Code	:	CSIR12
Course Title	:	BASICS OF PROGRAMMING (Theory & Lab)
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. To learn the fundamentals of computers.
2. To learn the problem solving techniques writing algorithms and procedures.
3. To learn the syntax and semantics for C programming language
4. To develop the C code for simple logic
5. To understand the constructs of structured programming including conditionals and iterations

Course Content

Introduction to computers – Computer Organization – Characteristics – Hardware and Software – Modes of operation – Types of programming languages – Developing a program.

Algorithms – Characteristics – Flowcharts - Principles of Structured programming – Sequential, selective structures - Repetitive structures –Bounded , Unbounded and Infinite iterations – Examples for each.

Introduction to C – C character set – Identifiers and Keywords – Datatypes – Constants – Variables – Declarations – Expressions – Statements – Symbolic constants – Operators– Library functions – Data input and output: Single character input and output – Entering input data – Writing output data – gets and puts functions. Control statements – Branching: if-else – Looping: while – do-while – for; Nested control structures – switch statement – break statement – continue statement – comma operator – goto statement.

Modular Programming – Functions and Procedures – Examples – Parameter passing methods.

Arrays – Defining an array – Processing an array – Multidimensional arrays-Pointers – Variable definitions and initialization – Pointer operators – Pointer expressions and arithmetic – Pointers and one-dimensional arrays- Functions – Defining a function – Accessing a function – Function prototypes – Passing arguments to a function –Passing arrays to a function – Passing pointers to a function – Recursion.

Laboratory Experiments

1. Programs using sequence construct
2. Programs using selection construct
3. Programs using iterative construct
4. Programs using nested for loops
5. Programs using functions with Pass by value
6. Programs using functions with Pass by reference



7. Programs using recursive functions
8. Programs using one dimensional Array
9. Programs using two dimensional Arrays
10. Programs using Pointers and functions
11. Programs using Pointers and Arrays

Reference Books:

1. Byron Gottfried, 'Programming with C', Third Edition, Tata McGraw Hill Education, 2010.
2. R.G.Dromey, 'How to Solve it By Computers?', Prentice Hall, 2001
3. J.R. Hanly and E.B. Koffman, 'Problem Solving and Program Design in C', 6th Edition, Pearson Education, 2009.
4. Paul Deital and Harvey Deital, 'C How to Program', Seventh Edition, Prentice Hall, 2012.
5. Yashavant Kanetkar, 'Let Us C', 12th Edition, BPB Publications, 2012.

Course Outcome

At the end of the course, student will be

1. Ability to write algorithms for problems
2. Knowledge of the syntax and semantics of C programming language
3. Ability to code a given logic in C language
4. Knowledge in using C language for solving problems

12. BRANCH SPECIFIC COURSE

Course Code	:	MEIR15
Course Title	:	INTRODUCTION TO MECHANICAL ENGINEERING
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. To explain the importance of concepts of mechanical engineering and conservation equations.
2. To introduce the techniques for analyzing the forces, momentum and power.
3. To introduce the various properties of materials, and the techniques of selection of materials.
4. To identify the basic elements of a mechanical system and write their constitutive equations and performance analysis techniques.

Course Content

Fundamentals Introduction to mechanical engineering, concepts of thermal engineering, mechanical machine design, industrial engineering, and manufacturing technology.

Thermal Engineering Laws of thermodynamics, types of systems, concepts and types of I.C. engine, air compressors, principle of turbomachines, properties of steam and steam generators, automobile engineering, introduction to gas turbines and refrigeration & airconditioning.



Engineering Materials Types of materials, selection of materials, material properties, introduction to materials structure, machine elements, transmission, fasteners, and support systems.

Manufacturing Technology Manufacturing, classification, lathe, drilling machines, milling machines, metal joining, metal forming, casting, forging, and introduction to powder metallurgy.

Reference Books:

1. Lecture notes prepared by Department of Mechanical Engineering, NITT.
2. K. Venugopal, 'Basic mechanical Engineering'

Course Outcome

At the end of the course, students will be able to identify, appreciate and analyze the problems by applying the fundamentals of mechanical engineering and to proceed for the development of the mechanical systems.

13. SUMMER INTERNSHIP

Course Code	:	MEIR16
Course Title	:	INTERNSHIP/ INDUSTRIAL TRAINING/ ACADEMIC ATTACHMENT (2 to 3 Months duration during summer vacation)
Number of Credits	:	2
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. To provide undergraduate engineering students with hands-on exposure to industry facilities, thereby furthering their understanding of the basics and operations of sciences and its applications
2. During the assignment period, students apart from technical exposure, will also learn to work in teams that possess diverse knowledge and skills; experience project management; develop time management; and most importantly learn to understand rules and regulations as well as adhere to policies and procedures.
3. Students' communication and presentation skills are expected to improve after the internship period as a result of constant contacts with mentors and administrative personnel.
4. Students must make the best use of this opportunity to apply their theoretical background in engineering learned at the PI to solve design and maintenance problems and demonstrate an awareness of current and future engineering applications in the industry.

Course Outcome

At the end of the course, students will be

1. An ability to function on multi-disciplinary teams.
2. An ability to identify, formulate and solve engineering problems.



3. An understanding of professional and ethical responsibility.
4. An ability to communicate effectively with written, oral and visual means.
5. The broad education necessary to understand the impact of engineering solution in a global and society context.
6. A recognition of the need for and ability to engage in life-long learning.

14. PROJECT WORK

Course Code	:	MEIR17
Course Title	:	PROJECT WORK
Number of Credits	:	6
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. To train the students in preparing project reports and to face reviews and viva voce examination.

Course Outcome

At the end of the course student will

1. Identify real world problems of mechanical engineering and related systems.
2. Interpret the working of mechanical engineering systems.
3. Apply the principles of mechanical engineering in real world systems.
4. Criticize and experiment to arrive at solutions for real world mechanical engineering problems.
5. Analyse and evaluate to obtain solution for problems in mechanical engineering systems.

15. COMPREHENSIVE VIVA

Course Code	:	MEIR18
Course Title	:	COMPREHENSIVE VIVA
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objectives

1. The objective of the comprehension exam is to attain an understanding of the concepts of simultaneous manufacturing systems including materials, fabrication process, product and process control, manufacturing with computer and quality management.
2. The students work in groups and solve different types of problems/ activities given to them.
3. The activities given to the students should be real time like problems in industries chosen by a team of faculty members of the concerned department.



4. A minimum of three small problems have to be solved by each group of students
5. The evaluation is based on continuous assessment by group of faculty members constituted by the professor in-charge of the course.

Course Outcomes

Recall, recognize, visualize, illustrate, demonstrate, criticize and appraise the aspects of mechanical engineering systems and the interaction among them.

16. INDUSTRIAL LECTURE

Course Code	:	MEIR19
Course Title	:	INDUSTRIAL LECTURE
Number of Credits	:	1
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

1. To provide hands-on training to truly appreciate the various fields of mechanical engineering related concepts.
2. Invited talks from industry experts are planned to further enrich the course.

Course Outcome

At the end of the course, student skills, personal, exposure and knowledge will be developed.

17. NSS/NCC/NSO

Course Code	:	SWIR11
Course Title	:	NSS/ NCC/ NSO
Number of Credits	:	0
Prerequisites (Course code)	:	-NIL-
Course Type	:	GENERAL INSTITUTE REQUIREMENTS

Course Learning Objective

To enable the students to gain knowledge about NCC/NSS/NSO/YOGA and put the same into practice

Course Content

NATIONAL CADET CORPS (NCC)

Any student enrolling as a member of National Cadet Core (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of academic year. Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum.



Grading shall be done based on punctuality, regularity in attending the parades and the extent of active involvement.

NATIONAL SERVICE SCHEME (NSS)

A student enrolling as member of NSS will have to complete 60 hours of training / social service to be eligible to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

NATIONAL SPORTS ORGANIZATION (NSO)

Each student must select one of the following games/sports events and practice for one hour per week. An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement. List of games/sports: Basket Ball, Football, Volley Ball, Ball Badminton, Cricket, Throw-ball, Track events Field events or any other game with the approval of faculty member.

Course Outcome

To imbibe in the minds of students the concepts and benefits of NCC/NSS/NSO/YOGA and make them practice the same

II. PROGRAMME CORE (PC)

Course Code	:	MEPC10
Course Title	:	ENGINEERING MECHANICS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To explain the importance of mechanics in the context of engineering and conservation equations
2. To explain the significance of centroid, center of gravity and moment of inertia.
3. To introduce the techniques for analyzing the forces in the bodies.
4. To analyze the internal member forces acting on cables and trusses.
5. To understand the basic principles of dynamics.

Course Content

Fundamentals: Mechanics and its relevance, concepts of forces, laws of mechanics – Lami's Theorem, Concept of free-body diagram, centroids, center of gravity, area moment of inertia, mass, moment of inertia.

Friction: Laws of friction, application of laws of friction, wedge friction, body on inclined planes.



Statics: Principles of statics, Types of forces, concurrent and non-concurrent forces, composition of forces, forces in a plane and space, simple stresses and strains, elastic constant.

Cables and Trusses: Cable subjected to concentrated loads, UDL with supports at different levels – analysis of Trusses – method of joints – method of sections.

Dynamics: Principles of dynamics, D'Alembert's principle, conservation of momentum and energy, vibrations of simple systems.

Reference Books:

1. Kumar K.L., Kumar V, 'Engineering Mechanics', Tata McGraw Hill, 2011.
2. Rajasekaran S and Sankarasubramanian G, 'Engineering Mechanics Statics and Dynamics', Third Edition, Vikas Publishing House Pvt.Ltd, 2005.
3. Timoshenko S, and Young D.H, 'Engineering Mechanics', Tata McGraw Hill, 2006.
4. Popov E.P, 'Engineering Mechanics of Solids', Prentice Hall, 1998.
5. Shames I.H, and Rao G.K.M, 'Engineering Mechanics – Static and Dynamics', Pearson Education, 2009.
6. Beer F.P and Johnson Jr.E.R, 'Vector Mechanics for Engineers', Tata McGraw Hill, 2009.

Course Outcomes

The terminal objectives of the course is that, on successful completion of teaching-learning and evaluation activities, a student would be able to identify and analyze the problems by applying the fundamental principles of engineering mechanics and to proceed to research, design and development of various engineering systems.

Course Code	:	MEPC11
Course Title	:	ENGINEERING THERMODYNAMICS
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To learn the principles of work and energy.
2. To acquire knowledge about the fundamentals of thermodynamic laws, concepts and principles.
3. To understand the principles of various cycles and to apply the thermodynamic concepts in various applications like IC engines and Air conditioning systems

Course Content

Review of basic concepts of thermodynamics, properties of pure substances - First law applied to control mass, control volumes. First law of thermodynamics steady flow energy equation - applications of SFEE - uniform state, uniform flow.



Second law statements - irreversible processes, Carnot theorem, Clausius Inequality — entropy, entropy change for pure substances – T-S diagram, entropy change applied to control mass, control volume-availability and irreversibility.

Vapour power cycles - Rankine cycle - Effect of pressure and temperature on rankine cycle - Reheat cycle - Regenerative cycle - Air standard power cycles - Assumptions regarding air standard cycles - Otto , Diesel , dual , Stirling and Brayton cycles.

Thermodynamic relations : Partial derivatives - Maxwell relations - Clapeyron equation, entropy of a pure substance - entropy change of an ideal gas - the ideal gas - Behavior of real gases - equations of state. Isothermal and adiabatic compressibility.

Mixture of non-reacting gases - Dalton's and Amalgam's model - calculation of C_p , C_v , R and U , h and s changes for gas mixtures fuels and combustion - combustion chemistry - calculation of air fuel ratio - exhaust gas analysis.

Reference Books:

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.
2. Cengel, Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, 5th ed., McGraw-Hill, 2006.
3. Nag, P.K., Engineering Thermodynamics, 3rd ed., Tata McGraw-Hill, 2005.

Course Outcomes

At the end of the course student will

1. Define the fundamentals of the first and second laws of thermodynamics and explain their application to a wide range of systems.
2. Analyze the work and heat interactions associated with a prescribed process path and to perform analysis of a flow system.
3. Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.

Course Code	:	MEPC12
Course Title	:	STRENGTH OF MATERIALS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To develop the theoretical basis about the stress, strain and elastic modulus concepts in various components.
2. To understand the mechanical behavior of materials.
3. To familiarize the student in calculating shear force, bending moment, deflection and slopes in various types of beams for different loading conditions
4. To solve practical problems related to springs and shafts.



Course Content

Axial and shear stresses and strains – Elasticity, Hook’s law – Lateral strain – Poisson’s ratio – Volumetric strain – Elastic constants – Stress in composite bars. Strain energy impact and suddenly applied loads.

Thin cylindrical and spherical shells subjected to internal pressure. Principal stresses and their planes. Plane of maximum shear – Mohr’s circle of stresses. Thick cylinders – Lamé’s equation, shrink fit. Compound cylinders.

Shear force and bending moment diagrams for beams subjected to different types of loads – Theory of simple bending and assumptions.

Leaf spring, shear stress. Deflection – The moment area method, Macaulay’s method – superposition (statically determinate beams only).

Torsion of solid and hollow circular shafts – Power transmission, strength and stiffness of shafts. Stress and deflection in open helical spring.

Reference Books:

1. Timoshenko, S.P., Gere, M.J., Mechanics of Materials, C.B.S., Publishers, 1980.
2. Ramamurtham, S., Strength of Materials,, Dhanpat Rai Publications, 2005.
3. Popov, E.P., Engineering Mechanics of Solids, Prentice-Hall, 1999.

Course Outcomes

At the end of the course student will

1. Analyse and design structural member subjected to tension,compression,torsion,bending and combined stresses using the fundamental concepts of stress,strain and elastic behaviour of materials.
2. Present the concept of shear force,bending moment,slope and deflection and their use in machine design.
3. Understand the mohr’s circle and be able to determine principle stresses.
4. Calculate the stresses and strain associated with thin wall spherical & cylindrical pressure vessels and types of springs.

Course Code	:	MEPC13
Course Title	:	APPLIED ELECTRICAL AND ELECTRONICS ENGINEERING
Number of Credits	:	4
Prerequisites (Course code)	:	EEIR11
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To understand the basics concepts of electric & magnetic circuits.
2. To learn the principle of operations of electrical machines.
3. To impart knowledge on different type of drives for various applications in industries.



4. To impart knowledge on different kinds of amplifiers.
5. To understand the concepts of Digital Circuits, Coupled amplifier, Multiplexers and Demultiplexers.

Course Content

Asynchronous Machines: Three phase induction motors – Principle of operation – Cage and Slip ring rotors. Torque – Slip Characteristics - Equivalent Circuit – Starting and Speed Control.

Single Phase induction motors – Types – Applications – Universal Motor. Selection of Drives: Electric drives – Individual and Group drives – Factors governing selection of drives – Motors for domestic uses.

Cranes, Lifts, General Factory, Textile Mill, Paper Mill, Mining Work, Cement Mill, Machine Tools, Belt Conveyors, Ships, Refrigeration and Air Conditioning.

Amplifier circuits – R.C. Coupled, Transformer Coupled, Direct Coupled; Differential amplifiers. Concept of negative feed-back; Feed-back amplifiers. Applications of operational amplifiers. Inverting and non-inverting amplifiers; Differentiator – Multiplier - Divider, Comparator - VI and IV converter.

Digital Circuits – D/A and A/D – Types; Sample and Hold circuit - Multiplexers, Demultiplexers, Decoder and Encoders. Practice on R.C. Coupled amplifier, OP amp, Multiplexers and Demultiplexers, SCR and Applications, Power supply and Regulator.

Reference Books:

1. Theraja, B.L., Electrical Technology, Vol – 2, S. Chand & Company, 1997.
2. Gupta, J.B., A Course in Electrical Power, S.K. Kataria & Sons, 1997.
3. Hughes, E., Electrical Technology, E.L.B.S. 1996.
4. Partab, H., Art & Science of utilization of Electrical Energy, Dhanpat Rai & Sons, 1997.
5. Sedra, A.S. and Smith, K.C., Micro Electronic Circuits, Oxford University Press, 2004.
6. Millman and Halkias, Integrated Electronics, Tata McGraw -Hill, 1998.
7. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw- Hill, 2002.

Course Outcomes

At the end of the course student will

1. Differentiate the synchronous motors from the three phase induction motor and their control.
2. Identify various applications of three phase and single phase induction machines.
3. Recognize and select the different type of drives for various applications in industries.
4. Demonstrate different kind of amplifiers, operational amplifiers and feedback circuits.
5. Recognize the different types of converters and their contributions in various circuits.
6. Construct and analysis of multiplexers, demultiplexers, decoders and encoders.



Course Code	:	MEPC14
Course Title	:	INSTRUMENTATION AND CONTROL ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To discuss the generalized instrumentation system and calibration of instruments.
2. To describe the status and dynamic characteristics of instruments
3. To analyze the error and uncertainty propagation of instruments
4. To recall principles and analysis of measurement systems used for measurement of flow, power, pressure and temperature
5. To explain the basics of control systems

Course Content

Generalized instrumentation system – Error theory – Calibration of instruments – Range – resolution – Span – Linearity, Sensitivity – Signal conditioning systems.

Static and dynamic characteristics of instruments zero order, first order, second order instruments.

Error analysis – Uncertainty propagation – Oscilloscope for analysis of dynamic and transient events.

Principles and analysis of measurement systems used for measurement of flow, power, pressure and temperature.

Basics of control system – Types of control – proportional control, Derivative control, Integral control, PID control – Programmable Logic Controllers.

Reference Books:

1. Doebelin, E.O., Measurement Systems – Application and Design, 5th ed., McGraw-Hill, 2004.
2. Beckwith, T.G., Buck, L. and Marangoni, R.D., Mechanical Measurements, Narosa Pub. House, 1987.
3. Hewlett Packard, Practical Temperature Measurements – Application Note 290, 1995.

Course Outcomes

At the end of the course student will be able to

1. To discuss the generalized instrumentation system and calibration of instruments
2. To describe static and dynamic characteristics of instruments
3. To analyze the error and uncertainty propagation of instruments
4. To recall principles and analysis of measurement systems used for measurement of flow, power, pressure and temperature
5. To explain the basics of control system.



Course Code	:	MEPC15
Course Title	:	PRODUCTION TECHNOLOGY – I
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To learn the various methods and types of castings, welding processes, sheet metal forming, plastics.
2. To impart knowledge on selection of suitable manufacturing process for the typical component.

Course Content

Moulding sands - Types and Properties, patterns - types of patterns, selection of patterns - pattern allowances - Classifications of castings - according to mould materials and moulding methods. Special casting techniques - Fettling and finishing of castings - defects in castings.

Classification of welding process: Principle of Gas welding, Arc welding, resistance welding, Solid State Welding, Thermochemical welding and radiant energy welding - Brazing and soldering - thermal cutting of metal/alloys.

Forging: Classification of forging processes - forging processes - forging defects and inspection. Rolling: Classification of rolling processes - rolling mill - rolling of bars and shapes. Extrusion: Classification of extrusion processes - extrusion equipments - examples.

Drawing: Drawing of rods, wires and tubes. Sheet metal forming methods: Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning: Spinning processes.

High Velocity Forming: Explosive forming, Electro hydraulic forming - magnetic pulse forming - pneumatic - mechanical high velocity forming. Plastics Working: Types of plastics - plastic moulding processes.

Reference Books:

1. Jain R.K., Production Technology, Khanna Publishers, 2001.
2. Hajra Choudhry, Elements of Workshop Technology, Vol – II Media Promoters & Publishers, 1994.
3. Production Technology by HMT, Tata McGraw-Hill, 2002.
4. Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd., 1986.

Course Outcomes

At the end of the course student will

1. Recognize the different types of casting process.
2. Select suitable manufacturing process for typical components.
3. Describe the various welding process.
4. Explain the concept of forging, rolling process and drawing.



Course Code	:	MEPC16
Course Title	:	THERMAL ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC11
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To familiarize with the types of working principle of two stroke and four stroke engines.
2. To understand the various parameters involved in Engine combustion and its significance
3. To provide knowledge on various steam power equipment and its performance measurements
4. To impart skills to analyse Air Compressor system and components
5. To acquire knowledge about analysis the vapour power system and Refrigeration system

Course Content

Classification of IC engines – Working of two and four stroke engines – valve and port timing diagrams – Deviation of engine indicator diagram from air standard cycles – Comparison of air standard and fuel air cycles – Losses in actual cycles – Comparison of Otto and diesel cycle – performance test on IC engines – heat balance test for IC engines

Fuel supply system – Simple and complete Carburettor – Diesel pump and injector system – MPFI – CRDI – Cooling, Lubrication, Ignition systems. – Fuels for IC engines – Stoichiometric air – Ignition temperature – Ignition lag – Normal combustion in SI engines – Engine knock – effect of variables on tendency to knock – Octane Number – Pre-ignition – Normal combustion in CI engines – Diesel knock – Cetane Number – IC Engine Emission and Air pollution – Catalytic converters and EGR – Combustion chamber and types

Classification of boilers – sub critical and supercritical boilers – Impulse and Reaction principles – compounding – velocity diagram for simple and multi stage turbines, speed regulations – Governors – Flow of steam through nozzles -- shapes of nozzles – effect of friction – critical pressure ratio – supersaturated flow

Reciprocating air compressors – types – construction – work of compression without clearance – effect of clearance – Multi staging – optimum intermediate pressure for perfect inter cooling – Compressor efficiencies and mean effective pressure.

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Description only) – Air conditioning system – Types and Working principles Concept of RSHF, GSHF, ESHF- Cooling Load calculations.

Reference Books:

1. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill, 2003.



2. Heywood, J.B., Fundamentals of Internal Combustion Engines, McGraw-Hill, 1988.
3. Ballaney, P.L., Thermal Engineering, Khanna Publishers, 1996.
4. M.M, El-Wakil, *Power Plant Engineering*, 1st ed., McGraw Hill, New York, 1985.
5. Sydney F Walker , Steam Boilers , Engines and Turbines, D Van Nostrand Company ,New York ,1908.
6. Arora.C.P, Refrigeration and Air Conditioning, Tata McGraw-Hill Publishers 1994.
7. Roy, J. Dossat., Principles of Refrigeration, Wiley Eastern Ltd., New Delhi, 2000.

Course Outcomes

At the end of the course student will :

1. Apply principles of Air standard cycle to improve the performance of energy conversion devices.
2. Identify the Engine Emissions and select suitable Emission control methods for Real time.
3. Perform tests on steam power thermal devices as per standards and interpret results.
4. Analyse the performance of Air compressor and select suitable intercooling system.
5. Appraise the refrigeration cycles and perform cooling load calculations for air-conditioning system

Course Code	:	MEPC17
Course Title	:	MECHANICS OF MACHINES – I
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC10
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To impart knowledge on various types of Mechanisms and synthesis
2. To impart skills to analyse the position, velocity and acceleration of mechanisms
3. To familiarize higher pairs like cams and gears

Course Content

Kinematics Fundamentals: Types of links, Degrees of freedom- Kinematic chains, mechanisms, Mechines- lower pairs and higher pairs- Mobility-Number Synthesis-isomers-Linkage Transformation-inversions-Grashof conditions- Barker's classification-Rotatability and revolvability of N bar linkages-Compliant Mechanism-MEMS

Introduction to animation software: working model

Graphical Linkage Synthesis: Two position synthesis, rocker output coupler output- three position synthesis- quick return mechanism- coupler curves-symmetrical 4-bar linkage-cognates- introduction to synthesis using coupler curve atlas-limiting conditions, toggle position and transmission angle



Position analysis: translation rotation and complex motion- Euler’s theorem and Chasles’ theorem-graphical position analysis-algebraic position analysis-vector loop equation for four bar linkages-circuits and branches in linkages

Velocity analysis: definition of velocity-graphical velocity analysis-instant centers of velocity-Kennedy’s rule-velocity analysis using instant centers-mechanical advantage-centrodes-analytical velocity analysis of a 4 bar linkage

Acceleration analysis: definition of acceleration-graphical acceleration analysis- analytical acceleration analysis-coriolis acceleration-human tolerance to acceleration

Cams: types of cams and followers-types of motion program-pressure angle and radius of curvature

Gears: fundamental law of gearing-involute tooth form-pressure angle –changing center distance-interference and under cutting- contact ratio-types of gears-simple gear trains- compound gear trains-epicyclic gear trains-Ferguson’s paradox

Reference Books:

1. Robert L. Norton.,” Design of Machinery: an introduction to synthesis and analysis of mechanisms and machines” 5th ed.,McGraw-Hill 2012
2. Uicker,J.J., Jr., Pennock,G.R., and Shigley, J.E., Theory of Machines and Mechanisms ,3rd ed., Oxford Univeristy Press,2003.
3. Robert Norton., “Kinematic s and Dynamics of machinery” 1st ed.,McGraw Hill India., 2009

Course Outcomes

At the end of the course student will

1. Synthesize and analyze 4 bar mechanisms
2. Use computers for mechanism animation and analysis
3. Understand cams and gears

Course Code	:	MEPC18
Course Title	:	FLUID MECHANICS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To familiarize with the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To classify flows and to understand and apply the conservation principles for fluid flows.
4. To understand the principles of dimensional analysis.



Course Content

Basic concepts - Fluid properties - Basic hydrostatic equation

Pressure at a point - Hydrostatic equations for incompressible and compressible fluids - Manometers - Hydrostatic force on submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies - Metacentre - Fluid in rigid motion bodies.

Fluid dynamics; integral and differential formulations - Continuity equation – euler equation – bernoulli's equation

Laminar and turbulent flows - Flow through pipes - Navier-Stokes equations - Some exact solutions of Navier-Stokes equations.

Fluid rotation and deformation - Stream function - Condition of irrotationality - Governing equations of potential flow - Laplace equation – basic potential flow patterns. Lift

and Kutta Jukowsky Theorem. Boundary layer concept - Prandtl's equation - Drag on flat plates - Buckingham π -theorem - Dimensionless numbers.

Reference Books:

1. Fox, R.W. and Mc Donald, A.T., Introduction to Fluid Mechanics, 6th ed., John Wiley, 2003.
2. White, F.M., Fluid Mechanics, 5th ed., McGraw-Hill, 2003.

Course Outcomes

At the end of the course student will be able to

1. Identify the values of fluid properties and relationship between them and understand the principles of continuity, momentum, and energy as applied to fluid motions.
2. Recognize these principles written in form of mathematical equations.
3. Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.

Course Code	:	MEPC19
Course Title	:	PRODUCTION TECHNOLOGY – II
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To understand the working of machine tools such as lathe, shaper, planner, slotter, milling, hobbing, and grinding.
2. To know the basic concepts of NC and CNC machine tool programming and computer aided part programming



Course Content

Lathes, capstan & turret lathe, drilling and boring machine -Classification - principles of working components, work holding & tool holding devices.

Shaper, planner & slotter, machines - Classification - principles of working components, work holding & tool holding devices.

Milling, hobbing, broaching & grinding machines - Classification - principles of working components, work holding & tool holding devices.

NC & CNC machine tools and manual part programming Machining centre, turning centre. NC part programming.

Computer aided part programming - APP: Post processors. APT programming - motion statements, additional apt statements.

Reference Books:

1. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol II , Dhanpat Rai & Sons, 1992.
2. Yoram Koren, Computer Control of Manufacturing Systems, McGraw-Hill, 1986.
3. Choudhry, S.K.H., Elements of Work Shop Technology, VoL II, Media Promoters & Publishers, 1994.
4. Production Technology by HMT, Tata McGraw-Hill, 2002.
5. Kundra, T.K., Rao., P.N., and Tiwari, N.L.K., Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill, 2006.

Course Outcomes

At the end of the course student will be able to

1. Explain the features and applications of lathe, milling, drilling and broaching machines.
2. Discuss features and applications of reciprocating machine tools like shaper, planer and slotting machine.
3. Write the programming to control and operate nc and cnc machines.

Course Code	:	MEPC20
Course Title	:	ENGINEERING MATERIALS
Number of Credits	:	4
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To impart knowledge on the atomic arrangement and structure of metals and alloys.
2. To acquire sound knowledge on phase diagram and heat treatment of materials.
3. To understand the various material testing methods.



Course Content

Atomic Arrangement and Phase Diagrams - Structure of metals and alloys: Phase diagram: phase rules.

Phase Diagrams and Ferrous Alloys Fe- FeC diagram, Critical temperature - Plain carbon steel and other steels. .

Heat Treatment of steel, CCT diagrams, austempering, martempering ausforming. Surface hardening process - non - ferrous alloys.

Testing of Materials I - Properties evaluated by tensile testing procedure, Engineering stress strain curve vs. true stress-strain curve, stress strain curve for typical materials. Hardness testing.

Testing of Materials II - Impact testing, Fracture toughness. Fatigue testing: Creep testing.

Reference Books:

1. Avner, S.H., Introduction to Physical Metallurgy, 2nd ed., Tata McGraw-Hill, 1997.
2. Dieter, G.E., Mechanical Metallurgy, McGraw-Hill, 1988.
3. Donald S.Clark, and Wilbur R. Varney, Physical Metallurgy for Engineers, East-West Press, 1999.
4. Suriyanarayana, A.V.K, Testing of metallic materials, Tata McGraw-Hill, 2001.

Course Outcomes

At the end of the course student will

1. Interpret the atomic arrangement and structure of metals and alloys.
2. Describe the iron-carbon equilibrium diagram and phase diagrams.
3. Explain the behavior of material upon heat treatment from iron-carbon equilibrium diagram and predict the behavior of materials upon impact, fracture and creep testing.

Course Code	:	MEPC21
Course Title	:	TURBOMACHINES
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC18
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. Provide students with opportunities to apply basic flow equations;
2. How to compare and chose machines for various operations.

Course Content

Introduction - Classification - Dimensional analysis - Specific speed - Basic laws and equations. Hydraulic turbines; Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines.



Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching.

Centrifugal and axial flow compressors; slip, surging and choking.

Steam turbines; basic cycle, impulse and reaction turbines - Gas turbine; basic cycle and multi-staging - Power and efficiency calculations.

Reference Books:

1. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachines, 5th ed., Butterworth-Heinemann, 2005.
2. Sayers, A.T., Hydraulic and Compressible Flow Turbomachines, CBLS, 2003.
3. Ganesan, V., Gas Turbines, 2nd ed., Tata McGraw-Hill, 2003.
4. Lakshminarayana, B., Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley-Interscience, 1995.

Course Outcomes

At the end of the course student will

1. Explain basic concepts of turbomachines and visualize dimensional analysis.
2. Describe the working of Pelton, Francis and Kaplan along their performance parameters.
3. Discuss the operation of centrifugal pumps, centrifugal and axial compressors.
4. Associate the effect of cavitation in turbines and pumps.
5. Express the basic cycles and calculations involved in the operation of steam and gas turbines.

Course Code	:	MEPC22
Course Title	:	HEAT AND MASS TRANSFER
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC11
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To learn the various modes of heat transfer and understand the basic concepts of mass transfer.
2. To understand the applications of various experimental heat transfer correlations in engineering applications.
3. To discuss the thermal analysis and sizing of heat exchangers.

Course Content

Conduction - general 3-D equation – one dimensional steady state heat conduction in simple geometries – plane wall – cylinder and sphere – composite walls – critical thickness of insulation – thermal contact resistance - heat generation in plane wall, cylinder and sphere – extended surfaces - unsteady state heat conduction.

Convection - boundary layer theory – conservation equations of mass, momentum and energy



for laminar flow over a flat plate – turbulent flow over a flat plate – flow over cylinders – spheres – bank of tubes - internal flows – natural convection – vertical, inclined and horizontal surfaces.

Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Green house effect.

Boiling and condensation – pool boiling regimes and correlations – critical heat flux - flow boiling correlations - Nusselt's theory – filmwise and dropwise condensation - Condensation over surfaces.

Heat exchangers - types - fouling factor - LMTD and NTU methods - Mass transfer - Fick's law - analogy between heat and mass transfer

Reference Books:

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 5th ed., John Wiley, 2002.
2. Holman, J.P., Heat Transfer, 10th ed., Tata McGraw-Hill, 2010.
3. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
4. Cengel, Y.A., Heat Transfer - A Practical Approach, 2nd ed., McGraw-Hill, 2002.
5. Sachedva, R.C., Fundamentals of Heat and Mass Transfer, 4th ed., New Age International, 2012.

Course Outcomes

At the end of the course student will be able to

1. Explain the real time applications of heat transfer in both solids and fluids.
2. Describe the fundamentals of natural and forced convective heat transfer processes.
3. Design the heat exchange equipment.
4. Explore the real time applications of radiation mode of heat transfer.
5. Relate the mass transfer concepts for various industrial applications.

Course Code	:	MEPC23
Course Title	:	MECHANICS OF MACHINES – II
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC17
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To impart knowledge about dynamic analysis of mechanisms and balancing
2. To familiarize about gyroscopes and flywheels
3. To give understanding various aspects of mechanical vibrations and their control

Course Content

Static and inertial force analysis of mechanisms



Balancing: rotating masses in single and several planes- reciprocating masses- single and multicylinder engines-Lanchester balancer

Gyroscopes: Gyroscopic effect- gyroscopes and their uses

Flywheel: industrial uses of flywheels- design of a flywheel of IC engines and punch press

Mechanical vibrations: linear and torsional vibrations- two rotor, three rotor and multi rotor systems- damped vibrations- coupled vibrations-forced vibrations- -vibration sensors

Vibration control: philosophy of vibration control-vibration isolations- suspension systems-tuned vibration absorbers- uses of vibration in condition monitoring

Reference Books:

1. George H. Martin., “Kinematics and Dynamics of Machines” 2nd ed., Waveland Pr Inc.,2002
2. Morrison.J.L.M., Crossland.B., “An Introduction to the Mechanics of Machines” 1st ed., Longmans ,1964
3. Daniel J. Inman., “ Engineering Vibrations” 3rd ed., Pearson Education 2009

Course Outcomes

At the end of the course student will

1. Perform static and dynamic analysis of mechanisms
2. Understand the issues related to balancing of reciprocating and rotating machinery
3. Know the working of gyroscopes and flywheels
4. Have understanding about the effect of vibration and vibration control

Course Code	:	MEPC24
Course Title	:	ANALYSIS AND DESIGN OF MACHINE COMPONENTS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC12
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To familiarize the various steps involved in the Design Process
2. To understand the principles involved in evaluating the shape and dimensions of a component
3. To satisfy functional and strength requirements.
4. To learn to use standard practices and standard data
5. To learn to use catalogues and standard machine components

Course Content

Mechanical engineering design - Design considerations - Material selection - Modes of failure - Theories of failure - Endurance limit - Stress concentration - Factor of safety.



Design of shafts and couplings - Design of cotter and knuckle joints.

Helical and leaf springs.

Fasteners and keys - Design of welded joints - Fillet and butt welds - Design of riveted joints.

Design of sliding contact bearings - Selection of rolling contact bearings.

Reference Books:

1. Sundararamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2003.
2. Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill, 2004.

Course Outcomes

At the end of the course student will

1. Describe the design process, material selection, calculation of stresses and stress concentrations under variable loading.
2. Design the solid, hollow shafts and to finding the critical speeds.
3. Differentiate between rigid and flexible couplings and also the knuckle joints.
4. Analyze bolted joints in eccentric loading.
5. Examine the welded joints for vessels and steel structures also have a design knowledge on sliding and rolling contact bearing.
6. Summarize the knowledge in helical, leaf, disc and torsional springs and also in levers.

Course Code	:	MEPC25
Course Title	:	AUTOMOBILE ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To study basic and advanced automotive systems and subsystems.
2. To impart knowledge on the construction and principle of operation of in automotive engine and auxiliary systems.
3. To make the students familiar with the operating principles of Transmission system, Steering, Brakes and Suspension Systems.
4. To study the recent trends in alternate fuels and automobile Noise, Vibrations, Harshness, comfort and safety systems

Course Content

VEHICLE STRUCTURE, COMFORT AND SAFTY

Automobiles - Vehicle Construction - layouts, chassis, frame, body material and construction.
 Vehicle Aerodynamics - Flow phenomenon related to vehicles, drag, side force, lift force, rolling



resistance, total road loads, performance optimization of car bodies. Introduction to vehicle dynamics.

Ergonomics and anthropometry - Driver seat for comfort and safety, safety belts, Air bags, Use of energy absorbing system, Impact protection. Recent trends in automotive safety systems - Safety regulations and testing.

Fundamentals of vehicle air-conditioning, cooling and heating system - automatic climate control. Noise, Vibrations and Harshness, Vehicle maintenance

ENGINE AND AUXILIARY SYSTEMS

SI and CI Engines – Principle of operation, components and materials. Air and Fuel systems - MPFI, GDI & CRDI, Turbochargers. Cooling and Lubrication systems. Typical performance, combustion and emission characteristics for automobile engines. Emission control and standards (Euro and BS).

Recent Trends in Automobile Engine - Variable Timing Control (VTC), Variable-Valve Timing (VVT), Variable compression ratio (VCR) and Lift Electronic Control (VTEC), Homogenous Charge Compression Ignition (HCCI) Advanced Turbulent Flow Technology (ATFT), Dual Twin Spark –ignition(DTS-i), Stratified Charged Engine, Dual fuel engine. Alternate energy sources, electric and hybrid vehicles.

TRANSMISSION SYSTEMS

Transmission system – need and Construction of Clutch, Gear Box - Manual and Automatic - Over Drives – Transfer Box, Fluid flywheel, Torque convertors. Hydraulic control systems of automatic transmission. Continuously Variable Transmission (CVT). Propeller shaft - Hotchkiss drives, Torque tube drive, radius rods, Universal joints. Final drive - Differential - conventional and Non-slip types, differential locks. Rear axle construction - full floating, three quarter floating and semi-floating arrangements.

STEERING, BRAKES AND SUSPENSION SYSTEMS

Front axle - rigid and split axle, construction and materials. Front wheel geometry - camber, castor, kingpin inclination, toe-in and toe-out. Steering Geometry - Ackermann and Davis steering - steering linkages, steering gear box, power steering. Turning radius, instantaneous centre, wheel wobble and shimmy. Over steer and under steer.

Hydraulic and Pneumatic Braking Systems - braking torque, materials, disc & drum brakes, brake actuating systems. Exhaust brakes, power and power assisted brakes. Factors affecting brake performance, Antilock Braking System (ABS) and traction control.

Suspension - types, factors influencing ride comfort, shock absorbers.

Wheels and Tyres – construction and materials. Static and rolling properties of pneumatic tyres, tubeless tyres, aspect ratio, tyre wear and maintenance.

AUTOMOTIVE ELECTRICAL AND ELECTRONICS

Introduction to automotive electrical systems - Automotive electricity generation, storage & distribution systems, wiring harness. Charging, starting & ignition System. Automotive lighting.



Automotive Sensors & Actuators, Engine Management Control System (EMS). Vehicle Management System- vehicle tracking system, Collision avoidance, Radar warning system, Global Positioning Systems.

Reference Books:

1. Newton, K., Steeds, W., and Garrett, T.K., The Motor Vehicle, Butterworth, 1989.
2. Joseph Heitner, "Automotive Mechanics", 2nd edition, East-West Press, 1999.
3. Heinz Heisler, "advanced Engine technology" SAE international publications USA, 1998.
4. Kirpal Singh, Automotive Engineering, Vol. I & II, Standard Publishers, New Delhi, 1997
5. Ganesan .V "Internal Combustion Engines" Third edition, Tata McGraw –hill, 2007.
6. J.B.Heywood, 'Fundamentals of Internal Combustion Engine', McGraw Hill Book Co, 1989.
7. P. L. Kohli, „Automotive Electrical Equipments“, Tata McGraw Hill Pub. Co. Ltd.
8. Tom Denton, „Automobile Electrical & Electronic Systems“, SAE International.
9. Tom Birch, "Automotive Heating and Air Conditioning" Pearson Education Inc., 2003
10. William H Crouse and Donald L Anglin, "Automotive air conditioning", McGraw - Hill Inc., 1990
11. Automotive vehicle safety by George Peters and Barbara Peters, CRC Press, 2002.
12. Automotive Safety Handbook by Ulrich W. Seiffert and Lothar Wech, SAE International, 2007.

Course Outcomes

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

1. Identify the automobile structure, various systems and components, Noise, Vibrations, Harshness, comfort and safety systems.
2. Differentiate between the principles of SI and CI engines and command over the recent development in the area of alternate fuels for automotive engines.
3. Understand the transmission system and principles of clutch, gear box, Propeller shaft, differential, axle, wheels, tyres, steering, brake and suspension system.
4. Appraise recent trends in Electrical and Electronics for Engine and Vehicle Management System.

Course Code	:	MEPC26
Course Title	:	DESIGN OF MECHANICAL DRIVES
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC12
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To teach students how to formulate the design and manufacturing problem for simple systems and mechanical components
2. To teach students how to apply the general mechanical engineering sciences in analyses specific to the design of mechanical components and systems
3. To teach students in a laboratory setting how to generate concepts, conduct analyses to size components, construct and assemble a prototype of a system and test its function
4. To reinforce students team skills through team projects, including problem formulation, problem solutions and written and oral reporting of results
5. To reinforce students visualization and hands-on skills through project virtual prototyping



and/or physical construction exercises

Course Content

Introduction to transmission elements - Positive and friction based drives.

Design of spur and helical gears based on contact and beam strength. Design of bevel and worm gears.

Importance of friction based drives - Design of flat and V-belts - Design of rope and chain drives.

Design of brakes; drum- shoe and band brakes - Design of positive and friction based clutches; single plate, multi-plate and cone clutches.

Design of multi-speed gearbox - Preparation of ray diagram and kinematic arrangement diagram for multi-speed gearbox.

Reference Books:

1. Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2003.
2. Shigley, J.E., Mechanical Engineering Design, 5th ed., McGraw-Hill, 1989.

Course Outcomes

At the end of the course student will

1. Recognize the need for friction drives and positive drives.
2. Apply BIS standards and catalogues in design and selection of belts and chain for requirement.
3. Select suitable drive combination based on requirement.
4. Explain failure modes in gears.
5. Establish suitability of a given drive elements whether to meet the requirement.

Course Code	:	MEPC27
Course Title	:	COMPUTER AIDED DESIGN AND DRAFTING
Number of Credits	:	3
Prerequisites (Course code)	:	MEIR12
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. To introduce the student to the basic tools of computer-aided design (CAD) and computer-aided manufacturing (CAM).
2. To expose the student to contemporary computer design tools for aerospace and mechanical engineers.
3. To prepare the student to be an effective user of a CAD/CAM system.



Course Content

CAD hardware - Product cycle - CAD tools, CAD systems; system evaluation, CAD specific I/O devices.

CAD software - Graphic standards – Modes of graphics operation, Software Modules.

Geometric modeling – Types and mathematical representation and manipulation of curves and surfaces.

Solid modeling- fundamentals, feature based modeling manipulations of solid models. Transformation of Geometric models and visual realism - Animation.

Reference Books:

1. Zeid, I., CAD/CAM Theory and Practice, Tata McGraw-Hill, 2008.
2. Rogers, D.E and Adams, J.A., Mathematical Elements for Computer Graphics, 2nd ed., McGraw-Hill, 1990.

Course Outcomes

At the end of the course student will

1. Explain lifecycle of a product and the role of computer-aided design (CAD) in product development.
2. Describe the concepts of geometric and solid modelling.
3. Visualize geometric models through animation and transform them into real world systems.

Course Code	:	MEPC28
Course Title	:	POWER PLANT ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC21
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. Describe sources of energy and types of power plants
2. Analyze different types of steam cycles and estimate efficiencies in a steam power plant
3. Describe basic working principles of gas turbine and diesel engine power plants. Define the performance characteristics of such power plants
4. List the principal components and types of nuclear reactors.

Course Content

Schematics of various power plants – steam, hydel, piston engine, Gas turbine, Combined Cycle, Fuel cell, Solar, Wind mill, Comparisons, Selection.

Steam generators – sub critical and supercritical, circulation systems, methods of efficiency calculation. Fuel handling, Dust collection, cycle analyses, auxiliaries of thermal power plants.



Fluidised Bed Boilers.

Nuclear reactors - types, comparison, waste disposal – Indian Scenario, Environmental aspects, and development trends.

Essential elements of hydel power plants, selection of turbines, microhydel plant developments, pumped storage plants, Wind mill developments, fuel cell power Hybrid power plants, advanced piston engine and gas turbine power plants, geothermal power plants.

Load duration curves, costing of electrical energy, tariff types, load sharing economics, Development pathways for power plants – national and global scenario.

Reference Books:

1. Culp Jr., A.W., Principles of Energy Conversion, McGraw-Hill, 1985.
2. Arora, S.C. and Domkundwar, S., A Course in Power Plant Engineering, Dhanpat Rai & Sons, 2001.
3. El Wakil, M.M., Power Plant Technology, Tata McGraw-Hill, 1985.
4. Nag. P.K., Power Plant Engineering, 2nd ed., Tata McGraw-Hill, 2002.

Course Outcomes

At the end of the course student will

1. Summarize the layout and components in a power plant.
2. Enumerate and classify the types of power plants available.
3. Recognize the steam cycles on pressure - volume and temperature diagram.
4. Outline the scenario of entire business of power plants along with performance parameters, load curves and tariff calculations.
5. Extend their knowledge to power plant economics and environmental hazards

Course Code	:	MEPC29
Course Title	:	METROLOGY AND QUALITY CONTROL
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	PROGRAMME CORE

Course Learning Objectives

1. Describe the evolution of quality standards and metrology
2. Describe key points and timelines for the evolution of the quality system as we know it today
3. Define what a quality system is and why it is utilized, Identify and provide the uses for various quality tools such as checksheets, pareto charts, flowchart, cause and effect diagrams, histogram, scatter diagram and control charts

Course Content

Standards - Errors in measurements - Calibration - Length measurements. Angle measurements. Limits and tolerances.



Surface finish; terminology and measurements - Optical measuring instruments.

Measurement of screw thread and gear elements - Acceptance test for machines.

Statistical Quality Control - Control charts - Sampling plans

Reference Books:

1. Gupta, I.C., Engineering Metrology, Dhanpat Rai & Sons, 2004.
2. Grant, E.L., Statistical Quality Control, Mc Graw-Hill, 2004.
3. Doebelin E.O., Measurement Systems, Mc Graw-Hill, 2004.

Course Outcomes

At the end of the course student will

1. Demonstrate different measurement techniques.
2. Reproduce the fundamental knowledge on metrology techniques.
3. Apply statistical process control and acceptance sampling procedures in a manufacturing environment to improve quality of processes / products.
4. Identify suitable metrological methods for measuring the components.
5. Explain the acceptance test for machines.
6. Outline the working of various optical measuring instruments.

III. ELECTIVES

a. PROGRAMME ELECTIVE (PE)

Course Code	:	MEPE10
Course Title	:	COMPRESSIBLE FLOW AND JET PROPULSION
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC18
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To study the basic difference between incompressible and compressible flow
2. To study about the phenomenon of shock waves and its effect on flow.
3. To gain some basic knowledge about the jet propulsion Rocket propulsion.

Course Content

Governing equations for inviscid-compressible flows - static and stagnation properties - speed of sound and Mach number.

Isentropic flow through variable area passage ducts - Choking of flow.

Normal and oblique shocks - Prandtl-Meyer flows.



Fanno flow - Rayleigh flow.

Fundamentals of jet propulsion - Propulsion cycle - Power and efficiency calculations - Turbojet, turbofan, and turboprop engines - Fundamentals of rocket propulsion.

References books:

1. Yahya, S.M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 3rd ed., New Age International Publishers, 2003.
2. Oosthuizen, P.H. and Carscallen, W.E., Compressible Fluid Flow, McGraw-Hill, 1997.
3. Zucker, R.D. and Biblarz, O., Fundamentals of Gas Dynamics, 2nd ed., John Wiley, 2002.

Course Outcomes:

At the end of the course student will

1. Interpret governing equations for inviscid-compressible flows.
2. Demonstrate isentropic flow through variable area passage ducts
3. Express Prandtl-Meyer flows, Fanno flow and Rayleigh flow.
4. Explain the fundamentals of jet propulsion, propulsion cycle and rocket propulsion.

Course Code	:	MEPE11
Course Title	:	COMPUTATIONAL FLUID DYNAMICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC18
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To introduce numerical modeling and its role in the field of heat transfer and fluid flow.
2. To enable the students to understand the various discretization methods and solving methodologies.
3. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers

Course Learning Objectives

4. To introduce numerical modeling and its role in the field of heat transfer and fluid flow.
5. To enable the students to understand the various discretization methods and solving methodologies.
6. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers.

Course Content

Classification of partial differential equations - Boundary conditions - Discretization methods - Finite difference and finite volume formulations - Errors in numerical approximation

Numerical solution of elliptical equations - Dirichlet and Neumann boundary conditions - Linear system of algebraic equations. Jacobi and Gauss Seidel schemes - Iterative schemes.



Numerical solution of parabolic equations - Consistency of numerical scheme - Stability analysis.

Numerical solution of hyperbolic equations - Explicit and implicit methods - High resolution schemes. Combined convection diffusion equations - Analytical and numerical solutions.

Incompressible Navier-Stokes equations and algorithms - Basics of grid generation - Introduction to FLUENT software.

Reference Books:

1. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, 2nd ed., Taylor & Francis, 1997.
2. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education Systems, 2000.
3. Anderson J.D., Computational Fluid Dynamics – The basics with Applications, Mc Graw-Hill, 1995.
4. Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics – The finite volume method, Longman Scientific & Technical, 1995.
5. Patankar, S.V., Numerical Heat Transfer & Fluid Flow, Hemisphere, 1980.

Course Outcomes

At the end of the course student will

1. Express numerical modeling and its role in the field of fluid flow and heat transfer.
2. Estimate the various errors and approximations associated with numerical techniques
3. Apply the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.
4. Interpret the knowledge, capability of analyzing and solving any concept or problem associated with heat energy dynamics and utilization.
5. Illustrate the working concepts of thermal engineering devices.

Course Code	:	MEPE12
Course Title	:	ADVANCED IC ENGINES
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. Learn to classify different types of internal combustion engines and their applications.
2. Apply principles of thermodynamics, fluid mechanics, and heat transfer to the design and analysis of engines and engine components.
3. Become aware of the relevance of environmental and social issues on the design process of internal combustion engines.
4. Develop mathematical methods for designing components and systems
5. Apply numerical methods to perform design calculations.
6. Advance proficiency in professional communications and interactions.



Course Content

Engine design parameters, properties of working fluids.

Analysis of engine cycles, fuel intake systems.

Combustion in SI and CI engines.

Pollutant formation and control in IC engines.

Engine performance and modeling.

Reference Books:

1. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.
2. Taylor, C.P., The Internal Combustion Engines in Theory and Practice, Vol. II, MIT Press, 1985.
3. Ganesan, V., Internal Combustion Engines, 2nd ed., Tata McGraw-Hill, 2003.

Course Outcomes

At the end of the course student will

1. Differentiate the internal combustion engines based on the classification parameters.
2. Analyze the internal combustion engine cycles and performance parameters.
3. Explain the combustion characteristics of internal combustion engines and identify the abnormalities in combustion.
4. Identify the exhaust pollutants.
5. Illustrate the measuring instruments appropriately while working on internal combustion engines.

Course Code	:	MEPE13
Course Title	:	COMBUSTION ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. This course starts with a review of chemical thermodynamics, statistical mechanics, equilibrium chemistry, chemical kinetics, and conservation equations.
2. Then the following subjects are covered: chemical and dynamic structure of laminar premixed, diffusion, and partially premixed flames; turbulent premixed combustion; turbulent diffusive combustion in one and two-phase flows;
3. Aerodynamics and stabilization of flames; ignition, extinction and combustion instabilities; non-intrusive combustion diagnostics and flame spectroscopy.

Course Content

Combustion of fuels - Combustion equations and air-fuel ratio calculations.



Thermodynamics of combustion - Thermochemistry - Kinetics of combustion.

Laminar and turbulent flames - Quenching, flammability, ignition and flame stabilization.
Combustion in SI and CI engines.

Emission and control methods.

Reference Books:

1. Turns, S.R., An Introduction to Combustion, 2nd ed., McGraw-Hill, 2000.
2. Glassman, I., Combustion, 3rd ed., Academic Press, 1996.
3. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.
4. Mukunda, H.S., Understanding Combustion, Macmillan, 1992.

Course Outcomes

At the end of the course student will

1. Formulate combustion equations to determine A/F, adiabatic flame temperature and pollutant concentration.
2. Relate the thermo chemistry and kinetics of combustion to evolve mathematical models for combustion.
3. Identify factors responsible for laminar and turbulent flame propagation.
4. Apply the different principles of flame stabilization and ignition to design combustor.
5. Summarize emission associated with combustion and identify their control techniques.

Course Code	:	MEPE14
Course Title	:	BIOFUELS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To provide students with the basic principles of biofuels and bioenergy systems design.
2. To identify biofuels and bioenergy sources; describe biofuels and bioenergy technologies,
3. To distinguish applications and efficiency; analyze biofuels and bioenergy manufacturing, distribution and integration issues.

Course Content

Biogas & bio-electricity, Bio-heat; Clean sustainable bioenergy, bio-electricity and biogas production from Dairy manure and Food Waste streams.

Pellets made from wood or grass biomass are commercially available at stores for heating homes, schools, businesses.



Seed-based biodiesel, bioethanol, conversion of waste oil to biodiesel, advanced biofuels including algae-biofuel, microbial biofuel, Conversion of waste vegetable oil into biodiesel, and advanced innovations in enzymatic conversion of non-food feed-stocks

Biomass conversion technologies for biofuel, Biofuels/energy related environmental, economics, & social issues.

The source, processing, and social impacts of biofuel utilization

Reference Books:

1. Filemon A. Uriarte Jr., Biofuels from plant oils, National Academy of Science and Technology, 2010.
2. Anju Dahiya, Bioenergy: Biomass to Biofuels, Elsevier, 2015
3. Sunggyu Lee and Y.T. Shah, Biofuels and Bio-energy Processes and Technology, CRC Press, Taylor and Francis Group, 2013.

Course Outcomes

At the end of the course student will be able to

1. Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications;
2. Address the desirable features of these biomass energy sources and their advantages over traditional fuels such as coal and oil
3. Identify their limited scope in terms of suitable sites, dependence on the elements, capital costs, and cost effectiveness compared with traditional sources

Course Code	:	MEPE15
Course Title	:	REFRIGERATION AND AIR CONDITIONING
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To understand the principles of refrigeration and air conditioning.
2. To calculate the cooling load for different applications.
3. To select the right equipment for a particular application.
4. To design and implement refrigeration and air conditioning systems using standards.
5. Energy Conservation and Management.

Course Content

Introduction about Refrigeration – Definitions of various terms. Methods of refrigeration. Air refrigeration system. Bell – Coleman cycle. Introduction about Air craft Air-Conditioning.

Analysis of Vapour compression cycle, Modifications to basic cycle. Multi pressure systems. Multi-evaporator system and Cascade systems.



Discussion of components of V.C system, Servicing. Vacuumizing and charging of refrigerant. Introduction to cryogenics. Properties of refrigerants. Selection of refrigerants.

Psychrometry – Definitions for properties. Introduction to cooling load calculations. Comfort conditions. Effective temperature concept.

Air-conditioning systems – discussion about the central plant with direct evaporator and chiller applications, Ice plant, refrigerators. Food preservation, IQF technique and freeze drying etc. Cold storage and thermal insulation.

Reference Books:

1. Arora, C.P., Refrigeration and Air Conditioning, 2nd ed., Tata McGraw-Hill, 2000
2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.
3. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.

Course Outcomes

At the end of the course student will

1. Illustrate the basic concepts of refrigeration system.
2. Analyze the vapour compression cycle and interpret the usage of refrigerants.
3. Explain the components of vapour compression system.
4. Demonstrate the use of psychrometry in analyzing refrigeration systems.
5. Discuss the theory and concept of air-conditioning systems.

Course Code	:	MEPE16
Course Title	:	FUNDAMENTALS OF HVAC SYSTEMS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To learn climate variation and its effects on the building heat load.
2. To learn building material characteristics and their influence on building heating / cooling load for all weather conditions.
3. To study various conversation techniques related to built environment and codes for the same.

Course Content

Factors that determine climate , climatic variations–Natural and Man made systems, Climate and Vernacular Architecture , Natural Cooling , Effects of Geographical Location.

Climate and its components, Characteristics of human metabolic activities with changing climate, The sensation of heat and comfort zone, Design of solar shading devices and Mechanical ventilation systems.



Building Aesthetics and Thermal Infiltration, Periodic heat flow through building elements for weather conditions all-round the air, tropical conditions

Air movement and Orientation of buildings, Landscaping in the tropics, Design consideration in different climate conditions, Tropical sky scrapers, Effects of greenery –Natural ventilation.

Energy Resources and Conservation related to Building Environment, Building Automation and Energy Management–Passive and Active Systems, Solar heating, ECBC concept.

Reference Books:

1. Konya, A., Design Primer for Hot climates, Architectural Press, London, 1980.
2. Davis A. J. and Schubert P. P., Alternative Natural Energy Sources in Building Design , II Edition , Van Nostrand Reinhold Co , New York , 1981.
3. ASHRAE Hand Book–HVAC Systems & Equipment 2008, HVAC Applications 2007, ASHRAE Inc. Atlanta.
4. National Building Code of India , 2005 , Bureau of Indian Standards
5. Givoni B., Man, Climate & Architecture, Barking Esser Applied Science, 1982.

Course Outcomes

At the end of the course student will

1. Estimate heating loads, space heat gains and space cooling loads using accepted engineering methods.
2. Determine the coil loads for cooling and heating systems.
3. Select equipment and design systems to provide comfort conditions within the building.

Course Code	:	MEPE17
Course Title	:	CRYOGENIC ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To builds a solid foundation in the fundamentals of cryogenics
2. To encourage a “hand’s – on” approach to solving cryogenic problems
3. To provide update cryogenic information

Course Content

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics - Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve-Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle Dual Pressure Cycle, Ortho-Para hydrogen conversion, Critical Components in Liquefaction Systems.



Binary Mixtures, T-C and H-C Diagrams , Principle of Rectification, Rectification Column Analysis- McCabe Thiele Method , Adsorption Systems for purification.

J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M. Cryocoolers, Pulse Tube Refrigerators Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators

Cryogenic Dewar Design, Cryogenic Transfer Lines. Insulations in Cryogenic Systems, Different Types of Vacuum Pumps, Instruments to measure Flow, Level and Temperature.

Reference Books:

1. Randall F. Barron, Cryogenic Systems, McGraw-Hill, 1985.
2. Scott R.B., Cryogenic Engineering, Van Nostrand and Co., 1988.
3. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press New York, 1989.
4. Herald Weinstock , Cryogenic Technology , 1969.
5. Robert W. Vance, Cryogenic Technology, Johnwiley & Sons, Inc., New York, London, 1969.

Course Outcomes

At the end of the course student will

1. Introduce the working principles of basic methods to achieve low temperature by using adiabatic expansion, provide a thorough understanding of applications of classical thermodynamics to different cryogenic technologies, gas separation and purification system, and low power cryocoolers.
2. Understand the structures of different cryogenic systems and the analytical method for cryogenic thermodynamic cycle, and cryogenic gases and liquids and their mixtures

Course Code	:	MEPE18
Course Title	:	NANOTECHNOLOGY
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC20
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. Understand how basic nanosystems work
2. Use physical reasoning to develop simple nanoscale models to interpret the behaviour of such physical system
3. Understand the major issues in producing a sustainable nanotech industry

Course Content

Introduction to the course, Historical perspective of micro and nano manufacturing technology, Advantages and applications of nanotechnology

Materials overview, atomic structure, bonding, polymers, electrical characteristics, periodic table, crystal structures and defects, physical chemistry of solid surfaces, Introduction to Si-based materials, Ge-based materials



Overview of Nano Fabrication Methods: Top-down and bottom-up approaches, lithography, deposition, CVD, PVD, etching, and material modification methods, processes and equipment, Characterization Tools, Optical microscopy, Profilometry, Ellipsometry, Spectrophotometer, Scanning Electron Microscope, AFM, FFM.

Zero dimensional Nano structures (Nano Particles) - Fabrication procedures, sol-gel processing, applications, properties and applications of Nano Particles, One dimensional Nano structures - Nano wires and nano rods, fabrication methods, Properties and applications of Nano Wires, Two dimensional nano structures.

Top down fabrication procedures, Lithography, Pattern transfer methods, Wet Etching and Dry etching, Nano material characterization methods, Application of nano materials, Carbon Nano Tubes, Quantum dots, etc., Organic compounds and bio-applications of nano materials.

Reference Books:

1. Jeremy J. Ramsden, Nanotechnology An Introduction, Elsevier, 2011.
2. Amretashis Sengupta, Chandan Kumar Sarkar, Introduction to Nano: Basics to Nanoscience and Nanotechnology (Engineering Materials), Springer, 2015.
3. William Illsey Atkinson, Nanotechnology, Amacom, 2010.

Course Outcomes

At the end of the course student will

1. Demonstrate a working knowledge of nanotechnology principles and industry applications.
2. Explain the nanoscale paradigm in terms of properties at the nanoscale dimension.

Course Code	:	MEPE19
Course Title	:	VEHICLE DYNAMICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC25
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. In-depth understanding of specialist bodies of knowledge within the engineering discipline
2. Application of established engineering methods to complex engineering problem solving
3. Fluent application of engineering techniques, tools and resources

Course Content

Multi Degree of Freedom Systems: Closed coupled system, Eigen value problems, Far coupled systems-Orthogonality of mode shapes-Modal analysis, Forced vibration by matrix inversion. Suspension and Tyres: Requirements. Spring mass frequency.

Wheel hop, wheel wobble, wheel shimmy. Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Ride characteristics of tyres, behaviour while cornering, power consumed by tyre, effect of driving and braking torque-Gough's



tyre characteristics.

Vehicle Handling: Oversteer, under steer, steady state concerning. Effect of braking, driving torques on steering. Effect of camber, transient effects in concerning. Directional Stability of vehicles. Stability of Vehicles: Load distribution.

Calculation of tractive effort and reactions for different drives-Stability of a vehicle on a slope, on a curve and a banked road.

Numerical Methods: Approximate methods for fundamental frequency, Dunker-Ley's lower bound, Rayleigh's upper bound-Holzer method for close-coupled systems and branched systems.

Reference Books:

1. Gillespie. T.D., Fundamentals of vehicle dynamics society of Automotive Engineers, Ic USA 1992
2. Heldt. P.M. Automotive Chassis, Chilton co., New York, 1992
3. Ellis.J.R., Vehicle Dynamics, Business Books Ltd., London, 1991.
4. Giles. J.G. Steering, Suspension and Tyres, Illifee Books Ltd, London, 1988.
5. Giri. N.K. Automobile Mechanics, Khanna Publishers. New Delhi, 1986.
6. Rao. J.S. & Gupta. K., Theory and Practice of Mechanical Vibrations, Wiley Eastern Ltd., New Delhi, 1999.

Course Outcomes

At the end of the course student will

1. Develop physical and mathematical models to predict the dynamic response of vehicles;
2. Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response;
3. Modify a model of a vehicle to enable it to meet design performance criteria;

Course Code	:	MEPE20
Course Title	:	COMPUTER APPLICATIONS IN DESIGN
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC27
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

Course Content

Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic



spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bicubic surface- Bezier surface and B-Spline surface- surface manipulations.

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations – boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc – Communication standards.

Laboratory session: Writing interactive programs generate graphics and to solve design problems - using any languages like Auto LISP/ C / FORTRAN etc. Each assessment should contain a component of Laboratory session.

Reference Books:

1. William M Neumann and Robert F. Sproul “Principles of Computer Graphics”, Mc Graw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 1992.
3. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
4. Foley, Van Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
5. David F. Rogers, James Alan Adams “ Mathematical elements for computer graphics” second edition, Tata McGraw-Hill edition.

Course Outcomes

At the end of the course student will

1. With laboratory classes in conjunction, It helps the students to get familiarized with the computer graphics application in design.
2. This understanding reinforces the knowledge being learned and shortens the overall learning curves which are necessary to solve CAE problems that arise in engineering.
3. Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.



Course Code	:	MEPE21
Course Title	:	DYNAMICS OF MACHINERY
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC23
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To understand the force-motion relationship in components subjected to External Forces
2. To analyse the force-motion characteristics of standard mechanisms
3. To study the undesirable effects of unbalances resulting from prescribed motions in mechanism.

Course Content

Single degree of freedom systems - Periodic excitations - Impulse response - Virtual work.
Forced vibrations.

Two degree of freedom systems - coupled vibrations.
Vibration of continuous systems.

Wave and Euler equations - Vibration of plates.

Reference Books:

1. Rao, J.S. and Gupta, K., Introductory Course on Theory and Practice of Mechanical Vibration, New Age International Pvt. Ltd., 2004.
2. Thomson, W.T., Theory of Vibration with Applications, CBS Publishers, New Delhi, 1990.

Course Outcomes

At the end of the course student will

1. State the single degree of freedom systems.
2. Sketch the impulse response for a periodic excited virtual work.
3. Examine the concept of forced vibration.
4. Extend the concept to two degree of freedom systems.
5. Manipulate the vibration of continuous systems.
6. Solve problems using wave and Euler equations.



Course Code	:	MEPE22
Course Title	:	MEMS DEVICES – DESIGN AND VIBRATION
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC13
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To think in an unified way about interdisciplinary Microsystems
2. Understand the operation of a wide range of sensors and actuators appropriate for microscale systems encompassing different energy domains represent microsystems as generalized networks.
3. To design, analysis and simulation master techniques for combining a structured top-down system design approach with bottom-up constraints propagation design and simulate microsystems using behavioral modeling languages and finite element analysis.

Course Content

An overview of microelectromechanical devices and technologies, and an introduction to design and modeling

Standard microelectronic fabrication technologies; bulk micromachining, surface micromachining, bonding technologies, related fabrication methods, and creating process flows.

Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials

Introduction to lumped modeling of systems and transducers; an overview of system dynamics

MEMS examples, energy methods, the thermal energy domain; modeling dissipative processes,

Fluids and Transport

Reference Books:

1. Tai – Ran Hsu, “MEMS& Microsystems Design and Manufacturing”, Tata McGraw-hill Edition, 2006
2. Mohamed Gad-el-Hak, “MEMS: Design and Fabrication (Mechanical Engineering)”, CRC; 1 edition, 2005.
3. Marc J. Madou, “Fundamentals of Microfabrication, the science of Miniaturization”, CRC Press Second Edition, 2002.
4. Sami Franssila, “Introduction to Microfabrication”, John Wiley; 1 edition, 2004.
5. John A. Pelesko, David H. Bernstein, “Modeling MEMS and NEMS”, CRC; 1 edition, 2002.

Course Outcomes

At the end of the course student will

1. Illustrate on the design and modeling of MEMS components.
2. Explain the various MEMS fabrication technologies.



3. Describe the mechanical, thermal, electrical, magnetic and chemical properties of materials.
4. Discuss the lumped modeling of systems and transducers.
5. Interpret the micro system dynamic.

Course Code	:	MEPE23
Course Title	:	VIBRATION ANALYSIS AND CONTROL
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC23
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To select appropriate sensors and techniques for diagnosing typical machinery malfunctions.
2. To read vibration signatures and evaluate machinery condition from vibration data.
3. To isolate the affected machinery components, recognize various common problems, and make recommendations for continued operation or scheduled repairs.

Course Content

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - Response To Arbitrary and non- harmonic Excitations – Transient Vibration – Impulse loads- Critical Speed Of Shaft-Rotor systems.

Introduction-Free Vibration of Undamped And Damped - Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh’s, and Holzer Method -Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments- System Identification from Frequency Response -Testing for resonance and mode shapes

Reference Books:

1. Rao, S.S.,” Mechanical Vibrations,” Addison Wesley Longman, 1995.
2. Thomson, W.T. – “Theory of Vibration with Applications”, CBS Publishers and Distributors, New



Delhi, 1990.

3. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa, New Delhi, 2000.

4. S. Graham Kelly & Shashidar K. Kudari, “Mechanical Vibrations”, Tata McGraw –Hill Publishing Com. Ltd New Delhi, 2007

Course Outcomes

At the end of the course student will

1. Understand vibration concept and measurements
2. Data collection from vibration analyzer

Course Code	:	MEPE24
Course Title	:	OIL HYDRAULICS AND PNEUMATICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC18
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. The cognitive objective of this course is for each student to comprehend foundational knowledge needed to perform stated entry-level industry competencies.
2. The performance objective of this course is for each student to apply foundational knowledge to hydraulic and pneumatic problems and exercises encountered in class.

Course Content

Basic concepts of fluid power system design - Hydraulic oils and fluid properties – Seals and Seal materials - Filters and Filtration.

Hydraulic pumps, cylinders, and motors - Construction, sizing, and selection.

Control valves; pressure, flow, and direction - Servo-valves.

Basic hydraulic circuits, hydrostatic transmission - Cartridge valve circuits.

Control of hydraulic circuits - Electrical, electronics, and PLC - Pneumatic components and basic circuits.

Reference Books:

1. Esposito. A., Fluid Power with Applications, 5th ed., Pearson Education, 2003.
2. Industrial Hydraulics, Vickers - Sperry Manual, 2002.

Course Outcomes

1. Recall various fluid properties and identify the appropriate fluid power system for particular application.
2. Recognize the suitable pump and actuators for particular application.



3. Select various control valves such as pressure control, flow control, direction control valves and use them in hydraulic and pneumatic circuit development.
4. Analyze the hydraulic and pneumatic circuit for energy efficiency.
5. Select the appropriate control system like electrical, electronics, and PLC to control the fluid power system.
6. Trouble-shoot and identify maintenance problems associated with fluid power system.

Course Code	:	MEPE25
Course Title	:	INDUSTRIAL ROBOTICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC13
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To introduce the basic concepts, parts of robots and types of robots
2. To make the students familiar with the various drive systems for robot, sensors and their applications in robots, programming of robots
3. To discuss about the various applications of robots, justification, implementation and safety of robot.

Course Content

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications, Principles and problems in robot design and control

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection, Segmentation Feature Extraction and Object Recognition - Algorithms. Applications – Inspection, Identification, Visual Servicing and Navigation.

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant



Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Reference Books:

1. Mair, G.M., Industrial Robotics, Prentice-Hall, 1988.
2. Considine, D.M. and Considine, G.D., Standard Hand Book of industrial Automation, Chapman and Hall, 1986.
3. Groover, M.P., Weiss, M., Nagel, R.N., and Odrey, N.G., Industrial Robotics, Technology, Programming, and Applications, McGraw-Hill, 1995.

Course Outcomes

At the end of the course student will

1. Classify and characterize the robots based on the configuration and work volume.
2. Explain and solve the problems related to robot design and control.
3. Illustrate the working of the transmission system in a robot.
4. Discuss the concept of vision system and image processing.
5. Write programs for automatic functioning of a robot.
6. Design a working model of a robot using the concepts and principles learnt.

Course Code	:	MEPE26
Course Title	:	MECHATRONICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC13
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. Apply mechanical engineering and electrical engineering knowledge and skills to problems and challenges in the areas of mechatronic engineering.
2. Integrate and use systems or devices incorporating modern microelectronics, information technologies and modern engineering tools for product design, development and manufacturing.
3. Engage in lifelong learning in their profession and practice professional and ethical responsibility.

Course Content

Introduction to Mechatronics system – Key elements – Mechatronics Design process – Types of Design – Design Parameter– Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.



Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.

Introduction-selection of interface cards-DAQ card-single channel-multichannel-RS232/422/485 communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch -Man machine interface. Introduction –Fuzzybased Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems. – Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing, System principle - Component design – System design – Scaling laws – Micro actuation – Micro robot – Micro pump – Applications of micro mechatronic components.

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp electrometer amplifier, carrier Amplifier – instrument power supply. Oscillographic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry. Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography

Blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

Reference Books:

1. Georg pelz, Mechatronics Systems: Modeling and simulation with HDL's, John wiley and sons Ltd, 2003
2. Devdas shetty, Richard A. Kolk, "Mechatronics System Design", Thomson Learning Publishing Company, Vikas publishing house, 2001.
3. Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
4. Bishop, Robert H, Mechatronics Hand book, CRC Press, 2002.
5. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.
6. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 1989.
7. Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2002.
8. Geddes L.A., and Baker, L.E., "Principles of Applied Bio-medical Instrumentation", 3rd Edition, John Wiley and Sons, 1995.

Course Outcomes

At the end of the course student will

1. To employ the basic mathematical skills needed to solve routine engineering problems.
2. To demonstrate knowledge of electrical circuits and logic design.
3. To implement engineering solutions and techniques to solve design problems.
4. To design mechatronic components and systems.



5. To apply spreadsheets, computer-based modeling and other computer-based methods to solve mechatronic problems.
6. To communicate through writing with others in the field of mechatronics.

Course Code	:	MEPE27
Course Title	:	INDUSTRIAL TRIBOLOGY
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC20
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. To impart knowledge on friction, wear and lubrication
2. To acquire knowledge on surface coatings and measurements.

Course Content

Tribology -- definition, Industrial significance, economic aspects, trends. Factors influencing Tribological phenomena. Engineering surfaces - Surface characterization, Computation of surface parameters.

Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction. Stick-slip friction behavior, frictional heating and temperature rise. Friction measurement techniques.

Wear and wear types. Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques.

Introduction to lubrication. Lubrication regimes. Introduction to micro and nano tribology. Coating characteristics, Coating performance evaluation, Powder coatings and types, application methods.

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method. Sliding friction and wear abrasion test, rolling contact and fatigue test, solid particle and erosion test, Use of transducers and instruments in Tribology

Reference Books:

1. Huling , J. (Editor) --"Principles of Tribology", MacMillan, 1984.
2. Williams J.A . "Engineering Tribology" ,Oxford Univ. Press,1994.
3. Neale M.J , "Tribology Hand Book ", Butterworth Heinemann, 1995.
4. I.M. Hutchings, "Tribology: Friction and Wear of Engineering Materials", Elsevier Limited, 1992.
5. G. W. Stachowiak, A. W. Batchelor, "Engineering Tribology", Elsevier Limited, 2005.
6. K.C. Ludema, "Friction, wear, lubrication: A text book in tribology", CRC Press, 1996.
7. Bharat Bhushan, "Nanotribology and Nanomechanics: An Introduction", Springer, 2008.



Course outcome

At the end of the course student will

1. Apply the knowledge of tribology in industries
2. Identify the types of wear
3. Know the working of surface measuring instruments

Course Code	:	MEPE28
Course Title	:	OPTIMIZATION IN ENGINEERING DESIGN
Number of Credits	:	3
Prerequisites (Course code)	:	MAIR31, MAIR46
Course Type	:	PROGRAMME ELECTIVE

Course Learning Objectives

1. Earn how MSDO can support the product development process of complex, multidisciplinary engineered systems
2. Learn how to rationalize and quantify a system architecture or product design problem by selecting appropriate objective functions, design parameters and constraints
3. Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model

Course Content

Introduction - Optimization techniques.

Single and multi variable optimization.

Constrained optimization.

Specialized algorithms - Integer, geometric.

Nontraditional algorithms.

Reference Books:

1. Deb, Kalyanmoy, Optimization for Engineering Design, Prentice - Hall, 1995.
2. Rao. S.S., Optimization Theory and Applications, Wiley Eastern Ltd., 1998.

Course Outcomes

At the end of the course student will

- 1 Enumerate the necessity of optimization in engineering design.
- 2 Identify the various optimization techniques pertaining to design oriented problems.
- 3 Solve problems with single and multi – variable.
- 4 Formulate constrained optimization problems.
- 5 Distinguish between integer and geometric specialized algorithm
- 6 Apply non-traditional algorithms for optimization of typical problems requiring their application.



b. OPEN ELECTIVE

Course Code	:	MEOE10
Course Title	:	RENEWABLE ENERGY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	OPEN ELECTIVE

Course Learning Objectives

1. To enable the students to understand the principle of working and the components of different non-conventional sources of energy and their utilization.
2. To get an exposure on the power plants working with non conventional energy

Course Content

Solar energy - Solar radiation - Heat transfer equations.

Solar thermal energy conversion - Efficiencies - Solar photo voltaic energy.

Bio energy - Conversion - bio degradation - Biogas generation - Fuel properties - Biomass gasifier.

Wind energy - Data and energy estimation, Conversion - Wind mill - Performance, applications
Geothermal.

Tidal energy - Magneto hydrodynamic - Thermionic - Fuel cell.

Reference Books:

1. Sukhatme, S.P., Solar Energy: Principle of Thermal Collection and Storage, 2nd ed., Tata McGraw Hill, 2000.
2. Rao, S. and Parulekar, R.B., Energy Technology - Nonconventional, Renewable and Conventional, Khanna Publishers, 1995.
3. Rai, G.D., Nonconventional Energy Sources, Khanna Publishers, 1999.
4. Le Gourieres, D., Wind Power Plant - Theory and Design, Pergaman Press, 1982.

Course Outcomes

At the end of the course student will

1. Explain solar radiation and heat transfer equations.
2. Analyze the properties of bio energy.
3. Compute wind energy potential and predict performance of wind turbines.
4. Point out the advantages of geothermal energy.
5. Describe the harvesting of tidal energy.
6. Distinguish the various form of energies such as magneto hydrodynamic, thermionic and fuel cell.



Course Code	:	MEOE11
Course Title	:	FINITE ELEMENT METHOD
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	OPEN ELECTIVE

Course Learning Objectives

1. The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in solid mechanics.
2. Different application areas will be dealt with after introducing the basic aspects of the method.
3. The analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages clearly spelt out.
4. It is expected that once the students are exposed to the course, they will be in a position to develop computer codes for any physical problem using Finite Element technique

Course Content

Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method - Variational approach - Rayleigh-Ritz method.

One-dimensional finite element analysis; bar element, beam element, frame element - Heat transfer problems.

Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems.

Applications to structural mechanics - Numerical integration - Solution of finite element equations.

Fluid flow problems - Dynamic problems.

Reference Books:

1. Seshu, P., Textbook of Finite Element Analysis, Prentice-Hall, India, 2003.
2. Segerlind, L.J., Applied Finite Element Analysis, John Wiley, 1987.

Course Outcomes

At the end of the course student will

1. Illustrate the basic concepts of finite element systems through spring systems and by solving problems.
2. Interpret one-dimensional and two-dimensional finite element analysis with examples.
3. Apply finite element methods to real world problems and obtain solutions.



Course Code	:	MEOE12
Course Title	:	COMPOSITE MATERIALS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	OPEN ELECTIVE

Course Learning Objectives

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

Course Content

Classification and characteristics of composite materials - Types of fiber and resin materials, functions and their properties – Application of composite to aircraft structures-Micromechanics-Mechanics of materials, Elasticity approaches-Mass and volume fraction of fibers and resins-Effect of voids, Effect of temperature and moisture.

Hooke's law for orthotropic and anisotropic materials-Lamina stress-strain relations referred to natural axes and arbitrary axes.

Governing equations for anisotropic and orthotropic plates- Angle-ply and cross ply laminates-Analysis for simpler cases of composite plates and beams - Interlaminar stresses.

Manufacture of glass, boron and carbon fibers-Manufacture of FRP components- Open mould and closed mould processes. Properties and functions of resins.

Netting analysis- Failure criteria-Flexural rigidity of Sandwich beams and plates – composite repair- AE technique.

Reference Books:

1. R.M. Jones, "Mechanics of Composite Materials", 2nd Edition, Taylor & Francis, 1999
2. L.R. Calcote, "Analysis of laminated structures", Van Nostrand Reinhold Co., 1989.
3. Autar K. Kaw, Mechanics of Composite Materials, CRC Press LLC, 1997
4. G.Lubin, "Hand Book on Fibre glass and advanced plastic composites", Van Nostrand Co., New York, 1989.
5. B.D. Agarwal and L.J. Broutman, "Analysis and Performance of fiber composites", John-Wiley and Sons, 1990.

Course Outcomes

At the end of the course student will

1. Given a type of material, be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.
2. Given a type of bond, be able to describe its physical origin, as well as strength. Be able to qualitatively derive a material's Young's modulus from a potential energy curve.



Course Code	:	MEOE13
Course Title	:	ADVANCES IN WELDING TECHNOLOGY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	OPEN ELECTIVE

Course Learning Objectives

To study the different types of welding process and its application in various fields

Course Content

Classification of welding processes: heat sources. Weld joint design - Weldability of steels and other materials - Weld defects.

TIG / A-TIG Welding, gas metal arc welding, Submerged arc welding, Friction welding, Explosive welding, Plasma arc welding

Electron beam welding, Laser beam welding - advantages and limitations, process variables and their effects,

Friction welding process - effects of speed and pressure –Types- Explosive welding –Process Parameters-Plasma arc welding

Cold pressure welding - Ultrasonic welding - Recent Advances in welding - Modeling and optimization of welding process.

Reference Books:

1. Parmar, R.S., "Welding Processes and Technology", Khanna Publishers, 1997.
2. Heine, R.W., Loper, C.R. and Rosenthal, P.C., "Principles of Metal casting", Tata McGraw- Hill, 1994.
3. Lancaster J.F, 'The Physics of Welding', Pergamon Press, 1984
4. American Society of Welding, "Hand book of Welding", Vol.I to V.
5. Jain, P.L., "Principles of Foundry Technology", Tata McGraw Hill, 2003.
6. Weman, K., "welding processes hand book", CRC press, 2003.
7. Nadkarni S.V., 'Modern Arc Welding Technology', Oxford and IBH Publishing, 1996

Course Outcomes

At the end of the course student will be able to get the knowledge about newly developed welding process and its parameters



Course Code	:	MEOE14
Course Title	:	INDUSTRIAL SAFETY ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	OPEN ELECTIVE

Course Learning Objectives

1. To Understand and apply the principles of science, technology, engineering, and maths to solve industry-related problems.
2. Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.

Course Content

Evolution of modern safety concept- safety policy - Safety Organization - Safety Committee - budgeting for safety.

Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident.

Machine Guarding, Guarding of hazards, Machine Guarding types and its application – Safety in welding and Gas cutting – Safety in Manual and Mechanical material handling- Safety in use of electricity

Toxicity- TLV- Types of Chemical Hazards-Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures

Fire triangle- Types of fire - first aid firefighting equipment – flammability limit- LPG safety

Overview of factories act 1948 – OHSAS-18000

Reference Books:

1. Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982
2. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973
3. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
4. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
5. John Ridley, “Safety at Work”, Butterworth & Co., London, 1983.

Course Outcomes

At the end of the course student will

1. Apply principles of safety management, its functions and technique in any organization,



2. Classify and categorize the factors contributing to accident,
3. Formulate accident investigation program in an organization, practice and develop accident reporting system within an organization and calculate accident indices for monitoring safety performances,
4. Apply material handling and machine guarding principles in industrial applications.
5. Realize chemical hazards, toxicity, fire and explosion in the work place and involve to take various control measures to prevent hazards.
6. Follow ohsas 18000 standards

c. MINOR (MI)

Course Code	:	MEMI10
Course Title	:	BASICS THERMODYNAMICS
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.
2. To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of psychrometry & properties of pure substances
3. To enlighten the basic concepts of vapor power cycles.

Course Content

Concept of continuum - thermodynamic systems. Property - state - path and process, quasi-static process, work - types of work, Zeroth law of thermodynamics, First law applied to control mass, control volumes. Steady flow energy equation - applications of SFEE

Second law of thermodynamics – statements of second law. Reversibility and irreversibility, Carnot theorem - Carnot cycle, Coefficient of performance. Clausius inequality - concept of entropy - entropy of ideal gas - principle of increase of entropy, Availability.

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapor phases - phase rule - PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes.

Gas mixtures – properties ideal and real gases, equation state, Avogadro's Law, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, exact differentials, Maxwell's relations, Clausius Clapeyron equations, Joule–Thomson coefficient.

Psychrometry, property calculations of air vapor mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes.



Reference Books:

1. Nag P.K., Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 1998.
2. Cengel Y.A., Thermodynamics – An Engineering Approach, Tata McGraw Hill, 2003
3. Borgnakke C Sonntag R.E., Fundamentals of Thermodynamics, John Wiley & Sons, 2009.
4. Jones J.B and Dugan R.E., Engineering Thermodynamics, Prentice-Hall of India, 1998.
5. Arora C.P., Engineering Thermodynamics, McGraw Hill Education, 2012.

Course Outcomes

At the end of the course student will

1. Analyze any engineering problem based on the basic concepts and logical sequences
2. Define the fundamental laws of thermodynamics and explain their application to a wide range of systems.
3. Analyze the work and heat interactions associated with a prescribed process path and to perform analysis of a flow system.
4. Apply the principle of efficient operation on energy utilization and value its impact on the personal and national economy
5. Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.

Course Code	:	MEM11
Course Title	:	FUNDAMENTALS OF THERMAL ENGINEERING
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
2. To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

Course Content

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency

Classification - Components and their function - Valve timing diagram and port timing diagram - Comparison of two stroke and four stroke engines - Carburettor system, Diesel pump and injector system.

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, speed regulations – Governors.



Classification and working principle of various types of compressors, work of compression, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency, multistage air compressor and inter cooling

Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems, Psychrometry, Psychrometric chart and mollier diagram.

Reference Books:

1. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar. A.V., "A course in thermal engineering," Dhanpat Rai & sons, Fifth edition, 2002
3. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
4. Arora.C.P, "Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 1994
5. Ganesan V." Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007
6. Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003

Course Outcomes

At the end of the course student will

1. Define the basic concepts of units and dimensions, systems (open and closed systems and control volumes) and its boundaries, properties, state, process, cycle, quasi-static process etc.- required as foundation for development of principles and laws of thermodynamics
2. Develop Intuitive problem solving technique
3. Use & Practice two property rule and hence thermodynamic tables, thermodynamic diagrams and concept of equation of state, also their simple application.
4. Explain heat, work and first law of thermodynamics. Application of energy balance

Course Code	:	MEM12
Course Title	:	FLUID MECHANICS AND MACHINERY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. The student is introduced to the mechanics of fluids through a thorough understanding of the properties of fluids.
2. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
3. The student is introduced with various types of hydraulic machines and its performance.

Course Content

Units & Dimensions. Properties of fluids – Fluid properties. Fluid statics : Pressure in a fluid - force on submerged planes - buoyancy - equilibrium of floating bodies.



Types of Fluid Flow - one dimensional continuity, momentum and Energy equations-Flow measurement - Orificemeter - Venturimeter, Pitot tube, orifices, mouthpieces, notches and weirs

Laminar and turbulent flows - Flow through pipes - Dimensional and Model analysis. Boundary layer concepts.

Pump - Centrifugal pump - types - specific speed - efficiencies. Reciprocating pumps, Indicator diagrams, Work saved by air vessels. Rotary pumps. Classification. Working and performance curves

Turbines - Hydraulic turbines - types - specific speed - pelton - Francis and Kaplan turbines - Calculation of power output efficiencies.

Reference Books:

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
3. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
4. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
5. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

Course Outcomes

At the end of the course student will

1. Understand the properties of fluids and basic principles of fluid mechanics
2. Ability to analyze the fluid flow problems with the application of the mass, momentum and energy equations.
3. Determine flow through hydraulics machines and pipes

Course Code	:	MEM13
Course Title	:	FUNDAMENTALS OF HEAT AND MASS TRANSFER
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course objective

1. To learn various modes of heat transfer and understand the basic concepts of mass transfer.
2. To understand the applications of various experimental heat transfer correlations in engineering applications.
3. To discuss the thermal analysis and sizing of heat exchangers.

Course Content

Conduction - general 3-D equation – one dimensional steady state heat conduction in simple



geometries – plane wall – cylinder and sphere – composite walls – critical thickness of insulation
 –types and applications – fin efficiency and effectiveness - unsteady state heat conduction.

Convection - boundary layer theory – conservation equation of mass – momentum and energy for laminar flow over a flat plate – turbulent flow over a flat plate – flow over cylinders – spheres –natural convection – vertical - inclined and horizontal surfaces.

Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Green house effect.

Boiling and condensation – pool boiling regimes and correlations – critical heat flux flow boiling – correlations- Nusselt's theory

Heat exchangers - Fouling factor, LMTD and NTU methods - Mass transfer - Fick's law - analogy between heat and mass transfer

Reference Books:

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 5th ed., John Wiley, 2002.
2. Holman, J.P., Heat Transfer, 9th ed., Tata McGraw-Hill, 2004.
3. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.
4. Cengel, Y.A., Heat Transfer - A Practical Approach, McGraw-Hill, 1998.
5. R.C. Sachdeva(2001) fundamentals of heat and mass transfer, New age international.

Course Outcomes

At the end of the course student will

1. Explain about the real time applications of heat transfer in both solids and fluids.
2. Describe the fundamentals of natural and forced convective heat transfer process.
3. Design the heat exchange equipment.
4. Explore the real time applications of radiation mode of heat transfer.
5. Relate the mass transfer concepts for various industrial applications.

Course Code	:	MEM14
Course Title	:	MACHINE DESIGN
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. To gain knowledge on the principles and procedure for the design of power Transmission components.
2. To understand the standard procedure available for Design of Transmission sip terms
3. To learn to use standard data and catalogues



Course Content

Selection of V belts and pulleys – selection of Flat belts and pulleys - Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse planeEquivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutchesinternal and external shoe brakes.

Reference Books:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Sundararamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
3. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 1985.
4. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994. 59
5. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000,
6. Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”, McGraw-Hill Book Co., 1999.
7. Ugural A,C, "Mechanical Design, An Integrated Approach", McGraw-Hill , 2003.

Course Outcomes

At the end of the course student will

1. Be able to analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts
2. Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
3. Be able to approach a design problem successfully, taking decisions when there is not a unique answer



4. Be proficient in the use of software for analysis and design

Course Code	:	MEM15
Course Title	:	FUNDAMENTALS OF AUTOMOTIVE TECHNOLOGY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. To understand the construction and working principle of various parts of an automobile.
2. To have the practice for assembling and dismantling of engine parts and transmission system

Course Content

Types of automobiles , vehicle construction and different layouts ,chassis, frame and body

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system, Electronic ignition system ,Turbo chargers, Catalytic converter

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joints, universal joints

Steering geometry and types, types of Front Axle, Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels

Reference Books:

1. Kirpal Singh, “ Automobile Engineering Vol 1 & 2 “, Standard Publishers, Seventh Edition ,1997, New Delhi
2. Jain,K.K.,and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002
3. Newton ,Steeds and Garet,” Motor Vehicles “, Butterworth Publishers,1989
4. Joseph Heitner, “Automotive Mechanics,”, Second Edition ,East-West Press ,1999
5. Martin W. Stockel and Martin T Stockle , “ Automotive Mechanics Fundamentals,” The Goodheart –Will Cox Company Inc, USA ,1978
6. Heinz Heisler , ‘Advanced Engine Technology,’ SAE International Publications USA,1998
7. Ganesan V..” Internal Combustion Engines” , Third Edition, Tata Mcgraw-Hill ,2007

Course Outcomes

At the end of the course student will

1. To develop electronically modified injection systems
2. Identify the use of fuels and its emission characteristics



3. To perform both hydraulic and pneumatic braking systems
4. To identify the type of transmission of motion in vehicles

Course Code	:	MEM16
Course Title	:	POWER PLANT TECHNOLOGY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

To understand the various components , operations and applications of different types of power plants

Course Content

Layout of Steam , Hydel, Diesel , Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection, Steam boilers and cycles.

Fuel and ash handling - Pulveriser, Dust collectors. Draught- Different Types, Surface condenser types, cooling Towers.

Nuclear Energy - Fission, Fusion Reaction, Types of Reactors, Waste disposal and safety
Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments

Types of diesel plants, components , Selection of Engine type, applications.
Gas turbine power plant - open and closed cycles- reheating – Regeneration and intercooling – combined cycle

Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

Reference Books:

1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai, 2001
2. Nag P.K ,”Power Plant Engineering”. Third edition Tata McGraw- Hill ,2007
3. El-Wakil M.M ,Power “Plant Technology,” Tata McGraw-Hill 1984
4. K.K.Ramalingam , “ Power Plant Engineering “, Scitech Publications, 2002
5. G.R,Nagpal , “Power Plant Engineering”, Khanna Publishers 1998 4. G.D.Rai, “Introduction to Power Plant technology” Khanna Publishers, 1995

Course Outcomes

At the end of the course student will be able to

1. Propose ash handling, coal handling method for thermal power plant.
2. Explain working principle of different types of nuclear power plant.
3. Calculate load factor, capacity factor, average load and peak load on a power plant.



Course Code	:	MEMI17
Course Title	:	FUNDAMENTALS OF REFRIGERATION AND AIR CONDITIONING
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

1. To understand the principles of refrigeration and air conditioning.
2. To design and implement refrigeration and air conditioning systems using standards.

Course Content

Introduction about Refrigeration – Definitions of various terms.

Methods of refrigeration. Air refrigeration system. Bell – Coleman cycle. Introduction about Air craft Air-Conditioning.

Analysis of Vapour compression cycle, Modifications to basic cycle

Psychrometry – Definitions for properties. Introduction to cooling load calculations

Air-conditioning systems – discussion about the central plant with direct evaporator and chiller applications, Ice plant, refrigerators.

Reference Books:

1. Arora, C.P., Refrigeration and Air Conditioning, 2nd ed., Tata McGraw-Hill, 2000
2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.
3. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.

Course Outcomes

At the end of the course student will

1. Illustrate the basic concepts of refrigeration system.
2. Explain the components of vapour compression system.
3. Demonstrate the use of psychrometry in analyzing refrigeration systems.
4. Discuss the theory and concept of air-conditioning systems.



Course Code	:	MEMI18
Course Title	:	PRINCIPLES OF TURBOMACHINERY
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives:

1. To understand the operating principles of various turbomachines and analyse their use for various engineering applications.

Course Content:

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation.

Velocity triangles. Thermal, Mechanical and overall efficiencies. Polytropic efficiency. Degree of reaction.

Dimensionless parameters for Turbomachines.
Centrifugal Fans and Blowers

Centrifugal and Axial Flow Compressors

Axial and Radial Flow Turbines

Reference Books:

1. Yahya, S.H., Turbines, Compressor and Fans, 3rd Edition, Tata McGraw Hill, 2005.
2. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co.2010.
3. Saravanamutto HH, Cohen H., Rogers CEC. & Straznicky PV, Gas Turbine Theory, 6th Edition, Printice Hall, 2009.

Course Outcome

At the end of the course student will able to explain the various systems, principles and applications and different types of turbo machinery components

Course Code	:	MEMI19
Course Title	:	FUNDAMENTALS OF INTERNALCOMBUSTION ENGINES
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives:

1. To understand the underlying principles of operation in different IC Engines and components.



- To provide knowledge on pollutant formation, control, alternate fuel etc.,

Course Content

Spark ignition Engine mixture requirements – Fuel and injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion

Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, NO_x, Smoke and Particulate matter – Methods of controlling Emissions

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – common Rail direct Injection Systems – Hybrid Electric vehicles – fuel Cells.

Reference Books:

- K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.
- R.B. Mathur and R.P. Sharma, Internal Combustion Engines.
- V. Ganesan, Internal Combustion Engines, II Edition, TMH, 2002.
- Duffy Smith, Auto Fuel Systems, The Good Heart Willox Company, Inc., 1987

Course Outcome:

At the end of the course student will impart the fundamental knowledge of Internal Combustion Engines

Course Code	:	MEMI20
Course Title	:	ENGINE POLLUTION AND CONTROL
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

- To create an awareness on the various environmental pollution aspects and issues.
- To give a comprehensive insight into the pollution in engine and gas turbines.
- To impart knowledge on pollutant formation and control.
- To impart knowledge on various emission instruments and techniques.

Course Content

Atmospheric pollution from Automotive and Stationary engines and gas turbines, Global warming – Greenhouse effect and effects of I.C. Engine pollution on environment.



Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes and Smoke, Particulate emission. Effects of Engine Design - operating variables on Emission formation – Noise pollution.

Non dispersive infrared gas analyzer, gas chromatography, chemiluminescent analyzer and flame ionization detector, smoke meters – Noise measurement and control

Engine Design modifications, fuel modification, evaporative emission control, EGR, air injection, thermal reactors, Water Injection, catalytic converters, application of microprocessor in emission control. Common rail injection system, Particulate traps, NOx converters, SCR systems. GDI and HCCI concepts

Transient dynamometer, Test cells, Driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards

Reference Books:

1. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill,1980
2. Ernest,S., Starkman, Combustion Generated Air Pollutions, Plenum Press, 1980.
3. George Springer and Donald J.Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum press, 1972.
4. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1980.

Course Outcome

At the end of the course student will

1. Learn about pollution formation in engines, and its control
2. The ways and means to protect the environment from various types of pollution

Course Code	:	MEMI21
Course Title	:	CAD/CAM
Number of Credits	:	3
Prerequisites (Course code)	:	-NIL-
Course Type	:	MINOR

Course Learning Objectives

To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

Course Content

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bicubic surface- Bezier surface and B-Spline surface- surface manipulations.



Basics- curves , lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

Reference Books:

1. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, Mc Graw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 1992.
3. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
4. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
5. David F. Rogers, James Alan Adams “Mathematical elements for computer graphics” second edition, Tata McGraw-Hill edition.

Course Outcomes

At the end of the course student will

1. With laboratory classes in conjunction, It helps the students to get familiarized with the computer graphics application in design.
2. This understanding reinforces the knowledge being learned and shortens the overall learning curves which are necessary to solve CAE problems that arise in engineering.
3. Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

IV. ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

Course Code	:	MELR10
Course Title	:	MACHINE DRAWING
Number of Credits	:	2
Prerequisites (Course code)	:	MEIR12
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To understand and apply national and international standards while drawing machine component.
2. To understand the concept of various tolerances and fits used for component design
3. To familiarize in drawing assembly, orthographic and sectional views of various machine components.



Course Content

Standardization - Interchangeability - Selective Assembly - Tolerance. Tolerance of form and position - grades of tolerance - fits -Standard tolerances - Machining symbols - surface finish indication - Functional and manufacturing datum.

Shaft Couplings: rigid, flexible: cotter joints , knuckle joints, Hook's joints. Bearings - Journal - Footstep, thrust or Collar bearing; Plummer block ; Pulleys for flat belts, V-belt and rope. Engine parts - Stuffing box, Connecting rod, Atomizer, spark plug, fuel injection pump. Valves - stop valve - safety valve, relief valve and non-return valve. Machine tool components - Drill jig, Tail stock, Toolpost, Tool head for shaping machine, machine vice, screw jack.

Reference Books:

1. Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company, 1996.
2. Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS, 1995.
3. Engineering Drawing Practice for Schools and Colleges SP: 46- 1988.

Course Outcomes

At the end of the course student will

1. Identify the national and international standards pertaining to machine drawing.
2. Apply limits and tolerances to assemblies and choose appropriate fits.
3. Recognize machining and surface finish symbols.
4. Explain the functional and manufacturing datum.
5. Illustrate various machine components through drawings

Course Code	:	MELR11
Course Title	:	STRENGTH OF MATERIALS LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC12
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To understand the procedure of doing different tests like hardness, compression, torsion, tension and impact etc in various materials
2. To impart knowledge about the testing of springs and beams and behavior of materials.

Course Content

Deflection test on open coil spring
 Deflection test on closed coil spring
 Deflection of simply supported beam - steel bar
 Deflection of simply supported beam - wooden beam
 Deflection of cantilever beams
 Tension test on mild steel



Torsion test on different grades of steel.
 Hardness test.
 Impact test on aggregate.
 Compressive test on concrete block.

Course Outcomes

At the end of the course student will

1. Describe the behavior of materials upon normal external loads.
2. Predict the behavior of the material under impact conditions.
3. Recognize the mechanical behavior of materials.

Course Code	:	MELR12
Course Title	:	THERMAL ENGINEERING LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC16
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To provide knowledge on testing of properties of fuels and lubricating oils
2. To demonstrate and conduct experiments, interpret and analyze data and report the results of IC Engine testing.

Course Content

1. Valve timing and port timing diagrams.
2. Heat balance test on 4-stroke water cooled and Air cooled Engine.
3. Morse test on Multi-cylinder four stroke SI Engine.
4. Performance test on Multi-cylinder four stroke Engine.
5. Performance test on single cylinder two stroke Engine
6. Performance and combustion studies on computerized IC engine test rig.
7. Study and performance test on a reciprocating Air Compressor
8. Determination of viscosity using Redwood viscometer.
9. Flash point and Fire point test using Cleveland apparatus.
10. Flash point and Fire point test using Pensky Martens apparatus.
11. Determination of calorific value for liquid and gaseous fuels.
12. Measurement of exhaust gas emissions.

Course Outcomes

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

1. Determine the property of fuels and lubricating oils.
2. Evaluate the performance of internal combustion engines and air compressors.
3. Interpret the emission characteristics of internal combustion engines.



Course Code	:	MELR13
Course Title	:	FLUID MECHANICS LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC18
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To provide practice in estimating friction losses.
2. To impart training to use various flow measuring devices for making engineering judgements.
3. To learn the working principles of hydraulic turbines and pumps.

Course Content

Determination of pipe friction.
 Calibration of venturimeter, orifice meter and water meter.
 Determination of discharge coefficients for notches, mouthpiece, orifice and weirs.
 Determination of minor losses, flow through helical coils and metacentric height.
 Performance characteristics of a reciprocating, centrifugal, gear oil, jet and submergible pump
 Characteristics test on francis, Kaplan, pelton wheel turbine

Course Outcomes

At the end of the course student will

1. Estimate the friction and measure the frictional losses in fluid flow
2. Experiment with flow measurement devices like venturimeter and orificemeter.
3. Predict the coefficient of discharge for flow through pipes
4. Perform test on turbines and pumps.

Course Code	:	MELR14
Course Title	:	HEAT TRANSFER, REFRIGERATION AND AIR CONDITIONING LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC22
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To expose the students to the basic knowledge of thermal equipments and help them to develop experimental skills.
2. To study the concepts, applications of the thermal engineering laboratory.



Course Content

Study and performance tests on vapour compression refrigeration.
 Study and performance tests on vapour absorption refrigeration.
 Study and performance tests on air conditioning test rig.
 Heat transfer experiments based on conduction and convection.
 Heat transfer experiments based on radiation.
 Experiments on heat exchangers.

Course Outcomes

At the end of the course student will

1. Demonstrate conduction, convection and radiation heat transfer through experiments.
2. Interpret heat transfer enhancement mechanisms.
3. Estimate the size and type of heat exchangers.
4. Calculate the cooling load of air conditioning systems and cooling towers.

Course Code	:	MELR15
Course Title	:	DYNAMICS LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC23
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To equip students with understanding of the fundamental principles of dynamics.
2. To develop a model of a mechanical system using a free body diagram.
3. To develop equations of motion for translational and rotational mechanical systems.

Course Content

Measurement of moment of inertia of rigid bodies.
 Gyroscope.
 Linear vibration.
 Torsional vibration.
 Balancing.
 Geared system

Course Outcomes

At the end of the course student will

1. Compute the moment of inertia of rigid bodies
2. Demonstrate the working principles of gyroscope.
3. Experiment with vibrations and balancing.



Course Code	:	MELR16
Course Title	:	AUTOMOBILE ENGINEERING LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC25
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To understand various components of automobile engines.
2. To impart knowledge in the assembling and dismantling of any vehicles and its sub-systems.
3. To Develop students with skills needed for troubleshooting the practical automobile problems

Course Content

1. Study on garage tools and equipments.
2. Automobile washing & greasing of vehicle.
3. Engine oil change & periodic maintenance of vehicle.
4. Study on battery, starting motors & electronic ignition system.
5. Study of ECU diagnostic system for fault finding
6. Dismantle any two or four stroke engine and assemble it to bring back in working condition.
7. Dismantling & assembly of Clutch (light / heavy duty vehicle).
8. Dismantling & assembly of Constant mesh gearbox and synchromesh gearbox.
9. Dismantling & assembly of Drive line (universal joint, propeller shaft, slip joint).
10. Dismantling & assembly Final drive & differential.
11. Dismantling & assembly of automatic transmission.
12. Dismantling & assembly of fluid flywheel & torque converter.
13. Wheel balancing and alignment.
14. Study on mechanical and power window mechanism.
15. Visit to any authorized service station for On Board Diagnosis.

Course Outcomes

At the end of the course student will be able to

1. Identify different automotive systems and subsystems
2. Ability to dismantle and assemble engine, transmission, steering, suspension, braking, electrical and electronics systems.
3. Illustrate working and functions of various automotive components



Course Code	:	MELR17
Course Title	:	COMPUTER AIDED DESIGN LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC27
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. To introduce the student to the basic tools of computer-aided design (CAD) and computer-aided manufacturing (CAM).
2. To expose the student to contemporary computer design tools for aerospace and mechanical engineers.
3. To prepare the student to be an effective user of a CAD/CAM system.

Course Content

Components drawing with dimensioning
 Assembly drawing using modeling software package
 Shaft coupling
 Bearings
 Automobile parts
 Machine tool parts

Course Outcomes

At the end of the course student will be able to sketch, construct and simulate the mechanical engineering parts and components which include shaft coupling, bearings, automobile parts, machine tool parts along with their assembly drawing in a CAD package.

Course Code	:	MELR18
Course Title	:	METROLOGY AND QUALITY CONTROL LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPC29
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives

1. Identify the uncertainties in dimensional metrology and the define the measurement standards; describe the fundamentals of dimensional and geometrical tolerances;
2. Measure length and angles using line-graduated instruments, i. e. vernier callipers, micrometers, bevel protractor, sine bar and surface plates;
3. Use comparative length-measuring instruments, i.e. dial indicator, to measure variations in the distance between two or more surfaces



Course Content

Measurements on precision instruments; sine bar, CMM - Universal measuring microscope, Profile projector - Electronic comparator, optical flat, surface roughness - Gear tooth thickness - MAAG gear tester - Calibration of LVDT - Statistical Quality Control charts.

Course Outcomes

At the end of the course student will

1. Illustrate on different metrological tools and perform measurements in quality impulsion.
2. Describe and explain the working of precision instruments.
3. Outline of electronic comparator, optical flat, surface roughness, gear thickness measuring instruments.
4. Demonstrate the statistical quality control chart.
5. Distinguish with the different instruments that are available for linear, angular, roundness and roughness measurements.
6. Locate appropriate measuring instrument according to a specific requirement.

Course Code	:	MELR19
Course Title	:	MECHATRONICS LABORATORY
Number of Credits	:	1
Prerequisites (Course code)	:	MEPE26
Course Type	:	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT

Course Learning Objectives:

1. To know the method of programming the microprocessor and also the design, modelling & analysis of basic electrical, hydraulic & pneumatic
2. Systems which enable the students to understand the concept of mechatronics

Course Content:

Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Fluid SIM Software

Study of PLC and its applications

Study of image processing technique

Traffic light interface

Study of various types of transducers

Course Outcome

At the end of the course student will able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.



V. ADVANCED LEVEL COURSES

Course Code	:	MEHO10
Course Title	:	ADVANCED HEAT TRANSFER
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC22
Course Type	:	HONORS

Course Objectives

1. To use Heisler and Grober charts and to discuss about transient heat conduction
2. To compare and optimization of longitudinal fin of rectangular, triangular and parabolic profiles
3. To understand boundary layers and to formulate pool and flow boiling correlations
4. To discuss thermal radiation, view factor, gas radiation, radiation effect on temperature measurement.

Syllabus

Transient heat conduction – Exact solution – Use of Heisler and Grober charts–Semi-infinite solids – Multidimensional systems.

Extended surfaces – Steady state analysis and optimization – Longitudinal fin of rectangular, triangular and parabolic profile radiating to free space – Radial fins.

Thermal boundary layers – Momentum and energy equations – Internal and external flows – Forced convection over cylinders, spheres and bank of tubes.

Heat transfer with phase change – Condensation and boiling heat transfer – Heat transfer in condensation, Effect of non-condensable gases in condensing equipment – Pool and flow boiling correlations.

Thermal radiation – View factor – Gas radiation – Transmitting, reflecting and absorbing media – Flame radiation in furnaces – Radiation effect on temperature measurement.

Course Outcome

At the end of the course student will

1. Discuss about transient heat conduction and to use Heisler and Grober charts
2. Analyze and optimize various fins like rectangular, triangular and parabolic profiles for heat transfer applications.
3. Understand thermal boundary layers, momentum and energy equations
4. Describe condensation and boiling heat transfer and estimate pool and flow boiling heat transfer
5. Analyze thermal and gas radiation in heat transfer equipment.

Reference Books

1. Ozisik, M.N., *Heat Transfer - A Basic Approach*, McGraw-Hill, 1987.
2. Incropera, P.P. and Dewitt, D.P., *Fundamentals of Heat and Mass Transfer*, 5th ed., John Wiley, 2002.



3. Bejan, A., *Heat Transfer*, John Wiley & Sons Inc., 1993.
4. Kakac, S. and Yener, Y., *Convective Heat Transfer*, CRC Press, 1995.
5. Kraus, A.D., Aziz, A., and Welty, J., *Extended Surface Heat Transfer*, John Wiley, 2001.

Course Code	:	MEHO11
Course Title	:	ADVANCED FLUID MECHANICS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC18
Course Type	:	HONORS

Course Learning Objectives

1. To familiarize with the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To classify flows and to understand and apply the conservation principles for fluid flows.
4. To understand the principles of dimensional analysis.

Course Content

Review of Basic concepts- Reynold's transport theorem, Fluid kinematics –

Physical conservation laws - Integral and differential formulations. Navier-Stokes and energy equations - Dimensionless forms and dimensionless numbers - Solution of Navier-Stokes equations.

Two-dimensional Potential flows - Different types of flow patterns. Boundary layer theory - Blasius solution –

Momentum integral approach. Turbulent flows - Reynolds equation - Prandtl and von Karman hypothesis- Universal velocity profile near a wall- flow through pipes Boundary layer concept-

Boundary layer thickness- prandtl's equations-blassius solution-skin friction coefficient.

Reference Books:

1. Currie, L.G., *Fundamental Mechanics of Fluids*, 3rd ed., CRC Press, 2002.
2. White, P.M., *Viscous Fluid Flow*, 2nd ed., McGraw-Hill, 1991.
3. Ockendon, H. and Ockendon, J., *Viscous Flow*, Cambridge Uni. Press, 1995.

Course Outcomes

At the end of the course student will

1. Identify and obtain the values of fluid properties and relationship between them and understand the principles of continuity, momentum, and energy as applied to fluid motions.
2. Recognize these principles written in form of mathematical equations.



3. Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.

Course Code	:	MEHO12
Course Title	:	SIMULATION OF IC ENGINES
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	HONORS

Course Learning Objectives

1. Calculate basic engine parameters of significance for the operation of an engine and the effect of varying them on performance and fuel economy.
2. Simulate engine operation through the use of ideal air cycle models, ideal air exchange models, fuel air processes with chemical equilibrium and time dependent models that include heat transfer and time dependent combustion.
3. Use simple models to describe the combustion processes in spark ignition and diesel engines
4. Evaluate the effect of the air exchange process on engine performance, fuel economy and other basic engine characteristics for 4-stroke engines

Course Content

First and second laws of thermodynamics – Estimation of properties of gas mixtures - Structure of engine models – Open and closed cycle models - Cycle studies

Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature, Chemical Equilibrium and calculation of equilibrium composition - – Heat transfer in engines – Heat transfer models for engines.

Combustion in SI engines, Flame propagation and velocity, Single zone models – Multi zone models – Mass burning rate, Turbulence models – One dimensional models – Chemical kinetics modeling – Multidimensional models.

Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe' model – Whitehouse way model, Two zone models - Multizone models- Meguerdichian and Watson's model, Hiroyasu's model, Lyn's model – Introduction to Multidimensional and spray modeling

Thermodynamics of the gas exchange process - Flows in engine manifolds – One dimensional and multidimensional models, Flow around valves and through ports Models for scavenging in two stroke engines – Isothermal and non-isothermal models.

Reference Books:

1. Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, John Wiley and Sons, 1980.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 1995.



3. V.Ganesan, Computer Simulation of Compression Ignition Engine Processes, Universities Press, 2002.
4. Gordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.
5. Horlock and Winterbone, The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II, Clarendon Press, 1986.
6. J.I.Ramos, Internal Combustion Engine Modeling, Hemisphere Publishing Corporation, 1989.
7. J.N.Mattavi and C.A.Amann, Combustion Modeling in Reciprocating Engines, Plenum Press, 1980.

Course Outcomes

At the end of the course student will

1. Conversant with Basic Concept of Modeling
2. To develop modeling of IC engines.
3. To develop of Laminar Flow modeling
4. Understands Simulation of IC Engines and its new concepts

Course Code	:	MEHO13
Course Title	:	DESIGN AND ANALYSIS OF TURBOMACHINES
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC21
Course Type	:	HONORS

Course Learning Objectives

1. Provide students with opportunities to apply basic flow equations;
2. How to compare and chose machines for various operations.

Course Content

Basics of isentropic flow – static and stagnation properties – diffuser and nozzle configurations - arearatio – mass flow rate – critical properties. Energy transfer between fluid and rotor velocity triangles for a generalized turbomachines - velocity diagrams. Euler's equation for turbomachines and its different forms. Degree of reaction in turbo-machines – various efficiencies – isentropic, mechanical, thermal, overall and polytropic

Centrifugal compressor - configuration and working – slip factor - work input factor – ideal and actual work - pressure coefficient - pressure ratio. Axial flow compressor – geometry and working

– velocity diagrams – ideal and actual work – stage pressure ratio - free vortex theory – performance curves and losses

Basics of combustion. Structure and working of combustion chamber – combustion chamber arrangements - flame stability – fuel injection nozzles. Flame stabilization - cooling of combustion chamber

Elementary theory of axial flow turbines - stage parameters- multi-staging - stage loading and flow coefficients. Degree of reaction - stage temperature and pressure ratios – single and twin spool arrangements – performance. Matching of components. Blade Cooling. Radial flow turbines.



Gas turbine cycle analysis – simple and actual. Reheated, Regenerative and Intercooled cycles for power plants. Working of Turbojet, Turbofan, Turboprop, Ramjet, Scramjet and Pulsejet Engines and cycle analysis – thrust, specific impulse, specific fuel consumption, thermal and propulsive efficiencies.

Reference Books:

1. Ganesan, V., Gas Turbines, Tata McGrawHill, 2011.
2. Khajuria P.R and Dubey S.P., Gas Turbines and Propulsive Systems, Dhanpat Rai Publications, 2003
3. Cohen, H., Rogers, G F C and Saravanmotto, H I H, Gas Turbine Theory, John Wiely, 5th Edition 2001.
4. Hill P G and Peterson C R, Mechanics and Thermodynamics of Propulsion, Addition-Wesley, 1970.
5. Mattingly J D, Elements of Gas turbine Propulsion, McGraw Hill, 1st Edition. 1997

Course Outcomes

At the end of the course student will

1. Explain basic concepts of turbomachines and visualize dimensional analysis.
2. Describe the working of Pelton, Francis and Kaplan along their performance parameters.
3. Discuss the operation of centrifugal pumps, centrifugal and axial compressors.
4. Associate the effect of cavitation in turbines and pumps.
5. Express the basic cycles and calculations involved in the operation of steam and gas turbines.

Course Code	:	MEHO14
Course Title	:	ADVANCED ENGINEERING MATERIALS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC20
Course Type	:	HONORS

Course Learning Objectives

1. Distinguish various classes of advanced materials, their processing, properties and applications
2. Interpret new terms and information on ultra-light materials, Biomaterials, coatings and thin films, composites, and high temperature refractory materials for aerospace applications.
3. Distinguish materials suitable for application at elevated temperatures and identify coatings suitable for protection applications

Course Content

Ultralight materials and metallic foams, material definition and processing, characterization of cellular metals, material properties

Bio-Materials, classes of materials used in medicine, application of materials in medicine and dentistry, various materials and coatings for implants.



Composite materials, classifications, properties and applications.

Advanced materials - coatings and high- temperature materials

Thin film shape memory alloys for MEMS application

Reference Books:

1. Handbook of Cellular metals, Production, processing, Application, Edited by Hans Peter Degischer and Brigitte Kriszt, Wiley - VCH, 2002.
2. Biomaterials Science, An Introduction to Materials in Medicine, Edited by B.D. Ratner, A.S. Hoffman, F.J. Schoen, and J.E.L Emons, Academic Press, second edition, 2004.
3. Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM international, 2003.

Course Outcomes

At the end of the course student will

1. Some understanding of types, manufacturing processes, and applications of advanced materials
2. A recognition of the need for and an ability to engage in life-long learning and knowledge of contemporary issues
3. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Code	:	MEHO15
Course Title	:	DESIGN OF HEAT EXCHANGERS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC22
Course Type	:	HONORS

Course Learning Objectives:

1. To learn the thermal and stress analysis on various parts of the heat exchangers
2. To analyze the sizing and rating of the heat exchangers for various applications

Course Content

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators
 Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations



Design of surface and evaporative condensers –cooling tower – performance characteristics

Reference Books:

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elsevier, 2007. 2. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
4. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.
5. Kuppam. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000.

Course Outcome

At the end of the course student will apply the mathematical knowledge for thermal and stress analysis on various parts of the heat exchangers components

Course Code	:	MEHO16
Course Title	:	DESIGN AND OPTIMIZATION OF THERMAL ENERGY SYSTEMS
Number of Credits	:	3
Prerequisites (Course code)	:	MEPC16
Course Type	:	HONORS

Course Learning Objective:

1. To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems.
2. To develop representational modes of real processes and systems.
3. To optimization concerning design of thermal systems.

Introduction to Energy System Design - Regression analysis and Equation fitting

Modeling of thermal equipment - heat exchangers, evaporators, condensers, turbomachines, distillation equipment. Absorber, generator, GAX.

System simulation - Application of successive method and Newton Raphson Method to Energy Systems

Mathematical Representation for Optimization Problems in Energy Systems-Applications of various search methods to Energy Systems - Waste Heat Recovery System - design of energy recovery systems

Cost analysis by present worth-annual cost-Evaluating potential Investments-Forecasting Techniques-Economic Factors in Energy Systems-Examples- Genetic Algorithms – using MATLAB.



Reference Books:

1. Hodge, B.K. and R.P. Taylor, Analysis and Design of Energy Systems, 3rd Edition, Prentice Hall, 1999.
2. Stoecker, W.F., Design of Thermal Systems, McGraw-Hill, 1989,
3. Burmeister, L.C., Elements of Thermal-Fluid System Design, Prentice Hall, 1998.
4. Jaluria, Y., Design and Optimisation of Thermal Systems, McGraw-Hill, 1998.
5. Janna, W.S., Design of Fluid Thermal Systems, PWS-Kent Publishing, 1993.

Course Outcome:

At the end of the course student will learn the modelling and optimization of thermal system with various equipment like piping, heat exchangers and pumping