DEPARTMENT
OF
MECHANICAL ENGINEERING

AUTONOMY CURRICULUM AND SYLLABUS
For
'2016-20' AND '2017-21' BATCH

Implemented from Academic Year 2016

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum - 2016

First Year First Semester

A. THEORY							
Sl No	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	M 101	Mathematics -I	3	1	0	4	4
2	CH 101/ PH 101	Chemistry (Gr. A) / Physics - I(Gr. B)	3	1	0	4	4
3	EE 101/ EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	1	0	4	4
4	HU 101	Professional Communication	2	0	0	2	2
5	ME 101	Engineering Mechanics	3	1	0	4	4
Total of Theory						**18**	**18**
B. PRACTICAL							
6	HU191	Lang. Lab. and Seminar Presentation	0	0	2	2	1
7	CH 191/ PH191	Chemistry Lab (Gr. A) / Physics -I Lab(Gr. B)	0	0	3	3	2
8	EE 191/ EC 191	Basic Electrical Engineering Lab (Gr. A) /Basic Electronics Engineering Lab(Gr. B)	0	0	3	3	2
9	ME 191	Engg Drawing & Graphics(Gr A)/ Workshop Practice (Gr-B)	0	0	3	3	2
Total of Practical						**11**	**07**
C. SESSIONAL							
10	**XC181.**	Extra-Curricular Activity (NSS/ NCC)	0	0	2	2	1
Total of Semester						**26**	

Group A (ECE , EE , AEIE , BIOMEDICAL)		Group B (CSE , IT , FT ,ME,CE)	
1st Semester	**2nd Semester**	**1st Semester**	**2nd Semester**
Chemistry	Physics - I	Physics - I	Chemistry
Basic Electrical Engineering	Basic Electronics Engineering	Basic Electronics Engineering	Basic Electrical Engineering
Engg Drawing & Graphics	Workshop Practice	Workshop Practice	Engg Drawing & Graphics

First Year Second Semester

A. THEORY

Sl. No	Course Code	Theory	Contact Hours /Week				Credit Points
			L	T	P	Total	
1	M 201	Mathematics -II	3	1	0	4	4
2	CH 201/PH 201	Chemistry (Gr. B) / Physics - I(Gr. A)	3	1	0	4	4
3	EE 201/ EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	1	0	4	4
4	CS 201	Computer Fundamentals & Principle of Computer Programming	3	1	0	4	4
5	ME 201	Engineering Thermodynamics & Fluid Mechanics	3	1	0	4	4
Total of Theory						**20**	**20**
B. PRACTICAL							
6	CS291	Computer Fundamentals & Principle of Computer Programming Lab	0	0	3	3	2
7	CH 291/ PH291	Chemistry Lab (Gr. B) / Physics -I Lab (Gr. A)	0	0	3	3	2
8	EE 291/ EC 291	Basic Electrical Engineering Lab (Gr. B) /Basic Electronics Engineering Lab (Gr. A)	0	0	3	3	2
9	ME 291	Engg Drawing & Graphics(Gr B)/ Workshop Practice (Gr-A)	0	0	3	3	2
Total of Practical						**13**	**08**
C. SESSIONAL							
10	MC 281	Soft Skill Development	0	0	2	2	0
Total of Semester							**28**

Group A (ECE , EE , AEIE , BIOMEDICAL)		Group B (CSE , IT , FT ,ME,CE)	
1st Semester	**2nd Semester**	**1st Semester**	**2nd Semester**
Chemistry	Physics - I	Physics - I	Chemistry
Basic Electrical Engineering	Basic Electronics Engineering	Basic Electronics Engineering	Basic Electrical Engineering
Engg Drawing & Graphics	Workshop Practice	Workshop Practice	Engg Drawing & Graphics

Second Year, 3rd SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	Contact hours/Week				Total Credits
				L	**T**	**P**	**Total**	
	A. THEORY							
1	PC	ME 301	APPLIED THERMODYNAMICS	3	0	0	3	3
2	PC	ME 302	STRENGTH OF MATERIALS	3	0	0	3	3
3	PC	ME 303	FLUID MECHANICS	3	0	0	3	3
4	ES	EE(ME)301	ELECTRICAL MACHINES	3	0	0	3	3
5	BS	M(ME) 301	MATHEMATICS- III	3	0	0	3	3
6	BS	PH(ME) 301	PHYSICS- II	3	0	0	3	3
Total of Theory							**18**	**18**
	B. PRACTICAL							
7	PC	ME 391	STRENGTH OF MATERIALS LAB	0	0	3	3	2
8	PC	ME 392	MACHINE DRAWING- I	0	0	3	3	2
9	ES	EE(ME)391	ELECTRICAL MACHINES LAB	0	0	2	2	1
10	BS	PH(ME)391	PHYSICS-II LAB	0	0	3	3	2
Total of Practical							**11**	**7**
	C. SESSIONAL							
11	MC	MC 381	TECHNICAL SKILL DEVELOPMENT	0	0	2	2 units	0
Total: Eleven				**18**	**0**	**13**	**31**	**25**

Second Year, 4th SEMESTER

Subject Type	Subject Code	Subject Name	Contact Hours / Week				Total Credits
			L	T	P	Total	
A. THEORY							
PC	ME 401	FLUID MACHINERY	3	0	0	3	3
PC	ME 402	PRIMARY MANUFACTURING PROCESS	3	0	0	3	3
PC	ME 403	ENGINEERING MATERIALS	3	0	0	3	3
PC	ME 404	MECHANISMS	3	0	0	3	3
BS	M(CS)401	NUMERICAL METHODS	3	0	0	3	3
HU	HU 401	ENVIRONMENTAL SCIENCE	2	0	0	2	2
Total of Theory						**17**	**17**
B. PRACTICAL							
PC	ME 491	FLUID MECHANICS & HYDRAULIC MACHINES LAB	0	0	3	3	2
PC	ME 492	MANUFACTURING TECHNOLOGY LAB	0	0	3	3	2
PC	ME 493	MATERIAL TESTING LAB	0	0	3	3	2
PC	ME 494	MACHINE DRAWING-II	0	0	3	3	2
BS	M(ME) 491	NUMERICAL METHODS LAB	0	0	3	3	2
Total of Practical						**15**	**10**
C. SESSIONAL							
HS	HU 481	TECHNICAL REPORT WRITING & LANGUAGE PRACTICE	0	0	2	2	1
		Total: Twelve	**17**	**0**	**15**	**34**	**28**

Third Year, 5th SEMESTER

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
A. THEORY:							
PC	ME 501	HEAT TRANSFER	**3**	**0**	**0**	**3**	**3**
PC	ME 502	DESIGN OF MACHINE ELEMENTS-I	**3**	**0**	**0**	**3**	**3**
PC	ME 503	DYNAMICS OF MACHINES	**3**	**0**	**0**	**3**	**3**
PC	ME 504	METROLOGY & MEASUREMENT	**3**	**0**	**0**	**3**	**3**
HU	HU 502	VALUES & ETHICS IN PROFESSION	**2**	**0**	**0**	**2**	**2**
PE-I	ME 505A	REFRIGERATION & AIR CONDITIONING	**3**	**0**	**0**	**3**	**3**
	ME 505B	MECHATRONICS					
	ME 505C	APPLIED FLUID MECHANICS					

Total of Theory						**17**	**17**
B. PRACTICAL:							
PC	ME591	HEAT TRANSFER LAB	0	0	3	3	2
PC	ME 592	DYNAMICS OF MACHINES LAB	0	0	3	3	2
PC	ME 593	METROLOGY & MEASUREMENT LAB	0	0	2	2	1
PE LAB-I	ME 594 A	REFRIGERATION & AIR CONDITIONING LAB	0	0	3	3	2
	ME 594 B	MECHATRONICS LAB					
	ME 594 C	APPLIED FLUID MECHANICS LAB					
Total of Practical						**11**	**7**
C. SESSIONAL							
PROJECT	ME 581	MINI PROJECT-I	0	0	3	3	2
MC	MC 582	SEMINAR	0	0	2	2	0
TOTAL: Twelve			**17**	**0**	**16**	**33**	**26**

ThirdYear:6th SEMESTER

Subject Type	**Subject Code**	**Subject Name**	**Contact Hours/Week**				**Total Credits**
			L	**T**	**P**	**Total**	
A. THEORY:							
PC	ME 601	MACHINING PRINCIPLES & MACHINE TOOLS	3	0	0	3	3
PC	ME 602	DESIGN OF MACHINE ELEMENTS-II	3	0	0	3	3
PC	ME 603	IC ENGINE & GAS TURBINE	3	0	0	3	3
PE-II	ME 604A	ROBOTICS: MECHANICS AND CONTROL	3	0	0	3	3
	ME 604B	COMPOSITE MATERIALS					
	ME 604C	FLUID POWER CONTROL					
OE-I	ME605A	RENEWABLE ENERGY SYSTEMS	3	0	0	3	3
	ME 605B	COMPUTATIONAL FLUID DYNAMICS					
	ME 605C	GAS DYNAMICS AND JET PROPULSION					
Total of Theory						**15**	**15**
B. PRACTICAL:							
PC	ME 691	MACHINING & MACHINE TOOLS LAB	0	0	3	3	2
PC	ME 692	DESIGN PRACTICE LAB	0	0	2	2	1
PC	ME 693	I C ENGINE LAB	0	0	3	3	2

PE-II LAB	ME 694 A	ROBOTICS LAB	0	0	3	3	2
	ME 694 B	COMPOSITE MATERIALS LAB					
	ME 694 C	FLUID POWER CONTROL LAB					
Total of Practical						**11**	**7**
C. SESSIONAL:							
PROJECT	ME 681	MINI PROJECT-II	0	0	3	3	2
MC	MC 682	GROUP DISCUSSION	0	0	2	2	0
		TOTAL: Eleven	**15**	**0**	**16**	**31**	**24**

Note: Vocational Training to be conducted up to 6th semester and to be evaluated in 7th semester

Fourth Year: 7th Semester

Subject Type	**Subject Code**	**Subject Name**	**Contact Hours/Week**				**Total Credits**
			L	**T**	**P**	**Total**	
A. THEORY:							
PC	ME 701	POWER PLANT ENGINEERING	3	0	0	3	3
PC	ME 702	ADVANCED MANUFACTURING TECHNOLOGY	3	0	0	3	3
PE-III	ME 703 A	ADVANCED WELDING TECHNOLOGY	3	0	0	3	3
	ME 703 B	BIOMECHANICS & BIOMATERIALS					
	ME 703 C	FINITE ELEMENT METHOD					
PE-IV	ME 704 A	TRIBOLOGY	3	0	0	3	3
	ME 704 B	OPERATIONS RESEARCH					
	ME 704 C	MATERIALS HANDLING					
OE-II	ME 705 A	ENERGY CONSERVATION & MANAGEMENT	3	0	0	3	3
	ME 705 B	QUALITY & RELIABILITY ENGINEERING					
	ME 705 C	HYDRO, WIND AND WAVE POWER					
Total of Theory						**15**	**15**
B. PRACTICAL:							
PC	ME 791	ADVANCED MANUFACTURING LAB	0	0	2	2	1
PE-III	ME 793	ADVANCED WELDING LAB	0	0	2	2	1

lab	A						
	ME 793 B	BIOMECHANICS & BIOMATERIALS LAB					
	ME 793 C	FINITE ELEMENT METHOD LAB					
Total of Practical						**4**	**2**
C. SESSIONAL:							
PW	ME 781	PROJECT- I	0	0	6	6	3
PW	ME 782	DESIGN OF MECHANICAL SYSTEM	0	0	3	3	2
PW	ME 783	VIVA-VOCE ON VACATIONAL TRAINING	0	0	0	0	2
Total of Sessional						9	7
		TOTAL: Ten	**15**	**0**	**13**	**28**	**24**

Fourth Year: 8th SEMESTER

Subject Type	**Subject Code**	**Subject Name**	**Contact Hours/Week**				**Total Credits**
			L	**T**	**P**	**Total**	
A. THEORY:							
HU	HU 804	PRICIPLES OF MANAGEMANT	2	0	0	2	2
PE-V	ME 802A	AUTOMOBILE ENGINEERING	3	0	0	3	3
	ME 802B	CAD/CAM					
	ME 802C	AUTOMATION & CONTROL					
OE-III	ME 803A	TURBO MACHINERY	2	0	0	2	2
	ME 803B	MAINTENANCE ENGINEERING					
	ME 803C	NUMERICAL HEAT TRANSFER					
OE-IV	ME 804A	SAFETY & OCCUPATIONAL HEALTH	2	0	0	2	2
	ME 804B	NUCLEAR POWER GENERATION AND SUPPLY					
	ME 804C	FRACTURE MECHANICS					
Total of Theory						**9**	**9**
B. SESSIONAL:							
PW	ME 881	PROJECT II	0	0	12	12	6
PW	ME 882	GRAND VIVA	0	0	0	0	2
		TOTAL: SIX	**9**	**0**	**12**	**21**	**17**

HS	Humanities and Social Sciences	**PC**	Professional -Core
BS	Basic Sciences	**PE**	Professional -Electives
ES	Engineering Sciences	**OE**	Open Electives

Credit points evaluation for B.Tech (ME) Programme - Total Credit: 198

Humanities and Social Sciences including Management (HS)					
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE** **Min.**	**Max.**	**Assigned Credits Autonomy syllabus (%)**
HU 101	2	10	5	10	5.05
HU 191	1				
HU 401	2				
HU 481	1				
HU 502	2				
HU 804	2				
Basic Sciences including Mathematics, Physics, Chemistry, Biology (BS)					
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE** **Min.**	**Max.**	**Assigned Credits for Autonomy syllabus (%)**
CH201	4	33	15	20	16.66
M101	4				
CH291	2				
PH101	4				
M201	4				
PH191	2				
M(ME)301	3				
PH(ME)301	3				
PH(ME)391	2				
M(ME)401	3				
M(ME)491	2				
Engineering Sciences (ES)					
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE norms** **Min.**	**Max.**	**Assigned Credits for Autonomy syllabus (%)**
ME101	4	33	15	20	16.66
EE101	4				
ME191	2				
EE191	2				
CS201	3				
ME201	4				
EC201	4				
EC291	2				
ME291	2				

CS291	2			
EE(ME)301	3			
EE(ME)391	1			
Professional Subjects-Core (PC)				
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE norms Min. Max.**	**Assigned Credits for Autonomy syllabus (%)**
ME301	3	71	30 40	35.85
ME302	3			
ME303	3			
ME391	2			
ME 392	2			
ME401	3			
ME402	3			
ME403	3			
ME404	3			
ME 491	2			
ME 492	2			
ME 493	2			
ME 494	2			
ME501	3			
ME 502	3			
ME 503	3			
ME 504	3			
ME 591	2			
ME 592	2			
ME 593	1			
ME 601	3			
ME 602	3			
ME 603	3			
ME 691	2			
ME 692	1			
ME 693	2			
ME 701	3			
ME 702	3			
ME 791	1			
Professional Subjects – Electives (PE)				
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE norms Min. Max.**	**Assigned Credits for Autonomy syllabus (%)**
ME 505 (A/B/C)	3	20	10 15	10.05
ME 594(A/B/C)	2			
ME 604(A/B/C)	3			
ME 694(A/B/C)	2			
ME 703(A/B/C)	3			
ME704(A/B/C)	3			

ME 793(A/B/C)	1			
ME 802(A/B/C)	3			
Open Subjects- Electives (OE)				
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE norms Min. Max.**	**Assigned Credits for Autonomy syllabus (%)**
ME 605(A/B/C)	3	10	5 10	5.05
ME 705(A/B/C)	3			
ME 803(A/B/C)	2			
ME 804(A/B/C)	2			
Project Work, Seminar and/or Internship in Industry				
Course Code	**Credits**	**Total Credits**	**Range of Total credits (%) as per AICTE norms Min. Max.**	**Assigned Credits for Autonomy syllabus (%)**
ME 581	2	20	10 15	10.10
ME 681	2			
ME 781	3			
ME 782	2			
ME 783	2			
ME 881	6			
ME 882	2			
XC 181	1			

DEPARTMENT OF MECHANICAL ENGINEERING

Syllabus for '2016-20' AND '2017-21' BATCH

First Year First Semester Curriculum

C. THEORY							
Sl No	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	M 101	Mathematics -I	3	1	0	4	4
2	PH 101	Physics - I(Gr. B)	3	1	0	4	4
3	EC 101	Basic Electronics Engineering (Gr. B)	3	1	0	4	4
4	HU 101	ProfessionalCommunication	2	0	0	2	2
5	ME 101	EngineeringMechanics	3	1	0	4	4
Total of Theory						18	18
D. PRACTICAL							

6	HU191	Lang. Lab. and Seminar Presentation	0	0	2	2	1
7	PH191	Physics -I Lab(Gr. B)	0	0	3	3	2
8	EC 191	Basic Electronics Engineering Lab(Gr. B)	0	0	3	3	2
9	ME 191	Workshop Practice (Gr-B)	0	0	3	3	2
Total of Practical						11	07

Sessional							
10	**XC181.**	Extra Curricular Activity (NSS/ NCC)	0	0	2	2	1
Total of Semester				**26**			

First Semester Theory

Course Name: Mathematics –I

Course Code: M101

Contact: 4L

Credit: 4

Prerequisite: Higher Secondary level knowledge in Mathematics

Course Outcomes:

After completion of the course students would be able to

CO1	Understand and recall the properties and formula related to matrix algebra, differential calculus, integral calculus and vector algebra. multivariable calculus, vector calculus and infinite series
CO2	Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.
CO3	Apply the appropriate mathematical tools of matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus and infinite series for the solutions of the related problems.
CO4	Analyze different engineering problems linked with matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus,
CO5	Apply different engineering problems linked with matrix algebra, differential calculus, Integral Calculus, multivariable calculus, vector calculus.

Course Articulation Matrix:

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
M 101.CO 1	3	3	2	-								2	2	2	2
M 101.CO 2	3	3	3	3								2	2	2	2
M 101.CO 3	3	3	3	3								2	2	2	2
M 101.CO 4	3	3	3	3								2	2	2	2
M 101.CO 5	3	3	3	3								2	2	2	2

Course contents

MODULE I [10L]

Matrix Algebra: Elementary row and column operations on a matrix, Rank of matrix, Normal form, Inverse of a matrix using elementary operations, Consistency and solutions of systems of linear equations using elementary operations, Linear dependence and independence of vectors, Concept & Properties of different matrices (unitary, orthogonal, symmetric, skew-symmetric, hermitian, skew-hermitian), Eigen values and Eigen vectors of a square matrix (of order 2 or 3), Characteristic polynomials, Caley-Hamillton theorem and its applications, Reduction to diagonal form (upto 3^{rd} order).

MODULE II [10L]

Calculus-I (Functions of single variable): Rolle's theorem, Mean value theorem- Lagrange & Cauchy, Taylor's and Maclaurin's theorems, Expansion of simple functions by Taylor's and Maclaurin's Theorems, Fundamental theorem of integral calculus, Evaluation of plane areas, volume and surface area of a solid of revolutionand lengths, Convergence of Improper integrals, Beta and Gamma Integrals - Elementary properties and the Inter relations.

MODULE III [12L]

Calculus-II (Functions of several variables): Introduction to functions of several variables with examples, Knowledge of limit and continuity, Partial derivatives, Total Differentiation, Derivatives of composite and implicit functions, Euler's theorem on homogeneous functions, Chain rule, Maxima and minima of functions of two variables – Lagrange‘s method of Multipliers, Change of variables-Jacobians (up to three variables), Double and triple integrals.

MODULE IV [8L]

Vector Calculus: Scalar and vector triple products, Scalar and Vector fields, Vector Differentiation, Level surfaces, Directional derivative, Gradient of scalar field, Divergence and Curl of a vector field and their physical significance, Line, surface and volume integrals, Green‘s theorem in plane, Gauss Divergence theorem, Stokes‘ theorem, Applications related to Engineering problems.

Text / Reference Books:

1. E. Kreyszig, Advanced engineering mathematics (8th Edition), John Wiley, 1999.

2.B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

3.R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.

4.H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley, 1995.

5.G. Strang, Linear algebra and its applications (4th Edition), Thomson, 2006.

6.S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India, 2000.

7.M. Apostol, Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.

8.TG. B. Thomas and R. L. Finney, Calculus and Analytic Geometry (9th Edition), ISE Reprint, Addison-Wesley, 1998.

9.Hughes-Hallett et al., Calculus - Single and Multivariable (3rd Edition), John-Wiley and Sons, 2003.

10.J. Stewart, Calculus (5th Edition), Thomson, 2003.

11.J. Bird, Higher Engineering Mathematics (4th Edition, 1st India Reprint), Elsevier,2006.

12.L.Rade and B.Westergen, Mathematics Handbook: for Science and Engineering (5th edition, 1st Indian Edition), Springer, 2009.

13. Murray R Spiegel and Seymour Lipschutz, Schaum's Outline of Vector Analysis.

14. Richard Bronson , Schaum's Outline of Matrix Operations.

Course Name: Physics -I

Course Code: PH 101

Contact: 4

Credit: 4

Prerequisites: Knowledge of Physics up to 12^{th} standard.

Course Objective:

The aim of courses in Physics is to provide an adequate exposure and develop insight about the basic physics principles along with the possible applications. The acquaintance of basic principles of physics would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. It can also create awareness of the vital role played by science and engineering in the development of new technologies. It also gives necessary exposure to the practical aspects, which is an essential component for learning sciences.

Course Outcomes (COs):

After completion of the course students would be able to

PH101.1	Describe different types of mechanical resonance and its electrical equivalence
PH101.2	Explain basic principles of Laser, Optical fibers and Polarization of light
PH101.3	Apply superposition principle to explain the phenomena of interference and diffraction
PH101.4	Analyze different crystallographic structures according to their co-ordination number and packing factors
PH101.5	Determine and justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

CO-PO/PSO mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PH 101.1	3	3	2	2										2	2
PH 101.2	3	3	2	2										2	2
PH 101.3	3	3	2	2										2	2
PH 101.4	3	3	2	2										2	2
PH 101.5	3	3	2	2										2	2

Course Content:

Module 1 (8L):- Oscillations

1.1 Simple harmonic motion: Concepts with examples, Superposition of SHMs in two mutually perpendicular directions: Lissajous' figures, Engineering Applications and related Numerical problems 2L

1.2 Damped vibration: Differential equation and its solution, Logarithmic decrement, quality factor, Engineering Applications and related Numerical problems. 3L

1.3 Forced vibration: Differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance, relevant applications including LCR circuits, Numerical problems 3L

Module 2 (10L):- Classical Optics:

2.1 Interference of light: Wave nature of light (Huygen's principle), Conditions of sustained interference double slit as an example; qualitative idea of spatial and temporal coherence, conservation of energy and intensity distribution; Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems. 3L

Fresnel's biprism (beyond the syllabus).
1L(ext)

2.2 Diffraction of light: Fresnel and Fraunhofer class, Fraunhofer diffraction for plane transmission grating (elementary treatment of intensity distribution for N-slits), single slit and double slits as examples, missing order, Rayleigh criterion, resolving power of grating and microscope (Definition and formula; no deduction required). Engineering Applications, Numerical Problems. 4L

2.3 Polarization: Definition, plane of polarization, plane of vibration, Malus law, fundamental concepts of plane, circular and elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: ordinary and extraordinary rays, Nicol's prism, Engineering applications, Numerical problems. 3L

Module 3 (9L):- Quantum Physics:

3.1 Quantum Theory: Inadequacy of classical physics; Planck's quantum hypothesis-Qualitative (without deductions), particle concept of electromagnetic wave (example: photoelectric and Compton effect; qualitative discussions only), wave particle duality; phase velocity and group velocity; de Broglie wave; Davisson and Germer experiment. 4L

3.2 Quantum Mechanics 1: Concept of wave function, Physical significance of wave function, Probability interpretation; wave function normalization condition and its simple numerical applications; uncertainty principle-applications, Schrödinger equation (no mathematical derivation). 4L

Module 4 (6L): X-ray & Crystallography

4.1 X-rays – Origin of Characteristic and Continuous X-ray, Bragg's law (No derivation), Determination of lattice constant, Applications, Numerical problems. 2L

4.2 Elementary ideas of crystal structure - lattice, basis, unit cell, Fundamental types of lattices – Bravais lattice, Simple cubic, fcc and bcc, hcp lattices, (use of models in the class during teaching is desirable) Miller indices and miller planes, Co-ordination number and Atomic packing factor, Applications, Numerical problems. 4L

Module 5 (8L): Modern Optics-I:

5.1 Laser: Concepts of various emission and absorption process, working principle of laser, metastable state, Population Inversion, condition necessary for active laser action, optical resonator, ruby laser, HeNe laser, semiconductor laser, Einstein A and B coefficients and equations, industrial and medical applications of laser. 5L

5.2 Fibre optics and Applications: Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, V number, Types of optical fibres (material, refractive index, mode), Losses in optical fibre- attenuation, dispersion, bending, Numerical problems. 3L

Recommended Text Books for Physics I (PH101):

Oscillations:

1. Classical Mechanics- J. C. Upadhyay (Himalya Publishers)
2. Classical Mechanics-Shrivastav
3. Classical Mechanics-Takwal & Puranik (TMH)
4. Sound-N. K. Bajaj (TMH)
5. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
6. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
7. A text book of sound-M. Ghosh (S. Chand publishers)
8. Electricity Magnetism-Chattopadhyay & Rakshit (New Central Book Agency)
9. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book& Allied Publisher)
10. R.P. Singh (Physics of Oscillations and Waves)
11. A.B. Gupta (College Physics Vol. II)
12. Chattopadhya and Rakshit (Vibration, Waves and Acoustics)

Classical Optics & Modern Optics-I:

13. A text book of Light- K.G. Mazumder & B.Ghoshs (Book& Allied Publisher)
14. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
15. Modern Optics-A. B. Gupta (Book& Allied Publisher)

16. Optics-Ajay Ghatak (TMH)
17. Optics-Hecht
18. Optics-R. Kar, Books Applied Publishers
19. Möler (Physical Optics)
20. E. Hecht (Optics)
21. E. Hecht (Schaum Series)
22. F.A. Jenkins and H.E White
23. C.R. Dasgupta (Degree Physics Vol 3)

Quantum Physics

24. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
25. Quantum Mechanics-Bagde Singh (S. Chand Publishers)
26. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
27. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
28. Quantum Mechanics-Bransden (Pearson Education Ltd.)
29. Perspective of Modern Physics-A. Beiser (TMH)
30. Eisberg & Resnick is published by Wiley India
31. A.K. Ghatak and S Lokenathan
32. E.E. Anderson (Modern Physics)
33 .Haliday, Resnick &Krane : Physics Volume 2 is Published by Wiley India
34. Binayak Dutta Roy [Elements of Quantum Mechanics]

X-ray & Crystallography

35. Solid state physics-Puri & Babbar (S. Chand publishers)
36. Materials Science & Engineering-Kakani Kakani
37. Solid state physics- S. O. Pillai
38. Introduction to solid state physics-Kittel (TMH)
39. Solid State Physics and Electronics-A. B. Gupta, Nurul Islam (Book & Allied Publisher)
40. S.O. Pillai (a. Solid state physics b. Problem in Solid state physics)

General Reference:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Basic Engineering Physics-I -Sujoy Bhattacharya, Saumen Paul (TMH)
4. Engineering Physics Vol: 1-Sudipto Roy, Tanushri Ghosh, Dibyendu Biswas (S. Chand).
5. Engineering Physics Vol:1-S. P. Kuila (New Central)
4. University Physics-Sears & Zemansky (Addison-Wesley)
5..B. Dutta Roy (Basic Physics)

6. R.K. Kar (Engineering Physics)
7. Mani and Meheta (Modern Physics)
8. Arthur Baiser (Perspective & Concept of Modern Physics)

Course Name: Engineering Mechanics

Course Code: ME101

Contacts: 4L

Credit: 4

Pre requisites: Higher Secondary with Physics, Chemistry & Mathematics.

Course Objective:

To develop the concept of force, equilibrium, moment and their interrelationships when applied to bodies at static and dynamic conditions.

Course Outcome:

Upon successful completion of the course, student should be able to:

1. Construct and understand a free body diagram.
2. Understand and calculate the reactions necessary to ensure static equilibrium.
3. Apply the effect of friction in static and dynamic conditions.
4. Analyse the different surface properties, property of masses and material properties.
5. Evaluate and solve different problems of kinematics and kinetics.

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME101.1	3	2	2	2											
ME101.2	3	3	2	3											
ME101.3	3	3	3	3									2	2	

ME101.4	3	3	3	3									2	2	
ME101.5	3	3	3	3									2	2	-

Course Content

Sl. No.	Syllabus	Contact Hrs.	Reference Books & Chapters and Problems for practice
Mod-1	Importance of Mechanics in engineering; Introduction to Statics; Concept of Particle and Rigid Body; Types of forces: collinear, concurrent, parallel, concentrated, distributed; Vector and scalar quantities; Force is a vector; Transmissibility of a force (sliding vector).	2L	Meriam & Kraig: Vol-I Chapt: 1/1, 2/2,1/3
	Introduction to Vector Algebra; Parallelogram law; Addition and subtraction of vectors; Lami's theorem; Free vector; Bound vector; Representation of forces in terms of i,j,k; Cross product and Dot product and their applications.	3L+1T	. Meriam & Kraig: Vol-I Chapt: 1/3, 2/4, 2/7 . I.H. Shames Chapt: 2.1 to 2.8 Probs: 2.1, 2.2, 2.3,2.6, 2.10, 2.48, 2.52, 2.54, 2.64, 2.68
	Two dimensional force system; Resolution of forces; Moment; Varignon's theorem; Couple; Resolution of a coplanar force by its equivalent force-couple system; Resultant of forces.	4L+1T	1. Meriam & Kraig: Vol-I Chapt: 2/3, 2/4, 2/5, 2/6, 2/9 Probs: 2/1 to 2/8; 2/13, 2/16, 2/20; 2/27, 2/31 to 2/33, 2/35, 2/37, 2/39; 2/53, 2/55, 2/57, 2/61, 2/66; 2/75, 2/77, 2/79, 2/78 to 2/82; 2/135 to 2/137,2/139,2/141,2/146,2/147,2/151, 2/157

Mod-II	Concept and Equilibrium of forces in two dimensions; Free body concept and diagram; Equations of equilibrium.	3L+1T	Meriam & Kraig: Vol-I Chapt: 3/2, 3/3 Probs: 3/1, 3/3, 3/4 to 3/7, 3/11, 3/13, 3/15, 3/21, 3/25, 3/27, 3/31,3/39
	Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.	3L+1T	Meriam & Kraig: Vol-I Chapt: 6/1, 6/2, 6/3 Probs: 6/1 to 6/6, 6/13, 6/15, 6/17; 2. I.H. Shames; Chapt: 7.1,7.2
Mod-III.	Distributed Force: Centroid and Centre of Gravity; Centroids of a triangle, circular sector, quadralateral, composite areas consisting of above figures.	4L+1T	1. Meriam & Kraig: Vol-I Chapt: 5/1, 5/2, 5/3 Sample probs: 5/1 to 5/5 Probs: 5/2, 5/5, 5/7, 5/9, 5/12, 5/20, 5/25, 5/30, 5/43,5/47
	Moments of inertia: MI of plane figure with respect to an axis in its plane, MI of plane figure with respect to an axis perpendicular to the plane of the figure; Parallel axis theorem; Mass moment of inertia of symmetrical bodies, e.g. cylinder, sphere, cone.	3L+1T	1. Meriam & Kraig: Vol-I Chapt: Appendix A/1, A/2 Sample Probs: A/1 to A/5; Probs: A/1, A/5, A/9, A/15, A/20
	Principle of virtual work with simple application	1L+1T	
	Concept of simple stresses and strains: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Factor of safety.	2L+1T	Elements of strength of Materials by Timoshenko & YoungChapt: 1.1,1.2,1.3, 2.2, Prob set 1.2 : Prob: 3,4,5,8,9,10, Prob set 1.3: Prob: 1,3,5,7, Nag & Chanda -3rd Part, Chapt: 1.1, 1.2.1 to 1.2.3, 1.2.6, 1.2.7
Mod-IV	Introduction to Dynamics: Kinematics and Kinetics; Newton's laws of motion; Law of gravitation & acceleration due to gravity; Rectilinear motion of particles; determination of position, velocity and acceleration under uniform and non-uniformly accelerated rectilinear motion; construction of x-t, v-t and a-t	3L+1T	Meriam & Kriag: Vol-II Chapt: 1/3, 1/5,1/7, 2/1,2/2 Probs: 1/1 to 1/10; 2/1 to 2/14; 2/15, 2/17, 2/19, 2/25, 2/27;

	graphs.		
	Plane curvilinear motion of particles: Rectangular components (Projectile motion); Normal and tangential components (circular motion).	3L+1T	Meriam & Kraig: Vol-II Chapt: 2/3, 2/4, 2/5, Probs: 2/59 to 2/65, 2/67, 2/71, 2/81, 2/84, 2/89; 2/97, 2/99 to 2/103;
Mod-V.	Kinetics of particles: Newton's second law; Equation of motion; D.Alembert's principle and free body diagram; Principle of work and energy ; Principle of conservation of energy; Power and efficiency.	5L+2T	Meriam & Kraig: Vol-II Chapt: 3/2, 3/3, 3/4,3/6, 3/7; Probs: 3/1, 3/3, 3/4,3/7, 3/11, 3/12; 3/17, 3/19, 3/23; 3/103 to 3/107, 3/113, 3/115, 3/116; Sample probs: 3/16, 3/17; Probs: 3/143,3/145, 3/158

Books Recommended

1. Engineering Mechanics [Vol-I & II]by Meriam & Kraige, 5th ed. – Wiley India
2. Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI
3. Engineering Mechanics by Timoshenko , Young and Rao, Revised 4th ed. – TMH
4. Elements of Strength of Materials by Timoshenko & Young, 5th ed. – E.W.P
5. Fundamentals of Engineering Mechanics by Debabrata Nag & Abhijit Chanda– Chhaya Prakashani
6. Engineering Mechanics by Basudeb Bhattacharyya– Oxford University Press.
7. Engineering Mechanics: Statics & Dynamics by Hibbeler & Gupta, 11th ed. – Pearson

Course Name: Basic Electronics Engineering

Course code: EC101

Contacts: 4L

Credit: 4

Prerequisite: Electric current and voltage-D.C and A.C., Complex impedance, conductivity, resistivity, transformer, charging and discharging of capacitor, active and passive elements.

Course Objective: To understand and apply the knowledge of Basic Electronicsin analyzing and solving problems of Mechanical Engineering

Course Outcomes: At the end of the course students' should be able to

CO.EC101.1	Demonstrate and understand the concept of Conductors, Insulators, and Semiconductors based on energy-band theory and analyze relevant problems
CO.EC101.2	Apply the working principles of P-N Junction Diode, zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.
CO.EC101.3	Analyze characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing therein
CO.EC101.4	Evaluate the operations of JFET, MOSFET and demonstrate their operations under CG, CS, CD configurations
CO.EC101.5	Determine parameters in Operational Amplifier circuit design for various applications

Course Articulation Matrix:

CO Codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.EC101.1	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO.EC101.2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO.EC101.3	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO.EC101.4	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO.EC101.5	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

Module-I: Basics of semiconductor
6L

Conductors, Insulators, and Semiconductors- crystal structure, Fermi Dirac function, Fermi level, E-k and Energy band diagrams, valence band, conduction band, and band gap; intrinsic, and extrinsic (p-type and n-type) semiconductors, position of Fermi level in intrinsic and extrinsic semiconductor, drift and diffusion current – expression only (no derivation) , mass action law , charge neutrality in semiconductor, Einstein relationship in semiconductor , Numerical problems on- Fermi level, conductivity, mass action law, drift and diffusion current .

Module-II: P-N Junction Diode and its applications
8L

p-n junction formation and depletion region , energy band diagram of p-n junction at equilibrium and barrier energy , built in potential at p-n junction , energy band diagram and current through p-n junction at forward and reverse bias, V-I characteristics and current expression of diode , temperature dependencies of V-I characteristics of diode , p-n junction breakdown – conditions , avalanche j and Zener breakdown , Concept of Junction capacitance, Zener diode and characteristics.

Diode half wave and full wave rectifiers circuits and operation (I_{DC} , I_{rms} , V_{Dc} , V_{rms}) , ripple factor without filter, efficiency ,PIV,TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems.

Module-III : Bipolar junction transistor(BJT)
6L

Formation of PNP/NPN Transistors ,energy band diagram, current conduction mechanism, CE ,CB,CC configurations , transistor static characteristics in CE ,CB and CC mode, junction biasing condition for active, saturation and cut-off modes ,current gain α ,β and γ, early effect.

Biasing and bias stability; biasing circuits - fixed bias; voltage divider bias; collector to base bias , D.C. load line and Quiescent point, calculation of stability factors for different biasing circuits.

BJT as an amplifier and as a switch – Graphical analysis; Numerical Problems.

Module-IV: Field effect transistor (FET)
4L

Concept of field effect, channel width modulation Classification of FETs-JFET, MOSFET, operating principle of JFET.drain and transfer characteristics of JFET (n-channel and p-channel), CS,CG,CD configurations, Relation between JFET parameters. FET as an amplifier and as a switch– graphical janalysis. E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel), Numerical Problems .

Module-V: Feedback and Operational Amplifier
10L

Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.

Operational amplifier – electrical equivalent circuit ,ideal characteristics , Non ideal characteristics of op-amp – offset voltages ;bias current ;offset current; Slew rate ; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non-inverting amplifier , Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower ; basic differentiator and integrator .

Problems on Characteristics of Op-amp, CMRR, slew rate, amplifier and application of Op-amp to be discussed. Any other relevant problems related to topic may be discussed or assigned.

Module-VI: Cathode Ray Oscilloscope (CRO)
2L

Operating principle of CRO with block diagram, measurement of voltage, frequency and phase.

Module-VII: Digital Electronics **4L**

Binary numbers and conversion, Basic Boolean algebra, Logic gates (AND,OR,NOR,NOT,NAND,XOR) and realization of functions.

Text Books:

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.
4. Sedra & Smith, Microelectronics Engineering

Reference Books:

1. John D. Ryder, Electronic Fundamentals and Applications, PHI
2. J.B.Gupta, Basic Electronics, S.K. Kataria.
3. Malvino: Electronic Principle.
4. Schilling & Belove: Electronics Circuits.

Course Name: Professional Communication

Course Code: HU101

Contacts: 2L

Credit: 2

Prerequisite: Basic knowledge of high school English.

Course Objective: Designed to meet the basic survival needs of communication in the globalized workplace, including knowledge of and competency in the use of macroskills in reading and writing proficiency, functional grammar and usage.

Course Outcomes(COs):

After completion of the course students would be able to

CO1	Understand and communicate in English through exposure to communication skills theory and practice.
CO2	Understand and apply the basic grammatical skills of the English language and develop reading and comprehension skills.
CO3	Understand and know about and apply the basic formats, templates of business and official communication.
CO4	Understand and know about and employ formal communication modes in meetings and reports.
CO5	Understand and know about and use objective and culturally neutral language in interpersonal and business communication.

Course Content

Rationale for Revision:

Listening and speaking sub-skills are not always specified or given an industry related or application-oriented grounding in the existing WBUT HU101 syllabus.

The target students lack grammatical competence and the course units on grammar are insufficient and the students need additionally, a grammar coursebook and knowledge of language functions. Also, the need for grammatical accuracy in the industry is not made clear to the students.

Emphasis needs to be on the modalities as well as mechanics of business writing—this is only partially addressed in the existing HU101 syllabus.

The proposed revised syllabus is as follows:

Unit 1: Communication: Interface in a Globalized World [5L]

a .Definition of Communication& Scope of Communication

b. Process of Communication—Models and Types

c. Verbal—Non-Verbal Communication, Channels of Communication

d. Barriers to Communication & surmounting them

[to be delivered through case studies involving intercultural communication]

Unit 2: Vocabulary and Reading [5L]

a. Word origin—Roots, Prefixes and Sufffixes, Word Families, Homonyms and Homophones

b. Antonyms and Synonyms, One word substitution

c. Reading—Purposes and Skills

d. Reading Sub-Skills—Skimming, Scanning, Intensive Reading

e. Comprehension Practice (Fiction and Non fictional Prose/Poetry)

Texts:

(i)Isaac Asimov, I Robot

(ii)George Orwell, Shooting an Elephant

(iii)Ruskin Bond, The Cherry Tree OR The Night Train at Deoli

(iv) Robert Frost, "Stopping by the Woods on a Snowy Evening."

f. Precis Writing

Unit 3: Functional Grammar and Usage [6L]

a. Articles, Prepositions, Verbs

b. Verb-Subject Agreement

c. Comparison of Adjectives

d. Tenses and their Use

e. Transformation of Sentences

f. Error Correction

Unit 4: Business writing [10L]

a. Business Communication in the Present-day scenario

b. Business Letters (Letters of Inquiry, Sales Letters, Complaint and Adjustment Letters, Job Application Letters)

c. Drafting of a CV and Résumé

d. Memo, Notice, Advertisement, Agenda, Minutes of Meetings

e. E-mails (format, types, jargons, conventions)

Assessment

Test Type	**Test**	**Slot**	**Marks**
MCQ, Short Questions	Unit Test-1 Unit Test-2	2nd week of September 3rd week of November	15
Assignment			10
Attendance			5
Written Exam		1st week of December	70

References:

1.Raymond Murphy. English Grammar in Use.3rd Edn.CUP, 2001.

2. Seidl & McMordie. English Idioms& How to Use Them. Oxford:OUP, 1978.

3. Michael Swan. Practical English Usage. Oxford:OUP, 1980.

4. Simeon Potter. Our Language. Oxford:OUP, 1950.

5. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.

6. IIT Kanpur, English Language & Communication Skills (ENG 112 C) syllabus.

First Semester Practical

Course Name: Language Lab. and Seminar Presentation
Course Code: HU191
Contacts: 2
Credit: 1

CourseOutcomes(COs):

After completion of the course students would be able to

CO1	Able to understand advanced skills of Technical Communication in English through Language Laboratory.
CO2	Able to apply listening, speaking, reading and writing skills in societal and professional life.
CO3	Able to demonstrate the skills necessary to be a competent Interpersonal communicator
CO4	Able to analyze communication behaviors.
CO5	Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

CO-PO/PSO mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1							2		3	3		2	2	2	3
CO 2							2		3	3		2	2	3	2
CO 3							2		3	3		2	1	1	3

CO 4							2		3	3		2	-	1	2
CO 5							2		3	3		2			

List of Experiments: The proposed revised syllabus is as follows:

Unit 1: Introduction to the Language Lab
a.The Need for a Language Laboratory, b. Tasks in the Lab, c. Writing a Laboratory Note Book

Unit 2: Active Listening
a.What is Active Listening, b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note taking, c. Contextualized Examples based on Lab Recordings

Unit 3: Speaking
a. Speaking and what it involves, b. Language Functions/Speech Acts, c. Speaking using Picture Prompts and Audio Visual inputs, d. Conversational Role Plays, e. Group Discussion: Principles and Practice

Unit 4: Lab Project Work
a. Keeping a Listening Log, b. Writing a Film Review/Advertisements

Assessment

Test Type	**Test**	**Slot**	**Marks**
MCQ, Short Qestions	Listening Test-1 Speaking Test-1 Reading Test-1 Oral Communication Test	(as per facilitator's discretion)	10 10 10 10
Lab Notebook			5
Attendance			5
Project			10
Lab Practical Exam		Mid November(tentative)	40

References:
1.IIT Mumbai**, Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

Physics-1 Lab
Course Code: PH191
Contacts: 3P
Credits: 2
Pre requisites: Knowledge of Physics upto 12^{th} standard.

After completion of the course students would be able to

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer
CO3	Analyze and participate as an individual and as a member or leader in groups in laboratory sessions actively.
CO4	Analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovative experiments.
CO5	Develop critical thinking skills to solve for real life challenges.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
PH 191.1	2	3	2	3	3										
PH 191.2	2	3	2	3	3										
PH 191.3	2	3	2	3	3										
PH 191.4	2	3	2	3	3									2	2
PH 191.5	2	3	2	3	2										

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.

ii) Proportional error calculation using Carrey Foster Bridge.

Any 7 to be performed from the following experiments

Experiments on Oscillations & Elasticity:

1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
2. Experiments on Lissajous figure (using CRO).

3. Experiments on LCR circuit.
4. Determination of elastic modulii of different materials (Young's modulus and Rigidity modulus)

Experiments on Optics:

5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. Determination of numerical aperture and the energy losses related to optical fiber experiment
8. Measurement of specific rotation of an optically active solution by polarimeter.

Experiments on Quantum Physics:

9. Determination of Planck's constant using photoelectric cell.
10. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

****In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.**

Probable experiments beyond the syllabus:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
2. Study of half-wave, quarter-wave plate (beyond the syllabus)
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory.

List of Experiments:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.

ii) Proportional error calculation using Carrey Foster Bridge.

Any 7 to be performed from the following experiments

Experiments on Oscillations & Elasticity:

1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
2. Experiments on Lissajous figure (using CRO).
3. Experiments on LCR circuit.
4. Determination of elastic modulii of different materials (Young's modulus and Rigidity modulus)

Experiments on Optics:

5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. Determination of numerical aperture and the energy losses related to optical fibre experiment
8. Measurement of specific rotation of an optically active solution by polarimeter.

Experiments on Quantum Physics:

11. Determination of Planck's constant using photoelectric cell.
12. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

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2. Study of half-wave, quarter-wave plate (beyond the syllabus)
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poyseullie's caplillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory.

Course Name: Basic Electronics Engineering Lab

Course Code: EC191

Contacts: 3P/Week

Credit: 2

Perquisite:

A basic course in electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Objective:

Students will become familiar with the circuit design using semiconductor diodes in Forward and Reverse bias; able to design rectifiers like half wave, full wave rectifiers etc. using diodes. The ability of circuit design with Bipolar Junction Transistor in CB, CE & CC configurations will be improved; will acquire the basic engineering technique and ability to design and analyze the circuits of OpAmp. Basic concepts and Circuit design with logic gates will be developed in the students. The students will be able design circuit using FET.

Course Outcome: After completion of this course student will be able to

EC191.1: Identify different types of passive and active electronic components, apply signals through

signal generators and measure signals using CRO, Multimeter etc

EC191.2: Demonstrate and analyze the characteristics for PN junction diode, Zener diode.

EC191.3: Describe the regulator circuit and analyze the parametric observation

EC191.4: Demonstrate and analyze the characteristics for BJT, FET.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
EC191.1	3	2	2	-	-	-	-	-	2	2	-	2	2	2	3
EC191.2	3	3	2	-	-	-	-	-	3	2	-	2	2	2	3
EC191.3	3	3	2	-	-	-	-	-	3	2	-	2	2	2	3
EC191.4	3	3	3	-	-	-	-	-	3	2	-	2	2	2	2
EC191.5	3	2	3	-	-	-	-	-	3	2	-	2	2	2	3

List of Experiments:

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, millimeters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs.
7. Study of I-V characteristics of Field Effect Transistors.
8. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
9. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
10. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.
11. Study of Logic Gates and realization of Boolean functions using Logic Gates.
12. Study of Characteristic curves for CB, CE and CC mode transistors.
13. Innovative Experiment

Course Name: Workshop Practice
Course Code: ME191
Contacts: 3P/Week
Credit: 2
Pre requisites: Higher Secondary with Physics, Chemistry & Mathematics

Course Objective: To get hands-on knowledge of several Workshop Practices like carpentry, fitting, welding, machining etc and learn safety regulations to be maintained in a shop floor.

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

1. Gain basic knowledge of Workshop Practice and Safety useful for our daily living.
2. Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc.
3. Apply and performing operations like such as Marking, Cutting etc used in manufacturing processes.
4. Analyse the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.
5. Get hands on practice of in Welding and apply various machining processes which give a lot of confidence to manufacture physical prototypes in project works.

CO Codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME 191.1	3						2		2	2					
ME 191.2	3						2		2	2					
ME 191.3	3						2		2	2			2		2
ME 191.4	3						2		2	2			2		2
ME 191.5	3	2	2				2		2	2					

List of Experiments:

Sl. No.	Syllabus	Contact Hrs
Module 1	Pattern Making	6
Module 2	Sheet Metal Work	6
Module 3	Fitting	9
Module 4	Machining in Lathe	9
Module 5	Welding	6

MODULE 1 – PATTERN MAKING.

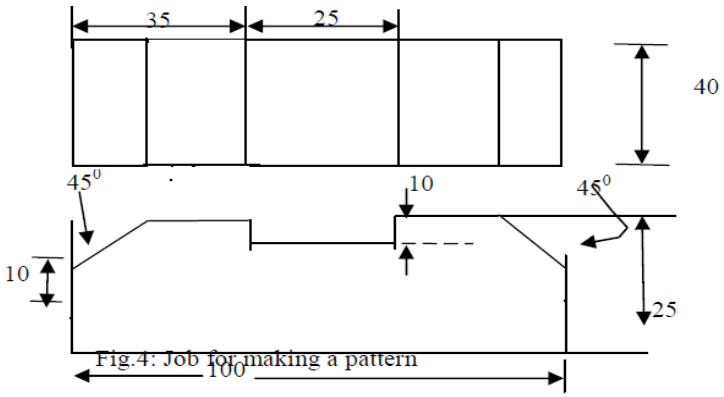
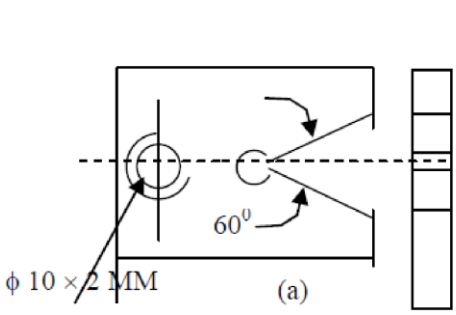
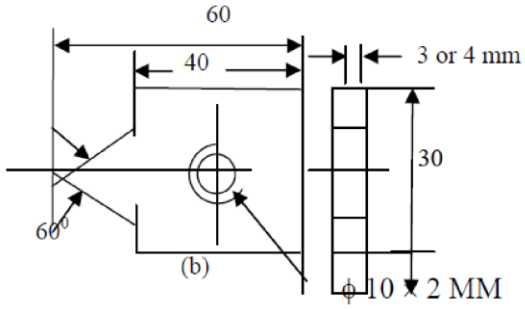


Fig.4: Job for making a pattern

MODULE 3- FITTING SHOP.



OR



MODULE 4 – MACHINING IN LATHE & SHAPING M/C

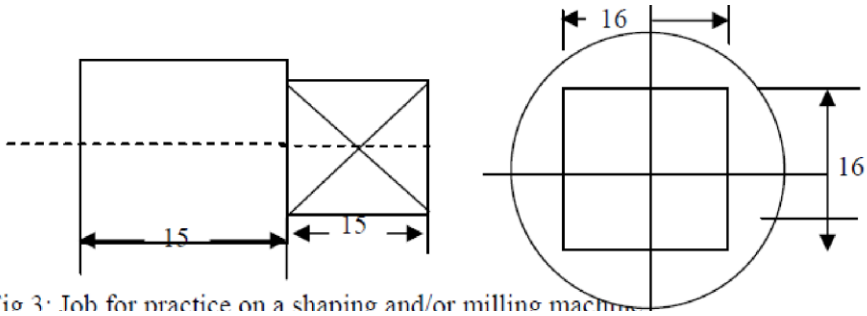
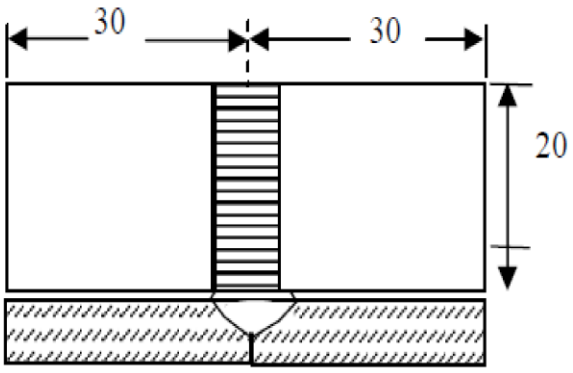


Fig.3: Job for practice on a shaping and/or milling machine

MODULE 5 – WELDING



Course Name: Extra Curricular Activity (NSS/ NCC)

Course Code: HU181

Contacts: 2

Credit: 1

List of Experiments:

a) Creating awareness in social issues

b) Participating in mass education programs

c) Proposal for local slum area development

d) Waste disposal

e) Environmental awareness

f) Production Oriented Programs

g) Relief & Rehabilitation work during Natural calamities

Creating awareness in social issues:

1. Women's development – includes health, income-generation, rights awareness.
2. Hospital activities – Eg. writing letters for patients, guiding visitors
3. Old age home – visiting the aging in-mates, arranging for their entertainment.
4. Children's Homes - visiting the young in-mates, arranging for their entertainment
5. Linking with NGOs to work on other social issues. (Eg. Children of sex-workers)
6. Gender issues- Developing an awareness, to link it with Women's Cell of college

Participating in mass education programs

1.Adult education

2. Children's education

Proposal for local slum area development

One or two slums to be identified and according to the needs, activities to be developed and proposals and reports are to be submitted.

Environmental awareness

• Resource conservation – Awareness to be developed on water, energy,soil.

• Preservation of heritage monuments- Marches, poster campaigns

• Alternative energy consciousness amongst younger school-children.

• Plantation and beautification- Plantation of trees, their preservation and upkeep, developing NSS parks.

• Waste disposal- Proper methods of domestic waste disposal.

Production Oriented Programmes

5. Working with people and explaining and teaching improved agricultural practices

6. Rodent control land pest control practices;

7. Soil-testing, soil health care and soil conservation;

8. Assistance in repair of agriculture machinery;

9. Work for the promotion and strengthening of cooperative societies in villages;

10. Assistance and guidance in poultry farming, animal husbandry, care of animal health etc.;

11. Popularization of small savings and

12. Assistance in procuring bank loans

Relief & Rehabilitation work during Natural calamities

g) Assisting the authorities in distribution of rations, medicine, clothes etc.;

h) Assisting the health authorities in inoculation and immunization, supply of medicine etc.;

i) Working with the local people in reconstruction of their huts, cleaning of wells, building roads etc.;

j) Assisting and working with local authorities in relief and rescue operation; Collection of clothes and other materials, and sending the same to the affected areas;

****

First Year Second Semester

B. THEORY							
Sl No	**Course Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	M 201	Mathematics -II	3	1	0	4	4
2	CH 201	Chemistry	3	1	0	4	4
3	EE 201	Basic Electrical Engineering	3	1	0	4	4
4	CS 201	Computer Fundamentals & Principle of Computer Programming	3	1	0	4	4
5	ME	Engineering Thermodynamics & Fluid	3	1	0	4	4

	201	Mechanics					
Total of Theory						20	20
C. PRACTICAL							
6	CS291	Computer Fundamentals & Principle of Computer Programming Lab	0	0	3	3	2
7	CH 291	Chemistry Lab (Gr. B)	0	0	3	3	2
8	EE 291	Basic Electrical Engineering Lab (Gr. B)	0	0	3	3	2
9	ME 291	Engg Drawing & Graphics(Gr B)	0	0	3	3	2
Total of Practical						13	08
C.SESSIONAL							
10	MC 281	Soft Skill Development	0	0	2	2	0
Total of Semester			**28**				

Second Semester Theory

Course Name: Mathematics-II

Course Code: M 201

Contact: 3L+1T

Credits: 4

Prerequisite: Knowledge of Mathematics in 10+2 standards

Course outcomes:

CO1	Determine and recall the properties and formula related to Ordinary differential equations,Basic Graph Theory and Laplace transform.
CO2	Determine the solutions of the problems related to Ordinary differential equations, Basic Graph Theory and Laplace transform.
CO3	Apply appropriate mathematical tools of Ordinary differential equations, Basic Graph Theory and Laplace transform.

CO4	Analyze Engineering problems on Ordinary Differential Equations, Basic Graph Theory and Laplace transform.
CO5	Apply engineering solutions by using Ordinary Differential Equations, Basic Graph Theory and Laplace transform.

Course Articulation Matrix:

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
M 101.CO 1	3	3	2	-								2			
M 101.CO 2	3	3	3	3								2			
M 101.CO 3	3	3	3	3								2	2	2	2
M 101.CO 4	3	3	3	3								2	2	2	2
M 101.CO 5	3	3	3	3								2	2	2	2

Course contents

Module I [10L]

Ordinary differential equations (First order): First order and first degree Exact equations,Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear equation, Bernoulli's equation, General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation), Applications related to Engineering problems.

Module II [10L]

Ordinary differential equations (Higher order): General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods for finding P.I., Method of variation of parameters, Cauchy-Eulerequations, Solution of simultaneous linear differential equations, Applications related to Engineering problems.

Module III [10L]

Basic Graph Theory:Graphs, Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph, Walks, Paths, Circuits, Euler Graph, Cut-sets and cut-vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph.Tree, Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees, Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using Kruskal's and Prim's algorithm.

** Extra lecture hours may be taken for this module

Module IV [10L]

Combinatorics: Fundamental Principles, Permutations, Combinations, Binomial coefficients,

Probability: Classical, relative frequency and axiomatic definitions of Probability, Addition rule, Conditional probability, Multiplication rule, Independent events, Total probability, Baye's theorem. Applications from Related Engineering Problems.

[Beyond syllabus]: Random variables, Binomial, Poisson and Normal Distribution.

Text / Reference Books:

1. E. Kreyszig, Advanced engineering mathematics (8th Edition), John Wiley, 1999.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.
3. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
4. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley, 2005.
5. R.K. Ghosh and K.C.Maity, An Introduction to Differential Equations, New Central Book Agency.
6. V. K. Balakrishnan,Graph Theory, Schaum's Outline, TMH.
7. J. Clark and D. A. Holton, A first course at Graph Theory,Allied Publishers LTD.
8. D. B. West, Introduction to Graph Theory,Prentice-Hall of India.
9. N. Deo, Graph Theory, Prentice-Hall of India.
10. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
11. N.G. Das, Statistical Methods, Tata McGraw Hill.
12. J. Bird, Higher Engineering Mathematics (4th Edition, 1st India Reprint), Elsevier, 2006.
13. L. Rade and B. Westergen, Mathematics Handbook: for Science and Engineering (5th edition,1st Indian Edition), Springer, 2009.

Course Name: Chemistry

Course Code: CH201

Contact: 4

Credit: 4

Pre requisites: Knowledge of Chemistry up to 12th standard.

Course Objective:

The aim of this course is to provide an adequate exposure and develop insight about the basic principles of chemistry along with the possible applications. This knowledge will help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. It can also create awareness of the vital role played by science and

engineering in the development of new technologies. It also gives necessary exposure to the practical aspects, which is an essential component for learning sciences

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Describe and apply fundamental concepts of the chemical thermodynamics to engineering applications
CO2	Ability to analyze & design different energy storage device
CO3	Determine, analyze and interpret the structure of organic molecules using different spectroscopic techniques
CO4	Apply the knowledge of fuel, composites, polymers and organic reactions to different industries.
CO5	Evaluate theoretical and practical aspects relating to the transfer of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

CO-PO Mapping

CO codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
CH201.1	**3**	**2**	**2**	**2**								**2**			
CH201.2	**3**	**3**	**3**	**3**								**2**			
CH201.3	**3**	**3**	**2**	**2**								**2**			
CH201.4	**3**	**2**	**3**	**2**								**2**			
5	**3**	**3**	**3**	**3**								**2**		2	2

Course contents

Module 1 [8L]

Chemical Thermodynamics –I

1.1 Concept of Thermodynamic system: Definition with example of diathermal wall, adiabatic wall, isolated system, closed system, open system, extensive property, intensive property.

Introduction to first law of thermodynamics: Different statements, mathematical form.

Internal energy: Definition, Example, Characteristics, Physical significance, Mathematical expression for change in internal Energy, Expression for change in internal energy for ideal gas.

2L

1.2 Enthalpy: Definition, Characteristics, Physical significance, Mathematical expression for change in Enthalpy, Expression for change in enthalpy for ideal gas.

Heat Capacity: Definition, Classification of Heat Capacity (Cp and CV): Definition and General expression of Cp - CV. Expression of Cp - CV for ideal gas.

Reversible and Irreversible processes: Definition, Work done in Isothermal Reversible and Isothermal Irreversible process for Ideal gas, Adiabatic changes: Work done in adiabatic process, Interrelation between thermodynamic parameters (P, V and T), slope of P-V curve in adiabatic and isothermal process.

Application of first law of thermodynamics to chemical processes: exothermic, endothermic processes, law of Lavoisier and Laplace, Hess's law of constant heat summation. **3L**

1.3 2nd law of thermodynamics: Statement, Mathematical form of 2nd law of thermodynamics (Carnot cycle). Joule Thomson and throttling processes; Joule Thomson coefficient for Ideal gas, Concept of inversion temperature (brief).

Evaluation of entropy: characteristics and expression, physical significance. Work function and free energy: Definition, characteristics, physical significance, mathematical expression of ΔA and ΔG for ideal gas, standard free energy and chemical potential, Condition of spontaneity and equilibrium reaction. **3L**

Module 2 [7L]

2.1 Reaction Dynamics

Reaction laws: rate and order; molecularity; zero and first order kinetics, second order kinetics (same reactant concentration), Pseudounimolecular reaction, Arrhenius equation. **3L**

Mechanism and theories of reaction rates (Content beyond the syllabus)

2.2 Solid state Chemistry

Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency).Role of silicon and germanium in the field of semiconductor, n-type, p-type semiconductor, photo voltaic cell, fabrication of integrated circuits.

4L

Module 3 [8L]

Electrochemistry

3.1 Conductance

Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance and ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). **1L**

3.2 Electrochemical cell

Cell EMF and its Thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half cell, calomel half cell (representation, cell reaction, expression of potential, Discussion, Application). **3L**

3.3 Concept of battery

Battery and Commercial electrochemical cell: Dry cell, acid storage cell, alkaline storage cell, fuel cell (construction, representation, cell reaction, expression of potential, discussion, application). **2L**

3.4 Corrosion and its control

Introduction, cause and effect of corrosion, types of corrosion: dry, wet and other: Electrochemical corrosion, galvanic corrosion, passivation and protective measure. **2L**

Module 4 [12L]

4.1 Structure and reactivity of Organic molecule

Electronegativity, electron affinity, hybridisation, Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals. Brief study of some addition, eliminations and substitution reactions. **3L**

4.2 Polymers

Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg.: Theory and mathematical expression only), Poly dispersity index (PDI).

Polymerization processes: addition and condensation polymerization (mechanism not required), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of Tm) and amorphicity (Concept of Tg) of polymer.

Preparation, structure and use of some common polymers: plastic (HDPE, LDPE, PVC, PP, PMMA, Polyester, PTFE, Bakelite), rubber (natural rubber, SBR), fibre (nylon 6, nylon 6,6), Vulcanization of rubber, Conducting polymers and bio-polymers. **7L**

4.3 Nano material

Basic principles of nano science and technology, classification, preparation, properties and application of nano material. **2L**

Module 5 [5L]

5.1 Industrial Chemistry

Fuels

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Proximate analysis of coal, Calorific value.

Liquid fuel: Petroleum, classification of petroleum, Refining, Octane number, Cetane number, Aviation Fuel (Aviation Gasoline, Jet Gasoline), Biodiesel.

Gaseous fuels: Natural gas, water gas, Coal gas, bio gas, CNG, LPG **3L**

5.2 Water

Introduction, source of water, water quality parameter, specification for drinking water (BIS and WHO standards), Chlorination of Water, Types of hardness- Units, Brief Softening methods.

2L

Short overview of water treatment plants(Content beyond the syllabus)

Reference Books

1. Engineering Chemistry: Bandyopadhyay and Hazra
2. Physical Chemistry: P.C. Rakshit
3. Organic Chemistry: Finar, vol-1
4. Engineering Chemistry: B.Sivasankar, Tata Mc Graw Hill, 2008
5. A Text book of Engineering Chemistry: S.S.Dara, 10th Edition, S.Chand & Company Ltd., New Delhi, 2003.
6. Engineering Chemistry Simplified: S. Nandi and R. Bhattacharyya, Chayya Prakashani Pvt. Ltd.

Course Name: Basic Electrical Engineering

Course Code: EE201

Contacts: 4L

Credit: 4

Prerequisite: Knowledge of Physics and Mathematics in 10+2 standards

Course Objective:

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context; provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices; to explain the working principle, construction, applications of DC machines, AC machines & measuring instruments; highlight the importance of transformers in transmissi**on and distribution of electric power.**

Course Outcome: After completion of this course student will be able to

EE201. 1:	Understand the behavior of any electrical and magnetic circuits.
EE201. 2:	Formulate and solve complex AC, DC circuits.
EE201. 3:	Identify the type of electrical machine used for that particular application.
EE201. 4:	Realize the requirement of transformers in transmission and distribution of electric power and other applications.

CO-PO/PSO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EE 201.1	3	3	3			3			3		2	3	2	2
EE 201.2	3	3	2			2			3		1	3	1	2
EE 201.3	3	3	3			1			3		1	3	3	3

Course Contents:

DC CIRCUITS (7L)

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems-Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

MAGNETIC CIRCUITS (3L)

Concept of Magnetic circuit, B-H curve, Analogous quantities in magnetic and electric circuits, Faraday's law, iron losses, self and mutual inductance, Energy stored in magnetic field.

AC SINGLE PHASE CIRCUITS (8L)

Sinusoidal quantities, Average and RMS values, peak factor, Form factor, Phase and Phase difference, concept of phasor diagram, V-I Relationship in R,L,C circuit, Combination R,L,C in AC series , parallel and series parallel circuits with phasor diagrams, impedance and admittance, Power factor, Power in AC circuit, Resonance in RLC series and parallel circuit, Q factor, band width of resonant circuit.

THREE PHASE CIRCUITS (3L)

Voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two watt meters method.

DC MACHINES (6L)

Construction, Basic concepts of winding (Lap and wave). DC generator: Principle of operation, EMF equation, characteristics (open circuit, load) DC motors: Principle of operation, Torque Equation ,Speed Torque Characteristics (shunt and series machine), starting (by 3 point starter), speed control (armature voltage and field control).

SINGLE PHASE TRANSFORMER (5L)

Constructional parts, Types of transformers, Emf equation, No Load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, open and short circuit tests, regulation and efficiency calculation.

THREE PHASE INDUCTION MOTOR (6L)

Types, Construction, production of rotating field, principle of operation, Slip and Frequency ,rotor emf and current, Equivalent circuit and phasor diagram, Torque Slip characteristics torque-speed characteristics Starting of induction motor by star delta starter and(DOL starter). Speed Control of Three phase induction motor by variation of supply frequency, supply voltage and number of poles.

GENERAL STRUCTURE OF ELECTRICAL POWER SYSTEM (3L)

Power generation to distribution through overhead lines and underground cables with single line diagram, Earthing of Electrical Equipment, Electrical Wiring Practice

Text books

1. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication
3. Chakrabarti,Nath & Chanda, Basic Electrical Engineering, TMH
4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education

Reference books

1. H. Cotton, Willey Press
2. J.B. Gupta, Basic Electrical Engineering, Kataria &Sons .
3. Kothari & Nagrath, Basic Electrical Engineering, TMH

Course Name: Computer Fundamentals & Principle of Computer Programming

Course Code: CS 201

Contacts: 3L + 1T = 4

Total No. of Lectures: 40

Credits: 4

Prerequisite: Knowledge of Mathematics, Physics.

Course Objective: The course is designed to provide complete knowledge of C language; students will be able to develop logics which will help them to create programs, applications; learners would be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.

CO1 Understand the fundamental concept of Computer and mathematical knowledge and apply the mindesigning and analyzing solution to engineering problem.

CO2 Understand the basic concept of Cprogramming and use of datatypes/ operators/ input/ outputfunctionfordevelopingandimplementingcompleteprogramleadingtosolutionofmathematical andengineering problem.

CO3 Useconditional branching, iteration, recursion and formulate algorithms and programs in solving mathematical/ scientific/ engineeringproblem and also analyze the same leading to lifelong learning.

CO4 Understand the concept of arrays, pointers, file and dynamic memory allocation and apply it for problem solving and also create new data types using structure, union and enum.

CO5 Understand how to decompose a problem into functions and assemblein to a complete program by means of modular programming possibly as a team.

CO-PO Mapping

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CS201.1	3	3	3	2	2								**3**	**3**	**3**
CS201.2	3	2	2	2	2								3	3	3
CS201.3	3	3	3	2	2								3	3	3
CS201.4	3	3	3	2	2								3	3	3
CS201.5	3	3	3	2	2								3	3	3

Fundamentals of Computer: (10 L)

History of Computer, Generation of Computer, Classification of Computers 1L

Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input& Output devices 2L

Binary and Allied number systems representation of signed & unsigned numbers, BCD, ASCII, Binary number Arithmetic – Addition and Subtraction (using 1's complement and 2's complement) 2L

Logic gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR - only truth tables, logic gate symbols and logic equations for gates only 1L

Assembly language, high level language, machine level language, compiler and assembler (basic concepts) 1L

Basic concepts of operating systems like MS DOS, MS WINDOW, UNIX 1L

Problem solving-Algorithm & flow chart 2L

C Fundamentals: (30 L)

Variable and Data Types:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements

3L

C Operators & Expressions:

Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields 5L

Branching and Loop Statements:

Statement and blocks, if - else, switch, goto and labels, Loops - while, for, do while, break and continue 3L

Fundamentals and Program Structures:

auto, external, static and register variablesFunctions, function types, function prototypes, functions returning values, functions not returning values, scope rules, recursion, C preprocessor and macro

6L

Arrays, Strings and Pointers:

One dimensional arrays, Two-dimensional arrays, Multidimensional arrays. Passing an array to a functionCharacter array and string, array of strings, Passing a string to a function, String related functionsPointers, Pointer and Array, Pointer and String, Pointer and functions, Dynamic memory allocation 6L

Files handling with C:

formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function 4L

Structures and Unions:

Basic of structures, arrays of structures, structures and pointers, structures and functions 3L

Text book:

Kerninghan B.W. & Ritchie D.M. - The C Programming Language

Gottfried - Programming with C Schaum

Kanetkar Y. - Let us C

Balaguruswamy - Programming in C

Recommended reference Books:

Pohl and Kelly - A Book on C

Kerninghan, B.W. - The Elements of Programming Style

Schied F.S. Theory and Problems of Computers and Programming

Rajaraman V. Fundamental of Computers

M.M.Oka Computer Fundamentals,EPH

Leon Introduction to Computers,Vikas

Leon- Fundamental of Information Technology,Vikas

Ram B. Computer Fundamentals, New Age International

Ravichandran D. Programming in C, New Age International

Xavier C. Introduction to Computers, New Age International

Course Name: Engineering Thermodynamics & Fluid Mechanics

Course Code: ME 201

Contacts: 3L + 1T = 4

Credits: 4

Pre requisites: Higher Secondary with Physics, Chemistry & Mathematics.

Course Objective: To understand the basic relationship of heat and work transfer for developing the primary concept of an engine.

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

1. Get the Knowledge about thermodynamic equilibrium, heat & work transfer,

2. Understand the First law of Thermodynamics and its application.

3. Apply the basic concepts of Heat Engine, Entropy from Second law of thermodynamics.

4. Analyse the thermodynamic characteristics of a pure substance and its application in power cycles (Simple Rankine cycles, Air Standard cycles)

5. Evaluation of basic principles of fluid mechanics, and ability to analyze fluid flow problems with the application of the momentum and energy equations.

CO-PO/PSO mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
ME201.1	3	2		2								2	2	2	
ME201.2	3	3		2								2	2	3	
ME201.3	3	3		3								3	3	3	
ME201.4	3	3		3								3	3	3	
Average	3	3		2								2	3	3	

Module 1 : 8L+3T

Basic Concepts of Thermodynamics

Introduction: Microscopic and Macroscopic viewpoints

Definition of Thermodynamic systems: closed, open and isolated systems Concept of Thermodynamics state; state postulate.

Definition of properties: intensive, extensive & specific properties. Thermodynamic equilibrium

Thermodynamic processes; quasi-static, reversible & irreversible processes; Thermodynamic cycles.Zeroth law of thermodynamics.Concept of empirical temperature.

Heat and Work

Definition & units of thermodynamic work.

Examples of different forms of thermodynamic works; example of electricity flow as work. Work done during expansion of a compressible simple system

Definition of Heat; unit of Heat

Similarities & Dissimilarities between Heat & Work

Ideal Equation of State, processes; Real Gas

Definition of Ideal Gas; Ideal Gas Equations of State.

Thermodynamic Processes for Ideal Gas; P-V plots; work done, heat transferred for isothermal, isobaric, isochoric, isentropic & polytropic processes.

Equations of State of Real Gases: Van der Waal's equation; Virial equation of state.

Properties of Pure Substances

p-v& P-T diagrams of pure substance like H2O

Introduction to steam table with respect to steam generation process; definition of saturation, wet & superheated status.

Definition of dryness fraction of steam, degree of superheat of steam.

Module 2 : 4L+3T

1st Law of Thermodynamics

Definition of Stored Energy & Internal Energy 1st Law of Thermodynamics for cyclic processes Non Flow Energy Equation

Flow Energy & Definition of Enthalpy

Conditions for Steady State Steady flow: Steady State Steady Flow Energy Equation

Module 3 : 6L+3T

2nd Law of Thermodynamics

Definition of Sink, Source Reservoir of Heat.

Heat Engine, heat Pump & Refrigerator; Thermal efficiency of Heat Engines & co-efficient of performance of Refrigerators

Kelvin – Planck & Clausius statements of 2nd Law of Thermodynamics Absolute or Thermodynamic scale of temperature, Clausius Integral Entropy

Entropy change calculation for ideal gas processes. Carnot Cycle & Carnot efficiency

PMM-2; definition & its impossibility

Module 4: 6L+3T

Air standard Cycles for IC engines

Otto cycle; plot on P-V, T-S planes; Thermal efficiency Diesel cycle; plot on P-V, T-S planes; Thermal efficiency

Rankine cycle of steam

Chart of steam (Mollier's Chart)

Simple Rankine cycle plot on P-V, T-S, h-s planes Rankine cycle efficiency with & without pump work (Problems are to solved for each module)

Module 5: 9L+3T

Properties & Classification of Fluids Ideal & Real fluids, Newton's law of viscosity; Newtonian and Non-Newtonian fluids, Compressible and Incompressible fluids

Fluid Statics Pressure at a point

Measurement of Fluid Pressure Manometers: simple & differential U-tube Inclined tube

Fluid Kinematics

Stream line, Laminar & turbulent flow external & internal flow Continuity equation

Dynamics of ideal fluids

Bernoulli's equation

Total head; Velocity head; Pressure head Application of Bernoulli's equation

Measurement of Flow rate : Basic principles

Venturimeter, Pilot tube, Orificemeter **Total: 33L+15T=48P**

(Problems are to be solved for each module)

Engineering Thermodynamics

Text :

1 Engineering Thermodynamics - P K Nag, 4th edn, TMH.

References :

1. "Fundamentals of Thermodynamics" 6e by Sonntag & Van Wylin published by Wiley India.
2. Engineering Thermodynamics – Russel & Adeliyi (Indian edition), OUP
3. Engineering Thermodynamics – Onkar Singhh, New Age International Publishers Ltd.
4. Basic Engineering Thermodynamics – R Joel, 5th Ed., Pearson

Fluid Mechanics

Text :

1. Fluid Mechanics and Hydraulic Machines - R K Bansal

References :

1. Introduction to Fluid Mechanics and Fluid Machines - S.K.Som and G.Biswas. 2nd edn, TMH
2. Fluid Mechanics by A.K.Jain.

Second Semester Practical

Course Name: Computer Fundamentals & Principle of Computer Programming Lab

Course Code: CS291

Contacts: 3P/Week

Credit: 2

Prerequisite: Basic knowledge of computer

Course Objective:

To develop an understanding of the design, implementation, and compilation of a C program, to gain the knowledge about pointers, a fundamental for understanding data structure issues, to understand the usage of user defined data type for application development.

CourseOutcomes(COs):

After completion of the course students would be able to

CO1: Understand and propose appropriate command or function in running system or developing program for engineering and mathematical problems depending on the platform used evening changed environment leading to their lifelong learning.

CO2: Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.

CO3: Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.
CO4: Explain and organized atain arrays, strings and structures and manipulate them through programs and also define pointers of different types and use the min defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution engineering and mathematical problem.
CO5: Prepare laboratory reports on interpretation of experimental results and analyse it for validating the same maintaining proper ethics of collaboration.

CO-PO/PSO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CS291 .1	3	3	3	3	3								3	3	3
CS291 .2	3	3	2	3	3								3	3	3
CS291 .3	3	3	3	3	3								3	3	3
CS291 .4	3	3	3	3	3								3	3	3
5	3	3	3	3	3								3	3	3

Experiment should include but not limited to the following:

- Some basic commands of DOS, Windows and Linux Operating System, File handling and Directory structures, file permissions, creating and editing simple C program, compilation and execution of C program.
- Writing C Programs on variable, expression, operator and type-casting.
- Writing C Programs using different structures of if-else statement and switch-case statement.
- Writing C Programs demonstrating use of loop (for loop, while loop and do-while loop) concept and use of break and continue statement.
- Writing C Programs demonstrating the concept of Single & Multidimensional arrays.
- Writing C Programs demonstrating the concept of Function and Recursion.

- Writing C Programs demonstrating concept of Pointers, address of operator, declaring pointers and operations on pointers.
- Writing C Programs demonstrating the concept of structures, union and pointer to structure.
- Writing C Programs demonstrating the concept of String and command line arguments.
- Writing C Programs demonstrating the concept of dynamic memory allocation.
- Writing C Programs demonstrating the concept of File Programming.

Text book:

1. Kerninghan B.W. & Ritchie D.M. - The C Programming Language
2. Gottfried - Programming with C Schaum
3. Balaguruswamy - Programming in C

Reference Books:

1. Pohl and Kelly - A Book on C
2. Kerninghan, B.W. - The Elements of Programming Style
3. Schied F.S. Theory and Problems of Computers and Programming

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Chemistry-1 Lab

Code: CH291

Contacts: 3

Credits: 2

Prerequisite: Knowledge of Chemistry in 10+2 standards

Course Objective: Acquiring knowledge on standard solutions and the various reactions in homogeneous and heterogeneous medium. Understanding the basic principles of pH meter and conductivity meter for different applications and analyzing water for its various parameters. Synthesis of Polymeric materials and Nano-materials.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand different types of instruments for estimation of small quantities chemicals used in industries, scientific and technical fields.
CO2	Analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.
CO3	Analyze different water quality parameters considering public health and environment
CO4	Synthesize drug and polymer materials considering public health and environmental safety

CO5 Design innovative experiments applying the fundamental theory of chemistry.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CH291.1	2	2	3	2		2						2			
CH291.2	2	2	3	2		2						2			
CH291.3	2	2	3	2		2						2			
CH291.4	2	2	3	2		2						2			
Average	3	3	3	3		2						2		2	2

List of Experiments:

1. To Determine the alkalinity in given water sample.

2. Redox titration (estimation of iron using permanganometry)

3. To determine calcium and magnesium hardness of a given water sample separately.

4. Preparation of phenol-formaldehyde resin (Bakelite).

5. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).

7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.

8. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.

9. Determination of dissolved oxygen present in a given water sample.

10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).

Innovative experiment:

Preparation of silver nano-particles.

Note: From the list of 10 (Ten) experiments a minimum of 7 (seven) experiments shall have to be performed by one student of which Sl. No. 4 (Preparation of Bakelite) has to be mandatory.

Course Name: Basic Electrical Engineering Lab

Course Code: EE291

Contacts: 3P

Credits: 2

Prerequisite: Knowledge of Mathematics and Physics in 10+2 standards

Course Objective: Provide knowledge for the analysis of basic electrical circuit, to introduce electrical appliances, machines with their respective characteristics. The ability to conduct testing and experimental procedures on different types of electrical machines and to analyze the operation of electric machines under different loading conditions.

Course Outcome After completion of this course student will be able to

EE291.1: Understand the response of any electrical circuit and network
EE291.2: Apply the operation of an electrical apparatus
EE291.3: Analyse a suitable measuring instrument for a given application and Evaluate the various parts and test of DC machine and transformer.

CO-PO/PSO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EE 291.1	2	2	3	3					3	3		2	2	2
EE 291.2	3	3	2	3					3	3		3	2	2
EE 291.3	2	3	3	2					2	3		2	2	2

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List of Experiments:

1. Characteristics of Fluorescent ,Tungsten and Carbon filament lamps
2. Verification of Thevenin's and Norton's Theorem
3. Verification of Superposition Theorem
4. Calibration of Ammeter and Wattmeter
5. Study of R-L-C series circuit
6. Open circuit and short circuit test of a single phase Transformer
7. Starting, Reversing of a and speed control of D.C shunt motor
8. Test on single phase Energy Meter
9. Familiarization of PMMC and MI type Meter
10. Familiarization with house wiring practice

Course Name: Engg. Drawing & Graphics
Course Code: ME291
Contacts: 3P/Week
Credit: 2

Pre requisites: Higher Secondary with Physics, Chemistry & Mathematics

Course Objective: To learn basics of engineering drawing or drafting as a tool for expressing an engineering design

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

1. Learn the basics of drafting
2. Understand the use of drafting tools which develops the fundamental skills of industrial drawings.
3. Apply the concept of engineering scales, dimensioning and various geometric curves necessary to understand design of machine elements.
4. Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.
5. Evaluate the design model to different sections of industries as well as for research & development.

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 291.1	2			2									2	2	2
ME 291.2	2			2									2	2	2
ME 291.3	3			2									2	2	2
ME 291.4	3			3									3	3	2
ME 291.5	3	2		3	2								3	3	2

Course Contents:

1. Lines, Lettering, Dimensioning, Scales (Plain scale & diagonal Scale).

2. Geometrical Construction and Curves – Construction of Polygons, Parabola, Hyperbola & ellipse

3. Projection of Points, Lines and Surfaces – orthographic projection- first angle and third angle projection, projection of lines and surfaces- Hexagon

4. Projection of Solids – (Cube, Pyramid, Prism, cylinder and Cone

5. Sectional Views – for simple sold objects

6. Introduction to Computer Aided Drafting – using auto cad & / or similar software- Introduction to Cartesian and polar coordinate systems, absolute and relative coordinates; Basic editing commands: line, point, trace, rectangle, polygon , circle, arc, ellipse, polyline; editing methods; basic object selection methods – window and crossing window, erase, move, copy, offset, fillet, chamfer, trim, extend, mirror; display command; zoom, pan, redraw, regenerate; simple dimensioning and text, simple exercises.

Department of Mechanical Engineering

COMMON AUTONOMOUS 3th Semester CURRICULUM & SYLLABUS

Sl. No.	Subject Type	Subject Code	Subject Name	Contact hours/Week				Total Credits
				L	T	P	Total	
	A. THEORY							
1	PC	ME 301	APPLIED THERMODYNAMICS	3	0	0	3	3
2	PC	ME 302	STRENGTH OF MATERIALS	3	0	0	3	3
3	PC	ME 303	FLUID MECHANICS	3	0	0	3	3
4	ES	EE(ME)301	ELECTRICAL MACHINES	3	0	0	3	3
5	BS	M(ME) 301	MATHEMATICS- III	3	0	0	3	3
6	BS	PH(ME) 301	PHYSICS- II	3	0	0	3	3
Total of Theory							**18**	**18**
	B. PRACTICAL							
7	PC	ME 391	STRENGTH OF MATERIALS LAB	0	0	3	3	2
8	PC	ME 392	MACHINE DRAWING- I	0	0	3	3	2
9	ES	EE(ME)391	ELECTRICAL MACHINES LAB	0	0	2	2	1
10	BS	PH(ME)391	PHYSICS-II LAB	0	0	3	3	2
Total of Practical							**11**	**7**
	C. SESSIONAL							
11	MC	MC 381	TECHNICAL SKILL DEVELOPMENT	0	0	2	2 units	0
Total: Eleven				**18**	**0**	**13**	**31**	**25**

Course Code: ME 301
Course Name: APPLIED THERMODYNAMICS
Contact Hour/Week (L:T:P) : 3L
Credits**: 3**
Total Lectures**: 36L**
Full Marks = **100** (30 for Continuous Evaluation; 70 for End Semester Exam.)
Pre requisites: Basic Thermodynamics (ME201)

Course Objectives: To analyze all relationships of heat and work transfer and develop detailed knowledge of vapour and gas power systems.

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

1. Understand the second law limitation of thermodynamic efficiencies and sort out realistic and unrealistic thermodynamic system claims.
2. Apply Entropy and Energy analysis of thermal systems to evaluate sustainability of practical equipment in industries.
3. Able to analyze the performance variables of vapor power and gas power cycles, evaluate losses and learn the modifications practiced in modern power sectors.
4. Get idea about gas compressors and evaluate the basics of Refrigeration & Air Conditioning to develop various project works.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME301.1	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
ME301.2	2	3	2	3	-	-	2	-	-	-	-	3	-	3	-
ME301.3	2	3	3	3	-	-	2	-	-	-	-	2	-	3	-
ME301.4	2	2	3	2	-	-	2	-	-	-	-	2	-	1	-
Avrg.	**2.25**	**2.5**	**2.75**	**2.66**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2.33**	**-**	**2.5**	**-**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	Review of fundamentals; Heat and work, First law for unsteady flow system.	2
2	Pure Substance, Properties of pure substance; Phases of pure substances- Phase rule; Phase Change Processes of Pure Substances – triple pt., critical pt.; Property diagrams of Phase change Processes; P-V-T surface for phase change; Property tables of real substances – compressed liquid, saturated, wet & superheated vapor.	2
3	The 2^{nd} Law of Thermodynamics; the corollaries & their proofs; the property of entropy; entropy change of apure substance; Tds equations and calculation of entropy change; concept and uses of entropy; the entropy generation principle. The second law of thermodynamics for an open system.	3
4	Exergy analysis, Reversible work and irreversibility, Exergy change of a system, 2^{nd} Law efficiency.	3

6	I.C.Engine, Air Standard cycles; Otto, Diesel, Dual Combustion.	5
7	Vapour power cycles & its modifications, Reheat & Regenerative cycle for steam, Binary cycle and cogeneration.	5
8	Reciprocating air compressors; the compressor cycle with and without clearance, efficiencies; volumetric efficiency & its effect on performance; multistaging.	5
9	Refrigeration cycles, reversed carnot cycle; components and analysis of simple vapour compression Refrigeration cycle, Actual Refrigeration cycles, Vapour Absorption Refrigeration cycle.	5
10	Use of psychometric charts & processes for air conditioning	3

Recommended Books:

1. Engineering Thermodynamics - 4e by P.K .Nag, TMH
2. Fundamentals of Thermodynamics - 6e by Sonntag, Borgnakke & Van Wylen, John Wiley.
3. Engineering Thermodynamics - P.K Chattopadyay, OUP
4. Thermodynamics- an Engineering approach - 6e, Cengel & Boles,TMH
5. Engineering Thermodynamics- M. Achyuthan, PHI

Course Name: **Strength of Materials**
Course Code: **ME302**
Contact Hour/Week(L:T:P) **: 3L**
Credit :**3**
Total Lectures**: 34L**
Full Marks = **100** (Internal Evaluation-30; End Semester Exam.-70)

Pre requisites: Engineering Mechanics, Basic Physics and Mathematics.
Course Objectives: To impart detailed knowledge on material strength while subjected to various stress and strain in mechanical bodies.

Course Outcomes:

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

1. Understand the knowledge of mathematics in analyzing tensile and compressive strength as well as able to understand and identify compound stresses developed in a material.
2. Apply to determine shear force and bending moment for designing system components to meet desired characteristics from economic, environmental and social considerations.
3. Able to analyze the beam stresses for a safe and sustainable design application and apply in constructive projects.
4. Evaluate the effect of torsion on beams and columns for a variety of loading conditions which boosts industrial skills.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME302.1	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
ME302.2	2	3	3	3	-	-	-	-	-	-	-	2	3	-	-
ME302.3	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-
ME302.4	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-
Avrg.	**2.75**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Course Contents:

Module No.	Syllabus for Autonomy	Number of lectures
1	***Simple Stress & Strain*** Concept of rigid body mechanics, General meaning of Stress, Simple Stress, Normal Stress & True Stress, unit of Stress,Shear Stress, Shear Stain, Hook's Law, Stress- Stain Diagram, Elastic Constant, Poison's ratio, Bars width, Cross section Varying in steps & Bars with continuously varying Cross section,Compound Bar.Volumetric Strain, Relation between modulus of elasticity & Modulus of rigidity, Relation between modulus of elasticity & Bulk Modulus. Stain Energy due to direct Stress and impact load, Stain Energy due to Shear Stress,	8
2	***Compound Stress*** Bi axial stress, Mohr's circle, Subjected unidirectional direct & Bi-axial direct stress.Stress in thin wall pressure vessels, longitudinal & hoop stress, its relations	4
3	***Shear force and Bending Moment in statically determinate beam*** Shear force and Bending Moment, sign convention, relationship Between load intensity sheer force and bending moment, shear Force and bending moment diagram ***SFD and BMD for standard cases*** a) Cantilever subjected to a central concentrated load b) Cantilever subjected to a uniformly distribute load (UDL) c) Cantilever subjected to a uniformly varying load (UVL) ***Simply Supported Beam*** a) Simply Supported Beam subjected to a central concentrated load b) Simply Supported Beam subjected to a uniformly distribute load (UDL) c) Simply Supported Beam subjected to an external moment at a distance x. d) Over hanging Beam subjected to a concentrated load at free ends	7

4	***Stresses in Beam*** Theory of Simple Bending, assumptions in Simple theory of bending, Relationship between bending stress & radius of curvature, Relationship between moment & radius of curvature, Moment Carrying capacity of a section of uniform strength, Leaf Spring, shear stress in beam of few standard sections,Rectangular section, Built up section	5
5	**Torsion** **Introduction** Pure torsion, Assumptions in the theory of pure torsion Derivation of torsional equation, Polar moment, power Transmission, torsional rigidity, Stiffness of shaft, Stepped Shaft and compound shaft, coupling, Strain energy in torsion, Closed coil helical spring	5
6	**Columns and struts** Short column, long column subjected to a axial load Euler's theory for axial loaded elastic long column for a) Both end hinged, b) One end hinged and other end free c) Both end fixed, d) one end fixed other end hinged, Effective length, Limitations of Euler's theory, Rankine's formula	5

Course Name: **Fluid mechanics**
Course Code: **ME303**
Contact Hour/Week(L:T:P) **: 3L**
Credit :**3**
Contact Hours/Week (L:T:P): **3:0:0**
Total Lectures**: 36L**
Full Marks = **100** (30 for Continuous Evaluation; 70 for End Semester Exam.)
Pre requisites: Basic fluid mechanics (ME201)

Course Objectives: To introduce and explain fundamentals of Fluid Mechanics which is useful in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics, Heat Transfer, Power Plant etc.

Course Outcomes:

Upon successful completion of this course, the student will be able to:
1. Get knowledge about fluid flow properties and analyze hydrostatic forces on flat or curved surfaces.
2. Apply the detailed analysis of kinematics and dynamics of fluid for laminar and turbulent flow and exploit the conservation equations for the flow regimes of practical interest.
3. Learn and analyse boundary layer theory for a variety of constraints and understand the basics of a turbulent flow.
4. Evaluate the basics of compressible flow and apply for dimensional analysis for practical prototyping.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME303.1	2	2	3	-	-	-	-	-	-	-	-	-	3	2	-
ME303.2	3	3	-	2	-	-	-	-	-	-	-	-	3	2	-
ME303.3	3	2	-	2	-	-	-	-	-	-	-	3	2	2	-
ME303.4	2	2	2	2	-	-	2	-	-	-	-	-	3	-	-
Avrg.	**2.5**	**2.25**	**2.5**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**2.75**	**2**	**-**

Course Contents:

Module No.	Syllabus	Contact Hrs. / No. of Lectures
1	**Introduction:** Introduction to Fluid Mechanics - Fluid, Fluid types, Introduction of Viscosity.	01
2	**Fluid statics:** Forces on submerged surfaces; forces or vertical, horizontal, inclined and curved surfaces, Center of pressure. Stability of floating bodies, Metacentre. **Fluid kinematics:** fluid flow and classifications. Continuity equation in 1D & 3D. Potential flow & Stream function; types of flow lines. **Dynamics of fluid:** equations of motion; Euler's equation; Navier-Stokes equation; Bernoulli's equation; Applications of Bernoulli's equation.	03 03 03
3	**Viscous flow:** Flow through circular pipes, Flow between parallel plates, momentum and energy correction factors **Elementary Turbulent Flow:** Reynold's experiment, characteristics of turbulent flow, velocity distribution in turbulent flow through pipes in terms of average velocity.	03 02
3	**Flow through pipes:** Fluid friction in pipes, head loss due to friction. Darcy–Weisbach equation of friction loss; hydraulic grade line and total energy line. Variation of friction factor with wall roughness – Moody's chart. Minor losses in pipes.	04
4	**Orifices, mouthpieces, notches and weirs:** Basic principle for flow through orifices, V-notches (rectangular-v), weirs (rectangular).	03
5	**Boundary layer flow:** Definition; Boundary layer separation – basic concept. Drag force on a flat plate due to boundary layer, Turbulent layer on a flat plate.	04
6	**Forces on submerged bodies:** Flow of fluid around submerged bodies; basic concepts of drag and lift.	03

7	**Dimensional Analysis and Model studies:** Dimensions and dimensional homogeneity, Importance and use of dimensional analysis. Buckingham's Pi theorem with applications. Geometric, Kinematic and Dynamic similarity. Non Dimensional Numbers.	03
8	**Compressible Flow:** Thermodynamic relations, Basic equations of compressible flow, velocity of pressure wave in a fluid, Mach number, Stagnation properties, area velocity relationship, flow of compressible fluid through orifices and nozzles fitted to a large tank.	04

Books Recommended

1. Introduction to Fluid Mechanics & Fluid Machines – Som & Biswas, TMH
2. Fluid Mechanics & Machinery – R.K.Bansal, Luxmi Publications.
3. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH
4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.
5. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.
6. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.
7. Mechanics of Fluid – Bernard Massey, Taylor & Francis.

Course Name Electrical Machine
Course Code EE(ME)301
Course Credit 3
Contact Hour 3L

Pre-requisite Basic Electrical

Course Outcome : On completion of the course students will be able to

1. Understand and remember the working of any electrical machine under loaded and unloaded conditions.
2. Apply and explain the principle of operation and performance of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
3. Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
4. Evaluate the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

Course Outcome

On completion of the course students will be able to

1. Understand and remember the working of any electrical machine under loaded and unloaded conditions.
2. Apply and explain the principle of operation and performance of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
3. Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
4. Evaluate the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

Course Articulation Matrix:

CO Codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
EE(ME)301.1	2	3	2	3	2	2	-	-	-	-	-	-	-	3	2
EE(ME)301.2	-	2	3	2	3	3	-	-	-	2	-	-	-	3	-
EE(ME)301.3	2	3	3	2	3	-	3	-	-	-	-	-	-	2	-
EE(ME)301.4	-	-	3	1	2	-	-	-	-	2	-	-	-	2	3
Avrg.	**2**	**2.66**	**2.75**	**2**	**2.5**	**2.5**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2.5**	**2.5**

Course Content

Module-I: DC Machines:

A general overview of rotating machines- Law of induction, interactive force, reluctance torque.
Construction and type of d.c. machine, EMF equation. (with Numerical). OCC and Voltage build-up in d.c. generator - concept of critical resistance & critical speed. External Characteristics.Armature reaction - function of Interpoles & Compensating windings.Commutation process - concept of reactance voltage.
Concept of back e.m.f. - Speed & Torque equation of d.c. motor (with Numerical). Characteristics of different d.c. motors. Speed control of DC motor. Losses and Efficiency - Hopkinson's and Swinburne's test (with Numerical).Application of d.c. Machine: Generator application, Motor application

Module-II: 3-Phase Induction machine:

Construction of 3-phase induction motor. Production of rotating magnetic field (concept only) - Working principle of 3-phase induction motor. Concept of synchronous speed & slip. Equation of rotor induced e.m.f., current and frequency (Numerical). Phasor diagram (at no-load & running condition). Equivalent circuit - No-load and Blocked rotor test (Numerical). Torque equation.Torque-slip characteristic. Power flow in 3-phase induction motor (Numerical). Speed control & Braking of Induction motor. Starting methods of 3-phase induction motor – DOL, Auto-transformer & Star-Delta starter. Industrial application of 3-phase Induction motor

Module-III: Synchronous Machines:

Construction & Types of synchronous machines.Method of excitation system.Working principle of synchronous machines - generator & motor modes.Armature reaction at different power factor - concept of synchronous reactance.Voltage regulation by synchronous impedance method (with Numerical). Synchronous machine connected to infinite bus, effect of change of excitation and speed of prime mover. Synchronization of two or more alternators and an alternator with infinite bus. Load sharing between them.Principle of operation of synchronous motor- its starting techniques - Damper winding & Hunting. 'V' Curves – Synchronous condenser

Module-IV: Fractional Kilowatt motors:

Single phase Induction motor: Construction, Double revolving field theory. Starting methods, Speed - torque characteristics & Application
Principle of operation & Application of Stepper motors

Principle of operation of Welding Transformer

Text Books:
1. P.S. Bhimra, Electrical Machinery, Khanna Publishers.
2. D.P. Kothari & I.J Nagrath, Electric machines, Tata Mc Graw-Hill Publishing Company Limited.
3. P.K. Mukherjee & S. Chakrabarty, Electrical Machines, Dhanpat Rai Publication.

Reference Books:
1. Bhag S. Guru and H.R. Hiziroglu, Electric Machinery & Transformers, Oxford University press.
2. R.K. Srivastava, Electrical Machines, Cengage Learning.
3. Alexander S Langsdorf, Theory of Alternating Current Machinery, Tata Mc Graw Hill.
4. M.G.Say, The performance and Design of Alternating Current Machines, CBS Publishers & Distributors.
5. Irving L Koskow, Electric Machinery & transformer, Prentice Hall India.

Course Name: Mathematics-III
Course Code: M(ME) 301
Contact: 3L+1T
Credits: 4
Total Lectures: 44L
Full Marks = 100 (30 for Continuous Evaluation; 70 for End Semester Exam.)

Prerequisite: Any introductory course on Calculus and Combinatorics.
Course Objective: The purpose of this course is to provide fundamental concepts of Fourier Series & Fourier Transform, Calculus of Complex Variables, Probability Distribution, Correlation & Regression, Ordinary Differential Equation, Partial Differential Equations.

Course Outcome:
On successful completion of the learning sessions of the course, the learner will be able to

M(ME)301.1: Recall the distinctive characteristics of mathematical approaches like Fourier Series & Fourier Transform, Calculus of Complex Variables, Probability Distribution, Correlation & Regression, Ordinary Differential Equation, Partial Differential Equations.

M(ME)301.2: Understand the theoretical workings of mathematical approaches like Fourier Series & Fourier Transform, Calculus of Complex Variables, Probability Distribution, Correlation & Regression, Ordinary Differential Equations, and Partial Differential Equations to evaluate the various measures in related field.

M(ME)301.3: Apply various principles of Fourier Series & Fourier Transform, Calculus of Complex Variables, Probability Distribution, Correlation & Regression,

M(ME)301.4: Evaluate various principles of Differential Equations, Partial Differential Equations to solve various problems.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
M(ME) 301.1	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-
M(ME) 301.2	-	3	2	2	-	-	-	-	-	-	-	2	3	-	-
M(ME) 301.3	-	3	2	2	-	-	-	-	-	-	-	-	2	-	-
M(ME) 301.4	3	3	2	-	-	-	-	-	-	-	-	2	3	-	-
Avrg.	3	3	2	2	-	-	-	-	-	-	-	2	2.75	-	-

Course Contents:

Module No.	Syllabus	No. of weekly classes
I	**Fourier Series and Fourier Transform:** Sub-Topics: Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave. Euler's Formulae for Fourier Series, Fourier Series for functions of period 2π, Fourier Series for functions of period, Dirichlet's conditions, Sum of Fourier series. Examples. Theorem for the convergence of Fourier Series (statement only). Fourier Series of a function with its periodic extension. Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (statement only).Examples	**10L**
	Fourier Transform: Sub-Topics: Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Sine and Cosine Integral Theorem (statement only), Fourier Cosine & Sine Transforms. Fourier, Fourier Cosine & Sine Transforms of elementary functions. Properties of Fourier Transform: Linearity, Shifting, Change of scale, Modulation. Examples.Fourier Transform of Derivatives.Examples.Convolution Theorem (statement only), Inverse of Fourier Transform, Examples.	
II	**Probability Distributions:** Definition of random variable.Continuous and discrete random variables. Probability density function & probability mass function for single variable only. Distribution function and its properties (without proof).Examples. Definitions of Expectation & Variance, properties & examples. Some important discrete distributions: Binomial, Poisson.	**10L**

	Continuous distributions: Normal. Determination of Mean, Variance and standard deviation of the distributions. Correlation &Regression analysis, Least Square method, Curve fitting.	
III	**Calculus of Complex Variable** Introduction to Functions of a Complex Variable, Concept of Limit, Continuity and Differentiability. Analytic functions, Cauchy-Riemann Equations (statement only). Sufficient condition for a function to be analytic. Harmonic function and Conjugate Harmonic function, related problems. Construction of Analytic functions: Milne Thomson method, related problems. **Complex Integration.** Concept of simple curve, closed curve, smooth curve & contour. Some elementary properties of complex Integrals. Line integrals along a piecewise smooth curve. Examples.Cauchy's theorem (statement only).Cauchy-Goursat theorem (statement only).Examples.Cauchy's integral formula, Cauchy's integral formula for the derivative of an analytic function, Cauchy's integral formula for the successive derivatives of an analytic function.Examples.Taylor's series, Laurent's series. Examples. **Zeros and Singularities of an Analytic Function & Residue Theorem**. Zero of an Analytic function, order of zero, Singularities of an analytic function. Isolated and non-isolated singularity, essential singularities. Poles: simple pole, pole of order m. Examples on determination of singularities and their nature. Residue, Cauchy's Residue theorem (statement only), problems on finding the residue of a given function, Introduction Conformal transformation, Bilinear transformation, simple problems.	**12L**
IV	**Basic concepts of** Partial **differential equation (PDE)**: Origin of PDE, its order and degree, concept of solution in PDE. Introduction to different methods of solution: Separation of variables, Laplace & Fourier transform methods. Topic: Solution of Initial Value & Boundary Value PDE's by Separation of variables, Laplace & Fourier transform methods. PDE I: One dimensional Wave equation. PDE II: One dimensional Heat equation. PDE III: Two dimensional Laplace equation. **Introduction to series solution of Ordinary differential equation (ODE)**:Validity of the series solution of an ordinary differential equation. General method to solve $P_o y''+P_1 y'+P_2 y=0$ and related problems to Power series method**.** Brief review on series solution of Bessel & Legendre differential equation. Concepts of generating functions.	**12L**

Recommended Books:

1.Rathor, Choudhari,:Descrete Structure And Graph Theory.
2. Gupta S. C and Kapoor V K: Fundamentals of Mathematical Statistics - Sultan Chand & Sons.
3.Lipschutz S: Theory and Problems of Probability (Schaum's Outline Series) - McGraw Hill Book. Co.
4. Spiegel M R: Theory and Problems of Probability and Statistics (Schaum's Outline Series) - McGraw Hill Book Co.
5. Goon A.M., Gupta M K and Dasgupta B: Fundamental of Statistics - The World Press Pvt. Ltd.
6. Spiegel M R: Theory and Problems of Complex Variables (Schaum's Outline Series) - McGraw Hill Book Co.

7. Bronson R: Differential Equations (Schaum's Outline Series) - McGraw Hill Book Co.
8. Ross S L: Differential Equations - John Willey & Sons.
9. Sneddon I. N.: Elements of Partial Differential Equations - McGraw Hill Book Co.
10. West D.B.: Introduction to Graph Theory - Prentice Hall
11. Deo N: Graph Theory with Applications to Engineering and Computer Science - Prentice Hall.
12. Grewal B S: Higher Engineering Mathematics (thirtyfifthedn) - Khanna Pub.
13. Kreyzig E: Advanced Engineering Mathematics - John Wiley and Sons.
14. Jana- Undergradute Mathematics
15. Lakshminarayan- Engineering Math 1.2.3
16. Gupta- Mathematical Physics (Vikas)
17. Singh- Modern Algebra
18. Rao B: Differential Equations with Applications & Programs, Universities Press
19. Murray: Introductory Courses in Differential Equations, Universities Press
20. Delampady, M: Probability & Statistics, Universities Press
21. Prasad: Partial Differential Equations, New Age International
22. Chowdhury: Elements of Complex Analysis, New Age International
23. Bhat: Modern Probability Theory, New Age International
24. Dutta: A Textbook of Engineering Mathematics Vol.1 & 2, New Age International
25. Sarveswarao: Engineering Mathematics, Universities Press
26. Dhami: Differential Calculus, New Age International

Course Name: **Physics-II**
Course Code: **PH-(ME)301**
Credit: **3**
Contact Hours/Week (L:T:P): **3:0:0**
Total Lectures**: 33L**
Full Marks = **100** (**Internal Assessment-30**; **End Semester Exam-70**)

Course Objective:
To understand and apply the knowledge of advance physics in analyzing and solving problems of Mechanical Engineering

Course Outcome:
At the end of the course students' should have the

CO1: ability to apply the knowledge of • Electrostatics to explain actions of dielectrics • Magnetism and semiconductor physics in data storage • Schrödinger equation in physical problems including semiconductor devices • Band theory explain electrical conductivity of metal, insulators and semiconductor
CO2: Ability to analyze • Use of insulators and magnetic materials in modern electrical circuitry and storage purposes. • The inability of direct measurement technique in quantum mechanics and role of operators • The need of suitable theoretical methods to explain electron transport in all types of materials • Role of defected solid structure in perspective of mechanical engineering
CO3: ability to design and realize • Mathematical framework for making measurements in quantum mechanical situation\

Mechanical engineering with new generation materials like Graphene
CO4: Ability to conduct experiments using Dielectric under alternating field Intrinsic semiconductor under electric and magnetic field Various types of magnetic materials Semiconductor Photovoltaic cell, Light emitting diodes, Light dependent resistor Band theory and electron transport in a semiconductor

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
PH-(ME)301.1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
PH-(ME)301.2	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
PH-(ME)301.3	2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
PH-(ME)301.4	2	-	2	-	-	-	-	-	-	-	-	-	3	-	-
Avrg.	2.25	2.66	2	-	-	-	-	-	-	-	-	-	2.75	-	-

Course Contents:

Module No.	Syllabus	No. of Lectures
Module 1:	**Electric and Magnetic properties of materials (7L)**	
	Module 1.01 : Insulating materials: Dielectric Material: Concept of Polarization, the relation between **D, E** and **P**, Polarizability, Electronic (derivation of polarizability), Ionic, Orientation & Space charge polarization (no derivation), internal field, Claussius Mossotti equation, ferroelctric and piezoelectrics (Qualitative study).	3L
	Module 1.02 : Magnetic materials and storage devices: Magnetic Field & Magnetization M, relation between **B, H, M**. Bohr magneton,	4L

	susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, concept of θ_p , Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.)	
Module 2	**Ultrasound and infrasound** **Ultrasound-**Introduction, definition and properties –Production of ultrasonics by Piezo-electric crystal and magnetostriction method; Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing, cavitations, measurement of gauge), **Infrasound** – Introduction and definition, production, application:	4L
Module 3	**Quantum Mechanics-II (7L)** Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunneling (solve only $E<V_0$)	3L 4L
Module 4:	**Statistical Mechanics (4L)** Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)-physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level.	4L
Module 5:	**Solid state physics (8L)** **5.01:** Introduction to Band theory (mention qualitatively improvement over free electron theory)- Kronig-Penny model (qualitative treatment)-Energy-band (E-k) diagram, formation of allowed and forbidden energy bands, Concept of effective mass – electrons and holes, crystal momentum. **5.02: Defects**: Point defects; line defects; Dislocations, Types of dislocations, Planar defects, stacking faults, twins, grain boundaries, defect propagation (qualitative). **5.03: Vibration in solids:** Lattice vibrations – Mono and diatomic lattice, concept of phonon, specific heat of solids-Dulong-Pettit law, Einstein, Debye theory (qualitative discussion).	3L 3L 2L
Module 6	**Physics of Nanomaterials** Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, grapheme, electronic, environment, medical).	3L

Course Name: **PHYSICS-II Lab**
Course Code: **PH (ME) 391**
Credits: **2**
Contact Hours/Week (L:T:P): **0:0:3**
Examination Scheme: **Total 100** [**Internal Assessment -** 40, **End Semester Exam –** 60]

*At least 7 experiments to be performed during the semester

Course Objective: To enable students carry out several experiments on applied physics and apply the knowledge in innovative solution in mechanical engineering.

Course Outcome: At the end of the course students' should have the

CO1: Ability to define, understand and explain • instruments used in spectroscopy • Oscilloscope (digital) • Solenoidal field, Magnetization, demagnetization • Cathitometer
CO2: Ability to apply the knowledge of • Hysteresis in magnetic storage • Photovoltaic action in solar cell • Band theory
CO3: Ability to analyze • Role of magnetic field in changing resistance of a sample
CO4:Ability to conduct experiments using • Intrinsic semiconductor • Temperature sensor • Photovoltaic cell, Light emitting diodes, Light dependent resistor • Various types of magnetic materials • Curie temperature of the given ferroelectric material

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PH(ME) 391.1	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
PH(ME) 391.2	2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
PH(ME) 391.3	2	3	2	2	-	-	-	-	-	-	-	-	3	2	-
PH(ME) 391.4	2	-	2	3	-	-	-	-	2	-	-	-	3	3	-
Avrg.	2.25	2.66	2	2.25	-	-	-	-	2	-	-	-	2.75	2.25	-

Course Contents:

Module	SYLLABUS - Description of the experiment
Module 1: Electric and Magnetic properties of materials	1. Study of dipolar magnetic field behavior. 2. Study of hysteresis curve of a ferromagnetic material using CRO. 3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup. 4. Measurement of Curie temperature of the given sample. 5. Determination of dielectric constant of given sample (frequency dependent)/Measurement of losses in a dielectric using LCR circuits
Module 2: Ultrasound and infrasound	6. Determination of velocity of ultrasonic wave using piezoelectric crystal.
Module 3: Quantum Mechanics-II	7. Determination of Stefan's radiation constant. 8. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power. 9. Measurement of specific charge of electron using CRT.
Module 5: Solid state physics (8L)	10. Study of lattice dynamics. 11. Determination of band gap of a semiconductor. 12. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor
Probable experiments beyond the syllabus:	1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method. 2. Determination of thermal conductivity of a good conductor by Searle's mothod. 3. Study of I-V characteristics of a LED. 4. Study of I-V characteristics of a LDR 5. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.

Course Name: Electrical Machines Lab
Course Code: ME(EE)391
Contact Hour: 3 hr./week
Semester: 3
End Semester Examination: 60 marks
Internal Assessment: 40 marks
Course Outcome
On completion of the course students will be able to

1. Understand and get the knowledge of working of any electrical machine under loaded and unloaded conditions.
2. Apply and Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
3. Troubleshoot the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

4. Evaluate the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

Course Articulation Matrix:

CO Codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ME(EE)391.**1**	-		3	2	-	-	-	-	2	-	-	-	3	2	2
ME(EE)391.**2**	-	-	2	3	-	-	-	-	3	-	-	-	2	2	3
ME(EE)391.**3**	2	-	3	3	-	-	-	-	3	-	-	-	2	3	3
ME(EE)391.**4**	3	-	3	3				-	3	-	-	-	3	3	3
Avrg.	**2.5**	-	2.75	2.75				-	2.75	-	-	-	**2.5**	**2.5**	2.75

Course Content:

At least 8 (eight) of the following experiments to be conducted.

1. Study of the characteristics of a separately excited d.c. generator.
2. Plot the O.C.C. of a d.c. generator & find the critical resistance.
3. Perform load test of d.c. shunt motor to determine efficiency and study the different characteristics of d.c. shunt motor.
4. Perform load test of d.c. series motor to determine efficiency and study the different characteristics of d.c. series motor.
5. Determine the efficiency of a D.C. motor by Swinburn's test.
6. Study different type of starting of 3 phase induction motor & their comparison.
7. Perform No-load test and Blocked-rotor test on 3-phase induction motor & draw the equivalent circuit from the two tests.
8. Study of performance of three phase squirrel- cage Induction motor –determination of Iron-loss, friction & windage loss.
9. Study the effect of capacitor on the starting and running condition of a single-phase induction motor.
10. Perform the load test on 3-phase induction motor and to study the performance characteristics of the motor.
11. Find the percentage regulation of alternator by synchronous impedance method at various power factor and load.
12. Plot V-curve & inverted V-curve of the synchronous motor.

Course Name: **Strength of Material Lab**
Course Code: **ME 391**
Credit :**2**
Contact Hours/Week (L:T:P): **0:0:3**
Full Marks = **100(Internal Evaluation - 40; End Semester Exam Evaluation - 60.)**

Course Objective:

To make students learn evaluating mechanical properties of a given specimen or structure.

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

1. Understand to measure tensile and compressive strength of a specimen for applying in a practical design based project work.
2. Understanding and applying the concept of bending in beams and to analyze the bending stresses which further build the foundation of using modern analysis softwares.
3. Analyse hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures or machines.
4. Evaluate the capacity of a material to withstand torsional stresses for a safe and sustainable design of machine elements.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ME391.1	3	2	3	2	-	-	-	-	-	-	-	-	2	2	-
ME391.2	3	2	2	3	-	-	-	-	-	-	-	-	3	2	2
ME391.3	2	3	3	2							-	-	2	-	**2**
ME391.4	2	3	3	3	-	-	-	-	-	-	-	-	2	2	-
Avrg.	**2.5**	**2.5**	**2.75**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**2**	**2**

Course Content:

Experiment No.	Description
1	Tension Test of ductile materials: stress-strain diagram, determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas, Observation of fractured surfaces.
2	Compression of a brittle material
3	Bend and rebend test of flat test pieces, determination of bending stresses
4	Torsion Test of a sample specimen.
5	Hardness Tests: Brinnel and Rockwell tests of sample specimen
6	Impact tests: Charpy and Izod tests of sample specimen.

Course Name: **Machine Drawing I**
Course Code: **ME 392**
Credit :**2**
Contact Hours/Week (L:T:P): **0:0:3**
Full Marks = **100** (**Internal Evaluation - 40; End Semester Exam Evaluation - 60**.)

Prerequisite: Basic knowledge of Machine elements, engineering drawing/drafting

Course Objective: The objective of this lab is to practically demonstrate the failure criteria of different mechanical elements or bodies.

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

1. To gain knowledge about the isometric view of a given three dimensional object/part.
2. To understand and draw the orthogonal projection of a solid body and assemble drawing using part drawings.
3. Apply and evaluate various materials and Mechanical components conventionally.
4. Analyse and evaluate the shape and structure of different types of screws, keys and Couplings.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME392.1	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
ME392.2	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
ME392.3	2	3	2	-	-	-	-	-	-	-	-	-	2	-	2
ME392.4	3	2	3	-	-	-	-	-	-	-	-	-	3	-	3
Avrg.	2.75	2.25	2.75	-	-	-	-	-	-	-	-	-	2.75	-	2.25

Course Content:

Experiment No.	Description
1	Schematic product symbols for standard components in mechanical welding symbols and pipe joints
2	Orthographic projections of machine elements different sectional views- full, auxiliary sectionsIsometric projection of components
3	Assembly and detailed drawings of a mechanical assembly 1) Plummer block 2) Tool head of a shaping machine 3) Tailstock of a lathe 4) Welded pipe joints indicating work parts before welding

Recommended Books:
1. Text Book on Engineering Drawing, Narayana/ Kannaia H, Scitech
2. Mechanical Engineering Drawing and Design, S. Pal and M. Bhattacharyya
3. Machine Drawing by N.D. Bhatt
4. Machine Drawing by P.S. Gill

Course Name: Technical Skill Development,
Course Code: MC 381
Prerequisite: Basic Communication skill
Course Objective: To grow a potential of industrial skill development for future career.
Course Outcomes: Upon successful completion of this course, students will be able to:
1. Nurture their subject knowledge and find their relevance to practical application
2. To create more laboratories and to explore new events.
3. To create small projects for the development of the society and environment.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	2	-	2	-	-	-			
CO2	-	-	-	-	-	1	-	-	2	-	-	-			
CO3	-	-	-	-	-	3	-	-	2	-	-	-			

Course Contents: Practice of verbal and Written Communication on small scale technical projects

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Department of Mechanical Engineering
COMMON AUTONOMOUS 4th Semester CURRICULUM & SYLLABUS

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
THEORY:							
PC	ME 401	Fluid Machinery	3	0	0	3	3
PC	ME 402	Primary Manufacturing Process	3	0	0	3	3
PC	ME 403	Engineering materials	3	0	0	3	3

PC	ME 404	Mechanisms	3	0	0	3	3
BS	M(CS)401	Numerical methods	3	0	0	3	3
HU	HU 401	Environmental science	2	0	0	2	2
PRACTICAL:							
PC	ME 491	Fluid mechanics & hydraulic machines lab	0	0	3	3	2
PC	ME 492	Manufacturing technology lab	0	0	3	3	2
PC	ME 493	Material testing lab	0	0	3	3	2
PC	ME 494	Machine drawing-ii	0	0	3	3	2
BS	M(ME)491	Numerical methods lab	0	0	3	3	2
SESSIONAL :							
HS	HU 481	Technical report writing & language practice	0	0	2	2	1
		Total: Twelve	17	0	17	34	28

Course Name: **Fluid Machinery**
Course Code: **ME401**
Contact Hour/Week (L:T:P) **: 3:0:0**
Credits**: 3**
Total Lectures**: 36L**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Knowledge of Fluid Mechanics and basic applications.

Course Objective: To understand the working principle of various hydraulic machines and judge their performance.

Course Outcomes: Upon successful completion of this course, students will be able to:
1. Understand the mechanism of jet propulsion for a variety of conditions and analyze it's effects for practical applications.
2. Learn the design and working principle of hydraulic turbines and apply in a practical case study or project work on hydel plants.
3. Analyze the working of centrifugal and reciprocating pumps and calculate their performance parameters of practical interest in a plethora of applications.
4. Get the knowledge and evaluate the working principles of various modern hydraulic machines for varied industrial applications.

Course Articulation Matrix:

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

ME401.1	3	2	3	2	2	2	2	-	2	-	-	-	3	3	-
ME401.2	2	3	3	2	2	3	2	-	2	-	-	-	3	3	-
ME401.3	2	2	2	2	2	2	2	-	2	-	-	-	3	3	-
ME401.4	2	3	3	2	3	3	3	-	3	-	-	-	2	-	-
Avrg.	2.25	2.5	2.75	2	2.25	2.5	2.25	-	2.25	-	-	-	2.75	2.25	-

Course Contents :

Module No.	Syllabus	Contact Hrs.
1.	Impact of Jets and Jet Propulsions: Force exerted by a liquid jet on a stationary flat plate, force exerted by a liquid jet on a stationary curved vane, force exerted by a liquid jet on a hinged plate, force exerted by a liquid jet on moving flat plates, force exerted by a liquid jet on moving curved vane, jet propulsion.	4
2.	Hydraulic Turbines: Essential element of a hydroelectric power plant; head and efficiencies of hydraulic turbines; classifications of hydraulic turbines, Pelton turbine, reaction turbine, Francis turbine, Kaplan turbine; draft tube; cavitation in hydraulic machines; dimensional analysis and similarity laws for rotodynamic machines; specific speed of hydraulic turbines; unit quantities of hydraulic turbines; characteristic curves of hydraulic turbines; governing of turbines.	8
3.	Centrifugal Pump: Components of a centrifugal pump, working principle, work done, different heads in a pumping system, different efficiencies, characteristics, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, specific speed, model testing, cavitation, net positive suction head.	8
4.	Reciprocating Pump: Components of a reciprocating pump, working principle, types of reciprocating pumps, discharge and power requirement, slip and coefficient of discharge, variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston, frictional head on suction and delivery pipes, indicator diagram, air vessels.	8
5.	Miscellaneous Hydraulic Machines: Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic ram, hydraulic lift, hydraulic crane, hydraulic coupling, hydraulic torque converter, gear pump, lobe pump, vane pump, piston pump, hydraulic actuators, hydraulic valves.	8

Recommended Books:

1. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH
2. Fluid Mechanics & Machinery – R.K.Bansal, Laxmi Publications.
3. Introduction to Fluid Mechanics & Fluid Machines– Som Biswas, Chakraborty, TMH.
4. Fluid Mechanics & Turbo Machines – M.M. Das, PHI, 2010.
5. Fluid Mechanics & Machinery – C. Ratnam, A.V. Kothapalli, I.K. International Publishing House Ltd, 2010.
5. Fluid Mechanics & Machinery – C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP.
6. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.
7. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

Course Name: **Primary Manufacturing Processes**
Course Code: **ME402**
Contact Hour/Week (L:T:P) **: 3:0:0**
Credits**: 3**
Total Lectures**: 39L**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Knowledge of basic workshop practices, material science.

Course Objective: To impart detailed knowledge on various primary manufacturing processes like casting, forming welding and power metallurgy.

Course Outcomes

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

1. Know and understand the basics of manufacturing processes and concerned behavior of material properties.
2. Learn and apply details of the casting process, design of gating system and solidification for different molding designs.
3. Analyse basic welding and forming techniques and modern improvements for sophisticated metal works.
4. Evaluate the basics of powder metallurgy to develop knowledge on modern nano-manufacturing for applied project works.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME402.1	3	2	-	2	-	-	-	-	-	-	2	-	2	-	3
ME402.2	3	3	3	2	-	-	-	-	-	-	2	-	2	-	2
ME402.3	3	3	2	3	-	-	-	-	-	-	3	-	2	-	3
ME402.4	3	3	-	2	-	-	-	-	-	-	2	-	-	-	3
Avrg.	**3**	**2.75**	**2.5**	**2.25**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2**	**-**	**2.75**

Course Contents :

Module No.	Syllabus	Contact Hrs.
1	Introduction: Manufacturing; Definitions and broad grouping.	1
2	Casting: Introduction, History, Definition, Major Classification, Casting Materials. Sand mould casting: Moulding sands: composition, properties & testing. Design of gating system: sprue, runner, ingate & riser, Estimation of powering time, Foundry equipments, Furnaces Melting, pouring and solidification Type of patterning, use of a core. Different type of sand mould casting: Floor mould casting, Centrifugal casting, Shell mould & CO2 casting ,Investment casting. Permanent mould casting: Die casting, types, methods, advantages & applications. Slush casting, principle & use. Casting defects, types, causes & remedy	12
3	Forming Processes: Forging: Introduction, definition, classification, hot forging & cold forging, characteristics & applications. Forging material operations, equipments & tools: Smith forging, Drop forging, Pressing or press forging, Forging dies, materials & design. Rolling: Introduction, basic principles, hot rolling & cold rolling, characteristics & applications. Rolling processes & applications, operations, equipments & roll stands. Wire drawing & extrusion: Basic principles & requirements. Classification, methods & applications. Miscellaneous forming processes.	8
4	Welding: Introduction to metallic parts, Major classification of joining processes, welding, brazing and soldering Broad classification of welding processes, types and principles. Fusion welding: types, principles, equipments, characteristics & applications, Sources of heat-chemical action, Gas welding & thermit welding ,Sources of heat-electrical energy, Arc welding, Submerged arc welding, TIG & MIG; Plasma arc welding, Resistance welding; Spot & butt welding. Solid state welding: Principles, advantages & applications of Hot forge welding, Friction welding, Pressure & percussion welding. Precision welding processes: Ultrasonic welding, Laser beam welding, Electron beam welding. Welding defects, types, causes & remedy.	12
5	Press tool works: Basic principles, systems, operations & applications, Shearing, parting, blanking, piercing & notching, Cupping (drawing), Spinning & deep drawing Blanks & forces needed for shearing & drawing operations, Coining & embossing.	3
6.	Powder Metallurgy: Development of powder metallurgy-scope of powder metallurgy, characterization of metal powders, physical properties and chemical properties. Powder manufacture: Reduction, electrolysis, and atomization processes. Compaction and sintering: Die compaction and other consolidation techniques, sintering, sintering with liquid phase, applications, advantages and limitations.	3

Recommended Books:

1. Manufacturing technology, Foundry, Forming & Welding-P.N Rao.
2. Manufacturing Science-A Ghosh & A Mullick.
3. Manufacturing Engineering & Technology-S Kalpakjian; Pub:Addison Wesley.
4. Principles of manufacturing materials & processes-James & Campbell.
5. Manufacturing engineering & technology-K Jain.
6. Processes & materials of manufacturing-R.A Lindberg.
7. Introduction to manufacturing technology-PP Date, Pub: Jaico.
8. Manufacturing processes-S.K Sharma & S Sharma, Pub: I.K International.

Course Name:**Engineering Materials**
Course Code: **ME403**
Contact Hour/Week (L:T:P) **: 3:0:0**
Credits**: 3**
Total Lectures**: 36L**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Basic Physics and Chemistry.

Course Objectives: To impart overall knowledge of material structure, properties and treatments used in industries for applyingthem in engineering applications.

Course Outcomes: Upon successful completion of the course the students will be able to:
1. Know and understand the different properties and classifications of materials that determine their applicability and concept of atomic structure, crystal structure, various imperfections in solids and solidifications.
2. Identify and apply the knowledge of Iron-carbon equilibrium phase diagram, isomorphous and eutectic phase diagrams and distinguish between steels, cast irons and various non-ferrous alloys and describe methods, purposes and control of various heat treatment processes.
3. Apply and evaluate the special characteristics and applications of various types of polymer, ceramic and Composites.
4. Illustrate and evaluate the brief idea about corrosion with their types and control procedures of changing different mechanical properties of metals.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME403.1	3	2	3	2	-	-	-	-	-	-	-	-	-	2	3
ME403.2	3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
ME403.3	3	3	2	-	3	-	-	-	-	-	-	2	-	3	2
ME403.4	3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
Avrg.	**3**	**2.5**	**2.25**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2.5**	**2.25**

Course Contents :

Module No.	Syllabus	Contact Hrs.
1	**1.1 Introduction:** Material Science—its importance in engineering; Atomic bonding in solids—bonding forces and energies; ionic/covalent/metallic bonding. **1.2 Crystal Structure:** Fundamental concepts; Space lattice; Unit cells; Seven crystal systems; Single crystal; Polycrystalline and Non-crystalline materials; Metallic crystal structures—FCC, BCC & HCP structures ,atomic packing factor calculation. **1.3 Imperfections in Metals:** Point defects due to vacancy & impurities; alloys, solid solutions, Hume Rothery rules; Dislocations—linear defects, interfacial defects, grain boundaries. **1.4Diffusion:** Definition; Interstitial and Substitutional diffusion Mechanism; Fick's first law and Fick's second law.	7
2	**Mechanical Properties of Materials**: Ductile and brittle material,Elastic properties of materials—tensile and compressive stress and strain, stress-strain behaviour, modulus of elasticity (Young's modulus), yield strength, tensile strength, plastic deformation(Slip, Twining), true stress and strain; Ductility; Resilience; Toughness, Concept of ductile and brittle fracture, impact tests; Hardness- Brinell, Rockwell and Vickers hardness and their testing procedures, correlation between hardness and tensile strength; Fatigue strength; Effect of temperature on tensile strength & impact properties, creep(definition, anelastic behavior,creep curve).	5
3	**3.1 Phase Diagrams:** Definition and basic concepts; solubility limit; Phase equilibria; Gibb's phase rule; one component phase diagram, binary phase diagram, interpretation of phase diagrams. **3.2 Iron-carbon System:** Allotropy of iron; iron-iron carbide phase diagram, properties and uses of; plain carbon steel. **3.3 Solidification:** Concept of homogeneous heterogeneous nucleation process and free energy calculation for homogeneous nucleation process.	5
4	**Heat Treatment:** Definition and purposes; structural change during heating and cooling, Austempering, Martempering; Heat treatment processes for steels—Hardening (Carburizing, nitriding, cyaniding, induction and flame hardening); Tempering; Normalizing; Annealing—full annealing, spheroidising annealing, stress–relieving, recrystallisation annealing; Preciptation or Age Hardening of non-ferrous alloys.	5
5	**Classification of Metals and Alloys- compositions, general properties and uses:** **5.1 Ferrous alloys:** Classification –low carbon steels, medium carbon steels, high carbon steels; Stainless steels; alloy steels; tool and die steel; cast irons. **5.2 Non-ferrous alloys:** Copper & Copper alloys; Aluminum alloys; Nickel alloys; Lead & Tin alloys.	4
6	**6.1 Polymers & Elastomers:** Definition; advantages and disadvantages; Polymer compounding, Processing- Extrusion, blow molding. **6.2 Ceramic Materials:** What is ceramics; Radius ratio rules; common ceramic materials AX type, Diamond and graphite structures and their characteristics; Properties and applications; Processing of ceramic—sintering and vitrification	6

	process. **6.3 Composite materials:** What is composites; Advantages and disadvantages of composites; Polymers matrix and their applications; Metal matrix and ceramic matrix composites and their applications. Processing of composites- autoclave process, compression and injection molding.	
7	**An introduction to advanced materials—** Smart materials; Nano-materials; Biomaterials and Semiconductor.	**1**
8	**Corrosion and Degradation of Engineering Materials:** Definition; Dry and wet corrosion; Introduction to uniform, pitting(P-B ratio), galvanic, intergranular corrosion, stress corrosion cracking and erosion; Corrosion control **—** material selection, environment control.	**2**
9	**Materials Selection Methodology:** Selection of material based on required properties, availability, cost of material, environmental issues and manufacturing process.	**1**

Recommended Books:

1. Materials Science and Engineering by W.D. Callister and adapted by R. Balasubramaniam, Willey India, 2010 Ed.
2. Materials Science and Engineering (In SI Unit) by William Smith, Javad Hashemi, Ravi Prakash, 4th Ed., The McGraw-Hill Companies.
3. Materials Science and Engineering by V.Raghavan, 5th Ed., Prentice Hall India.
4. Materials Science by S.L.Kakani and Amit Kakani , New age International Publishers.
5. Materials & Processes in Manufacturing by E.P.Degarmo and adapted by Black & Kosher, 10th Ed., Wiley India.

Course Name:**Mechanism**
Course Code: **ME404**
Contact Hour/Week (L:T:P) **: 3:0:0**
Credits**: 3**
Total Lectures**: 36L**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Basic Physics.

Course Objectives: To develop the knowledge on theory of machines for Analysis and design ofgears, cams, and linkages.

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. Know and understand the basic relations between distance, time, velocity, and acceleration and distinguish between kinematic and kinetic motion.
2. Apply and design basic gear trains, cam systems and also create a schematic drawing of a real-world mechanism.
3. Analyse and determine the degrees-of-freedom (mobility) of a mechanism.
4. Evaluate the motion of a planar mechanism.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME404.1	2	2	2	2	2	-	-	-	-	-	-	-	2	-	-
ME404.2	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
ME404.3	2	2	2	2	3	-	-	-	-	-	-	-	3	2	-
ME404.4	2	2	2	3	2	-	-	-	-	-	-	-	3	-	-
Avrg.	2.25	2.25	2.25	2.25	**2.5**	-	-	-	-	-	-	-	**2.75**	2	2

Course Contents :

Module	Syllabus	Contact Hrs.
1	Basics of Mechanisms Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) Grashoff's law-Kinematic Inversions of four-bar chain and slider crank chain , Mechanical Advantage-Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements - Indexing Mechanisms	10L
2	Kinematic Analysis Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) -Graphical Methods for displacement, velocity and acceleration; Shaping machine mechanism - Coincident points – Coriolis acceleration - Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism	6L
3	Belt-drive Introduction; Law of belting, Length of flat belt for open and cross belt connections; Stepped pulley for open flat belt; Tension in flat belt and V-belts; Power transmitted in belt drive.	4L
4	Gears Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio- Interference and under cutting. Gear trains – Simple, compound and Epicyclic gear trains -Differentials.	6L
5	Kinematics of Cams	5L

	Classification of Cams and followers; Radial Cam, Analysis of knife-edge, roller and flat face follower motion – constant velocity, simple harmonic, constant acceleration & deceleration; Offset follower.	
6	Kinematic Synthesis: Introduction to problems of function generation, path generation and rigid body guidance; Type, Number and Dimensional Synthesis; Two and three position synthesis of four bar mechanism and slider –crank mechanism : Graphical – pole, Relative pole and Inversion method; Analytical solution - Freudenstein's Method	5L

Recommended Books:

1. Elements of Mechanism – Daughty and James, McGraw Hill
2. Theory of Machines – S S Rattan, Tata McGraw Hill
3. Theory of Mechanisms & Machines – A.Ghosh & A.K.Mallik, AEWP
4. Design of Machinery – R.L.Norton, Tata McGraw Hill
5. Mechanism & Machine Theory – Rao, R.V. Dukkipati, Wiley
6. Theory of Machines, V.P.Singh, Dhanpat Rai & Co

Course Name: **Environmental Science**
Course Code: **ME401**
Contact Hour/Week (L:T:P) **: 0:0:2**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 40; End Semester Exam - 60)

Course Objective:
To make student enough cognizant about their environment in terms of natural resources and all type of environmental pollutions questing the sustainability of human race.

Course Outcomes:

1. Demonstrate understanding of the complex interactions of humans and ecological systems in the natural world.
2. Learn to interpret and apply basic statistical analysis or systems modeling methodology in environmental analysis.
3. Interpret, synthesize, and apply a wide range of scientific literature in the ecological and environmental sciences, particularly dealing with both climate change and global change.
4. Interpret a wide range of scientific literature in biology, ecology, and environmental science and apply this information to problem-solving analysis, specifically in the realms of environmental and natural resource sciences and sustainability.
5. Prepare technical reports and analyses of environmental, resource ecology, and sustainability issues and present analytical results and conclusions effectively in both written and oral communication.
6. Interpret environmental, resource management, and sustainability conflicts from multiple perspectives.

7. Effectively analyze and integrate the social and natural sciences to understand diverse environmental and sustainability challenges ranging from local issues to global environments

Course Contents :

Module	Syllabus	Contact Hours
1	**1.1 Natural Resources**: Forest Resource, water resource, mineral resource, energy resources (renewable,non-renewable, potentially renewable)	**6L**
	1.2 Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield	
	1.3Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)	
	1.4Ecology & Ecosystem: Elements of ecology, definition of ecosystem-components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems	
	1.5 Environmental Management: Environmental impact assessment, Environmental laws and protection act of India, Different international environmental agreement.	
2	**Air pollution and control**	**6L**
	2.1Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant	
	2.2 Types of air pollutants: primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),	
	2.3Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion	
	2.4 Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion	
	2.5 control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury),	
3.	**Water Pollution** 3.1 Classification of water (Ground & surface water) **3.2** Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds. **3.3 Surface water quality parameters:** pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD Lake: Eutrophication [Definition, source and effect]. **3.4Ground water:** Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control) **3.5 Quality of Boiler fed water:** DO, hardness , alkalinity, TDS and Chloride **3.7 Layout of waste water treatment plant** (scheme only).	**6L**
4	**Land Pollution** **4.1** Types of Solid Waste: Municipal, industrial, commercial, agricultural,	**2L**

	domestic, hazardous solid wastes (bio-medical), E-waste **4.2** Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).	
5	**Noise Pollution** **5.1** Definition of noise, effect of noise pollution on human health, **5.2** Average Noise level of some common noise sources **5.3** Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, *L*10 (18 hr Index). **5.4** Noise pollution control.	**2L**

Recommended References/Books

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
2. Environmental Studies, Dr. J P Sharma, University Science Press
3. Environmental Engineering, J K Das Mohapatra, Vikas Publication

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Course Name: **Numerical Methods**
Course Code:**M(CS)401**
Contact Hour/Week (L:T:P) **: 3:0:0**
Credits**: 3**
Total Lectures**: 33L**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Concept of Calculus and Algebra.
Course Objective: The purpose of this course is to provide basic understanding of the derivation and the use of the numerical methods along with the knowledge of finite precision arithmetic.

Course outcome: On successful completion of the learning sessions, the learner will be able to:
M(ME)401.1: Recall the distinctive characteristics of various numerical techniques and the associated error measures.
M(ME)401.2: Understand and apply the theoretical workings of various numerical techniques and to solve the engineering problems.
M(ME) 401.3: Analyse and evaluate the principles of various numerical techniques to solve various problems.
Course Articulation Matrix

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**P10**	**P11**	**P12**	**PSO 1**	**PSO 2**	**PSO 3**
M(CS) 401.1	-	3	-	-	-	-	-	-	-	-	-	2	3	-	
M(CS) 401.2	-	3	2	-	-	-	-	-	-	-	-	-	2	-	
M(CS) 401.3	-	-	3	-	-	-	-	-	-	-	-	2	2	-	

Course Contents :

MODULE	Syllabus	Contact Hrs
Numerical method I	**Approximation in numerical computation:** Truncation and rounding errors, Propagation of errors. Propagation of errors, Fixed and floating-point arithmetic.	(2L)
	Interpolation: Newton forward/backward interpolation, Stirling & Bessel's Interpolation formula, Lagrange's Interpolation, Divided difference and Newton's divided difference Interpolation.	(7L)
	Numerical integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3 rule, Weddle's Rule, Romberg Integration, Expression for corresponding error terms.	(5L)
	Numerical solution of a system of linear equations: Gauss elimination method, Tridiagonal matrix algorithm, LU Factorization method, Gauss-Seidel iterative method, Successive over Relaxation (SOR) method.	(6L)
Numerical method II	**Solution of polynomial and transcendental equations:** Bisection method, Regula-Falsi, Secant Method, Newton-Raphson method.	(5L)
	Numerical solution of ordinary differential equation: Taylor series method,Euler's method, Euler's modified method,fourth order Runge-Kutta method and Milne's Predictor-Corrector methods.	(6L)
	Numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.	(2L)

Recommended Text Books:

1. Shishir Gupta &S.Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
2. C.Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta& Jana: Introductory Numerical Analysis. PHI Learning
4. J.B.Scarborough: Numerical Mathematical Analysis.Oxford and IBH Publishing
5. Jain, Iyengar ,& Jain: Numerical Methods (Problems and Solution).New age International Publisher.
6. Prasun Nayek: Numerical Analysis, Asian Books.

References:

1. Balagurusamy: Numerical Methods, Scitech. TMH
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. SoumenGuha& Rajesh Srivastava: Numerical Methods, Oxford Universities Press.
5. Srimanta Pal: Numerical Methods, Oxford Universities Press.
6. Numerical Analysis, Shastri, PHI
7. Numerical Analysis, S. Ali Mollah. New Central Book Agency.
8. Numerical Methods for Mathematics ,Science&Engg., Mathews, PHI
9. NumericalAnalysis,G.S.Rao,New Age International
10. Programmed Statistics (Questions – Answers),G.S.Rao,New Age International
11. Numerical Analysis & Algorithms, PradeepNiyogi, TMH
12. Computer Oriented Numerical Mathematics, N. Dutta, VIKAS
13. NumericalMethods,Arumugam,ScitechPublication
14. Probability and Statisics for Engineers,Rao,ScitechPublication
15. Numerical Methods in Computer Application,Wayse,EPH

Course Name: **Numerical Methods Laboratory**
Course Code:**M(CS)491**
Contact Hour/Week (L:T:P) **: 0:0:3**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 30; End Semester Exam - 70)

Prerequisite: Any introductory course on C/ Mat lab.
Course Objective: The purpose of this course is to provide basic programming skills for solving the problems in numerical methods.
Course outcome: On successful completion of the learning sessions, the learner will be able to:
M(ME) 491.1: Apply the programming skills to solve the problems using multiple numerical approaches.
M(ME) 491.2: Analyze and evaluate, if the results are reasonable, and then interpret and clearly communicate the results.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**P10**	**P11**	**P12**	**PSO 1**	**PSO 2**	**PSO 3**
M(CS) 491.1	2	3	-	-	-	3	2	-	-	3	-	3	2	-	3
M(CS) 491.2	2	-	-	-	-	-	2	-	-	3	-	3	3	-	3
Avrg.	**2**	**3**	**-**	**--**	**-**	**3**	**2**	**-**	**-**	**3**	**-**	**3**	**2.5**	**-**	**3**

Course Contents :

Serial No.	**Assignments**
1	Assignments on Newton forward /backward, Lagrange's interpolation, Sterling & Bessel's Interpolation formula, Newton's divided difference Interpolation.
2	Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule and Romberg Integration.
3	Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. Successive over Relaxation (SOR) method, LU Factorization method.
4	Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method
5	Assignments on ordinary differential equation: Euler's method, Euler's modified method,

	Runge-Kutta methods, Taylor series method and Predictor-Corrector method
6	Assignments on numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.
7	Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab / Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group/Python.

Course Name:**Fluid mechanics & Hydraulic Machines Lab**
Course Code: **ME491**
Contact Hour/Week (L:T:P) **: 0:0:3**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 40; End Semester Exam - 60)

Prerequisite: Knowledge of hydraulic machines

Course Objective: To expose students for operating hydraulic machines by themselves and measure their performance.

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. Measure the coefficient of discharge for several flow measuring devices to explore the reasons of differences in theoretical calculation and practical measurements.
2. Run variety of hydraulic turbine and carry out their performance study useful hydel power plants.
3. Run pumps and analyse their behavior under given constraints.
4. Evaluate frictional forces applicable in a flow channel to determine major and minor losses.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME491.1	3	-	3	-	-	-	-	-	-	-	-	-	3	3	-
ME491.2	2	3	2	-	-	-	-	-	-	-	2	-	3	2	-
ME491.3	1	3	3	-	-	-	-	-	-	-	-	-	3	2	-
ME491.4	2	3	3	-	-	-	-	-	-	-	-	-	2	2	-
Avrg.	**2**	**3**	**2.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2.75**	**2.25**	**-**

Course Contents :

Experiment No.	Description
1	To determine co-efficient of discharge of V-notch.
2	To determine co-efficient of discharge of rectangular notch.
3	To determine co-efficient of discharge of venturimeter.
4	To determine co-efficient of discharge of orificemeter.
5	Experimental verification of Bernoulli's theorem.
6	To determine co-efficient of friction of fluid flowing through pipes.
7	Reynold's experiment: Determination of Reynold's number for laminar and turbulent flow through pipes
8	To determine efficiency of Francis turbine
9	To determine efficiency of Pelton turbine
10	To determine efficiency of centrifugal pump

Course Name: **Manufacturing Technology Lab**
Course Code: **ME492**
Contact Hour/Week (L:T:P) **: 0:0:3**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 40; End Semester Exam - 60)

Course Objective:
To get the practical knowledge of several steps of casting, pattern usage, mould creation, gating design, produce a casting and check casting defects.

Course Outcome: Upon the completion of the course the student would be able to
1. Fabricate basic parts and assemblies using powered and non-powered machine shop equipment in conjunction with mechanical documentation.
2. Ascertain product and process quality levels through the use of precision measurement tools and statistical quality control charts.
3. Practice basic welding and forming techniques and modern improvements for sophisticated metal works.
4. Know the basics of powder metallurgy for applied project works.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME492.1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
ME492.2	2	2	2	3	-	-	-	-	-	-	-	-	3	-	2
ME492.3	3	2	3	3	-	-	2	-	-	-	-	-	-	-	2
ME492.4	2	2	3	3	-	-	3	-	3	-	3	-	-	-	3
Avrg.	2.5	2.25	**2.75**	3	-	-	2.5	-	3	-	3	-	3	-	2.5

Course Contents :

Experiment No.	Description
1	To determine the percentage of clay content in dry sand
2	To determine the grain fineness number of dry and clay free sand.
3	To determine the moisture content quickly is fresh sand and mounding sand.
4	To determination the compressive strength, splitting strength and shearing strength of green sand by Pendulum Type Universal Strength Machine
5	To determine the permeability number of Green sand, Core sand and Raw sand.
6	Mould preparation and casting of metals after preparation of suitable moulds.
7	Study on the properties of post casting, fettling, cleaning, deburring and polishing operations.
8	Practicing smithy or forging of carbon steels and testing for its property changes.
9	Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW and SMAW and Testing for Joint defects.

Course Name:**Material testing Lab**
Course Code: **ME493**
Contact Hour/Week (L:T:P) **: 0:0:3**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 40; End Semester Exam - 60)
Prerequisite: Knowledge of Material Science, Basic Sciences.

Course Objective: To test several properties of material like ductility, surface roughness, malleability, hardenability etc.

Course Outcome: Upon the completion of the course the student would be able to
1. Determine toughness value of industrial specimens.
2. Carry out various type of heat treatments of a given specimen to change associated mechanical properties and grain size
3. Find out surface or subsurface defects relevant to almost all manufacturing industries.
4. Measure the mechanical properties like drawability, endurance limit of a steel specimen necessary for material selection in design and development.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME493.1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3
ME493.2	3	-	2	-	-	-	-	-	-	-	-	3	3	2	2

ME493.3	3	-	2	-	-	-	3	-	-	-	-	-	2	2	3
ME493.4	3	2	3	-	-	-	-	-	-	-	-	-	2	3	2
Avrg.	3	2.5	2.25	-	-	-	3	-	-	-	-	3	2.5	2.25	2.5

Course Contents :

Experiment No.	**Description**
1	Impact tests: Charpy and Izod tests; Ferrous and non ferrous material
2	Fatigue test of a typical sample.
3	Sample preparation and etching of ferrous and non-ferrous metals and alloys for metallographic observation;
4	Experiments on heat treatment of carbon steels under different rates of cooling and testing for the change in hardness and observing its microstructure changes through metallographic studies
5	Observation of presence of surface/ sub-surface cracks using dye penetration (DP) test.
6	Observation of presence of surface/ sub-surface cracks of a welded joint by Ultrasonic Testing Machine.
7	Test for drawability of sheet metals through cupping test

Course Name:**Machine Drawing-II**
Course Code: **ME494**
Contact Hour/Week (L:T:P) **: 0:0:3**
Credits**: 2**
Full Marks = **100** (Internal Evaluation - 40; End Semester Exam - 60)

Prerequisite: Engineering Drawing.
Course Objective: To develop the capability of modeling important machine components using CAD.

Course Outcomes: After successful completion of the course, the student would be able to

1. Independently run Computer Aided Drafting software like AutoCAD.
2. Model basic two dimensional objects, modify and dimension them to form more complex machine parts of engineering importance.
3. Understand geometric construction and Solid Modeling concepts and techniques for both on Course and software.
4. Model three dimensional views of important machine parts and explore the plotting techniques for standard presentation.

Course Articulation Matrix:

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
ME494.1	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

ME494.2	3	3	3	-	3	-	-	-	-	-	-	-	2	-	2
ME494.3	3	3	2	-	3	-	-	-	-	-	-	-	3	-	3
ME494.4	3	3	2	-	3	-	-	-	-	-	-	-	3	-	3
Avrg.	3	3	2.25	-	3	-	-	-	-	-	-	-	2.5	-	2.5

Course Contents :

Assignment No.	Description
1	Assembly and detailed drawings of a mechanical assembly: A simple gear box
2	Assembly and detailed drawings of a Flange Coupling
3	Welded bracket joined by stud bolt on to a structure
4	Practicing AutoCAD or similar graphics software
5	Making orthographic projections of different components using AutoCAD
6	Making isometric projections of different components using AutoCAD

(At least six assignments must be conducted)

Recommended References:

1. Text Book on Engineering Drawing, Narayana and Kannaia H, Scitech.
2. Mechanical Engineering Drawing and Design, S. Pal and M. Bhattacharyya.
3. Machine Drawing by N.D. Bhatt.
4. Machine Drawing by P.S. Gill.
5. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International Pub.
6. Engineering Drawing with an Introduction to AutoCAD by D.A. Jolhe, Tata-McGraw-Hill Co.

Department of Mechanical Engineering

COMMON AUTONOMOUS 5th Semester CURRICULUM & SYLLABUS

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
THEORY:							
PC	**ME 501**	**HEAT TRANSFER**	**3**	**0**	**0**	**3**	**3**
PC	**ME 502**	**DESIGN OF MACHINE ELEMENTS-I**	**3**	**0**	**0**	**3**	**3**
PC	**ME 503**	**DYNAMICS OF MACHINES**	**3**	**0**	**0**	**3**	**3**
PC	**ME 504**	**METROLOGY & MEASUREMENT**	**3**	**0**	**0**	**3**	**3**
HU	**HU502**	**VALUES & ETHICS IN PROFESSION**	**2**	**0**	**0**	**2**	**2**
PE-I	**ME 505A**	**REFRIGERATION& AIR CONDITIONING**	**3**	**0**	**0**	**3**	**3**

	ME 505B	**MECHATRONICS**					
	ME 505C	**APPLIED FLUID MECHANICS**					
PRACTICAL:							
PC	**ME591**	**HEAT TRANSFER LAB**	**0**	**0**	**3**	**3**	**2**
PC	**ME 592**	**DYNAMICS OF MACHINES LAB**	**0**	**0**	**3**	**3**	**2**
PC	**ME 593**	**METROLOGY & MEASUREMENT LAB**	**0**	**0**	**2**	**2**	**1**
PE LAB-I	**ME 594 A**	**REFRIGERATION& AIR CONDITIONING LAB**	**0**	**0**	**3**	**3**	**2**
	ME 594 B	**MECHATRONICS LAB**					
	ME 594 C	**APPLIED FLUID MECHANICS LAB**					
SESSIONAL							
PROJECT	**ME 581**	**MINI PROJECT-I**	**0**	**0**	**3**	**3**	**2**
MC	**MC 582**	**SEMINAR**	**0**	**0**	**2**	**2**	**0**
		TOTAL: Twelve	**17**	**0**	**16**	**33**	**26**

SEMESTER V-Theory

Course Name: Heat Transfer,
Course Code: ME 501
Prerequisite: Basic Physics, Fluid mechanics, Thermodynamics
Course Objectives:
To Study the basic principles of heat transfers like conduction, convection and radiation for analyzing all heat exchanging devices used in industries.

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

1. Understand the basic laws & constraints of heat transfer to analyze problems involving steady state or transient heat conduction in simple geometries.
2. Apply the analytical solutions of free and forced convection problems to apply in modern research sectors of heat and mass transfer.
3. Analyse and evaluate the radiation heat transfer between black body and gray body surfaces and obtain numerical solutions of combined mode heat transfer problems in practice.
4. Analyze and evaluate the effectiveness of several type of heat exchanger and develop skills for industrial design solutions of complex problems.

Course Articulation Matrix:

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
ME501.1	3	3	2	3	-	-	-	-	-	-	-	2	3	3	-
ME501.2	3	3	3	3	-	-	-	-	-	-	-	2	3	3	-

ME501.3	2	2	2	2	-	-	-	-	-	-	-	-	2	3	-
ME501.4	3	2	3	3	-	-	-	-	-	-	-	-	2	3	-
Avrg.	**2.75**	**2.5**	**2.5**	**2.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.5**	**3**	**-**

Course Contents:

Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction to modes of Heat Transfer, Basic equations.	2
2.	Conduction: Fourier's law for isotropic materials.Thermal conductivity: 1-D and 3- D heat conduction equations, Boundary conditions. Solution of steady 1-D conduction problemwith & without heat generation. Analogy with electrical circuits. Critical thickness of insulation.	4
3.	Fins- rectangular and pin fins, fin effectiveness and fin efficiency.	3
4.	Introduction to transient heat conduction, Lumped parameter approach, Time constant, Biot number: 1-D transient heat conduction solution without heat generation.	4
5.	Heat exchangers: types of heat exchangers, parallel and counter flow types, Introduction to LMTD. Correction factors, fouling factor. E- NTU method for heat exchangers.	4
6.	Convective heat transfer, Newton's law of cooling and significance of heat transfer coefficients. Momentum and energy equation in 2-D.	3
7.	Non – dimensional quantities in heat transfer, importance and physical significant order of magnitudes, Analysis for a flow over a flat plate, order of magnitude analysis.	3
8.	Boundary layer concepts, Velocity and thermal boundary layer by integral method.	3
9.	1-D solution for Coutte flow and Poiseullie flow. Concept of developing and developed flow. Introduction to the concept of similarity.	4
10.	Natural convection over a vertical plate. Concept and correlation.	3
11.	Radiation: Physical mechanism of thermal radiation, laws of radiation, Definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity.	3
12.	Radiation exchange between black bodies, concept of Gray- Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.	4
13.	Mass Transfer: Introduction, Modes of Mass Transfer, Concentrations, Velocities and Fluxes, Fick's Law, General Mass diffusion Equation in Stationary Media, Steady State Diffusion Through a plain membrane, Steady state equimolar counter diffusion, Isothermal evaporation of water into air from a surface, Mass transfer coefficient, convective mass transfer, Correlation for mass transfer.	

Recommended Books:

1. S.K. Som, Introduction to Heat Transfer, PHI.
2. Yunus A. Cengel, Heat and Mass Transfer, The McGraw-Hill Companies.
3. Sarif K. Das, Fundamentals of Heat & Mass Transfer, Narosa.
4. Incropera, DeWitt, Bergmam, &Lavine, Fundamentals of Heat and Mass Transfer, Wiley India Edn.
5. N.V. Suryanarayana, Engineering Heat Transfer, Penram International.
6. Kreith, Principles of Heat Transfer, Cengage learning.
7. P.K. Nag, Heat & Mass Transfer, TMH.
8. P.S. Ghoshdastidar, Heat Transfer, Oxford University Press.
9. M. Thirumaleshwar, Fundamentals of Heat & Mass Transfer, Pearson.
10. O.P. Single, Heat & Mass Transfer, Macmillan India.
11. J P Holman &Souvik Bhattacharyya, Heat Transfer, TMH.

Course Name: DESIGN OF MACHINE ELEMENTS-I,
Course Code: ME 502
Prerequisite: Strength of Materials.
Course Objectives: To teach analytical methods of applying the concepts of stress analysis, theories of failure and material science to design, analyze or select commonly used machine components.

Course Outcomes: Upon successful completion student will be able to:

1. Gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.
2. Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process. e.g., fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME502.1	3	2	3	2	2	-	-	-	2	-	-	-	2	-	2
ME502.2	2	2	2	2	-	-	-	-	-	-	-	-	2	-	2
ME502.3	2	3	3	3	2	-	-	-	-	-	-	-	3	-	3

ME502.4	2	2	2	2	-	-	-	-	-	-	-	2	2	2	2
Avrg.	**2.25**	**2.25**	**2.5**	**2.25**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2.25**	**2**	**2.25**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Objective and scope of Mechanical Engineering Design; Design considerations; Review and selection of materials and manufacturing processes; codes and standards;	5
2.	Modes of failure; Design/allowable stress; Factor of safety (FoS); Theories of failure – maximum normal stress theory, maximum shear stress theory, Distortion energy theory. Choice of Failure criteria; Design for stability : buckling analysis – Johnson and Euler columns.	6
3.	Fatigue in metals; S-N curve; Endurance limit and fatigue strength; Stress concentration factors – effect of discontinuity, fillets and notches; Effect of size, surface finish, stress concentration and degree of reliability on endurance limit; Design for finite and infinite life; Goodman, modified Goodman and Soderberg diagrams with respect to fatigue failure under variable stresses; Cumulative fatigue damage – Miner's equation.	6
4.	Design of (i) Cotter joint; (ii) Knuckle joint and (iii) Fillet Welded joint of brackets under different types ofloading.	6
5.	Bolted joints : Metric thread, standard sizes, use of lock nuts and washers; Applications in structures including brackets, turn buckle; Pre-stressed bolts; Riveted joints : Unwin's formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap / cover plate; simple strength design; joint efficiencies.	6
6.	Design of : (i)Solid and hollow shafts, strength design of shafts, design based on torsional rigidity; (ii)Shaft coupling-rigid, pin-bush and geared flexible type, alignment of coupling; (iii)Belt drives-geometrical relations, derivation of torque and power transmission by flat and V-belt drives, selection of belt from manufacturers' catalogues, pulley. (iv)Chain drives – roller chains, polygonal effect, power rating, sprocket wheel, silent chain.	10
7.	Design of: (i)Transmission screw, Screw jack, (ii)Helical compression spring - stress and deflection equations, stiffness, curvature effect : Wahl's factor, springs in parallel and series; (iii)Multi-leaf springs : load-stress and load-deflection equations, Nipping	9

Recommended Books:

1. V. B. Bhandari, Design of Machine Elements, TMH.
2. Shigley and Mischke, Mechanical Engineering Design, TMH.
3. Hall, Holowenko and Laughlin, Theory and Problems of Machine Design, TMH.
4. P.C. Gope, Fundamentals of Machine Design, PHI.
5. M.F. Spotts, Design of Machine Elements, Prentice Hall.
6. P. Kannaiah, Machine Design, Scitech Publications.

Course Name: DYNAMICS OF MACHINES

Course Code: ME503

Prerequisite: Engineering Mechanics

Course Objectives: To study the dynamic behavior of a machine like vibration, balancing, governing etc.

Course Outcomes: Upon successful completion student will be able to:

1. Understand forced and free vibration in mechanical systems and use mathematical models to evaluate dynamic forces involved in such systems.
2. Construct static or dynamic balancing rotating and reciprocating equipment to apply to all type of industries.
3. Analyze the design of governors and flywheels for establishing mechanical control over rotating mechanical linkages.
4. Evaluate the method of retaining the stability of Automobiles, Aeroplanes and ships using the understanding of gyroscopic effects.

CO Codes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
ME503.1	3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
ME503.2	2	2	3	-	-	-	-	-	-	-	-	-	-	3	2
ME503.3	2	3	3	3	-	-	-	-	-	-	-	-	2	2	2
ME503.4	2	2	3	2	-	-	-	-	-	-	-	-	-	3	3
Avrg.	**2.25**	**2.25**	**2.75**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.5**	**2.25**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.A	Vibration: Definition & types of vibration; Differential equations of vibratory motions (longitudinal & torsional); Natural frequency of free longitudinal vibration-Equilibrium method, Energy method (Rayleigh's maximum energy principle); Effect of inertia in longitudinal vibration; Natural frequency of free transverse vibration of a beam due to point loads - Rayleigh's method.	6
1.B	Whirling of shaft, synchronous whirling; critical speed - Dunkerley's method.	2
2.	Free damped vibration; Damping factor; Logarithmic decrement.	2
3	Forced vibration, concept of under damped, critically damped and over damped system; Dynamic magnifier (magnification factor); Vibration isolation and transmissibility.	4
4.	Inertia force and inertia torque in reciprocating engine; Equivalent dynamical system; correction couple (torque); Turning moment diagram and flywheel design.	6
5.	Balancing: Static balancing; Dynamic balancing of rotating masses - graphical and analytical methods; Balancing of inline single cylinder and four cylinder engine; Balancing of symmetric two cylinder V-engine; Swaying couple; Hammer blow.	9
6.	Governors: Use and classification; Study and analysis of Porter, Proell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors; Controlling force diagram and stability criteria analysis; coefficient of insensitiveness.	5
7.	Gyroscope: Gyroscopic couple and precessional motion; Effect of gyroscopic couple on aeroplane and ship; Stability of two wheel and four wheel vehicles taking turn.	2

Recommended Books:

1. W.T. Thomson, Theory of vibration with Applications, McGraw Hill.

2. Uicker, Pennock&Shigley, Theory of Machines and Mechanisms, OUP.

3. A. Ghosh & A.K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Publication.

4. Rao &Dukkipati, Mechanism and Machine Theory, New Age Int. Pub.

5. J.S. Rao, The Theory of Machines Through Solved Problems, New Age Int. Pub.

6. S.S. Rattan, Theory of Machines, Tata McGraw Hill.

Course Name: Metrology and Measurement
Course Code: ME504
Prerequisite: Knowledge of basic science upto 12th

Course Objectives:
To develop the knowledge of basic Measuring devices used in industries and research.

Course Outcome: Upon successful completion of this course Students will be able to

1. Demonstrate the knowledge and understand the length and angle measuring and apply for checking the quality of manufactured products.
2. Apply the knowledge of the instruments for displacement, temperature, pressure, load and force measurement based on their working principle and their uses in industries.
3. Analyse limit, fit & tolerance and calibrate some unknown parameter of engineering interest.
4. Evaluate the surface texture, flatness and roughness of a given specimen which is important in all kind of manufacturing.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME504. 1	3	2	-	-	2	-	-	-	-	-	-	-	3	-	3
ME504. 2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	3
ME504. 3	3	2	-	-	3	-	-	-	-	-	-	-	2	-	2
ME504. 4	3	2	-	-	3	-	-	-	-	-	-	-	2	-	2
Avrg.	**3**	**2**	**-**	**-**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.5**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Definition and importance of Metrology Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SIprefixes of units.	3
2.A	Linear Metrology: Vernier scale; construction and use of Vernier calliper, Vernier height and depth gauge, micrometer; slip gauge.	3
2.B	Angular Metrology: Constructional features and use of protractor, Vernier bevel protractor, angle gauges, sine bar and slip gauges.	2
2.C	Measurements of : (i) Level using spirit-level; (ii) Flatness using straight edge, interferrometry (Newton's rings) and surface plate; Parallelism, cylindricity and concentricity using dial indicator.	3

3.	Interchangeability of components; concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and filler gauges.	5
4.	Definition, use and essential features of Comparators; working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) optical comparator-profile projector.	4
5.	Measuring Instruments: Functional elements of an instrument – sensing, conversion & manipulation, data transmission and presentation element; Characteristics – accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, calibration, response, dynamic or measurement error; Transducers – definition, primary and secondary, active and passive.	5
6.	Measurement of Surface Finish: Definition; Terminologies – geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principle of operation of a Talysurf.	4
7.	Principle of operation of a few measuring instruments: displacement by LVDT; force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer; liquid velocity by pitot tube; water flow by orifice meter.	7

Recommended Books:

1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, TMH
2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House.
3. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson.
4. Bewoor and Kulkarni, Metrology & Measurement, TMH.
5. R.K. Jain, Metrology, Khanna Publication, New Delhi.

VALUES & ETHICS IN PROFESSION

HU502

Contacts:2L

Credits- 2

Course Contents:

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development

Energy Crisis: Renewable Energy Resources

Environmental degradation and pollution.Eco-friendly Technologies. Environmental Regulations, Environmental Ethics

Appropriate Technology Movement of Schumacher; later developments

Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.

Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation.

Human centered Technology.

Ethics of Profession:

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social andvethical responsibilities of Technologists.Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:

Values Crisis in contemporary society

Nature of values: Value Spectrum of a good life

Psychological values: Integrated personality; mental health

Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.

Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity

Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Recommended Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)

2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.

3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

Professional Electives I

SL.No.	Course Code	Subject Name
1.	ME505 A	REFRIGERATION AND AIR CONDITIONING
2.	ME 505 B	MECHATRONICS
3.	ME 505 C	APPLIED FLUID MECHANICS

Course Name: REFRIGERATION & AIR CONDITIONING
Course Code: ME505A
Prerequisite: Applied Thermodynamics
Course Objective: To study and analyze various refrigeration systems along with Air Conditioning principle and design.

Course Outcomes
After taking this course the students will be able to:

1. Understand and explain different types of Refrigeration cycles and its applications in multi compressor and multi evaporator systems.
2. Apply and evaluate the selection and design of different components of Refrigeration systems
3. Analyse the knowledge of psychometric processes and air conditioning systems.
4. Evaluate and design the air-conditioning system for a given conditions including refrigerating equipments as well as ducting systems.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME505A.1	3	2	2	3	-	-	2	-	-	-	-	2	3	2	-
ME505A.2	3	2	2	-	-	-	-	-	-	-	2	2	2	2	-
ME505A.3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
ME505A.4	3	2	3	-	-	-	3	-	-	-	2	2	2	2	-
Avrg.	3	2.25	2.5	3	-	-	2.5	-	-	-	2	2.25	2.5	2.25	-

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Concepts of Refrigeration and Air-conditioning. Unit of refrigeration, Refrigerants– Desirable Properties, Nomenclature	2
2.	Simple Vapour Compression Refrigeration System (Simple VCRS): Vapour compression cycle on ph and T-s diagrams. Cycles with subcooling and superheating, their effects; Effect of changes in evaporator	5

	pressure and condenser pressure on the performance of a simple VCRS; dry compression, wet compression of refrigerant; actual Vapour Compression Cycle.	
3.	Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle.	3
4.	Vapour Absorption Refrigeration System (VARS): Advantages of VARS over VCRS. Working principle of simple VARS, practical VARS. Limitations of VARS, maximum COP of a VARS, Lithium bromide - water System; Aqua-ammonia systems.	4
5.	Equipment and Control: Major Refrigeration Equipment - Compressors: Types; reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves.	5
6.	Ventilation – Definition & Requirement, Natural & Mechanical Ventilation, Ventilation Load Calculation.	3
7.	Basic definitions and principles related to Psychometry ; Psychometric Charts & Their Uses; Heating, Cooling, Heating & Humidification & Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor.	5
8.	Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification.	4
9.	Duct Sizing & Design.	2
10.	Air-conditioning equipment: Air handling units, Cooling Towers.	3

Recommended Books:

1. Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill.
2. C.P. Arora, Refrigeration and Air Conditioning.
3. P.L. Ballaney, Refrigeration and Air Conditioning.
4. R.C.Arora, Refrigeration and Air Conditioning, TMH.
5. Arora and Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai Publication.

Course Name: MECHATRONICS
Course Code: ME505B
Prerequisite: Fluid Mechanics, Basic Electronics

Course Objectives: To study various type of mechanical actuators and their control system applicable in industrial instrumentation.

Course Outcomes

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

1. Describe Mechatronics systems and have an overview of the types of actuators.
2. Distinguish between various sensors, transducers, actuators and their applications.
3. Apply the basic concept of microprocessor.

4. Evaluate various signal conditioning units, amplifiers, logic gates and their role in Programmable logic controllers.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME505 B.1	2				1							1			
ME505 B.2	3	1	2		2		1				1	1	2		1
ME505 B.3	2		1		2							1			1
ME505 B.4	3	2	2		3		1				3	1	3		2
Avrg.	**2.5**	**0.75**	**1.25**		**2**		**0.5**				**1**	**1**	**1.25**		**1**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction to Mechatronics: Definition, Mechatronics in design and manufacturing, Comparison between Traditional and Mechatronic approach; Concurrent engineering.	**3**
2.	Review of fundamentals of electronics, Logic gates and their operations, Signal processing devices, Data conversion devices, Input and output devices. Sensors and Transducers, Actuators, Limit switches, Relays.	**6**
3.	Control Systems: Open loop and closed loop control, block diagrams, transfer functions, Laplace transforms.	**3**
4.	Electrical Drives: Stepper motors, servo drives.	**2**
5.	Mechanical Drives: Different mechanisms, Ball screws, Linear motion bearings, Transfer systems.	**3**
6.	Pneumatic and Hydraulic Drives: Elements of pneumatic and hydraulic drives, comparison between them.Design of pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc.	**4**
7.	Basics of 8085 microprocessor, programmable register architecture, buses, memory mapping, clock pulse and data transfer operations, and simple assembly and mnemonic programming on 8085 microprocessor.	**5**
8.	Use of On-Off, PI and PID controllers to control different drives, Programming in PLC controller using Ladder diagram.	**4**
9.	Mathematical modeling of physical systems, such as spring-mass vibration system, linear and rotary motion and its Laplace Transform.	**2**
10.	Basics of time domain analysis, Introduction to discrete-time systems and Z-transform.	**2**

11.	Introduction to Mechatronic systems, such as automatic brake, door closing and opening, robot, CNCmachine, AGV, etc.	**2**

Recommended Books:

2. N.P. Mahalik, Mechatronics, Tata McGraw Hill Publication
3. W. Bolton, Mechatronics, Pearson Education
4. A. Smaili and F. Arnold, Mechatronics, Oxford University Press, Indian Edition
5. M.D. Singh and J.G. Joshi, Mechatronics, Prentice Hall of India Pvt. Ltd.
6. K.K. AppuuKuttan, Mechatronics, Oxford University Press, New Delhi
7. HMT Ltd., Mechatronics, Tata McGraw Hill Publication
8. F.H. Raven, Automatic Control Engineering, McGraw Hill International.
9. K. Ogata, Modern Control Engineering, Prentice Hall.
10. B.C. Kuo, Automatic Control Systems, Prentice Hall.

Course Name: APPLIED FLUID MECHANICS

Course Code: ME505C

Prerequisite: Basic fluid Mechanics

Course Objectives: Understand and analyze fluid behavior through various conduits and machineries.

Course Outcomes: On successful completion of the course, the student will be able to,

1. Understand the detail of potential flows and infer basic design concept of nozzles to use in practical projects.
2. Analyze forces over an aerofoil section having huge practical application in Aviation industries.
3. Describe and analyse the operating principles and constructional details of hydro turbine, compressors, fans and blowers etc.
4. Apply and evaluate the knowledge gathered in designing, testing, and installation of modern hydraulic systems.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME505 C.1	3	3	2	2					3				2		1
ME505 C.2	3	2	2	3		1			3		2	1	1	1	2
ME505 C.3	2	2	2	1		2			2		2	2	1	2	
ME505	1	1	3	3		2	1	1	3	1	3	3	3	3	2

C.4															
Avrg.	**2.25**	**2**	**2.25**	**2.25**		**1.25**	**0.25**	**0.25**	**2.75**	**0.25**	**1.75**	**1.5**	**1.75**	**1.5**	**1.25**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	**Specific energy, Hydraulic Jump**	**3**
2.	Compressible Flow: speed of propagation of a small disturbance through a compressible fluid, sonic 9velocity, Mach number, mach cone and Mach wave; isentropic flow, stagnation properties of a compressible flow, isentropic pressure, temperature and density ratios; compressibility correction factor in the measurement of air speed; area – velocity relationship for compressible flow through a variable area duct, mass flow rate through a duct, critical condition and choking; flow through convergent-divergent nozzle.	**6**
3.	Ideal Fluid Flow: rotation of a fluid particle, vorticity, rotational and irrotational motion; velocity potential function, circulation, stream function, flownet; governing equation for two dimensional irrotational motion, simple two dimensional irrotational flows like uniform flow, plane source, plane sink etc; superimposition of simple irrotational flows, combination of a source and a sink.	**5**
4.	Analysis of flow through propellers and windmills – slip stream theory, actuated disc theory; jet propulsion devices – analysis of thrust and other performance parameters.	**5**
5.	Similarity and model study in turbomachines: dimensional analysis of incompressible flow turbomachines, flow coefficient, head coefficient and power coefficient; non-dimensional plot of performance curves; specific speed; Cordier diagram; specific speed as a design parameter of imcompressible flow turbomachines; unit quantities for hydroturbines.	**4**
6.	Mechanical, hydraulic and volumetric loss in a turbo-pump; different types of losses in a hydroturbineinstallation; different efficiencies in turbomachines.	**3**
7.	Interaction of a turbomachine with the pipeline system; system head curve and point of operation, surging, series and parallel operation of pumps and fans.	**4**
8.	Testing of hydroturbines, different performance characteristics of hydroturbines like operatingcharacteristics, main characteristics, Muschel curves; speed governing of hydroturbines – different methods.	**4**
9.	Torque converter and fluid coupling – function and performance.	**2**

Recommended Books:

1. N.P. Mahalik, Mechatronics, Tata McGraw Hill Publication
2. W. Bolton, Mechatronics, Pearson Education
3. A. Smaili and F. Arnold, Mechatronics, Oxford University Press, Indian Edition
4. M.D. Singh and J.G. Joshi, Mechatronics, Prentice Hall of India Pvt. Ltd.
5. K.K. AppuuKuttan, Mechatronics, Oxford University Press, New Delhi
6. HMT Ltd., Mechatronics, Tata McGraw Hill Publication
7. F.H. Raven, Automatic Control Engineering, McGraw Hill International.
8. K. Ogata, Modern Control Engineering, Prentice Hall.
9. B.C. Kuo, Automatic Control Systems, Prentice Hall.

5thSemester - Practical Courses

Course Name: Heat Transfer Lab

Course Code:ME-591

Contacts: 3P

Credits: 2

Prerequisite: Basic Physics, Fluid mechanics, Heat Transfer Theory

Course Objective: Practically measure the heat transfer through different kind of mediums.

Course Outcomes: Upon successful completion student will be able to:

1. Understand the problems involving steady state heat conduction in simple geometries.
2. Apply experimental solutions for problems involving free and forced convection
3. Analyse and differentiate radiation capabilities of black and grey surfaces by practical observation.
4. Evaluate performance of basic types of heat exchangers and solve complex industrial problems.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME591.1	3	3	-	-	-	-	-	-	-	-	-	2	3	3	-
ME591.2	2	2	2	-	-	-	-	-	-	-	-	-	2	2	-
ME591.3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
ME591.4	3	3	2	3	-	-	2	-	-	-	-	2	3	3	-
Avrg.	**2.75**	**2.75**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2.75**	**2.75**	**-**

Course Contents: List of Experiments

1) Determination of dryness fraction of steam by combining separating and throttling calorimeter.
2) Study and performance test of a single acting reciprocating air compressor.
3) Determination of thermal conductivity of a metal rod.
4) Determination of thermal conductivity of an insulating powder/or an insulating plate.
5) Determination of 'h' for forced convection over a pin fiN.
6) Verification of emissivity of a plate.
7) Study of a shell and tube heat exchanger and determination of LMTD.

Course Name: Dynamics of Machines Lab
Course Code:ME-592
Contacts: 3P
Credits: 2
Prerequisite: Theory of machines, Dynamics of Machine Theory

Course Objective: To practically observe the dynamic behaviors of machines and their components.

Course Outcomes: After taking this course the students should be able to:

1. Understand several types of vibrating systems by using vibration measuring instruments, vibration of continuous systems and random vibrations.
2. Apply methods of balancing of rigid rotors, reciprocating machines, flywheels, planar linkages and instruments.
3. Analyse the working principle of gyroscope and governors to apply in future projects
4. Apply the practical knowledge on Cam dynamics used in various industrial applications.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME592.1	3	3	3	-	-	-	-	-	-	-	-	2	-	2	3
ME592.2	3	3	2	3	3	-	-	-	-	-	-	-	-	2	3
ME592.3	2	3	3	2	-	-	-	-	2	-	-	-	-	-	2
ME592.4	3	-	3	2	-	-	-	-	-	-	-	-	-	-	2
Avrg.	**2.75**	**3**	**2.75**	**2.33**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**2.5**

Course Contents: List of Experiments

1. Studying and designing different mechanisms for performing specific tasks in a machine tool, and for common engineering applications.

2. Studying vibratory systems of single and more than one degree of freedom in linear and rotory systems;

3. Static and dynamic balancing of rotating masses;

4. Balancing of reciprocating masses;

5. Experiments on working of governor, operation and analysis.

6. Experiments on working of gyroscope, operation and analysis.

7. Designing cam,

8. Studying operation of cams and its analysis.

Course Name: Metrology & Measurement Lab

Course Code:ME-593

Contacts: 3P

Credits: 2

Prerequisite: Metrology & Measurement Theory, Physics.

Course Objective: Hands on experience with various measuring instruments to utilize in industries.

Course Outcomes: Upon completion of this course Students are able to

1. Demonstrate and use different length measuring instruments like vernier calipers and micrometers.
2. Apply different angle measuring instrument like universal bevel protractor, sine bar
3. Analyse some unknown quantity or parameter of engineering interest.
4. Evaluate the surface quality of a given specimen which is important in all kind of manufacturing

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME593.1	3	2	-	3	2	-	-	-	-	-	-	-	3	-	3
ME593.2	3	2	-	2	2	-	-	-	-	-	-	-	2	-	3
ME593.3	3	2	-	3	3	-	-	-	-	-	-	-	2	-	2
ME593.4	3	2	-	2	3	-	-	-	-	-	-	-	2	-	2
Avrg.	**3**	**2**	**-**	**2.5**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.5**

Course Contents: List of Experiments

1. Taking measurements using following instruments :

(i) Vernier height & depth gauge, (ii) Dial micrometer, (iii) Thread gauge, (iv) Radius gauge, (v) Filler gauge, (vi) Slip gauge.

2. Measurement of angle of a component using :

(i) Vernier bevel protractor, (ii) angle gauges , (iii) Sine-bar and slip gauges.

3. Checking / measuring parallelism, cylindricity and concentricity of components using dial indicator.

4. Measurement of a specific dimension for a lot of components, and prepare a histogram from the data obtained.

5. Measurement of surface finish by a Talysurf instrument.

6. Measurement of micro feature of a product (eg. Thread of a bolt or saw etc.) in a profile projector.

7. Determine natural cooling characteristics of a heated object by using a thermocouple.

8. Measurement of air velocity across an air duct using anemometer.

9. Fixing a strain gauge on a cantilevered flat section of steel. Then calibration of it as a force dynamometer using a Wheatstone bridge and loading arrangement.

Professional Electives Lab- I

SL.No.	Course Code	Subject Name
1.	ME594 A	REFRIGERATION AND AIR CONDITIONING LAB
2.	ME 594 B	MECHATRONICS LAB
3.	ME 594 C	APPLIED FLUID MECHANICS LAB

Course Name: Refrigeration & Air Conditioning Lab;
Course Code: ME 594A
Contacts: 3P
Credits: 2

Prerequisite: Applied Thermodynamics, Refrigeration & Air Conditioning Theory

Course Objective: To gain hands-on practice with refrigerating circuits and develop air-conditioning systems.

Course Outcomes: On successful completion of the course, the student will be able to,

1. Demonstrate a domestic refrigerator and identify its important components.
2. Apply and analyze the performance parameters of a vapor compression based refrigeration system

3. Analyse the components of a basic air conditioning setup and operate it to analyze its performance index.
4. Evaluate the components of a thermoelectric refrigeration setup and measure its coefficient of performance useful in future project applications.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 594A.1	3	2	2	3	-	-	2	-	-	-	-	2	3	2	-
ME 594A.2	3	2	2	-	-	-	-	-	-	-	2	2	2	2	-
ME 594A.3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
ME 594A.4	3	2	3	-	-	-	3	-	-	-	2	2	2	2	-
Avrg.	3	2.25	2.5	3	-	-	2.5	-	-	-	2	2.25	2.5	2.25	-

Course Contents: List of Experiments

1. Study of a Domestic Refrigerator.
2. Study of a room (window type) Air Conditioner.
3. Study of a room (split type) Air Conditioner.
4. Determination of C.O.P of a vapour compression refrigeration system.
5. Experiment in an Air Conditioning Test Unit; Determination of bypass factor and plotting of the cooling – dehumidification process on a psychometric chart.
6. Performance test of thermoelectric refrigeration system.

Course Name: Mechatronics lab
Course Code: ME594B
Contacts: 3P
Credits: 2

Prerequisite: Fluid Mechanics, Basic Electronics, Mechatronics Theory
Course Objective: To expose students to modern control system using mechanical actuators.

Course Outcomes: On successful completion of the course, the student will be able to

1. Describe and demonstrate Mechatronics systems and overview of control systems & actuators.
2. Distinguish between various sensors, transducers and actuators and their applications.
3. To understand the basic concept of microprocessor and perform simple operations on it.

Identify various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME594B.1	1		2		1				2	1	2				
ME594B.2	1		2		1					1	3	1	2		1
ME594B.3	1		2		2					1	2				
ME594B.4	2		3		1					1	3		1		1
Avrg.	**1.25**		**2.25**		**1.25**				**0.5**	**1**	**2.5**	**0.25**	**0.75**		**0.5**

Course Contents: List of Experiments

1. Open loop position control;
2. Closed loop position control using positional and velocity feedback;
3. Use of analog and digital servosystems,
4. Use of PID control;
5. Experiments on pneumatic drives and actuators;
6. Experiments on hydraulic drives and actuators;
7. Use of logic gates;
8. Programming on a 8085 Microprocessor training kit.
9. Programming on a PLC for simple control operations.

Course Name: Applied Fluid Mechanics Lab;

Course Code: ME 594C

Contacts: 3P

Credits: 2

Prerequisite: Basic Fluid Mechanics, Applied Fluid Mechanics theory

Course Objective: To expose students towards advanced experiments related to research.

Course Outcomes: On successful completion of the course, the student will be able to,

1. Understand and distinguish the nature of turbulence inside a flow at various flow velocities.
2. Apply the Stokes law by experimental investigation.
3. Analyse with hydro turbines and analyze their characteristics.
4. Evaluate the flow patterns of an open channel flow and understand its practical implications.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME594C.1			2						3	1					1
ME594C.2			2						3	1					2
ME594C.3		2	2						2	1	1		1	1	
ME594C.4		1	3	1					3	1			1	2	2
Avrg.		0.75	2.25	0.25					2.75	1	0.25		0.5	0.75	1.25

Course Contents: List of Experiments

1. Study of cavitation characteristics of centrifugal pump.
2. Study of the characteristics of submerged jet.
3. Study of characteristics of hydraulic jump.
4. Study of cavitation phenomenon.
5. Verification of Stokes law.
6. Determination of loss through pipes and fittings.
7. Performance test of pumps in series & parallel.

Course Name: Mini Project-I

Course Code: ME 581

Contacts: 3P

Credits: 2

Course Object: To impart the knowhow of carrying out a project on an engineering problem

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

1. Explore several subject domains to choose a practical problem of interest
2. Understand the methods of literature survey to analyze research works

3. Analyze, design and evaluate necessary components for the project work
4. Assess the utility of the project work and present through written and oral communication

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME581.1	2	2	1	2	-	2	1	-	-	1	1	3		1	2
ME581.2	2	3	2	2	-	1	1	1	-	2	2	3		1	3
ME581.3	1	3	2	2	3	1		2	-	3	3	2		1	2
ME581.4		2	2	2	2	2		1	-	3	3	3		2	2
Avrg															

Course contents:

Students in small groups will perform either an Industrial case study, or Preparation of a feasibility report, or Experimental investigation, or Computational/ Theoretical work, or Design and development of equipment/system.

An industrial case study/ project, if undertaken by the student, is to be supervised jointly by industry personnel and a teacher. The task is to complete over a period of two semesters, and the progress of the work will be evaluated through presentation of the same in front of a panel of examiners followed by a viva voce examination.

Course Name: Seminar

Course Code: ME 582

Contacts: 3P

Credits: 2

Prerequisite: Basic Communication Skill

Course Objective: Train students to deliver an effective technical presentation in front of any audience.

Course Outcomes: On successful completion of the course, the student will be able to,

1. Get thorough knowledge of preparing a technical seminar presentation in power point format which will be visually effective to reach any number of audiences.
2. Understand the methods of delivering and explaining technical terms through effective diagram selection and white board.
3. Analyze all core areas of Mechanical Engineering for variety of topics and enhance presentation skill by increasing level of detailing.
4. Produce confidence to face any audience and communicate with them in a disciplined manner, face and reply queries patiently

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME591.1	3	-	2	-	-	-	1	-	2	1	1	-	2	2	2
ME591.2	2	-	2	1	-	1	-	-	1	1	1	-	1	2	2
ME591.3	1	-	1	-	-	-	-	-	3	2	1	-	2	1	3
ME591.4		-	1	-	-	-	-	-	2	-	-	-	1	1	1
Avrg.	2	-	1.5	0.25	-	0.25	0.25	-	2	1	0.75	-	1.5	1.5	2

Course Contents:

Students in small groups or individual will make a report and presentation of any Industrial equipment's/case study etc.

Department of Mechanical Engineering

6th Semester CURRICULUM & SYLLABUS

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
A. THEORY:							
PC	ME 601	MACHINING PRINCIPLES & MACHINE TOOLS	3	0	0	3	3
PC	ME 602	DESIGN OF MACHINE ELEMENTS-II	3	0	0	3	3
PC	ME 603	IC ENGINE & GAS TURBINE	3	0	0	3	3
PE-II	ME 604A	ROBOTICS: MECHANICS AND CONTROL	3	0	0	3	3
	ME 604B	COMPOSITE MATERIALS					
	ME 604C	FLUID POWER CONTROL					
OE-I	ME605A	RENEWABLE ENERGY SYSTEMS	3	0	0	3	3
	ME 605B	COMPUTATIONAL FLUID DYNAMICS					
	ME 605C	GAS DYNAMICS AND JET PROPULSION					
Total of Theory						15	15

B. PRACTICAL:							
PC	**ME 691**	**MACHINING & MACHINE TOOLS LAB**	**0**	**0**	**3**	**3**	**2**
PC	**ME 692**	**DESIGN PRACTICE LAB**	**0**	**0**	**2**	**2**	**1**
PC	**ME 693**	**I C ENGINE LAB**	**0**	**0**	**3**	**3**	**2**
PE LAB-II	**ME 694 A**	**ROBOTICS LAB**	**0**	**0**	**3**	**3**	**2**
	ME 694 B	**COMPOSITE MATERIALS LAB**					
	ME 694 C	**FLUID POWER CONTROL LAB**					
Total of Practical						**11**	**7**
C. SESSIONAL:							
PROJECT	**ME 681**	**MINI PROJECT-II**	**0**	**0**	**3**	**3**	**2**
MANDATORY	**MC 682**	**GROUP DISCUSSION**	**0**	**0**	**2**	**2**	**0**
		TOTAL: Eleven	**15**	**0**	**16**	**31**	**24**

Note: Vacational Training to be conducted up to 6th semester and to be evaluated in 7th semester.

MECHANICAL ENGINEERING SYLLABUS (2016) FOR 6TH SEMESTER COURSES

THEORY COURSES

Course Name : Machining Principles and Machine Tools
Course Code : ME 601
YEAR : THIRD
SEMESTER : 6th Semester
CONTACT HOURS : 3L
CREDITS : 3

Prerequisite: WORKSHOP TECHNOLOGY, PRIMARY MANUFACTURING PROCESS

Course Objective: The objective of the course is to enlighten students about the detailed mechanism of metal cutting, cutting force, tool life and varying processes of machining.

Course Outcomes: After the completion of this course, the student should be able to:

1. Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting and oblique cutting.
2. Apply cutting mechanics to metal machining based on cutting force and power consumption.
3. Analyse the operations of lathe, milling machines, drill press, grinding machines, etc.
4. Evaluate cutting tool materials, tool geometries and appropriate machining processes and conditions for different metals.

Course Articulation Matrix:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME601.1	3	2	3	2	-	-	2	-	-	-	-	-	2	-	2
ME601.2	2	3	3	2	-	-	2	-	-	-	-	-	2	-	-
ME601.3	2	3	-	2	-	-	2	-	-	-	-	-	3	-	-
ME601.4	3	2	3	3	2	-	3	-	-	-	-	-	2	-	2
AVG	**2.5**	**2.5**	**3**	**2.25**	**2**	**-**	**2.25**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Machining: Basic principle, definition and requirements. Geometry of cutting tools: Geometry of single point turning tools in ASA, ORS and NRS systems, Conversion of tool angles by graphical and vector methods, Geometry of drills and milling cutters.	5
2.	Mechanism of machining: Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain. Built-up edge formation and effects, orthogonal and oblique cutting. Chip formation in drilling and milling. Mechanics of machining: Determination of cutting forces, cutting force, Merchant's circle diagram, analytical methods, Dynamometers, working principles of strain gauge type and piezoelectriccrystals type dynamometers.	8
3.	Cutting temperature: Heat generators and cutting zone temperature, Effect of machining parameters. Determination of cutting121 temperature by analytical and experimental methods, application of cutting fluids. Cutting tools- failure mechanisms, geometry and assessment of tool wear. Tool life assessment, Taylor's tool life equation. Cutting tool materials, essential properties, applications of HSS, carbide, ceramic, diamond and CBN	5

	tools.	
4.	Broaching and grinding: Modes of chip formation, Grinding forces, surface roughness and wheel life. Machinability and grindability, improvement and evaluation of optimum cutting velocity and tool life.	3
5.	Machine tools – Introduction, Purpose of use, definition and general features of machine tools. Generatrix and Directrix and tool–work motions in different operations of conventional machine tools. Major components and their functions in lathes; shaping, planing and slotting machines; drilling machines and milling machines. Machining operations and application of the common machine tools and their way of specification.	7
6	Kinematic structure of machine tools: Kinematic structure of centre lathe, shaping, planing and slotting machine. Kinematic structure of drilling (column/radial) and milling machines, capstan lathe, turret lathes. Automation: Purposes, degree, type and economy of machine tool automation; broad classification of machine tools.	6

Recommended Books:

1. A. B. Chattopadhyay, Machining and Machine Tools, Wiley India (P) Ltd., New Delhi.
2. G. Kuppuswamy, Principles of Metal Cutting, University Press, Hyderabad.
3. Stephenson & Agapion, Metal Cutting Theory and Practice, Taylor and Francis, NY.
4. M.C. Shaw, Metal Cutting Principles and Practices, Oxford University Press.
5. G.C. Sen and A. Bhattacharyya, Principles of Machine Tools, New Cantral Book Agency (P) Ltd., Kolkata.
6. Acharkan, Machine Tool Design, Vol. I, II, III and IV, Mir Publication, Moscow.

Course Name : Design of machine elements-II
Course Code : ME 602
YEAR : THIRD
SEMESTER : 6th Semester
CONTACT HOURS : 3L
CREDITS : 3

Prerequisite: ENGINEERING GRAPHICS, ENGINEERING MATERIALS

Course Objective: The objective of the course is to enable student for design and analysis of several power transmission devices like shafts, gears, bearings, brakes and clutches

Course Outcomes (CO):

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

1. Demonstrate the knowledge of basic machine elements to withstand loads and deformations for a given application, while considering additional specifications.

2. Formulate and solve engineering problems based on design of spur gears with respect to tooth bending strength and surface strength specifications
3. Analyze the design of bearings using design charts and custom software and select appropriate bearings for an application using printed and electronic catalog data.
4. Evaluate shaft design, brakes and clutches subjected to static or dynamic loads and present their designs orally and in writing.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 602.1	3	-	2	2	2	-	-	-	-	-	-	2	3	3	-
ME 602.2	2	3	3	3	2	-	-	-	-	-	-	3	3	3	3
ME 602.3	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-
ME 602.4	2	3	3	3	3	-	-	-	-	-	2	-	2	-	3
AVG	**2.5**	**3**	**2.5**	**2.5**	**2.25**	-	-	-	-	-	**2**	**2.5**	**2.75**	**3**	**3**

Course Contents :

Module No.	Syllabus	Contact Hrs.
1.	Clutches: Function, types; Friction clutches – torque capacity based on uniform pressure and uniform wear theory for disc and cone clutch; Centrifugal clutch; Friction materials; Considerations for heat dissipation.	4
2.	Brakes: Function, types; pivoted block brake (single and double block brakes), internal expanding shoe brake, self energizing and self locking; Pivoted block brake; Band brake-simple and differential; Energy equation for braking time calculation; Magnetic and hydraulic thruster operated fail-safe brakes; Brake lining materials; Thermal considerations during braking.	4
3.	Gears: Design objectives, types, terminologies, conjugate action and involute tooth profile, tooth systems, standard modules; Gear materials. Spur Gear : Strength design, static and dynamic considerations in strength design, Lewis formula, Lewis form factor, beam strength, Buckingham equation for dynamic tooth load; Endurance strength and wear strength; Designing a pinion based on above considerations; Helical Gear: Helix angle, minimum face width, virtual number of teeth; Strength design, Buckingham formulae for checking dynamic	6

	load and wear load.	
4.	Bevel Gear: Terminologies, formative number of teeth; Lewis equation, dynamic load, endurance strength and wear strength checking. Worm- worm wheel: Terminologies and their inter-relation; Preferred combination of various parameters; Efficiency; Materials.	4
5.	Pressure vessels– thin cylinder, thick cylinder, Lame's equation, Clavarino's equation, Birnie's equation, Autofrettage– compound cylinders, End Covers, Opening in pressure vessel – area compensation method, Fired and unfired vessels – category, Industrial Code.	6
6.	Sliding contact bearings: Bearing types and materials; Stribeck Curve, Petroff equation, Hydrodynamic lubrication theory - pressure development; Tower experiment, Reynolds equation, Finite bearings – Raimondi Boyd charts, Design factors/variables, Heat Generation & dissipation; Hydrostatic bearing; Plummer block.	6
7.	Rolling contact bearings: Bearing types, nature of load; Static and dynamic load capacity, Stribeck equation, Load - Life relation; Bearing selection from manufacturers' catalogues; Methods of lubrication; Bearing mounting on journal and bearing block.	4

Recommended Books

1. V. B. Bhandari, Design of Machine Elements, TMH.
2. Shigley and Mischke, Mechanical Engineering Design, TMH.
3. Hall, Holowenko and Laughlin, Theory and Problems of Machine Design, TMH.
4. Hamrock, Schmid, Jacobson, Fundamentals of Machine Elements, Mcgraw Hill.
5. Burr and Cheatham, Mechanical Analysis and Design, Prentice Hall.
6. P. Kannaiah, Machine Design, Scitech Publications.
7. P.C. Gope, Fundamentals of Machine Design, PHI.

Course Name : **I. C. Engines and Gas Turbines**
Course Code : **ME 603**
YEAR : **THIRD**
SEMESTER : **6th Semester**
CONTACT HOURS : **3L**
CREDITS : **3**

Prerequisite: ENGINEERING THERMODYNAMICS

Course Objective: The course is designed to expose students in the detailed knowledge of components and working of Internal combustion engines along with the assessment of engine performance.

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

1. Get the knowledge of engine nomenclature, performance parameters and characteristics of different fuels to differentiate several types of I C engine designs.
2. Understand and apply real characteristics of engine performance parameters and several losses due to various operational constraints in the presence of fuel.
3. Analyse performance and fuel economy trends with good accuracy, based on an in-depth analysis of the fuel air mixing and combustion process.
4. Evaluate modern injection systems, cooling & lubrication systems and supercharging to optimize the thermal efficiency and emission standards.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME603. 1	2	2	2	2	-	-	-	-	-	-	-	-	3	2	-
ME603. 2	3	3	3	-	-	-	2	-	-	-	-	-	3	2	-
ME603. 3	3	-	-	2	-	-	3	-	-	-	-	3	3	2	-
ME603. 4	2	-	-	2	-	-	-	-	-	-	-	-	-	3	-
AVG	2.5	2.5	2.5	2	-	-	2.5	-	-	-	-	3	3	**2.25**	-

Module No.	Syllabus	Contact Hrs.
1.	Classification and working of basic engine types: 2-stroke & 4-stroke Engines, SI & CI Engines, Engine Nomenclature, Review of Air Standard Cycles	3
2.	Fuel-Air cycles: Assumptions, Effect of specific heat & Dissociation, Performance analysis of fuel air cycle. Actual cycles: Assumptions, Heat Loss, Time loss and	5

	Blowdown loss, Optimum spark advance	
3.	Fuels: classification and desirable characteristics, HCV and LCV, Rating of fuels, Alternative fuels. Combustion of fuels in S.I and C.I engines, Parameters influencing combustion, Detonation and knocking in S.I. and C.I. engines and their preventions, Types of combustion chambers, Analysis of combustion product	6
4.	Fuel-Air mixing in SI Engines, Analysis of a simple carburetor, Disadvantages. Fuel injection systems: Working principle, Injection pumps and nozzles, electronic fuel injection system, Basic principles of MPFI	6
5.	Ignition systems: ignition timing and spark advance, firing order. Scavenging: ideal and actual, scavenging pumps, Supercharging and Turbo charging	4
6.	Introduction to Gas Turbine Cycles & Performance, Effect of Intercooling, Reheating and Regeneration, Applications of Gas Turbine	4
7.	Cooling and Lubrication: Properties of lubricating oil, Air and liquid cooling. Scavenging: ideal and actual, scavenging pumps, Supercharging and Turbo charging	3
8.	Performance and testing; Measurement of speed, torque, fuel consumption, IHP, BHP and FHP, SFC, thermal efficiency, Emission Control	3

Recommended Books:

1. V. Ganesan, Internal Combustion Engines, The McGraw-Hill Companies.
2. M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai & Sons.
3. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Private Ltd.

Professional Electives II

Sl. No.	Course Code	Subject Name
1.	ME604 A	ROBOTICS: MECHANICS AND CONTROL
2.	ME 604 B	COMPOSITE MATERIALS
3.	ME 604 C	FLUID POWER CONTROL

Course Name : **Robotics: Mechanics And Control**
Course Code : **ME 604A**
YEAR : **THIRD**
SEMESTER : **6th Semester**
CONTACT HOURS : **3L**
CREDITS : **3**

Prerequisite: Basic Electronics, Primary manufacturing

Course Objective: The course is designed in such a way that students can understand the basic mechanisms of a robot and various end effectors, actuators as well as supporting sensors.

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

1. Get the knowledge of engine nomenclature, performance parameters and characteristics of different fuels to differentiate several types of I C engine designs.
2. Understand real characteristics of engine performance parameters and several losses due to various operational constraints in the presence of fuel.
3. Predict performance and fuel economy trends with good accuracy, based on an in-depth analysis of the fuel air mixing and combustion process.
4. Develop an understanding of modern injection systems, cooling & lubrication systems and supercharging to optimize and evaluate the thermal efficiency and emission standards.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME603.1	3	2	2	2	-	1	1	-	-	-	2	2	2	3	
ME603.2	2	1	3	2	-	2	2	1	-	-	2	2		2	2
ME603.3	3	3	3	3	2	1	1	-	-	-	3	2	1		3
ME603.4	2	1	2	2	3	3	3	1	-	-	2	2	1	1	3
AVG	**2.5**	**2**	**2.5**	**2**	**2.5**	**2**	**22**	**1**			**2**	**2**	**1**	**2**	**2**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	**Introduction** Brief history of robotics; definition of robot; Main components of robot: manipulator, sensors, controller, power conversion unit; Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, joined; Classification of robot according to coordinate system: cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications: payload, accuracy, repeatability resolution, maximum tip speed, reach stroke:	4
2.	**Robot End Effector** End effector: definition, gripper, tools; Gripper : main parts, source of power; Types of grippers: mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers, Hooks, scoops, ladles, universal gripper; Robot Tools: Spot welding gun, pneumatic impact wrench, pneumatic nut runner, inert gas welding torch, heating torch, grinder, spray painting gun.	4
3.	**Robot Actuators:** Definition; Characteristics: power to weight ratio, stiffness, compliance, reduction gears; Conventional actuators: hydraulic actuator, pneumatic actuator, electric motor, direct drive motor, stepper motor, servo motor; Special actuators: magnetostrictive, shape memory alloy, elastomer.	4
4.	**Robot Sensors:** Definition; of Sensor and transducer; Calibration; Basic categories of measuring devices: analog, discrete; Main types of sensors: position, velocity, acceleration, force and pressure, torque, slip and tactile, proximity. Definition of digital image, generation of digital image; Robot Vision System: definition, use, functions, components, classification; vision cameras; Techniques of image processing and analysis: Image data reduction, segmentation, feature extraction, object recognition; Application of robot vision system.	7
5.	**Robot Kinematics:** Definition of Robot kinematics, Tool frame and base frame. Word –coordinate system, Direct kinematics, Inverse kinematics, Describing position and orientation of an object in space, Homogenous transformation, Translational transformations, Rotational transformations, Denavit- Hartenberg representation.	5
6.	**Robot Programming** Definition of robot programming; Different methods of robot programming: teach-pendant programming, key board programming; Programming languages: VAL II, AML/2, ARM BASIC	4
7.	**Industrial Applications of Robots** Welding, Spray painting, Grinding; Material Transfer: machine loading and unloading, Processing operation; Assembly operation; Inspection. Special applications: underwater prospecting and repairs, Mining, Space Exploration, Surgery.	4

Recommended Books

1. Klafter, Richard D. Chmielewski, Thomas A. and Negin, Michael (2001) - Robotic Engineering: An Integrated Approach, Prentice-Hall of India Pvt. Limited.
2. Mikell P. Groover, Mitchell.Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics:

Technology, Programming and Applications, McGraw-Hill International Edition
3. S.R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Publication.
4. S.K. Saha, Introduction to Robotics, The McGraw-Hill Publication
5. Niku, Saeed B., Introduction to Robotics Analysis, Systems, Applications, Prentice Hall of India Private Limited, New Delhi
6. Koren, Yoram, Robotics for Engineers, McGraw-Hill Book Company, Singapore

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Course Name : Composite Materials
Course Code : ME 604B
YEAR : THIRD
SEMESTER : 6th Semester
CONTACT HOURS : 3L
CREDITS : 3

Prerequisite: ENGINEERING MATERIALS

Course Objective: The course is designed to introduce formation, characteristics and fabrication of composite materials along with various applications.

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

1. Know the structure and basic properties of composite and nano-composite materials.
2. Explore and understand the several methods of composite fabrication.
3. Predict the characteristics and performance of composite materials.
4. Apply varying composite materials in automotive, aerospace and other applications.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME604A.1	3	2	2	1	-	-	-	-	-	-	-	-	2	3	-
ME604A.2	2	-	1	2	1	-	-	1	-	-	2	1	1	2	2
ME604A.3	2	2	2	1	1	1	-	-	-	-	1	1	1	2	3
ME604A.4	2	1	2	2	1	1	-	1	-	-	2	3	1	2	3
AVG	**2.25**	**1.6**	**1.75**	**1.5**	**1**	**1**		**1**			**1.6**	**1.6**	**1.25**	**2.25**	**1.6**

Module	Syllabus	Contact Hours
1	**Introduction:** Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites	3
2	**Performance of Structural and Nonstructural Composites:** Combination effects, Basic analytical concepts, Performance analysis by various models, Strengthening mechanisms, Stress distribution in fibre and the matrix, critical length of fibre for full strengthening, Composites in Electrical, Superconducting and Magnetic applications, Nano-composite devices	6
4	**Fabrication of Composites :** Fabrication of Metal Matrix Composites: Commonly used Matrices, , solidification processing of composites – XD process, Spray processes – Osprey Process, Rapid solidification processing, Dispersion Processes – Stir-casting & Compocasting, Screw extrusion, Liquid metal impregnation technique – Squeeze casting, Fabrication of Polymer Matrix Composites – Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites – Various techniques of vapor deposition, Liquid phase method and Hot pressing etc., Fabrication of nanocomposites	8
5	**Characterization Composites:** Control of particle/fibre and porosity content, particle/fibre distribution, Interfacial Reaction of matrix-reinforcing component, Coating of reinforcing component, Strength analysis	5
6	**Secondary Processing and Joining of Composite :** Forging and extrusion of composites – critical issues, dynamic recovery and dynamic recrystallisation, mechanical properties; Induction Heating, Fusion Bonding, Ultrasonic welding, Gas tungsten arc welding, Gas metal arc welding, Resistance spot & seam welding, Resistance brazing, Resistance spot joining, Resistant spot brazing, Resistance welding of thermoplastic graphite composite, Weld bonding, Brazing of MMC.	6
7	**Industrial Application of Composite Materials :** Civil constructions of structures/anels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, House hold and sports components	4

References:

1. Composite materials, K.K. Chawala, 2nd ed., (1987) Springer-Verlag, New York.

2. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH

Verlag GmbH Co. KgaA, Weinheim.

3. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Kidlington, Oxford OX5Lgb, UK.

4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London.

5. Advances in composite materials, G. Piatti, (1978) Applied Science Publishers Ltd., London.

Course Name : Fluid Power Control
Course Code : ME 604C
YEAR : THIRD
SEMESTER : 6th Semester
CONTACT HOURS : 3L
CREDITS : 3

Prerequisite: FLUID MECHANICS, BASIC ELECTRONICS

Course Objective: The course exploits the knowledge of several actuators, valves and other control devices running on hydraulic and pneumatic power which finds huge industrial application.

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

1. Understand and explain the working principle of hydraulic and pneumatic systems.
2. Apply the performance of pumps and actuators used in control devices.
3. Analyse hydraulic valve in different industrial applications.
4. Design and evaluate fluid powered control circuits and express through proper drawing.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME604C.1	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
ME604C.2	3	2	2	2	-	-	-	-	-	-	-	-	2	-	3
ME604C.3	3	3	3	2	-	-	-	-	-	-	-	-	3	-	2
ME604C4	3	3	2	2	-	-	-	-	-	-	-	-	**2**	-	3
AVG	**3**	**2.5**	**2.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.25**

Course contents:

Module No.	Syllabus	Contact Hrs.
1	Introduction to Fluid power Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a hydraulic fluid; advantage of mineral oil over water; definition of terms like pressure, head, force, density, specific gravity, kinematic and absolute viscosity, compressibility and incompressibility, Pascal's law; analysis of simple hydraulic jack, Mechanical advantage; continuity equation; hydraulic power of a cylinder.	5
2.	Hydraulic Pumps: positive displacement pumps; constructional features, working principle and volumetric Capacity of external gear pump, vane pump, axial piston pump and radial piston pump.	6
3.	Hydraulic Actuators : (i) Constructional features of single acting and double acting hydraulic cylinders; mounting of cylinders, cushioning of cylinder; different application of cylinder through mechanical linkages; force, velocity and Power from a cylinder. (ii) Hydraulic motors; torque, power and flow rate in a hydraulic motor.	4
4.	Advantages & disadvantages of pneumatic system compared to hydraulic system; constructional details and operation of a reciprocating compressor; working principle and use of filter, pressure regulator, lubricator and silencer; symbols of different pneumatic components; compressed air distribution system in a plant; drawing Pneumatic circuits for different operations.	5
5.	Hydraulic Valves : Direction control valves – operation and graphical symbol of 3 way and 4 way valves; different modes of activation of valves; Operation and symbols of check valves, pressure relief valve, pressure reducing valve, unloading valve and flow control valve.	4
6.	ANSI symbols for different hydraulic components. Analysis of hydraulic circuits : single acting cylinder control, double acting cylinder control, regenerative circuit, pump unloading circuit, double pump hydraulic system, cylinder synchronization circuit, speed control of a hydraulic motor, circuit to lift and hold heavy load, Automatic sequencing of two cylinders.	5
7.	Use of electrical devices for controlling fluid circuits; function of electrical devices like push-button switches, limit switches, pressure switches, solenoids, relays and timers and their symbols; concept of ladder diagram, study of circuits using electrical control devices	3

Open Electives I

SL. No	Course Code	Subject Name
1.	ME605A	RENEWABLE ENERGY SYSTEMS
2.	ME 605B	COMPUTATIONAL FLUID DYNAMICS
3.	ME 605C	GAS DYNAMICS AND JET PROPULSION

Course Name	**:**	**Renewable Energy Systems**
Course Code	**:**	**ME 605A**
YEAR	**:**	**THIRD**
SEMESTER	**:**	**6th Semester**
TOTAL CONTACT HOURS	**:**	**32L**
CREDITS	**:**	**3**

Prerequisite: Thermodynamics, Power Plant Engineering

Course Objective: Aware students about the various renewable energy systems necessary for controlling global warming and creating sustainable development.

Course Outcomes: On successful completion of the course, the learner will be able to

1. Create awareness among students about renewable sources of energy and application of renewable technologies in different areas of the country.
2. Apply the concept of working principle of various renewable energy technologies and systems like solar, wind, tidal and geothermal resources.
3. Analyse the knowledge of Storage technologies from renewable energy sources.
4. Evaluate the need and application of alternative biofuels in the field of power production.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ME605 A.1	3	2	-	-	-	3	3	-	-	-	-	-	-	2	2
ME605 A.2	3	2	-	-	-	3	3	-	-	-	-	-	-	2	3
ME605 A.3	3	3	-	-	-	3	3	-	-	-	-	-	-	2	-
ME605 A.4	3	2	-	-	-	3	3	-	-	-	-	-	-	-	-
AVG	3	**2.25**	-	-	-	3	3	-	-	-	-	-	-	2	2.5

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Principles of Renewable Energy: The history and future of energy scenario, Sustainable Development and role of renewable energy, Scientific Principles of renewable energy. Review of principles: thermodynamics, fluid dynamics and heat transfer	4

2.	Solar radiation: (i) Sun-Earth geometry (ii) Extraterrestrial Solar Radiation (iii) Measurement and estimation of solar radiation. Photovoltaic Generation: (i) Photon absorption at Silicon p-n junction (ii) Solar Cell (iii) Application and Systems.	6
3.	Solar Water Heating: (i) Flat Plate Collectors: Heat Transfer analysis, Testing (ii) Evacuated Tube Collectors. Applications: (i) Air heaters (ii) Water Desalination (iii) Space Cooling (iv) Solar Concentrators (v) Solar ponds.	5
4.	Wind Power: Wind Turbine types & Principles, Calculation of Power production from Wind mills, Betz Criteria	4
5.	Wave Power & tidal Power: Basic Concepts of Wave Power, Tidal Basins, Determination of energy conversion. Ocean Thermal Energy Conversion.	5
6.	Geothermal Energy: Location and Extraction, Petrothermal systems, Geothermal energy based vapor power cycles	4
7.	Biomass & Bio fuels: (i) Use of Biomass (ii) Classification & Use of Bio fuels. Energy Storage, Pumped Hydro Systems	4

Recommended Books:

1. Renewable Energy – G. Boyle, 2nd edition, OUP, 2010.
2. Renewable Energy Resources- Twidell, J & Weir, T, 2nd edition, Taylor & Francis, 2006.
3. Non Conventional Energy Resources- B.H. Khan, T M H, 2010.
4. Non Conventional Energy Sources- G.D. Rai, Khanna Publishers.

Course Name : COMPUTATIONAL FLUID DYNAMICS
Course Code : ME 605B
YEAR : THIRD
SEMESTER : 6th Semester
TOTAL CONTACT HOURS : 32L
CREDITS : 3

Prerequisite: Fluid Mechanics, Finite Element Methods
Course Objective: Introduce students to the domain of computational methods used in solving complex engineering problems based on fluid related applications.

Course Outcomes: On successful completion of the course, the learner will be able to
1. Understand the conservation equations and boundary conditions of fluid flow for varying cases.
2. Explore and analyze finite difference and finite volume methods of discretization.
3. Apply and analyse several computational solution methods based on finite element analysis.
4. Evaluate the new methods in computational fluid dynamics.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ME605B .1	3	2	2	2	-	2	3	-	-	-	-	3	2	3	-
ME605B .2	2	-	2	-	-	2	3	-	-	-	-	2	1	2	2
ME605B .3	2	-	1	-	-	2	3	-	-	-	-	2	1	2	3
ME605B .4	-	-	-	-	-	2	3	-	-	-	-	3	1	2	3
AVG	2	2	1.3	2	-	2	3	-	-	-	-	2	**1.25**	**2.25**	**1.6**

Course Contents:

Module	Syllabus	Contact Hours
1.	**Introduction:** Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description. Boundary and initial conditions; overview of numerical methods.	6
3.	**Finite Difference Techniqu**e: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion; treatment of boundary conditions; boundary layer treatment; accuracy of f.d. method.	4
4.	**Finite Volume Technique:** Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem.	5
5.	**Finite Element Methods:** Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications.	5
6.	**Methods of Solution:** Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform.	6
7.	**Time integration Methods:** Single and multilevel methods; predict or corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems. Basics of numerical grid generation.	6

References:

1. S.V.Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
2. H.K.Versteeg & W. Malalasekera,An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical. J. H. Ferziger and M.Peric, Computational Methods for Fluid Dynamics,Springer.
3. John C. Tannehill, Dale A.Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer
4. Taylor &Francis. John D.Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company

: GAS DYNAMICS AND JET PROPULSION

Course Name
Course Code : ME 605C
YEAR : THIRD
SEMESTER : 6th Semester
TOTAL CONTACT HOURS : 32L
CREDITS : 3

Prerequisite: Fluid Mechanics, Applied Fluid Mechanics

Course Objective: Introduce students to the domain of compressible flow and jet propulsion application in several industries.

Course Outcomes: On successful completion of the course, the learner will be able to
1. Understand the basics of compressible flow.
2. Explore and analyze compressible flow characteristics in constant and variable area ducts.
3. Apply and analyse the knowledge of shock theories in complex engineering situations.
4. Evaluate jet propulsion techniques applicable in aerospace industries.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME605 B.1	3	2	2	2	-	2	3	-	-	-	-	3	2	3	-
ME605 B.2	2	-	2	-	-	2	3	-	-	-	-	2	1	2	2
ME605 B.3	2	-	1	-	-	2	3	-	-	-	-	2	1	2	3
ME605 B.4	-	-	-	-	-	2	3	-	-	-	-	3	1	2	3
AVG	2	2	1.3	2	-	2	3	-	-	-	-	2	**1.25**	**2.25**	**1.6**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	COMPRESSIBLE FLOW - FUNDAMENTALS Energy and momentum equations for compressible fluid flows - various regions of flows - reference velocities - stagnation state - velocity of sound - critical states - Mach number – critical Mach number - types of waves - Mach cone - Mach angle - effect of Mach number on flow.	5
2.	FLOW THROUGH VARIABLE AREA DUCTS Isentropic flow through variable area ducts- T-s and h-s diagrams for nozzle and	6

	diffuser flows - Area ratio as a function of Mach number - Mass flow rate through nozzles and diffusers - Effect of friction in flow through nozzles.	
3.	FLOW THROUGH CONSTANT AREA DUCTS Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation - variation of flow properties - variation of Mach number with duct length. Isothermal flow with friction in constant area ducts. Flow in constant area ducts with heat transfer (Rayleigh flow) - Rayleigh line and Rayleigh flow equation - variation of flow properties - Maximum heat transfer.	6
4.	NORMAL AND OBLIQUE SHOCKS Governing equations - Variation of flow parameters like static pressure, static temperature , static density, stagnation pressure and entropy across the normal shock - Prandtl Meyer equation - impossibility of shock in subsonic flows - flow in convergent and divergent nozzle with shock - normal shock in Fanno and Rayleigh flows, flow with oblique shocks.	7
5.	PROPULSION Jet Propulsion: Aircraft propulsion - types of jet engines – energy flow through jet engines- performance of turbo jet engines - thrust - thrust power - propulsive and overall efficiencies – thrust augmentation in turbo jet engine - ram jet and pulse jet Engines. Space Propulsion: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion –Terminal and characteristic velocity - Applications.	8

Recommended Books

1. YAHYA. S.M. - "Fundamental of compressible flow"- New Age International (p) Ltd. - New Delhi 1996.
2. PATRICH.H. OOSTHVIZEN-WILLIAM E.CARSCALLEN- "Compressible fluid flow"- McGraw-Hill- 1997
3. COHEN. H. - ROGERS R.E.C AND SRAVANAMUTOO- "Gas turbine theory"- Addison Wesley Ltd. - 1987.
4. GANESAN. V. - "Gas Turbines"- Tata McGraw-Hill- New Delhi- 1999
5. RATHAKRISHNAN.E- "Gas Dynamics"- Prentice Hall of India- New Delhi- 2001
6. HILL.D and PETERSON .C, Mechanics & Thermodynamics of propulsion - Adisson Wesley Publishing Company, 1999.
7. G.P.Sutton- "Rocket Propulsion Elements "- John Wiley- 1986- New York.
8. ZUCROW N.J Principles of Jet Propulsion and Gas Turbines - John Wiley Newyork, 1970

Practical Courses

Course Name: Machining & Machine Tools Lab
Course Code: ME 691
Contacts: 3P
Credits: 2
Prerequisite: Workshop, Machining & Machine Tools theory

Course Objective: To expose students into different kind of machine tools and machining processes
Course Outcomes: After the completion of this course, the student should be able to:

1. Understand how to Measure cutting forces (P_Z and P_X or P_Y) in straight turning at different process

parameters.

2. Apply the measurement of average cutting temperature and surface roughness in turning under different speed – feed combinations.
3. Study and analyse chip formation (type, color & thickness) in turning mild steel and evaluation of role of variation of cutting velocity and feed on chip reduction coefficient.
4. Produce a straight toothed spur gear from a cast or forged disc and convert circular rod into square rod.

Course Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME691.1	3	2	3	2	-	-	2	-	-	-	-	-	2	-	2
ME691.2	2	3	3	2	-	-	2	-	-	-	-	-	2	-	-
ME691.3	2	3	-	2	-	-	2	-	-	-	-	-	3	-	-
ME691.4	3	2	3	3	2	-	3	-	-	-	-	-	2	-	2
AVG	**2.5**	**2.5**	**3**	**2.25**	**2**	**-**	**2.25**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2**

CourseContents:

1. Measurement of cutting forces in straight turning at different feeds and velocities
2. Measurement of surface roughness in turning under different conditions
3. Study of chip formation and evaluation of chip reduction coefficient
4. Measurement of tool – wear and evaluation of tool life
5. Acceptance test of a machine tool.
6. Study of gear cutting in milling machine

Course Name : Machine Design Practice
Course Code : ME 692
YEAR : THIRD
SEMESTER : 6th Semester
CONTACT : 2P
CREDITS : 1

Prerequisite: Design of machine elements theory
Course Objective: The objective of the course is to make students practice design and analysis of several power transmission devices like shafts, gears, bearings, brakes and clutches

Course Outcomes (CO):

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

1. Demonstrate the knowledge of basic machine elements to withstand loads and deformations for a given application, while considering additional specifications.
2. Formulate and solve engineering problems based on design of spur gears with respect to tooth bending strength and surface strength specifications
3. Analyze the design of bearings using design charts and custom software and select appropriate

bearings for an application using printed and electronic catalog data.

4. Design shafts, brakes and clutches subjected to static or dynamic loads and present their designs orally and in writing.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME 692.1	3	-	2	-	2	-	-	-	2	-	-	2	3	3	-
ME 692.2	2	3	3	3	2	-	-	-	-	-	3	3	3	3	3
ME 692.3	3	3	2	2	2	-	-	-	2	-	2	-	3	3	-
ME 692.4	2	3	3	-	3	-	-	-	-	-	-	-	2	-	3
AVG	**2.5**	**3**	**2.5**	**2.5**	**2.25**	**-**	**-**	**-**	**2**	**-**	**2.5**	**2.5**	**2.75**	**3**	**3**

Course Contents:
Drawing board exercises and Computer terminal exercises compatible to theory course on ME 502 and ME 602: Design of Machine Elements I & Design of Machine Elements II

1. At least **three assignments** on 2-D modelling of mechanical components using Drawing board exercises
2. At least **two assignments** on 2-D and 3-D modelling of mechanical components and systems using software packages like AUTOCAD, CATIA, PRO E or similar software
3. At least **one assignment** on design analysis of mechanical components using software packages like CATIA, PRO E or similar software.
4. At least **one assignment** on Design Practice using codes, e.g., Pressure vessel codes, Gear design codes etc.
5. At least **one assignment** on Selection of mechanical components from manufacturers' catalogue, e.g., chain drive, rolling element bearings etc.

Course Name: INTERNAL COMBUSTION ENGINE LAB (ME 693)
Course Code: ME 693
Contacts: 3P
Credits: 2
Prerequisite: ENGINEERING THERMODYNAMICS,IC ENGINE

Course Objective: To train students with hands on practice of handling I C engines and measuring the performance parameters

Course Outcomes: After the completion of this course, the student should be able to:
1. Understand the practical operation of 2 stroke and 4 stroke I.C engines using valve timing diagram
2. Apply the performance of multi cylinder engines with the variation of various performances like load

and speed.
3. Analyse and determine the quality of Engine fuels by analyzing its calorific value.
4. Analyze and evaluate the constituents of combustion products for emission characteristics related to public safety.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME693.1	2	2	2	2	-	-	-	-	-	-	-	-	3	2	-
ME693.2	3	3	3	-	-	-	-	-	-	-	-	-	3	3	-
ME693.3	3	-	-	2	-	-	-	-	-	-	-	-	3	-	-
ME693.4	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
AVG	2.5	2.5	2.5	2	-	-	-	-	-	-	-	-	3	2.5	-

CourseContents:
1) Study of cut models of Two stroke and four stroke Petrol and Diesel Engines.
2) Study of valve timing diagram of Petrol & Diesel Engine.
3) Determination of flash point and fire point of sample oil.
4) Determination of calorific value of a fuel by Bomb calorimeter.
5) Performance Test of a Diesel Engine using Mechanical and Electrical dynamometer.
6) Morse Test on multi cylinder petrol engine by electrical break dynamometer.

Professional Electives Lab II

SL. No.	Course Code	Subject Name
1.	ME 694 A	ROBOTICS LAB
2.	ME 694 B	COMPOSITE MATERIALS LAB
3.	ME 694 C	FLUID POWER CONTROL LAB

Course Name	**:**	**ROBOTICS LAB**
Course Code	**:**	**ME 694 A**
YEAR	**:**	**THIRD**
SEMESTER	**:**	**6th Semester**
TOTAL CONTACT HOURS	**:**	**3P**
CREDITS	**:**	**2**

Course Objective: To train students with hands-on practice of handling robots and program them according to a specific objective.

Course Outcomes: After the completion of this course, the student should be able to:

1. Understand the practical operation of robots and test their degree of freedoms
2. Analyze the gripper performance as per varying objectives.
3. Carry out case studies with robots for practical applications.
4. Evaluate the robot using simulation software.

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME693.1	1		2			2	1		2	1	1	1	2	3	2
ME693.2	1	1	3	2		1	1		3	1	1	2	2	3	2
ME693.3			2			2	2		3	1	1	3	1	3	1
ME693.4		3	2			2	3	1	3	1	1	3	1	2	3
AVG	0.5	2	2.25	0.5	0	1.25	1.25	0.25	2.75	1	1	2.25	1.5	2.75	2

Coure contents:

1. Demonstration of ROBOT with 2 DOF, 3 DOF, 4 DOF
2. Study and selection of Gripper.
3. Programming exercise of robots for Pick and Place activity.
4. Case studies of applications in industry like Spray Painting or Welding
5. Exercise on Robotic Simulation software, using Fanuc Robo guide

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Course Name	**:**	**COMPOSITE MATERIALS LAB**
Course Code	**:**	**ME 694B**
YEAR	**:**	**THIRD**
TOTAL CONTACT HOURS	**:**	**3P**

Prerequisite: Composite Materials theory

Course Objective: The course is designed to test the characteristics and fabrication of composite materials.

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

1. Know the structure and basic properties of composite and nano-composite materials.
2. Apply and understand the several methods of composite fabrication.
3. Predict and analyse the characteristics and performance of composite materials.
4. Evaluate and apply varying composite materials in automotive, aerospace and other applications.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME694.1	3	2	3	-	-	-	-	-	-	-	3	-	3	-	-
ME694.2	2	-	-	-	2	-	-	-	-	-	2	-	3	-	2
ME694.3	2	3	2	-	-	-	-	-	-	-	2	-	3	-	3
ME694.4	2	-	2	-	2	-	-	-	-	-	2	-	2	-	3
AVG	**2.25**	**1.25**	**1.75**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2.25**	**-**	**2.75**	**-**	**2**

Course contents:
1. Fabrication of any Metal Matrix Composite
2. Fabrication of any Polymer/ceramic Matrix Composite
3. Welding of two composite specimens
4. Determination of Mechanical properties of a composite specimen
5. Determination of Porosity of a composite specimen

Course Name	**:**	**FLUID POWER CONTROL LAB**
Course Code	**:**	**ME 694C**
YEAR	**:**	**THIRD**
SEMESTER	**:**	**6th Semester**
CONTACT HOURS	**:**	**3P**
CREDITS	**:**	**2**

Prerequisite: FLUID MECHANICS, BASIC ELECTRONICS

Course Objective: The course exploits the knowledge of several actuators, valves and other control devices running on hydraulic and pneumatic power which finds huge industrial application.

Course Outcomes: Upon completion of this course students will be able to
1. Explain the working principle of hydraulic and pneumatic systems.
2. Understand and analyze the performance of pumps and actuators used in control devices.
3. Apply hydraulic valves in different industrial application.
4. Design and evaluate fluid powered control circuits and express through proper drawing.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME694C.1	3	3	3	2	-	2	1	-	1	2	1	-	2	3	2
ME694C.2	3	3	3	2	1	1	1	1	-	-	1	1	2	2	1
ME694C.3	3	2	2	1	1	1	1	-	1	1	-	1	1	2	2
ME694C.4	2	1	3	2	1	1	-	1	-	-	-	-	1	1	2
AVG	**2.75**	**2.25**	**2.75**	**1.75**	**0.75**	**1.25**	**0.75**	**0.5**	**0.5**	**0.75**	**0.5**	**0.5**	**1.67**	**2**	**1.67**

Course Contents:

1. To demonstrate the motion of a single acting cylinder and double acting cylinder in pneumatic system.
2. To demonstrate the use of direction control valve with double acting cylinder in hydraulic system.
3. To demonstrate the use of pressure control valve in a circuit.
4. To perform AND & OR logic for forward stroke of a double acting cylinder using two manual control.
5. To control the speed of a double acting cylinder using metering in and metering out flow control valve
6. To operate two double acting cylinders (Sequence of operation: A+B+A-B-).

SESSIONAL

Mini Project-II

ME 681

Contacts: 3P

Credits: 2

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

5. Explore several subject domains to choose a practical problem of interest
6. Understand the methods of literature survey to analyze research works
7. Analyze, design and evaluate necessary components for the project work
8. Assess the utility of the project work and present through written and oral communication

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME681.1	2	2	1	2	-	2	1	-	-	1	1	3		1	2
ME681.2	2	3	2	2	-	1	1	1	-	2	2	3		1	3
ME681.3	1	3	2	2	3	1		2	-	3	3	2		1	2
ME681.4		2	2	2	2	2		1	-	3	3	3		2	2

Course Contents:
Students in small groups will perform either an Industrial case study, or Preparation of a feasibility report, or Experimental investigation.

Course Name:Group Discussion
Course Code: ME682
Contact Hours: 2P
Credit: 0
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Communicate effectively in an interview
2. Grow leadership and negotiation skills.
3. Learn discipline, body language, positive attitude and ethics to follow whole life.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME682.1					-	**1**			-	3	2	2		1	2
ME682.2					-	**1**			-	3	2	2		1	3
ME682.3						1			-	3	2	2		1	3

Students in small groups will perform discussion on educational , societal, economic and current affairs . Group of students will discuss on a given topic or debate demonstrating their communication and interpersonal skills.

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Department of Mechanical Engineering

COMMON AUTONOMOUS 7th Semester CURRICULUM & SYLLABUS

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
A. THEORY:							
PC	ME 701	POWER PLANT ENGINEERING	3	0	0	3	3
PC	ME 702	ADVANCED MANUFACTURING TECHNOLOGY	3	0	0	3	3
PE-III	ME 703 A	ADVANCED WELDING TECHNOLOGY	3	0	0	3	3
	ME 703 B	BIOMECHANICS & BIOMATERIALS					
	ME 703 C	FINITE ELEMENT METHOD					
PE-IV	ME 704	TRIBOLOGY	3	0	0	3	3

	A						
	ME 704 B	OPERATIONS RESEARCH					
	ME 704 C	MATERIALS HANDLING					
OE-II	ME 705 A	ENERGY CONSERVATION & MANAGEMENT	3	0	0	3	3
	ME 705 B	QUALITY & RELIABILITY ENGINEERING					
	ME 705 C	HYDRO, WIND AND WAVE POWER					
Total of Theory						**15**	**15**
B. PRACTICAL:							
PC	ME 791	ADVANCED MANUFACTURING LAB	0	0	2	2	1
PE-III lab	ME 793 A	ADVANCED WELDING LAB	0	0	2	2	1
	ME 793 B	BIOMECHANICS & BIOMATERIALS LAB					
	ME 793 C	FINITE ELEMENT METHOD LAB					
Total of Practical						**4**	**2**
C. SESSIONAL:							
PW	ME 781	PROJECT- I	0	0	6	6	3
PW	ME 782	DESIGN OF MECHANICAL SYSTEM	0	0	3	3	2
PW	ME 783	VIVA-VOCE ON VACATIONAL TRAINING	0	0	0	0	2
Total of Sessional						9	7
		TOTAL: Ten	**15**	**0**	**13**	**28**	**24**

SYLLABUS OF 7TH SEMESTER COURSES

Theory Courses

Course Name: Power Plant Engineering
Course Code: ME 701
Contact Hours: 34L
Credit: 3
Course Outcomes (CO):
Upon successful completion of this course, the student will be able to:
1. Know and understand the performance of a variety of steam based thermal power cycles and understand the economics of a power plant.
2. Get detailed knowledge about the part and parcel of a steam generator and apply the concept to design the mountings and accessories by analytical investigations.
3. Propose coal handling, air handling, ash handling and firing methods in a thermal power plant and the involvement in further research areas for modernization.
4. Analyze and evaluate the working of steam nozzles and a variety of turbines to carry out design based project works and solution of industrial problems.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME701.1	3	2	3	-	-	2	2	-	-	-	-	-	3	2	-
ME701.2	3	2	-	-	-	2	2	-	-	-	-	-	3	3	-
ME701.3	2	2	3	-	-	2	2	-	-	-	-	-	3	2	-
ME701.4	2	2	-	-	-	2	2	-	-	-	-	-	3	3	-
AVG	2.5	2	1.5	-	-	2	2	-	-	-	-	-	3	2.5	-

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Power plant process layout, Plant economics: load curve and various factors, cost of power generation.	4
2.	Boilers: Definition, classification, fire tube and water tube boilers, mountings and accessories. Introduction to boiling and circulation in boilers. Boilers accessories: Super heater, economizer and air-pre heater. Power station boilers - Benson, Lamont. Supercritical boiler. Combined Cycle power generation.	6
3.	Coal and combustion: Properties of coal, proximate and ultimate analysis, calculation of theoretical and actual air. Fuel bed firing, PF firing and Fluidized bed boilers. Losses in boilers, boilers efficiency, equivalent evaporation. Draft in boilers. Ash handling systems.	8
4.	Steam turbine- i) parts and classification, ii) nozzles types, flow through nozzles and nozzle efficiency. Impulse turbine - velocity diagram, work done and blade efficiency.	6
5.	Pressure compounding and velocity compounding of steam turbine. Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine. Governing in Steam turbine.	4
6.	Condensing Systems, Cooling Towers	2
7.	Introduction to Hydel, Nuclear and Renewable power plants.	4

Recommended Books:

1. P.K. Nag, “Power plant Engineering,” Tata McGraw - Hill.
2. Arora and Domkundwar, “A course in Power plant Engineering” Dhanpat Rai & Sons.
3. M.M.EI- Wakil, “Power plant technology,” Tata McGraw - Hill.

Course Name: Advanced Manufacturing Technology
Course Code: ME 702
Contact Hours: 34L
Credit: 3
Course Outcomes: After successful completion of the course, the student would be able to

1. Understand the principle of working, mechanism of metal removal in the nonconventional machining processes like AJM, WJM, and USM.
2. Apply the process parameters involved in machining process and analyze their effect on surface finish achieved in USM, ECM, and EDM.
3. Analyse the principles of Laser Beam Machining and an introduction to hybrid machining
4. Get an overview and evaluate the concept of rapid prototyping and use of 3D printing.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME702.1	3	2	3	3	3	-	2	-	-	-	3	3	3	-	3
ME702.2	3	2	2	2	3	-	-	-	-	-	2	2	3	-	-
ME702.3	3	-	3	2	3	-	-	-	-	-	2	3	-	-	2
ME702.4	3	3	2	2	2	-	2	-	-	-	2	2	3	-	-
AVG.	3	2.5	2.5	**2.25**	**2.75**	-	2	-	-	-	**2.25**	2.5	**2.25**	-	**1.25**

Course Contents

Module No.	Syllabus	Contact Hrs.
1.	Introduction to Advanced Manufacturing Technology	1
2.	Manufacturing Systems and Automation : Job shop, Flowlines, Transfer lines, Project shop, Continuous processes, Cellular manufacturing system, Flexible Manufacturing System: Automation: 9. degree of automation and their justified application in different levels of production (ii) benefits and draw backs of employing automation (iii) examples of conventional non-automatic, semi-automatic and automatic machine tools (iv) extent of automation in transfer machines Integrated Manufacturing Production System: Steps involved in implementation, forming the linked-cell factory.	8
3	Basic systems of NC and CNC machines: coordinate system, control – open loop and closed loop, dimensioning – absolute and incremental CNC machine tools ;	7

	structure and working principle machining centre (MC) – characteristics and applications. Control of tool – work travel, point – to – point and contouring, interpolation – linear and circular Part programming for NC, CNC and MC systems, Codes used, sequential steps, examples; part programming for machining in CNC lathes, drilling machines and milling, Computer aided part programming, advantages, programming languages, statements in APT, examples	
4.	Non Traditional Manufacturing –Advantages, classification, characteristics Abrasive Jet Machining (AJM): principle, material removal rate Water Jet Machining, Applications, Advantages and limitations. Ultrasonic Machining (USM): Working principle, Influence of Process parameters, Applications. Plasma Arc Machining- principle, applications. Chemical Machining- Blanking, Design factors, advantages and disadvantages. Electro-Chemical Machining, Applications. Electrical Discharge Machining (EDM), Wire-cut EDM: working principle, Dielectric fluid, Advantages & Disadvantages. Electron Beam Machining Principle and Applications. Die sinking. Laser Beam Machining (LBM): Characteristics of Ruby laser, Carbon Dioxide laser, Welding Heat treating, cladding. Hybrid Machining	12
7.	Rapid Prototyping- Overview of Rapid Prototyping, Basic Process- CAD Model Creation, Conversion to STL format, Slice the STL File, Layer by layer construction, Clean and finish. Principles, systems, relative advantages and applications of the common RP methods ; 10. stereo lithography (SLG) (ii) selective laser sintering (SLS) (iii) fused deposition modeling (FDM) (iv) laminated objects manufacturing (LOM) (v) 3-D Inkjet Printing	6

Recommended Books:

1. Fundamentals of Modern Manufacturing by Mikeel P. Grover– 3E Wiley
2. Automation, Production systems and CIM – M.P. Groover , Prentice Hall
3. Non conventional machining – P.K. Mishra, Narosa
4. Manufacturing science – Ghosh & Mullick, EWP
5. Rapid prototyping – A. Ghosh, EW Press
6. Nontraditional Manufacturing Processes by Gary F. Benedict– Marcel Dekker
7. Micromaching of Engineering Material by Mc Geongh, J.A. – Marcel Dekker
8. Advanced Machining Process, Nontraditional and Hybrid Machining Processes by Hassan Abdel- Gawad El- Hofy – McGraw Hill, Mechanical Engineering Science

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Professional Electives III

SL. No.	Course Code	Subject Name
1	**ME 703 A**	**ADVANCED WELDING TECHNOLOGY**
2	**ME 703 B**	**BIOMECHANICS & BIOMATERIALS**
3	**ME 703 C**	**FINITE ELEMENT METHOD**

Course Name: Advanced Welding Technology
Course Code: ME 703A
Contact Hours: 32L
Credit: 3
Course Outcomes: Upon completion of this course, the student will be able to achieve:

1. Deeper knowledge of welding materials and technology of welding.
2. Deeper knowledge of different metals and their properties in welded constructions
3. Knowledge of quality techniques at production by welding
4. Knowledge of current computer systems and cost for welding operations

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME703A.1	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
ME703A.2	3	2	2	3	-	-	-	-	-	-	-	-	3	-	-
ME703A.3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	2
ME703A.4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
AVG	3	2.5	2.5	**2.25**	-	-	-	-	-	-	-	-	**2.25**	-	**1.25**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Review of welding processes, joint design.	3
2.	Process descriptions of and parametric influences on fusion welding; arc welding- SMAW, submerged arc welding, GMAW, GTAW and FCAW, solid state welding processes- pressurewelding, friction welding, diffusion welding; resistance welding processes.	6
3.	Arc welding- different types of equipment, power sources, arc characteristics, electrode selection.	5
4.	Critical and precision welding processes like: PAW, LBW, EBW, USW, friction stir welding, under-water welding. Welding of plastics, ceramics and composites.	5
5.	Welding metallurgy, HAZ, effects of different process parameters on the characteristics of weldment. Welding fixtures, welding automation and robotic applications	5
6.	Weldability of plain carbon steels, stainless steel, cast iron, aluminium and	4

	its alloys.	
7.	Welding defects- types, causes, inspection and remedial measures; testing of welded joints by visual inspection, dye-penetration (DP) test, ultrasonics and radiography. Safe Practices in Welding.	4

Recommended Books:

1. O.P. Khanna, A Text Book of Welding Technology, Dhanpat Rai & Sons.
2. R.S. Parmar, Welding Engineering and Technology, Khanna Publishers.
3. M. Bhattacharyya, Weldment Design, The Association of Engineers, India Publication, Kolkata.
4. J.C. Lippold and D.J. Kotecki, Welding Metallurgy and Weldability of Stainless Steels, Wiley-India (P) Ltd., New Delhi.
5. Udin, Funk and Wulf, Welding for Engineers, John Wiley and Sons.
6. J.L. Morris, Welding Process and Procedures.
7. S.V. Nadkarni, Modern Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd./ Advani-Oerlikon Ltd.

Course Name: Biomechanics & Biomaterials
Course Code: ME 703B
Contact Hours: 32L
Credit: 3
Course Objectives:
The objective of the course is to make student aware about the application of mechanics and advanced materials for human welfare in the biological perspective.

Course Outcomes: After completion of the course student will be able to
ME703B.1 Understand the fundamentals of biomechanics and its relation with human motion.
ME703B.2 Apply a broad knowledge of different types of biomaterials including metals, polymers, ceramics and composites and their use in typical biomedical devices and clinical applications..
ME703B.3 3Design an implant using fundamental concept and modern engineering tools to develop hard tissue and soft tissue replacement materials by suitable material selection.
ME703B.4. Analyze the design of various biocompatible implants and artificial organ to develop and improve Health Care Service to serve mankind and society.

Module No.	Syllabus	Contact Hrs.
1	**Musculoskeletal Anatomy**: Basic Statics and Joint Mechanics (elbow, shoulder, spine, hip, knee, ankle)	4
2	**Basic Dynamics to Human Motion**: Review of linear and angular kinematics; Kinetic equations of motion; Work & energy methods; Momentum methods; Examples in biomechanics; Modern kinematic measurement techniques; Applications of human motion analysis Structure, Function, and Adaptation of Major Tissues and Organs	6
3	**Fundamental Strength of Materials in Biological Tissues**: Introduction to Viscoelasticity.	6

	Fundamentals of biomaterials science. Concept of biocompatibility. Classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance. Disinfection and sterilization of biomaterials.	
4	**Physico-chemical properties of biomaterials**: mechanical (elasticity, yield stress, ductility, toughness, strength, fatigue, hardness, wear resistance), tribological (friction, wear, lubricity), morphology and texture, physical (electrical, optical, magnetic, thermal), chemical and biological properties	6
5	**Elements in contact with the surface of a biomaterial**: blood composition, plasma proteins, cells, tissues. Phenomena at the biointerfaces. Molecular and cellular processes with living environment, blood-materials interaction, short and long term reactions to the body.	6
6	**Testing of biomaterials**: in vitro, in vivo preclinical and in vivo clinical tests. Technologies of biomaterials processing, as implants and medical devices; improvement of materials biocompatibility by plasma processing.	4

Recommended Books:

1. Fundamentals of Biomechanics: D V Knudson, Springer.
2. Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, by Ozkaya and Nordin, Springer.
3. Biomechanics: Mechanical Properties of Living Tissues, by Fung, Springer
4. Basic Biomechanics of the Musculoskeletal System, by Nordin & Frankel, Barnes & Noble.
5. Biomaterials Science, An Intoduction to Materials in medicine, Eds. B. D. Ratner and A. S. Hoffman, Academic Press, New York.

Course Name: Finite Element Method
Course Code: ME 703 C
Contact Hours: 3L
Credit: 3
Course Outcomes: Upon successful completion of this course, students will be able to
1) Understanding of the fundamental theory of the FEA method.
2) Develop the ability to generate the governing FE equations for systems governed by partial differential equations.
3) Analyse the basic finite element methods for structural applications using truss, beam frame, and plane elements.
4) Analyze the FE method and compare the result with FEA package like-Ansys.

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
ME703 C.1	2		2	2	3										
ME703 C.2	2	3		3	2										
ME703 C.3	3	3		2	2										
ME703 C.4				1	2										

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Historical background, Relevance of FEM to design problems, Application to the continuum– Discretisation, Matrix approach, Matrix algebra– Gaussian elimination, Governing equations for continuum, Classical Techniques in FEM, Weighted residual method, Ritz method, Galerkin method	8
2.	One dimensional problems: Finite element modeling– Coordinates and shape functions, Potential energy approach– Element matrices and vectors, Assembly for global equations, Boundary conditions, Higher order elements- Shapes functions, Applications to axial loadings of rods– Extension to plane trusses, Bending of beams– Finite element formulation of stiffness matrix and load vectors, Assembly to Global equations, boundary conditions, Solutions and Post processing, Example Problems.	8
3.	Two dimensional problems– scalar variable problems: Finite element modeling– CST element, Element equations, Load vectors and boundary conditions, Assembly, Application to heat transfer, Examples	4
4.	Two dimensional problems– vector variable problems: Vector Variable problems, Elasticity equations– Plane Stress, Plane Strain and Axisymmetric problems, Formulation, element matrices, Assembly, boundary conditions and solutions Examples	8
5.	Isoparametric elements for two dimensional problems: Natural coordinates, Iso parametric elements, Four node quadrilateral element, Shape functions, Element stiffness matrix and force vector, Numerical integration, Stiffness integration, Displacement and Stress calculations, Examples.	6
6.	Computer implementation: Pre-processor, Processor, Post-processor. Discussion about finite element packages.	2

Recommended Books:

1. R.D. Cook, D.S. Malkus and M.E. Plesha, Concepts and Applications of Finite Element Analysis, Prentice Hall-India, New Delhi.
2. T.R. Chandrupatla and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall of India.
3. C.S. Krishnamoorthy, Finite Element Analysis, TMH.
4. K-J. Bathe, Finite Element Procedures, Prentice Hall.
5. O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Elsevier.
6. J.N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill.

Professional Electives IV

Sl. No.	Course Code	Subject Name
1	ME 704 A	TRIBOLOGY
2	ME 704 B	OPERATIONS RESEARCH
3	ME 704 C	MATERIALS HANDLING

Course Name: TRIBOLOGY
Course Code: ME 704A
Contact Hours: 32L
Credit: 3

Course Outcomes: Upon successful completion of this course, students will be able
1. To become familiar with mathematical tools used to analyze Tribological processes.
2. Apply Tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals, and braking systems.
3. Analyse common anti-friction and anti-wear components.
4. To design and evaluate a Tribological system for optimal performance.

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME704 A.1	3	2	2	1								1			
ME704 A.2	2	1	1	1								1			
ME704 A.3	3	2	1	2								1			
ME704 A.4	2	1	2	1								1			

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: History, Industrial Importance. Engineering Surfaces: Properties and Measurement: Measurement Methods, Surface Profilometry, Statistical Description of Roughness.	4
2.	Surface Contact: Hertz contact theory, Greenwood-Williamson model, Elastic-plastic contact. Adhesion: Basic Models, Factors influencing Adhesion.	4
3.	Friction: Measurement Methods, Origin of Friction, Friction Theories – adhesion and ploughing, Mechanisms, Friction of Metals, Non-metallic	4

	Materials.	
4.	Wear: Types: Adhesive, Abrasive, Corrosive, Fatigue, Minor Forms: Fretting, Erosion, Percussion, Delamination Theory, Wear Debris Analysis, Wear Testing Methods, Wear of Metals, Ceramics, Polymers.	6
5.	Surface Engineering: Surface Treatments: Microstructural and Thermochemical Treatments, Surface Coatings: Hard Facing, Vapour Deposition Processes: PVD, CVD, PECVD etc.	4
6.	Lubrication: Basic Equations for Fluid Film Lubrication. Hydrodynamic lubrication -Thrust and Journal bearings, Squeeze Film Bearings, Hydrostatic lubrication, Gas-Lubrication. Lubrication of rolling element bearings. Boundary lubrication – metal working lubrication, solid film lubrication. Hygiene of lubricants.	8
7.	Nanotribology: Measurement Tools: Surface Force Apparatus, Scanning Tunneling Microscope, Atomic / Friction Force Microscope.	2

Recommended Books:

1. P. Sahoo, Engineering Tribology, Prentice Hall-India, New Delhi, 2009.
2. B. Bhushan, Introduction to Tribology, Wiley, 2002.
3. G W Stachowiak and A W Batchelor, Engineering Tribology, Butterworth-Heinemann,2005.
4. S.K. Basu, S.N. Sengupta, B.B. Ahuja, Fundamentals of Tribology, Prentice Hall-India, 2005.
5. B C Majumdar, Introduction to Tribology of Bearings, S Chand & Co, 2012.

Course Name: Operations Research
Course Code: ME 704 B
Contact Hours: 32L
Credit: 3
Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CODE	DESCRIPTION
ME704B.1	Understand the characteristics of different types of decision-making environments to formulate and solve a real-world problem as a mathematical programming model.
ME704 B.2	Apply the theoretical workings of appropriate decision making approaches and tools to identify the optimal strategy in competitive world.
ME704 B.3	Solve and analyse network models like the shortest path, minimum spanning tree, and maximum flow problems
ME704 B.4	Create and evaluate the model of a dynamic system as a queuing model and compute important performance measures.

Course Articulation Matrix:

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME704B.1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
ME704 B.2	-	-	-	3	-	-	-	-	-	-	-	2	3	-	3
ME704 B.3	2	2	-	2	-	-	-	-	-	-	-	2	-	-	3
ME704 B.4	-	-	3	-	-	-	-	-	-	-	-	2	-	-	3
AVG.	2	2	3	2.5	-	-	-	-	-	-	-	2	**3**	**-**	**3**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	**Introduction:** Brief history; different O.R. problems and techniques, Inventory control, Metaheuristics	2
2.	**Decision Theory:** Structure of the problem (decision table); Decision making under uncertainty with optimistic, pessimistic and average outcome criteria; Decision making under risk with expected value and expected loss criteria; Sequential decision using decision trees.	4
3.	**Linear Programming (LP);** Nature of LP problems through examples; Formulation of LP Problems; Graphical solutions of two decision variable problems; Properties of a solution to LP problems: convex solution space and extreme point solution; General form of LP model; Simplex method and its meaning; Steps of simplex method in tabular form; Solving LP problems by Simplex Method; Sensitivity analysis.	6
4.	**Transportation & Assignment Problems:** Nature of a transportation or distribution problem; Tabular representation of a transportation problem; North-West Corner initial solution; Stepping stone method; Concept of dummy source or destination; Vogel's approximation method. Nature of an Assignment problem; Tabular representation; Hungarian method for solving assignment problems.	5
5.	**Network Analysis:** Network models and terminologies like arcs, nodes, paths, tree, spanning tree; shortest path/route problem; The minimum spanning tree problem; The maximal flow problem.	5
6.	**Waiting line Problems:** Structure of a waiting line System: Single-channel waiting line, process of arrivals, distribution of service times, queue discipline, steady stage operation; Single channel model with Poisson arrivals and exponential service time; Multiple channel model with Poisson arrival and exponential service times; Single channel model with Poisson arrivals and arbitrary service time (M/G/1); Economic analysis of waiting lines	6
7.	**Non-Linear Programming:** Graphical illustration; Unconstrained optimization by (i) direct search method, (ii) steepest decent method; Constrained optimization by lagrange multipliers; Integer linear programming by branch & bound technique; Dynamic programming problems and their characteristics.	4

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.
2. I.A. Taha, Operations Research: An Introduction, Pearson Publication
3. C.K. Musatfi, Operations Research, New Age International Publishers
4. S.S. Rao, Engineering Optimization, New Age International Publishers
5. R. Panneerselvam, Operations Research, Prentice Hall of India
6. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, The McGraw Hill Companies.

Course Name: Materials Handling
Course Code: ME 704 C
Contact Hours: 32L
Credit: 3
Course Outcomes: Upon completion of the subject, students will be able to

1. Understand the basic roles of the different materials handling equipment.
2. Recognizeand apply the importance of safety issues in the areas of warehouse and material handling.
3. Analyze in handling legal aspects of business, employment laws and to deal with public and government.
4. Evaluate their abilities in Key areas such as Purchase Management, Inventory Control, Logistics, Warehousing and Human Resource Management.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME704 C.1	3		2			1						1			
ME704 C.2	3		1			1						1			
ME704 C.3	2	1				1						3			
ME704 C.4	2					1						3			

Module No.	Syllabus	Contact Hrs.
1.	Introduction : Definition, importance and scope of materials handling (MH); classification of materials; codification of bulk materials ; utility of following principles of MH – (i) materials flow, (ii) simplification, (iii) gravity, (iv) space utilization, (v) unit size, (vi) safety, (vii) standardization, (viii) dead-weight, (ix) idle time, (x) motion.	4
2.	Unit load : Definition; advantages & disadvantages of unitization; unitization by use of platform, container, rack, sheet, bag and self contained unit load; descriptive specification and use of pallets, skids, containers, boxes, crates and cartons; shrink and stretch wrapping.	3

3.	Classification of MH Equipment : Types of equipment – (i) industrial trucks & vehicles, (ii) conveyors, (iii) hoisting equipment, (iv) robotic handling system and (v) auxiliary equipment; Independent equipment wise sub classification of each of above type of equipment..	4
4.	Industrial trucks & vehicles : Constructional features and use of the following equipment – (i) wheeled hand truck, (ii) hand pallet truck, (iii) fork lift truck; Major specifications, capacity rating and attachments of fork lift truck.	4
5.	Conveyors : Use and characteristics of belt conveyor, constructional features of flat and troughed belt conveyor; Use and constructional features of Flg. types of chain conveyors – (i) apron, car and trolley type; Construction of link-plate chains; Dynamic phenomena in chain drive; Use and constructional features of roller conveyors; Gravity and powered roller conveyor; Pneumatic conveyor-use and advantages; Positive, negative and combination system of pneumatic conveyors; constructional feature, application and conveying capacity of screw conveyor.	8
6.	Hoisting Equipment : Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments : hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist , (ii) winch; (iii) bucket elevator, (iv) Jib crane, (v) overhead traveling crane and (vi) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane.	4
7.	Robotic handling: Materials handling at workplace; Major components of a robot; Applications of robotic handling, AGVs	2
8.	Auxiliary Equipment: Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) Chutes, (iv) positioners like elevating platform, ramps, universal vise; (v) ball table.	3

Recommended Books:

1. S. Ray, Introduction to Materials Handling, New Age Int. Pub.
2. T. K. Ray, Mechanical Handling of Materials, Asian Books Pvt. Ltd.
3. T.H. Allegri, Materials Handling: Principles and Practices, CBS Publishers and Distributors.
4. J.A. Apple, Material Handling System Design, John Wiley & Sons.

Other Electives II

Sl. No	Course Code	Subject Name
1.	ME 705 A	ENERGY CONSERVATION & MANAGEMENT
2.	ME 705 B	QUALITY & RELIABILITY ENGINEERING
3.	ME 705 C	HYDRO, WIND AND WAVE POWER

Course Name: Energy Conservation & Management
Course Code: ME705 A
Contact Hours: 34L
Credit: 3
Course Outcomes: Upon successful completion of this course, students will be able to
CO 1: Obtain knowledge about energy conservation policy, regulations and business practices
CO 2: Apply and design to improve the thermal efficiency by designing suitable systems for heat recovery and co-generation
CO 3: Analyze the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure
CO 4: Evaluate the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization

Co-PO/PSO mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
ME705 A.1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
ME705 A.2	-	-	-	3	-	-	-	-	-	-	-	-	-	3	3
ME705 A.3	2	2	-	2	-	-	-	-	-	-	-	-	-	2	3
ME705 A.4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3
AVG.	2	2	3	2.5	-	-	-	-	-	-	-	-	-	2.5	**3**

Course Contents:

Module No.	**Syllabus**	**Contact Hrs.**
1.	The Energy Resources; Finite & Renewable Sources	3
2.	The Need for Energy Conservation- estimation of Finite fuel resource; Hubbert's model for oil reserve	3
3.	Total Energy Concept- CHP Cycles & their applications	4
4.	Waste Heat Recovery; Waste Heat Exchangers; Commercial Waste Heat Recovery Devices- Recuperators, Regenerative Heat Exchangers, Heat Pipes	8
5.	Industrial Energy Conservation- Industrial Insulations; Case Studies for HVAC, Air Compressor, Mechanical Handling & Other Systems, Study of energy efficient methods	8
6.	Energy Audit; Basic Steps; Graphical representation; Case Studies	4
7.	The Economics of Energy Saving Schemes; Costs; investment analysis	4

Recommended Books:

1. Energy Management- Murphy WR, G Mckay- Butterworth Heinmann, 2007
2. Energy Mangement, Audit & Conservation-De Barun, , Vrinda Publications, Delhi, 2007
3. Eastop & Croft- Energy Efficiency, Longman, 1990
4. Turner- Energy management Handbook, 2nd Ed., Fairmont Press, 1993

Course Name: Quality & Reliability Engineering
Course Code: ME 705B
Contact Hours: 34L
Credit: 3
Prerequisites: General knowledge of industries and workflow

Course Outcomes: Upon successful completion of this course, students will be able to
CO 1: Obtain knowledge about product quality and
CO 2: Understand total quality management tools and techniques
CO 3: Analyze process controlparameters and quality management systems
CO 4: Assess risk and reliability of a production system

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME 705B .1	3	2		2	1		2	3		2					
ME 705B .2	3	1	2			1	2	1	1	1					
ME 705B .3	2	2		2	1		2	2		L					
ME 705B .4	3		2			2		3		2					

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Management of Product Quality: Evolution of Quality Control; Changing Quality Concepts; Modern Concept of Total Quality Management; Contribution of Quality masters (Deming, Juran, Crosby, Ishikawa, Taguchi).	3
2.	Creating Quality by Design: Assessment of Customer's needs; Formulation of Design Specifications; Standardization; Costs of Quality; Quality Circles; 5-S concept;	4
3.	Total Quality Management: Concept of Total Quality, Difference between "Quality" Management and "Total Quality" Management, total quality maintenance, total quality in service sector; Role of Customer and People in Total Quality Management; Steps for Quality Improvement, Kaizen; Organizing for effective Quality Management;	4
4.	Process Control: Control Charts; Statistical Quality Control Tools; Statistical Process Control and Process Capability, Zero defect program; Six – Sigma approach;	4

5.	Quality Management Systems: ISO 9000 Series of Standard; ISO 14000 Series of Standards;	4
6.	Strategic tools and Techniques for TQM: Need for Tools and Techniques in TQM; Commonly used Tools for TQM; Approaches and Deployment of Tools for Quality Planning – Quality Function Deployment (QFD), concurrent engineering; Tools for continuous Improvement – Deming's Plan – Do – Check – Act (PDCA) cycle, Poka – Yoke (Mistake – Proofing), Taguchi's Quality Loss Function.	5
7.	Reliability: Concept and definition of reliability; Reliability Parameters: Reliability as a function of time, failure rate as a function of time, constant failure rate, mean time to failure (MTTF), MTTF as a function of failure rate, mean time between failure (MTBF), mean down time (MDT), maintainability & availability, increasing failure rate, bath-tub curve; Brief discussion on hazard models: constant hazard model, linearly increasing hazard model, nonlinear hazard model and weilbull distribution, Advantages of weibull distribution; System reliability models: series system, parallel system, series-parallel system.	6
8.	Risk Assessment & Reliability in Design: Causes of failures, Failure modes & Effects Analysis (FMEA), faulty tree analysis (FTA); Tribological failure and monitoring techniques; Design based on reliability, redundancy in design.	4

Recommended Books:

1. H. Lal, Total Quality Management – A Practical Approach – New Age International (P) Ltd. Publishers
2. S. K. Mondal –Total Quality Management Principles and Practice –Vikas Publishing House Pvt. Ltd.
3. A. V. Feigenbum– Total Quality Control, Mcgraw-Hill Book Company
4. Juran's Quality Control Handbook –McGraw Hill Book Company
5. Amitava Mitra, Fundamentals of quality Control and Improvement – PHI
6. Grant and Leavenworth-Statistical Quality Control, 7thEdition, Tata Mcgraw Hill
7. E. Balaguruswamy , Reliability Engineering – TMH
8. Bhadury and Basu- Terotechnology: Reliability Engineering and Maintenance Management, Asian Books Pvt. Ltd.

Course Name:HYDRO, WIND AND WAVE POWER
Course Code: ME705 C
Contact Hours: 3L
Credit: 3
Course Outcomes: On successful completion of the course, the learner will be able to
1. Create awareness among students about renewable sources of energy
2. Understand the working principle of hydro wind and wave based energy resources.
3. Evaluate the efficiency of hydro, wind and wave power plants
4. Apply the expertise of hydro, wind and wave powerto realtime project works and industries.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ME705C .1	2	2	2	2	-	2	3	-	-	-	-	3	2	3	-
ME705C .2	2	-	2	-	-	2	3	-	-	-	-	2	1	2	2
ME705C .3	2	-	1	-	-	2	3	-	-	-	-	2	1	2	3
ME705C .4	-	-	-	-	-	2	3	-	-	-	-	3	1	2	3
AVG	2	2	1.3	2	-	2	3	-	-	-	-	2	**1.25**	**2.25**	**1.6**

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	Wind Energy Basics: Status, Advantages and disadvantages of wind energy systems, Advantages and disadvantages, Types of wind energy converters, local Effects on wind, Site selection: roughness length, wind shear, Wind Speed Variability, Obstacles to wind flow,	4
2	Working principles of wind energy: Energy content in wind, Energy Conversion at the Blade, Wind variations: Weibull distribution. Components of a wind energy converter: Rotor Blades, Gearboxes, Synchronous or Asynchronous Generators, Towers, Miscellaneous components, Turbine Selection	4
3	Operation and Control of Wind Energy Converters: grid requirements, Issue of Noise and Its Control, Power Curve and Capacity Factor, Pitch control, Stall Control, Yaw Control	4
4	Design of wind turbines- wind turbine design considerations, methodology, theoretical simulation of turbine loss, uxiliar of wind turbines and testing methods. Mechanical and hydrochemical power transmission system, Aerodynamic and Mechanical Breaking, mechanisms and control. Dynamics of large wind turbine systems and associated instrumentation and control. Economics of wind energy utilization	6
5	Hydropower basics: Water Cycle in Nature, Classification of Hydropower Plants, Status of Hydropower Worldwide, Advantages and Disadvantages of Hydropower, Operational Terminology, Legal Requirements	4
6	Working principles: Locating a Hydropower Plant, Basics of Fluid Mechanics for hydro power, single and multiple reservoir system, cascaded power plants	4
7	Important Parts of Hydropower Station: Turbine, Electric Generator, Transformer and Power House, Structural parts: Dam and Spillway, Surge Chambers, Stilling Basins, Penstock and Spiral Casing, Tailrace, Pressure Pipes, Caverns, uxiliary parts.	5
8	Hydraulic turbines: Classification of Hydraulic Turbines, Theory of Hydro Turbines: Francis, Kaplan, Pelton turbines, efficiency and selection of turbine	5

Recommended Books:

1. Renewable Energy – G. Boyle, 2nd edition, OUP, 2010.
2. Renewable Energy Resources- Twidell, J & Weir, T, 2nd edition, Taylor & Francis, 2006.
3. Non Conventional Energy Resources- B.H. Khan, T M H, 2010.
4. Non Conventional Energy Sources- G.D. Rai, Khanna Publishers.

Practical Courses

Course Name:Advanced Manufacturing Technology Laboratory
Course Code: ME791
Weekly Contact Hours: 3P
Credit: 2
Course Outcomes: After successful completion of the course, the student would be able to

1. Program a CNC turning or milling machine for preparing a job.
2. Study any nonconventional machining process and 3D printing.
3. Analyze the principles of Robot programming and carryout handson practice
4. Evaluate the process parameters involved in CNC machining .

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME791.1	3	3	3	3	3	-	2	-	3	-	-	-	3	-	3
ME791.2	3	2	2	2	3	-	-	-	2	-	-	-	3	-	2
ME791.3	3	3	3	2	3	-	-	-	2	-	-	-	-	-	3
ME791.4	3	2	2	2	2	-	2	-	2	-	-	-	3	-	2
Avrg.	3	2.5	2.5	2.25	2.75	-	2	-	2.25	-	-	-	2.25	-	2.5

Course Contents:

1) Programming study on CNC Turning machine.
2) Programming study on CNC Milling Machine
3) Study of geometry of robot manipulator, actuators and grippers
4) Robot Programming.
5) Parametric Study of Electric-Discharge Machining
6) Study of AJM/USM/ECM

Professional Electives Lab III

SL.No.	Course Code	Subject Name
1.	ME 793 A	ADVANCED WELDING LAB
2.	ME 793 B	BIOMECHANICS & BIOMATERIALS LAB
3.	ME 793 C	FINITE ELEMENT METHOD LAB

Course Name:ADVANCED WELDING LAB

Course Code: ME 793A

Weekly Contact Hours: 2P

Credit: 1

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

1. Handling practice of welding materials in MIC and TIG.
2. Advanced knowledge of different metals and their properties in welded constructions
3. Knowledge of quality techniques at production by welding
4. practice of resistance welding

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME793A.1	3	3	3	3	-	-	-	-	-	-	-	-	3	-	2
ME793A.2	3	2	2	2	-	-	-	-	-	-	-	-	3	-	2
ME793A.3	3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
ME793A.4	3	2	2	2	-	-	-	-	-	-	-	-	3	-	3
AVG	3	2.5	2.5	2.25	-	-	-	-	-	-	-	-	2.25	-	2.25

Course Contents: List of Experiments:

1. At least 2 welding jobs to be produced using MIG
2. At least 2 welding jobs to be produced using TIG
3. 1 job from Brazing exercise
4. 1 job from Resistance welding

Course Name:BIOMECHANICS AND BIOMATERIALS LAB
Course Code: ME793B
Weekly Contact Hours: 2P
Credit: 1
Course Contents: List of Experiments
1. Hardness testing of biomaterials
2. Measurement of torque required to tap and screwing in jaw bone.
3. Determination of moment of inertia of human limb using dynamometer.
4. Measurement of viscosity of body fluid.
5. Determination of moment of inertia of human bone using compound pendulum method.
6. Surface roughness measurement of biomaterials.

Course Name:FINITE ELEMENT METHOD LAB

Course Code: ME 793C

Weekly Contact Hours: 2P

Credit: 1

Course Outcomes: Upon successful completion of this course, students will be able to
1) Understand of the fundamental theory of the FEA.
2) Generate the governing FE equations for systems governed by partial differential equations.
3) Use the finite element methods for structural applications using truss, beam frame, and plane elements.
4) Analyze the FE method and compare result with FEA package like-Ansys.

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME793 C.1	2		2	2				1	1		2	1			
ME793 C.2	2	3		3	2			1	1		2	1			
ME793 C.3	3	3	2	2	2			1	1		2	3			
ME793 C.4			3	1	3			1	1		2	3			

Course Contents:
At least 6 relevant problems need to be coded and solutions presented in graphical for

SESSIONAL COURSES

ME781
Project (Part I)
Contact Hours: 6P
Credit: 3
Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Explore several subject domains to choose a practical problem of interest

2. Understand the methods of literature survey to analyze research works
3. Analyze, design and evaluate necessary components for the project work
4. Assess the utility of the project work and present through written and oral communication

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME781.1	2	2	1	2	-	2	1	-	-	1	1	3	1	1	2
ME781.2	2	3	2	2	-	1	1	1	-	2	2	3	1	1	3
ME781.3	1	3	2	2	3	1		2	-	3	3	2	1	1	2
ME781.4		2	2	2	2	2		1	-	3	3	3	1	2	2

Course Contents:

Students in small groups will perform either an Industrial case study, or Preparation of a feasibility report, or Experimental investigation, or Computational/ Theoretical work, or Design and development of equipment/system. An industrial case study/ project, if undertaken by the student, is to be supervised jointly by industry personnel and a teacher.

The task is to complete over a period of two semesters, and the final work will be submitted in the form of a printed hardcopy and will be evaluated through presentation of the same in front of a panel of examiners followed by a viva voce examination.

ME782
Design of a Mechanical System
Contact Hours: 3P
Credit: 2
Course Outcomes:

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

1. Explore domains of engineering problems to choose one of interest
2. Understand the working principle of the related component or instrument to be designed
3. Analyze, design and evaluate necessary components for the work
4. Assess the utility of the project work and present through written and oral communication

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME782.1	2	2	1	2	-	2	1	-	-	1	1	3	1	1	2
ME782.2	2	3	2	2	-	1	1	1	-	2	2	3	1	1	3
ME782.3	1	3	2	2	3	1		2	-	3	3	2	1	1	2
ME782.4		2	2	2	2	2		1	-	3	3	3	1	2	2

Course Contents:

In this sessional course work the students have to make design calculations and prepare component & assembly drawings/sketches (preferably in CAD) on a mechanical system assigned to a group of 4 to 5 students. Mechanical systems will include plants, equipment,instruments, drives, mechanisms, hydraulic/pneumatic/lubrication systems etc. The teachers will allocate one suitable mechanical system appropriate for a 8th. semester Mechanical Engineering student to each group of students.The students have to carryout the design work in consultation with the respective teacher/s and submit the designwork in bound volumes individually and face a viva voce examination as proof of their individual understanding of the design work.

ME783
Viva Voce on Vocational Training
Contact Hours: 0 Credit: 2

Department of Mechanical Engineering

COMMON AUTONOMOUS 8th Semester CURRICULUM & SYLLABUS

Subject Type	Subject Code	Subject Name	Contact Hours/Week				Total Credits
			L	T	P	Total	
A. THEORY:							
HU	HU 804	PRICIPLES OF MANAGEMANT	2	0	0	2	2
PE-V	ME 802A	AUTOMOBILE ENGINEERING	3	0	0	3	3
	ME 802B	CAD/CAM					
	ME 802C	AUTOMATION & CONTROL					
OE-III	ME 803A	TURBO MACHINERY	2	0	0	2	2
	ME 803B	MAINTENANCE ENGINEERING					
	ME 803C	NUMERICAL HEAT TRANSFER					
OE-IV	ME 804A	SAFETY & OCCUPATIONAL HEALTH	2	0	0	2	2
	ME 804B	NUCLEAR POWER GENERATION AND SUPPLY					
	ME 804C	FRACTURE MECHANICS					
Total of Theory						**9**	**9**
B. SESSIONAL:							
PW	ME 881	PROJECT II	0	0	12	12	6
PW	ME 882	GRAND VIVA	0	0	0	0	2
		TOTAL: SIX	**9**	**0**	**12**	**21**	**17**

SYLLABUS OF 8TH SEMESTER COURSES

Theory Courses

Course Name: PRINCIPLE OF MANAGEMANT
Course Code: HU804
Contact Hours: 2L
Credit: 2

Module No.	Syllabus	Contact Hrs.
1	**Introduction** : System concept of production; Product life cycle; Types and characteristics of production system; Productivity; Process and product focused organization structures; Management decisions – strategic, tactical and operational	3
2	**Forecasting** : Patterns of a time series – trend , cyclical, seasonal and irregular; Forecasting techniques : moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component.	4
3	**Materials Management and Inventory Control** : Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned shortages, Quantity discounts for EOQ model; ABC analysis; Just-in-time inventory management.	4
4	**Materials Requirement Planning** : MRP concept – bill of materials (BOM), master production schedule; MRP calculations.	3
5	**Machine Scheduling** : Concept of Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, Earliest due date (EDD) rule to minimize maximum lateness, Total tardiness minimizing model; Minimizing makespan with identical parallel machines; Johnson's rule for 2 and 3 machines scheduling.	3
6	**Project Scheduling** : Activity analysis; Network construction; critical path method (CPM); Crashing of project network.	3
7	**Quality Assurance** : Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : x-chart and Rchart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.	4

Books Recommended :

1. Buffa and Sarin, Modern Production/Operations Management, John Wiley & Sons.
2. R. Panneerselvam, Production and Operations Management, PHI.
3. Russell & Taylor, Operations Management, PHI.
4. Adam and Ebert, Production and Operations Management, PHI.
5. Production & Operations Management by Starr, Cenage Learning India.

Professional Electives IV

Sl. No.	Course Code	Subject Name
1.	ME 802A	AUTOMOBILE ENGINEERING
2.	ME 802B	CAD/CAM
3.	ME 802C	AUTOMATION & CONTROL

Course Name: Automobile Engineering
Course Code: ME 802 A
Contact Hours: 34L
Credit: 3
Course Outcomes: After taking this course the students should be able to

1. Understand power train function and the translation of torques and speeds throughout
2. Calculate dynamic wheel loads as influenced by accelerations, grades, aerodynamics and towed vehicles
3. Analyse the design and proportion a brake system and Understand the fundamentals of ride excitation sources and how to tune vehicle responses for best ride
4. Evaluate the knowledge of various suspension types and methods of analysis to determine their essential properties

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME802 A.1	2	2	2	-	-	-	-	-	-	-	-	-	3	2	-
ME802 A.2	3	3	3	-	-	3	2	-	-	-	-	-	3	3	-
ME802 A.3	3	-	-	-	-	3	3	-	-	-	-	-	3	-	-
ME802 A.4	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
AVG.	2.5	2.5	2.5	-	-	3	2.5	-	-	-	-	-	3	2.5	-

Course Contents :

Module No.	Syllabus	Contact Hrs.
1.	Introduction: History & Development of Automobile. Various sub system of Automobile.	1
2.	Prime Mover: Engine for Two –Wheeler & Three- Wheeler vehicles, Engine for passenger cars, commercial and other vehicle, Fuel system for carburetted engine, MPFI engine andDiesel engine, Lubrication and cooling system.	5
3.	Auto Electrical: Electric Motor as prime mover, Battery, generator,	5

	Ignition system, Starting system, lighting & signaling	
4.	Steering System: Devis steering & Ackerman steering system. Rack & pinion, cam & lever, worm & sector system.	3
5.	Transmission System: Flywheel & clutch. Gearbox sliding and constant mesh type, Automatic Transmission, Universal joint, Propeller shaft.	5
6.	Differential & Axle: Construction & function of differential, Different types of front & rear axles.	3
7.	Suspension System: Conventional and independent suspension system, application.	3
8.	Brake System: Disc & drum brake, Hydraulic brake, Parking brake. Stopping distance.	3
9.	Power Requirement: Various resistances such as air resistance, gradient resistance, rolling resistance. Tractive effort. Torque- Speed curve. Horse power calculation.	4
10.	Maintenance of Vehicle.	2

Recommended Books:

1. Motor Vehicle by Newton, Steed and Garrette 2nded, Butter worth.
2. Automobile Mechanics by N.K.Giri, 7thed, Khanna Publishers.
3. Automobile Engineering by Amitosh De, Revised edition 2010, Galgotia Publication Pvt. Ltd.
4. Automobile Mechanics by Heitner Joseph, East West Press.

Course Name: CAD/CAM
Course Code: ME802B
Contact Hours: 34L
Credit: 3

Course Outcome: At the end of the course the students shall be able to:

1. Describe the mathematical basis of representing geometric entities like points, lines, parametric curves, surfaces, solid, and the technique of transformation using transformation matrix.
2. Carry out analysis of stress in intricate geometric parts by FEM and describe the use of GT and CAPP for the product development.
3. Describe the various types of tool and work handling systems and their application.
4. Identify the various elements and their activities in the Computer Integrated Manufacturing Systems.

Course Articulation Matrix:

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
ME802 B.1	3	1	1								3				
ME802 B.2	3	3	2	1	1						1	1			
ME802 B.3	2		1	2							2				
ME802 B.4	1		2								2	2			

Course Contents

Module No.	Syllabus	Contact Hrs.
1.	Fundamentals of CAD- Design process, benefits of computer aided design, graphics standards	3
2.	Geometric modeling- wire-frame, surface and solid modeling Transformation- translation and rotation exercise problems and programming	6
3.	Stress analysis- basics of FEM, formation of stiffness matrix for two elements.	6
4.	Introduction to computer aided manufacturing (CAM) systems, basic building blocks ofcomputer integrated manufacturing (CIM).	4
5.	Toolings of CNC machines, tool and work handling systems involving robot, AGV, RTV, AS/RS, ATC, APC	3
6.	Robotics; types, anatomy, drives and applications.	3
7.	Computer aided production planning and control, Manufacturing from product design- CAD-CAM interface, concept of group technology (GT), CAPP.	6
8.	Control systems, Process monitoring, Adaptive control systems, etc.,	2
9.	Automatic inspection systems, use of CMM, Reverse Engineering.	1

Recommended Books:

1. P.N. Rao, N.K. Tewari and T.K. Kundra, Computer Aided Manufacturing, TataMcGraw-Hill Publication.
2. M.P. Groover and E.W. Zimmers Jr., CAD/CAM, Prentice Hall of India
3. P. Radhakrishnan, S. Subramanyan and V. Raju, CAD/CAM/CIM, New Age International Publishers.
4. P.N. Rao, CAD/CAM, Tata McGraw Hill Publication.
5. M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall of India.
6. I. Zeid, CAD/CAM - Theory and Practice, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
7. S.R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Publication.
8. S.K. Saha, Introduction to Robotics, The McGraw-Hill Publication
9. P.B. Mahapatra, Computer-Aided Production Management, Prentice Hall of India.

Course Name: AUTOMATION & CONTROL
Course Code: ME 802 C
Contact Hours: 3L
Credit: 3
Course Outcome: At the end of the course the students shall be able to:

1. Discover and apply the basics if a control system and explore its types
2. Analyze the mathematical models of dynamics systems and understand error analysis
3. Carry out time domain analysis, frequency domain analysis to assess stability of a system
4. Evaluate control system performance indicators.

Module No.	Syllabus	Contact Hrs.
1.	**Introduction to control system:** Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function. **Mathematical modeling of dynamic systems:** Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. **Control system components:** Potentiometer, Synchros, Resolvers, Position encoders.	8
2.	**Time domain analysis:** Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. **Error Analysis:** Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	8
3.	**State variable Analysis:** State variable model of Linear Time-invariant system, properties of the State transition matrix, State transition equation, Definition of transfer function & Characteristic equation, definition of controllability and observability.	8
4.	**Stability Analysis using root locus:** Importance of Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. **Frequency domain analysis of linear system:** Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichols chart. Mcircle and M-Contours in Nichols chart.	8

5.	**Control System performance measure:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD and PID control.	4

**** Numerical problems to be solved in the tutorial classes.**

Text and Reference Books:

1. K. Ogata, Modern Control Engineering, 4th Edition, Pearson Education.
2. I. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publication.
3. D. Roy Choudhury, Control System Engineering, PHI
4. B.C. Kuo and F. Golnaraghi, Automatic Control Systems, 8th Edition, PHI
5. Bandyopadhyaya, Control Engineering Theory & Practice, PHI
6. K.R. Varmah, Control Systems, Mc Graw hill
7. Norman Nise, Control System Engineering, 5th Edition, John Wiley & Sons

Open Electives III

Sl. No	Course Code	Subject Name
1.	ME 803A	TURBO MACHINERY
2.	ME 803B	MAINTENANCE ENGINEERING
3.	ME 803C	NUMERICAL HEAT TRANSFER

Course Name: TURBO MACHINERY
Course Code: ME 803 A
Contact Hours: 32L
Credit: 3
Prerequisite: Fluid Mechanics and Fluid machinery
Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Basic knowledge about rotary machines, nozzle, diffuser etc.
2. Understand and apply the calculation of efficiency, power etc. of steam turbines and hydraulic turbines.
3. Evaluate of efficiency, power required etc. of pumps and compressor
4. Design and evaluate various incompressible and compressible flow machines.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME803A.1	3					2	1					3			
ME803A.	3	2							1			3			

2															
ME803A .3	3	2							2			3			
ME803A .4	3	3	3	3	1	2	1		1		2	3			

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Classification: Incompressible and compressible flow machines; Radial, axial and mixed flow machines; Turbines vs pumps, fans and compressors. Applications: Water supply, ventilation, power generation, propulsion.	4
2.	Incompressible- Flow Machines: Hydraulic Turbines: Headrace, penstock, nozzle, runner, draft tube and tail race; Gross head and net head; Velocity diagrams for impulse and reaction turbines; Discharge, head, power and efficiencies. Pumps: Reservoir, foot valve, suction line, pump, delivery line and overhead tank; Static head and losses; Velocity diagrams; Discharge, head, power and efficiencies.	8
3.	Compressible-Flow Machines: Static and stagnation states; Isentropic and adiabatic expansion and compression processes; Nozzle, diffuser and rows of stationary and moving blades; Efficiencies.	8
4.	Dimensional Analysis: Similarity laws, Volume-flow, mass-flow head and power coefficients, pressure ratio, enthalpy ratio, Reynolds number, Mach number; Specific speed and machine selection.	4
5.	Testing and Performance Analysis: Measurement devices; affinity laws and unit quantities. Set up and operating characteristics of pumps, turbines; fans and turbo-compressors. Cavitation– cause of cavitation and definition of Thoma's cavitation parameter, surge and choking.	8

Recommended Books:

1. S.M. Yahya, Turbine, Compressors and Fans.
2. J. Lal, Hydraulic Machines.
3. S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics & Fluid Machines, TMH.
4. M.M. Das, Fluid Mechanics & Turbo Machines, PHI, 2010.
5. R.K. Bansal, Fluid Mechanics & Machinery, Luxmi Publications.
6. C. Ratnam, A.V. Kothapalli, Fluid Mechanics & Machinery, I.K. International Publishing House Ltd, 2010.
7. C.S.P. Ojha, R. Berndtsson, P.N. Chandramouli, Fluid Mechanics & Machinery, Oxford University Press.
8. Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Publication.
9. A.T. Sayers, Hydraulic and Compressible Flow Turbomachines.
10. R.K. Bansal, Fluid Mechanics and Hydraulic Machines.

Course Name: Maintenance Engineering
Course Code: ME803B

Contact Hours: 34L

Credit: 3

Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Basic knowledge about types and procedure of maintenance, instruments and tools.
2. Understand and apply organizational and economic structure of maintenance.
3. Design and analyse the maintenance tools for various applications like bearings, drives, pumps, piping etc.
4. Evaluate the performance of tools associated with maintenance and lubrication.

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
ME803B.1	2	-	2	-	-	3	-	-	-	-	2	-	-	3	2
ME803B.2	3	-	3	-	-	3	-	-	-	-	3	-	-	3	3
ME803B.3	3	-	3	-	-	3	-	-	-	-	3	-	-	3	-
ME803B.4	2	-	2	-	-	3	-	-	-	-	2	-	-	2	-
AVG.	2.5	-	2.5	-	-	3	-	-	-	-	2.5	-	-	2.75	2.5

Course Contents :

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Definitions of repair and maintenance; Importance of maintenance; Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Maintainability, failure pattern, availability of equipment / systems, design for maintainability. Total Productive Maintenance (TPM): definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE)	8
2.	Organizational structures for maintenance: Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	4
3.	Economic Aspect of Maintenance: Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools, planning, reports.	4
4.	Function and use of Maintenance Equipment, Instruments & Tools: Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricatorsand lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc.	6
5.	Lubrication: Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals;	4
6.	Repair & Maintenance Procedures: Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of	8

	shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, electrical wiring, isolators and main switches, small induction motors; Steps for installation of a machine.	

Recommended Books:

1. Mishra and Pathak, Maintenance Engineering and Management, PHI
2. Srivastava, Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi.
3. K. Venkataraman, Maintenance Engineering and Management, PHI

Course Name: NUMERICAL HEAT TRANSFER
Course Code: ME 803 C
Contact Hours: 34L
Credit: 3

Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. The knowledge about discretization techniques used to analyze fluid flow associated with heat transfer.
2. Understand modeling conduction and convection problems using finite volume method and central difference schemes.
3. Analyze effect of turbulence and multi phase conditions.
4. Solve and evaluate practical problems using software with proper understanding of grid structure and boundary conditions

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ME803 C.1	3	2	1	1							1				
ME803 C.2	2	2	1	1					1		2				
ME803 C.3	2	2	2	1					1		2				
ME803 C.4	1	2	3	2	3				1		1	2			

Course Contents:

Module	Syllabus	Contact Hrs.
1. Introduction Basics of heat transfer	Fluid flow. Mathematical description of fluid flow and heat transfer: conservation equations for mass	5
2. Discretization techniques	Discretization techniques using finite difference methods: Taylor Series and control volume formulations. Finite element discretization techniques.	4
3. Modelling of diffusion problems using finite volume method	One dimensional steady state diffusion problems; discretization technique. Solution methodology for linear and non-linear problems: Point-by-point iteration, TDMA. Two and three dimensional discretization. Discretization of unsteady diffusion problems: Explicit, Implicit and Crank-Nicolson's algorithm; stability of solutions.	5
4. Modelling of ConvectionDiffusion Problems	One dimensional convectiondiffusion problem: Central difference scheme. Discretization based on analytical approach (exponential scheme). Hybrid and power law. Higher order schemes (QUICK algorithm).	5
5.Flow modelling	Discretization of incompressible flow equations. Pressure based algorithm: SIMPLE, SIMPLER etc	5
6. Unstructured grids	Introduction to FVM with unstructured grids.	2
7. Multiphase problems	Modelling of multiphase problems: enthalpy method, volume of fluid (VOF) and Level Set Methods	2
8. Introduction to turbulence modeling	Large Eddy Simulation (LES). Direct Numerical Simulation (DNS).	2
9. Projects / Exercises	Solving simplified problems: formulation, discretization with coarse grids, applying appropriate boundary and initial conditions and solving by hand calculations. Solving practical problems through software: writing user sub-routines; post-processing and interpretation of results.	4

References:

1. S. V. Patankar, "Numerical Heat Transfer and Fluid Flow," Hemisphere Publishing Corporation, 1980.
2. D. A. Anderson, J. C. Tannehill, and R. H. Pletcher, "Computational Fluid Mechanics and Heat Transfer," Hemisphere Publishing Corporation, 1984.
3. J. H. Ferziger and M. Peric, "Computational Methods for Fluid Dynamics", Second Edition, Springer, Berlin, 1999.
4. H. K. Versteeg and W. Malalasekera, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman Scientific & Technical, 1 9 9 5.

Other Electives IV

Sl. No	Course Code	Subject Name
1.	ME 804A	SAFETY & OCCUPATIONAL HEALTH
2.	ME 804B	NUCLEAR POWER GENERATION AND SUPPLY
3.	ME 804C	FRACTURE MECHANICS

Course Name: Safety & Occupational Health

Course Code: ME 804 A
Contact Hours: 32L
Credit: 3
Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Primary knowledge of industrial and occupational safety and accident prevention
2. Understand and apply occupational health and safety rules and regulations.
3. Analyze the safety management issues along with accident compensation acts.
4. Evaluate and manage real life problems in the industries related to accident prevention and safety.

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ME804 A.1	-	-	-	-	-	3	-	3	2	-	2	-	-	3	2
ME804 A.2	-	-	-	-	-	2	-	3	3	-	2	-	-	2	3
ME804 A.3	-	-	-	-	-	2	-	3	3	-	-	-	-	3	-
ME804 A.4	-	-	-	-	-	2	-	2	2	-	-	-	-	-	-
AVG	-	-	-	-	-	2.25	-	2.75	2.5	-	2	-	-	**2**	**2.5**

Course Contents:

Module No.	**Syllabus**	**Contact Hrs.**
1.	Development of industrial safety Developments in Occupational Health, Occupational Safety and Health in India	2
2.	Accidents and their prevention Theory of accident, Anatomy of an accident, How Accidents are Caused , Cost of Accidents, Principles of Accident Prevention, Techniques of Accident Prevention, Safe Work Environment, Housekeeping, Job Safety Analysis, Investigation of Accidents, Ergonomics, Personal Protective Equipment, Promotion of Health and Safety, Basic Safety Programming	6
3.	Fire hazard Types of fire, Fire Hazards, Fire Explosion, fire prevention, Means of Escape in Case of Fire Inspection Safety Supervision Safety, Responsibility Safety Inspection, Fire prevention authorities, Rules Safety Training Safety Appraisal Safety Communication Safety Audit	4

4.	Occupational health and safety Occupational Health, Occupational Health Services in Places of Employment, Occupational Physician, Occupational Health in Developing Countries, Occupational Safety, Occupational Safety in Developing Countries, Promoting Occupational Health and Safety, Work Related Diseases, Occupational Health Hazards Recognition of Hazards, Industrial Hygiene, Occupational Diseases, basics of OHSAS 18001	6
5.	Health and safety at workplaces Health and Safety hazards, Occupational Health Requirements, Occupational Safety Requirements, Occupational Welfare Requirements, Abstracts and Notices, Obligations of a Worker, Obligations of Occupier, Personal protective equipment, Causes of Accidents, Prevention of Accidents, Safety Legislation, Safety Guidelines, emergency actions, related acts (related to chemical processes, mines, workshop practices, construction work, electrical installations)	6
6.	Health and safety management Basics of Safety management, Role of safety supervisor, planning for safety, Safety Policies, Safety Promotion, Safety Committee, safety education & training, Health and Safety Process, Measuring Safety, Risk Management and Loss Control	4
7.	Accident compensation Brief introduction to different acts - The Dangerous Machines (Regulations) Act, 1983, The Employers' Liability Act, 1938 The (Indian), Fatal Accidents Act, 1855 The Public Liability Insurance Act, 1991, The Workmen's Compensation Act, 1923, The Employees' State Insurance Act, 1948, Role of National Safety Council, International labour office	4

Recommended Books:

1. Safety management Systems, A. Waring, (Chapman & Hall,1996)
2. Environmental Health & Safety Management – A Guide to Compliance, N.P.Cheremisinoff, M.L.Graffia, (Noyes Publin. 2003)
3. Safety at Work, J.Ridley & J.Channing (5th. Edn.), (Butterworth & Heinemann, 2001)
4. Occupational Health & Hygiene, J.Stranks, (Pitman Publn., 1995)
5. Safety management: Strategy & Practice, R.Pybuss, (Butterworth & Heinemann, 1997)
6. Essentials of Safety management, H.L.Kalia, A.Singh, S.Ravishankar & S.V.Kamat, (Himalaya Publishing House, 2002)
7. Industrial Health & Safety Management, A.M.Sarma, (Himalaya Publishing House, 2002)

Course Name:NUCLEAR POWER GENERATION AND SUPPLY
Course Code: ME 804 B
Contact Hours: 34L
Credit: 3
Prerequisite: Physics, Chemistry, Heat Transfer, Power plant Engineering,

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Detailedknowledge of nuclear reactor types and associated systems
2. Analyze variety of nuclear power plants based on fission and fusion.
3. Evaluate the safety assessments and waste management.
4. Design and simulate equivalent conditions for practical problem solving.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME804 B.1	3	2	2	1		1	1				1	1			
ME804 B.2	2	1	1	2		2	1				1	2			
ME804 B.3	2	2	3	1		3	2				1	2			
ME804 B.4	1	1	1	1	2	3	2				2	2			

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Basics of a Nuclear Power Generation, energy from fission and fusion reactions	4
2.	Systems in nuclear reactor- Reactor fuel system: Natural and enriched fuels, sources, merits and demerits of different fuels for reactor use, fabrication, handling of fuels and irradiated fuels, fuel management, storage, reprocessing of irradiated fuels. Reactor shutdown systems: Materials for reactor control and choices, liquid vs. solid shut down systems, design aspects Primary heat transport (cooling) system: Heat generation and distribution, Coolant characteristics, Selection of coolants, Coolant Circuit, Core thermal hydraulics, Decay heat removal system. Reactor structure: Core composition, Reflector, Reactor vessel, Safety vessel, Shielding. Thermal, biological, Shield cooling system, Moderator system: Materials, Selection, Design consideration, Circuit, Radioactivity aspects. Cover gas system: Purpose, Selection of material, Design considerations, Circuit. Reactor regulating system: Purpose, Methodology, Design considerations, Actuating mechanism.	10
3.	Reactor Design- Principles, Safety classifications, Seismic quality group, Loading considerations under normal operations, design basis accidents such as earthquake, loss of coolant accident (LOCA),blackout, flood, missiles, operator error, Safety features for server accidents, standards, soft ware, verifications etc.	6
4.	Nuclear power plants- Types .Thermal reactors: BWR, PWR, PHWR, GCR, APWR, AHWR etc. Fast reactors Breeders; Fusion power; Off-land NPPs:- space power unit, nuclear ships, submarines. Economics of NPPs: Various costs, ROI,	6

	Sizing, Operational characteristics.	
5.	Radiation protection: Radiation hazard, Exposure pathways, dose unit, measurement, CRP Radioactive Waste Management: Waste categorization, Generation, Handling of wastes.	4
6.	Reactor Stages and Safety Assurances- Nuclear safety assurance.	4

Recommended Books:

1. A.K. Raja, A.P. Srivastava & M. Dwivedi, An Introduction on Nuclear Engineering,
2. Arora &Domkundwar, A course in Power Plant Engg-
3. P.K. Nag.-Nuclear Power Plant, Power Plant Engg. (Steam & Nuclear)
4. Glasstone & Sesons- Nuclear Engineering

Course Name:FRACTURE MECHANICS
Course Code: ME 804 C
Contact Hours: 32L
Credit: 3
Course Outcomes:

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

1. Explore several types of fractures and important parameters associated with it.
2. Understand and analyse the elasto-plastic behavior of a crack based on stress functions
3. Evaluate SERR using computational J Integral methods,
4. Use the knowledge of fatigue fracture and evaluate creep fracture to solve practical problems.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME804C.1	3	2	1	1	-	1		-	-	-	1	2	2	1	2
ME804C.2	3	2	2	2	-	1		1	-	-	2	2	2	-	3
ME804C.3	2	3	2	1	-	1	1	2	-	-	1	2	2	-	2
ME804C.4	2	2	2	2	-	2	1	1	-	-	1	2	2	-	-

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Basic modes of fracture, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing.	6
2.	Crack-tip plasticity and elasto-plastic fracture mechanics in metals. Mixed mode problems and evaluation of critical fracture parameters. Classical theoretical analyses based on complex stress function approaches.	8
3.	Computational fracture mechanics: SERR evaluations, J-Integral methods.	4
4.	Fatigue damage theories, fatigue test, endurance limit, fatigue fracture under combined loading, fatigue controlling factors, effect of stress concentrations, notch sensitivity and cumulative fatigue damage concepts.	7
5.	Creep fracture: creep-stresstime temperature relations, creep relaxation theories; creep in tension, bending, torsion and combined loading; creep buckling; creep in piping and high temperature pressure vessel systems.	7

Recommended Books:

1. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.
2. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
3. K. R.Y.Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited, 2001
4. D.Broek,Elementary Engineering Fracture Mechanics,Kluwer Academic Publishers, Dordrecht, 1986.
5. T.L.Anderson, Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 200

SESSIONAL

Course Name:Project Part-II
Course Code:ME881
Contact Hours: 12P
Credit: 6
Course Outcomes:

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

5. Explore several subject domains to choose a practical problem of interest
6. Understand the methods of literature survey to analyze research works
7. Analyze, design and evaluate necessary components for the project work
8. Assess the utility of the project work and present through written and oral communication

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME881.1	2	2	1	2	-	2	1	-	-	1	1	3		1	2
ME881.2	2	3	2	2	-	1	1	1	-	2	2	3		1	3
ME881.3	1	3	2	2	3	1		2	-	3	3	2		1	2
ME881.4		2	2	2	2	2		1	-	3	3	3		2	2

Course Contents:

Students in small groups will perform either an Industrial case study, or Preparation of a feasibility report, or Experimental investigation, or Computational/ Theoretical work, or Design and development of equipment/system. An industrial case study/ project, if undertaken by the student, is to be supervised jointly by industry personnel and a teacher.
The task is to complete over a period of two semesters, and the final work will be submitted in the form of a printed hardcopy and will be evaluated through presentation of the same in front of a panel of examiners followed by a viva voce examination.

Course Name: GRAND VIVA
Course Code: ME882
Contact Hours: 0L
Credit: 2
Course Outcomes:
Upon successful completion of this course, the student will be able to:

4. Carry an overall knowledge of major engineering subjects
5. Communicate effectively in an interview
6. Learn discipline, body language, positive attitude and ethics to follow the whole life.

Course Articulation Matrix:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ME882.1	1	1	1		-				-	1		1		1	2
ME882.2					-	**1**			-	2		2		1	3
ME882.3						1			-	3	1	2		1	3

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