MANAV RACHNA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

B.Tech. Mechanical Engineering

BATCH: 2018-2022

MANAV RACHNA UNIVERSITY, FARIDABAD

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER - 1

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CHH144-T	CHEMISTRY-I	NIL	PH	HARD	CORE	3	1	0	0	4	4
CHH144-P	CHEMISTRY-I LAB	NIL	PH	HARD	CORE	0	0	2	0	2	1
MAH102B	MATHEMATICS-I (CALCULUS, LINEAR ALGEBRA & COMPLEX VARIABLE)	NIL	MA	HARD	CORE	3	1	0	0	4	4
MEH101B	ENGINEERING MECHANICS (STATISTICS & DYNAMICS)	NIL	ME	HARD	CORE	3	1	0	0	4	4
ECH103B-T	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	NIL	ECE	SOFT	CORE	3	1	0	0	4	4
ECH103B-P	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	NIL	ECE	SOFT	CORE	0	0	2	0	2	1
MEW102B	ENGINEERING GRAPHICS & DRAWING	NIL	ME	WORKSHOP	CORE	0	0	3	0	3	1.5
LWH324	CONSTITUTION OF INDIA	NIL	LW	SOFT	AUDIT	1	1	0	0	2	0
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**13**	**5**	**7**	**0**	**25**	**19.5**

	SEMESTER - 2										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MAH105B-T	MATHEMATICS-II (ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS FOR SOLVING PDE)	NIL	MA	HARD	CORE	3	1	0	0	4	4
MAH105B-P	MATHEMATICS-II LAB (ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS FOR SOLVING PDE)	NIL	MA	HARD	CORE	0	0	2	0	2	1
PHH103B-T	PHYSICS-I (INTRODUCTION TO MECHANICS)	NIL	CH	HARD	CORE	3	1	0	0	4	4
PHH103B-P	PHYSICS-I LAB (INTRODUCTION TO MECHANICS)	NIL	CH	HARD	CORE	0	0	2	0	2	1
CSH101B-T	PROGRAMING FOR PROBLEM SOLVING	NIL	CS	HARD	CORE	3	1	0	0	4	4
CSH101B-P	PROGRAMING FOR PROBLEM SOLVING LAB	NIL	CS	HARD	CORE	0	0	2	0	2	1
MEH103B-T	MANUFACTURING PROCESSES	NIL	ME	HARD	CORE	3	0	0	0	3	3
MEH103B-P	MANUFACTURING PROCESSES LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1

HLS104B/HLS103B	PROFESSIONAL ENGLISH BASICS/PROFESSIONAL ENGLISH ADVANCED	NIL	HUM	HARD	CORE	1	0	2	0	3	2
CHH137B	ENVIRONMENTAL STUDIES	NIL	CH	SOFT	AUDIT	2	0	0	0	2	0
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**15**	**3**	**10**	**0**	**28**	**21**
MEO104B	**Post 2nd Sem Summer Training (Mandatory) (Engineering Exploration) (60 Hrs)**										**2**
	SEMESTER - 3										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/**	**COURSE TYPE (Core/Elective/**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS**	**NO. OF CREDITS**
EDS288/ EDS289/ EDS290	HUMANITIES-I (APPLIED PHILOSOPHY, APPLIED PSHYCHOLOGY, APPLIED SOCIOLOGY)	NIL	ED	SOFT	ELECTIVE	1	0	2	0	3	2
PHH204B-T	PHYSICS-II (QUANTUM MECHANICS)	NIL	PH	HARD	CORE	3	1	0	0	4	4
PHH204B-P	PHYSICS-II LAB (QUANTUM MECHANICS)	NIL	PH	HARD	CORE	0	0	2	0	2	1
MAH203B	MATHEMATICS-III (PROBABILITY & STATISTICS)	NIL	MA	HARD	CORE	3	1	0	0	4	4
MEH201B	THERMODYNAMICS	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH202B-T	MATERIALS SCIENCE	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH202B-P	MATERIALS SCIENCE LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEW203B	3D CAD SOFTWARE	NIL	ME	WORKSHOP	CORE	0	0	0	2	2	1
RDO501	INTRODUCTION TO RESEARCH	NIL	ME	PROJECT BASE/INNOVATION		0	0	1	0	1	0.5
FLS101/FLS102/FLS103	FOREIGN LANGUAGE-I	NIL	FL	AUDIT	ELECTIVE	2	0	0	0	2	0
CDO201	PROFESSIONAL COMPETENCY ENHANCEMENT-I			Outcome Based		0	0	0	1	1	0.5
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**15**	**4**	**7**	**3**	**29**	**22**

	SEMESTER - 4										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH204B-T	APPLIED THERMODYNAMICS	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH204B-P	APPLIED THERMODYNAMICS LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH205B-T	STRENGTH OF MATERIALS-I	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH205B-P	STRENGTH OF MATERIALS-I LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH206B-T	KINEMATICS & THEORY OF MACHINES	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH206B-P	KINEMATICS & THEORY OF MACHINES LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH207B-T	FLUID MECHANICS & MACHINES	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH207B-P	FLUID MECHANICS & MACHINES LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
LWS323/LWS325	CYBER LAWS/LAW RELATING TO INTELLECTUAL PROPERTY RIGHTS	NIL	LW	HARD	CORE	2	0	0	0	2	2
FLS105B/FLS106B/FLS107B	FRENCH-II/SPANISH-II/GERMAN-II	NIL	FL	AUDIT	ELECTIVE	2	0	0	0	2	0
RDO502	INTRODUCTION TO RESEARCH	NIL	ME	PROJECT BASE/INNOVATION		0	0	1	0	1	0.5
CDO202	PROFESSIONAL COMPETENCY ENHANCEMENT-II			Outcome Based		0	0	0	1	1	0.5
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**16**	**4**	**9**	**1**	**30**	**23**

MEO208B	**Post 4th Sem Summer Training (Mandatory) (60 Hrs)**										**2**
	SEMESTER - 5										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH301B-T	MANUFACTURING TECHNOLOGY	NIL	ME	HARD	CORE	3	0	0	0	3	3
MEH301B-P	MANUFACTURING TECHNOLOGY LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH302B-T	MACHINE DESIGN-I	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH303B-T	HEAT TRANSFER	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH303B-P	HEAT TRANSFER LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH304B-T	INTERNAL COMBUSTION & GAS TURBINES	NIL	EC	HARD	CORE	2	0	0	0	2	2
MEH304B-P	INTERNAL COMBUSTION & GAS TURBINES LAB	NIL	EC	HARD	CORE	0	0	2	0	2	1
MEH305B/MEH306B/MEH307B/MEH308B-T	ROBOTICS/STRENGTH OF MATERIALS-II/TOOL ENGINEERING DESIGN/PRODUCT DESIGN & DEVELOPMENT	NIL	ME	HARD	CORE	3	0	0	0	3	3
MEH305B/MEH306B/MEH307B/MEH308B-P	ROBOTICS LAB/STRENGTH OF MATERIALS-II LAB/TOOL ENGINEERING DESIGN LAB/PRODUCT DESIGN & DEVELOPMENT LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1

CHS234/CSS325B/ ECS306B	ENVIRONMENTAL ETHICS & SD/GREEN COMPUTING/E-WASTE MANAGEMENT	NIL	CH/ ECE	SOFT	ELECTIVE	1	0	2	0	3	2
EDS240	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	NIL	HSMC	SOFT	AUDIT	2	0	0	0	2	0
RDO601	RESEARCH METHDOLOGY	NIL	ME	PROJECT BASE/INNOVATION		0	0	1	0	1	0.5
CDO301	PROFESSIONAL COMPETENCY ENHANCEMENT-III			Outcome Based		0	0	0	1	1	0.5
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**17**	**2**	**11**	**1**	**31**	**23**

	SEMESTER - 6										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH311B-T	REFRIGERATION & AIR CONDITIONING	NIL	ME	HARD	CORE	3	1	0	0	4	4
MEH311B-P	REFRIGERATION & AIR CONDITIONING LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MEH312B/ MEH313B/MEH314B-T	MECHANICAL VIBRATIONS/AUTOMOBILE ENGINEERING/COMPOSITE MATERIALS	NIL	ME	HARD	ELECTIVE	3	0	0	0	3	3

MEH312B/ MEH313B/MEH314B-P	MECHANICAL VIBRATIONS LAB/AUTOMOBILE ENGINEERING LAB/COMPOSITE MATERIALS LAB	NIL	ME	HARD	ELECTIVE	0	0	2	0	2	1
ECW204B/CSW317B	ELECTRONIC DESIGN WORKSHOP/AGILETECHNOLOGIES	NIL	CS	HARD	CORE	0	0	2	0	2	1
ECW310B/CSW318B	SENSORS & IOT/R PROGRAMMING	NIL	ME	WORKSHOP	CORE	0	0	2	0	2	1
CDO302	PROFESSIONAL COMPETENCY ENHANCEMENT-IV			Outcome Based		0	0	1	0	1	0.5
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**6**	**1**	**9**	**0**	**16**	**11.5**
MEO317B	**Post 6th Sem Summer Training (Mandatory) (80 to 90 Hrs)**										**3**

	SEMESTER - 7										
SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEH401B/MEH402B/MEH403B/MEH404B	RENEWABLE ENERGY SOURCES/MACHINE DESIGN-II/POWER PLANT ENGINEERING/LEAN MANUFACTURING	NIL	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH405B/MEH406B/MEH407B/MEH408B-T	COMPUTATIONAL FLUID DYNAMICS/OPTIMIZATION TECHNIQUES/DESIGN OF HEAT EXCHANGERS/ENERGY CONSERVATION & MANAGEMENT	NIL	ME	HARD	ELECTIVE	3	0	0	0	3	3

MEH405B/MEH406B/MEH407B/MEH408B-P	COMPUTATIONAL FLUID DYNAMICS LAB/OPTIMIZATION TECHNIQUES LAB/DESIGN OF HEAT EXCHANGERS LAB/ENERGY CONSERVATION & MANAGEMENT LAB	NIL	ME	HARD	ELECTIVE	0	0	2	0	2	1
ECH403B/CSH414B-T	WIRELESS SENSORS NETWORK/INFORMATION RETREIVAL	NIL	ME	HARD	ELECTIVE	3	1	0	0	4	4
ECH403B/CSH414B-P	WIRELESS SENSORS NETWORK LAB/INFORMATION RETREIVAL LAB	NIL	ME	HARD	ELECTIVE	0	0	2	0	2	1
MEH409B/MEH410B/MEH411B-T	HEATING, VENTILATION & AIR CONDITIONING/FINITE ELEMENT ANALYSIS/NANOCOMPOSITES	NIL	ME	HARD	CORE	3	0	0	0	3	3
MEH409B/MEH410B/MEH411B-P	HEATING, VENTILATION & AIR CONDITIONING LAB/FINITE ELEMENT ANALYSIS LAB/NANOCOMPOSITES LAB	NIL	ME	HARD	CORE	0	0	2	0	2	1
MCS368B	ENTREPRENEURSHIP	NIL	MGMT	SOFT	CORE	1	0	2	0	3	2
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**13**	**1**	**8**	**0**	**22**	**18**

SEMESTER - 8

SUBJECT CODES	**SUBJECT NAME**	**PRE-REQUISITE**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MEN411B	PROJECT/INDUSTRIAL TRAINING	NIL	ME	NTCC	CORE	0	0	0	16	16	8
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					**0**	**0**	**0**	**16**	**16**	**8**
											153

MANAV RACHNA
vidyanatariksha

MANAV RACHNA UNIVERSITY
(FORMERLY MANAV RACHNA COLLEGE OF ENGINEERING
NAAC ACCREDITED 'A' GRADE INSTITUTION)
Declared as State Private University under section 2f of the UGC act, 1956

DEPARTMENT OF MECHANICAL ENGINEERING
B.TECH (ME) – MEU01B
Batch 2018-22

MANAV RACHNA UNIVERSITY

Department of Mechanical Engineering

MECHANICAL ENGINEERING

Vision

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens

Mission

- **To impart outcome based holistic education**
- **To disseminate education in frontier areas**
- **To produce globally competitive, ethical and socially responsible human resources**
- **To produce human resources sensitive to issues of Environment and Sustainable Development**
- **To develop Environment and Sustainable development as a thrust area of research and development.**

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- **To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.**
- **To promote Research Environment and Management Practices.**
- **To enhance the quality of the student learning experience.**
- **To provide Resources and Infrastructure for Academic Excellence.**

MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Vision: To become centre of excellence by providing state-of-art education in teaching, research, innovation, entrepreneurship, environmental sustainability and develop an ethical human beings for service of the society.

Mission:

- To develop globally competent engineers, who address future issues of the society innovatively.
- Operating and maintaining various smart manufacturing aides optimally by providing state-of-art facilities and conduct research in latest technologies.
- To nurture talents who strive to serve society through sustainable methods while maintaining the highest professional and ethical standards.
- Maintaining highest quality standards and ensure satisfaction of all stakeholders.
- To work for continuous improvement in collaboration with Industry.

B.Tech. Mechanical Engineering

Programme Educational Objectives (PEOs):

PEO1	**To prepare mechanical engineering graduates with an outstanding knowledge of mathematical, scientific, engineering, technology, management, humanities and various other interdisciplinary subjects for a successful career.**
PEO2	**To equip students with modern tools, technology and advanced software's for deliberating engineering solutions.**
PEO3	**To equip students with broad based knowledge to support the service industries, economic development and to address social and engineering challenges of the nation.**
PEO4	**To inculcate students with leadership skills with high level of integrity and ethical values for team building and team work.**

MECHANICAL ENGINEERING

Programme Specific Outcomes (PSOs):

PSO-1	**Our Students will be equipped with Industrial Management Skills and Interdisciplinary Technologies**
PSO-2	**Our Students shall be conscious of sustainable use of resources in professional work which they will undertake.**

PROGRAM OUTCOMES (POs):

PO1. Engineering Knowledge: Apply knowledge of mathematics, science and engineering fundamentals and Production and Industrial Engineering specialization to the solution of complex Production and Industrial Engineering problems.

PO2. Problem Analysis: Identify, formulate, research literature and analyze complex Production and Industrial Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. Design/ Development of Solutions: Design solutions for complex Production and Industrial Engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4. Conduct investigations of complex Production and Industrial Engineering problems using research-based knowledge and research methods including analysis, interpretation of data and synthesis of information to provide valid conclusions.

PO5. Modern Tool Usage: To apply appropriate techniques, resources and engineering and IT tools for modelling of different Production and Industrial Engineering problems with an understanding of the limitations.

PO6. The Engineer and Society: Apply contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of professional Production and Industrial Engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of Production and Industrial Engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PO10. Communication: Communicate effectively on complex Production and Industrial Engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of Production and Industrial Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12. Life Long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MECHANICAL ENGINEERING

SEMESTER-1

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	No. of Contact Hours per week	Credits
CHH144B-T/P	CHEMISTRY	CH	HARD	CORE	3	1	2	6	5
MAH102B	MATHEMATICS-I (CALCULUS & LINEAR ALGEBRA)	MA	HARD	CORE	3	1	0	4	4
MEH101B	ENGINEERING MECHANICS	ME	HARD	CORE	3	1	0	4	4
ECH103B-T/P	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	ECE	HARD	CORE	3	1	2	6	5
MEW102B	ENGINEERING GRAPHICS & DRAWING	ME	WORKSHOP	CORE	0	0	3	3	1.5
LWS324	INDIAN CONSTITUTION	LW	AUDIT	CORE	1	0	2	3	0
TOTAL (L/T/P/CONTACT HOURS/CREDITS					13	4	9	26	19.5

Course Title/Code	Chemistry-I (CHH144-T)	
Course Type	Core	
L-T-P Structure	3-1-0	
Credits	4	
Course Outcomes (COs)		Mapping
CO1	Understand the basics in structure of an atom and periodic properties of the elements in periodic table	Skill Development
CO2	Understand the importance of intermolecular forces and learn the use of thermodynamic concepts in chemical equilibria	Skill Development
CO3	Understand the water chemistry and corrosion concepts with their theories, effects and treatments/prevention methods.	Employability
CO4	Understand the stereochemistry terms, 3D representation and isomerism in organic molecules	Skill Development
CO5	Understand the principles of green chemistry and learn to emphasis on green synthesis over conventional synthesis for commonly used molecules.	Skill Development
CO6	Understand various spectroscopic techniques with its principle, instrumentation and applications	Employability

SECTION-A

Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular

distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

Periodic properties: Electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital, energies of atoms in the periodic table, polarizability and Polarization, Fajan's Rule, oxidation states and their stabilities.

SECTION-B

Intermolecular forces and potential energy surfaces: Ionic, dipolar and van der waals interaction, equations of state of real and gases and critical phenomenon.

Use of free energy in chemical equilibrium: Thermodynamic functions: entropy and gibbs free energy; estimations of entropy and free energies.

Relationship between Free energy and emf Cell potentials. Nernst equation and application. Acid base, oxidation reduction and solubility equilibria, Water chemistry: Introduction - Use of water for Industrial and domestic purposes, sources of water supply, Hardness of water, degree of hardness and its estimation by EDTA methods). PH-value of water, disinfection of water Softening of hard water (Lime-Soda method, calgon methods. corrosion: introduction, cause and theories: Dry and wet theory and prevention methods, use of free energy consideration in metallurgy through Ellingham Diagram.

SECTION-C

Stereochemistry: Representations of three dimensional structures, introduction to the terms: achirality, chirality, enantiomers, diastereomers, optical activity, structural isomers and stereoisomers, relative and absolute configurations, conformational analysis of ethane and n-butane. Structural isomerism in transitional metal compounds.

Organic reactions and synthesis using conventional and green approach: Introduction to Green Chemistry, its 12 principles, Synthesis of a commonly used molecules: Aspirin, Ibuprofen, bio-diesel and bio-ethanol.

SECTION-D

Spectroscopic techniques and applications: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging.

Suggested Text Books

(i) University chemistry, by B. H. Mahan

(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell

(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan (v) Physical Chemistry, by P. W. Atkins

(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

http://bcs.whfreeman.com/vollhardtschore5e/default.asp

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO2	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO3	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO4	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO5	1	-	1	-	1	-	2	-	-	-	1	1	-	1
CO6	1	-	1	-	1	-	-	-	-	-	1	1	-	1

Course Title/Code	Chemistry-I LAB (CHH144-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credit	1	
Course Outcomes (COs)		Mapping
CO1	To familiarize in water analysis by determining alkalinity and hardness of the given water sample.	Employability
CO2	To practice the synthesis of resins like urea formaldehyde and phenol formaldehyde	Skill Development
CO3	To explore the determination of dissolved oxygen, free chlorine and carbon dioxide in water sample by titration.	Employability
CO4	To develop understanding in the concepts of viscosity, partition coefficient and adsorption.	Skill Development

LIST OF EXPERIMENTS:

1. Determination of chloride content of water
2. Colligative properties using freezing point depression 3. Determination of the rate constant of a reaction
4. Synthesis of a polymer (UF, Resol, PMMA).
5. Determination of surface tension and viscosity.
6. Determination of cell constant and conductance of solutions.
7. Saponification/acid value of oil.
8. Adsorption of acetic acid by charcoal.
9. Determination of the partition coefficient of a substance between two immiscible liquids.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO2	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO3	1	-	1	-	1	-	-	-	-	-	1	1	-	1
CO4	1	-	1	-	1	-	-	-	-	-	1	1	-	1

MECHANICAL ENGINEERING

Course Title/ Code	**MATHEMATICS-I /MAH102B**
Course Type:	**CORE**
Course Nature:	**Hard**
L-T-P Structure	**(3-1-0)**
Credit	**4**

Course Outcome	Mapping
CO1: Understand and apply the concepts of differential calculus & vector Calculus to solve mathematical & complex engineering problem.	**Employability**
CO2: Demonstrate the ability to Analyze infinite series.	**Employability**
CO3: Understand and apply the tool Fourier series for solving mathematical & complex engineering problem.	**Employability**
CO4: Understand and apply the knowledge of matrices to solve the problems of linear equations and use in various fields of technology.	**Employability**

SECTION –A

Calculus: Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Calculus: Rolle’s Theorem, Mean value theorems, Taylor’s and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

SECTION –B

Sequences and series: Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval’s theorem.

SECTION –C

Multivariable Calculus (Differentiation): Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

SECTION –D

Matrices Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3								1				
CO2	3	3								1				
CO3	3	3								1				
CO4	3	3								1				

MECHANICAL ENGINEERING

Course Title/ Code	**ENGINEERING MECHANICS / MEH101B**
Course Type:	**CORE**
Course Nature:	**Hard**
L-T-P Structure	**(3-1-0)**
Credit	**4**

Course Outcome	**Mapping**
CO1: Construct free body diagram and calculate the reactions necessary to ensure static equilibrium.	**Employability**
CO2: Study the effect of friction in static and dynamic conditions.	**Employability**
CO3 : Understand the different properties of surfaces in relation to moment of inertia.	**Employability**
CO4: Analyse and solve different problems of kinematics and kinetics.	**Employability**

SECTION-A

Basics and Statics of Particles : Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

SECTION-B

Equilibrium of Rigid Bodies: Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

SECTION-C

Properties of Surfaces And Solids: Centroids and center of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – 28 Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

SECTION-D

Dynamics of Particles: Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

Friction and Elements of Rigid Body Dynamics: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9 th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

CO-PO Mapping

Course Outcomes													PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1:	3				2				2			3	3	3
CO2:	3				2				2			3	3	3
CO3 :			3		2				2			3	3	3
CO4:	3				2				2			3	3	3

MECHANICAL ENGINEERING

Course Title/ Code	**BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING / ECH103B-T**
Course Type:	**CORE**
Course Nature:	**Hard**
L-T-P Structure	**(3-1-0)**
Credit	**4**

Course Outcomes (COs)		**Mapping**
1	**Apply the fundamental concepts of Basic Electrical circuits.**	**Employability**
2	**Apply the concepts and working principles of Diodes for its various applications**	**Employability**
3	**Demonstrate familiarity with electronic devices viz., Transistors, Feedback Amplifiers and Oscillators and design implementation.**	**Employability/ Skill Development**
4	**Analyse and Design Operational Amplifiers and real-life applications using 555 Timer.**	**Employability/ Skill Development**

SECTION A

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion. MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractor, Serial and Parallel Adders, BCD Adder.

SECTION B

Sequential Logic Design: Building blocks like S-R, J-K and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

SECTION C

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits. Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

SECTION D

8- bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. 8051 Architecture Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer,

Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles. Addressing mode, 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Text/Reference Books:

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition ,2006.
4. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.
6. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education, 2007.
7. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	-	-	-	-	-	-	3	2
CO2	3	3	2	2	1	1	-	-	-	-	-	-	3	2
CO3	3	3	2	2	1	1	-	-	-	-	-	-	3	2
CO4	3	3	2	2	1	1	-	-	-	-	-	-	3	2

Course Title/ Code	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB / ECH103B-P
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcomes (COs)	Mapping
CO1: Demonstrate the working principle, operation and applications of various types of diodes and special diodes.	Skill Development
CO2: Differentiate and analyze the working of various transistors	Skill Development
CO3: List, analyze and design various feedback amplifiers.	Skill Development

LIST OF EXPERIMENTS:

1. Familiarization with the components, breadboard, resistor coding and various types of meters and implementation of a circuit on breadboard.
2. Verification of Kirchhoff's law: (a) Kirchhoff's voltage law (b) Kirchhoff's current law.
3. Measurement of power in single phase AC circuits.
4. Calculation of efficiency and regulation of a single phase transformer OC and SC test on single phase transformer 5.To plot OCC for a DC separately excited shunt generator.
5. To perform direct load test on a DC separately excited shunt generator and plot load voltage vs load current 6. Armature voltage control and field current control of speed of DC shunt motor
7. Familiarization with the working knowledge of the CRO & Function generator, calculation of form factor, peak factor.
8. To plot V-I characteristics of PN junction diode, Zener diode and calculate cut-in voltage and break down voltage

9. Frequency response of CE configuration
10. Integrator and differentiator using op-amp

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	-	-	-	-	-	-	3	2
CO2	3	3	2	2	1	1	-	-	-	-	-	-	3	2
CO3	3	3	2	2	1	1	-	-	-	-	-	-	3	2

MECHANICAL ENGINEERING

Course Title/ Code	ENGINEERING GRAPHICS & DRAWING /MEW102B
Course Type:	Core
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5

Course Outcome	Mapping
CO1: Describe the fundamentals of engineering drawing and drafting and can Enhance visualization skill using projections of point and lines.	Employability
CO2: Students will be able to understand projections of solids	Employability/Skill
CO3: Students will be able to understand isometric projections	Employability/Skill
CO4: Students will be able to understand and perform the 2D drawing on AutoCAD.	Employability/Skill

SECTION-A

Introduction to Engineering Drawing :Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Orthographic Projections: Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

SECTION-B

Projections of Regular Solids: Inclined to both the Planes- Auxiliary Views; Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Sections and Sectional Views of Right Angular Solids : Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

SECTION-C

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, Customization & CAD Drawing

SECTION-D

Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; introduction to Building Information Modeling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
(iv) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
(v) Corresponding set of) CAD Software Theory and User Manual.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	-	-	-	-	1	-	-	-	- -	-	-	3	2	-
CO2	-	-	-	-	2	-	-	-	2	-	-	3	2	-
CO3	-	-	-	-	3	-	-	-	-	-	1	3	2	-
CO4	-	-	-	-	3	-	-	-	-	1	1	3	2	-

MECHANICAL ENGINEERING

Course Title	**INDIAN CONSTITUTION / LWS324**
Course Type	**CORE**
Course Nature	**AUDIT**
L-T-P structure	**1-0-2**
Credits	**0**

Course Outcome	Mapping
CO1: the students will know about the Basic features and fundamental principles on the Constitution of India.	**Employability/Skill/Entrepreneurship**

SECTION-A

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India

SECTION-B

Scheme of the fundamental rights, The scheme of the Fundamental Duties and its legal status, The Directive Principles of State Policy – Its importance and implementation

SECTION-C

Federal structure and distribution of legislative and financial powers between the Union and the States, Parliamentary Form of Government in India – The constitution powers and status of the President of India, Local Self Government – Constitutional Scheme in India

SECTION-D

Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3

MECHANICAL ENGINEERING

SEMESTER-2

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/ NTCC	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	No. of Contact Hours per week	Credits
MAH105B-T/P	MATHEMATICS-II	MA	HARD	CORE	3	1	2	6	5
PHH103B-T/P	PHYSICS-I	PHY	HARD	CORE	3	1	2	6	5
CSH101B-T/P	PROGRAMMING FOR PROBLEM SOLVING USING C	CSE	HARD	CORE	3	1	2	6	5
MEH103B-T/P	MANUFACTURING PROCESSES	MEE	HARD	CORE	3	0	2	5	4
HLS103/HLS104B	PROFESSIONAL ENGLISHADVANCED/BASIC	EDU	WORKSHOP	CORE	2	0	2	4	3
CHH137	ENVIRONMENTAL SCIENCE	CHEM	AUDIT	CORE	2	0	2	4	0
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					16	3	12	31	22
MEO104B		SUMMER TRAINING			2 Credits (60 Hrs.)				

MECHANICAL ENGINEERING

Course Title/ Code	**MATHEMATICS-II / MAH105B-T**
Course Type:	**CORE**
Course Nature:	**Hard**
L-T-P Structure	**(3-1-0)**
Credit	**4**

Course Outcome	**Mapping**
CO1. Use the mathematical tools needed in evaluating multiple integrals and their usage	**Employability/Skill**
CO2 Apply the effective mathematical tools for the solutions of differential equations that model physical processes.	**Employability/Skill**
CO3. Understand differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems	**Employability/Skill**
CO4 Solve & analyze the Mathematical problems related to integral calculus, differential equations and complex functions.	**Employability/skill**

SECTION –A

Multivariable Calculus (Integration):Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

SECTION –B

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

SECTION –C

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

SECTION –D

Complex Variable – Integration Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(iii) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

(iv) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

(v) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

(vi) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

(vii) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.

(viii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

(ix) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3										2		
CO2	3	3										2		
CO3	3	3										2		
CO4					3									

Course Title/ Code	**MATHEMATICS-II Lab/ MAH105B-P**
Course Type:	**CORE**
Course Nature:	**Hard**
L-T-P Structure	**(0-0-2)**
Credit	**1**

Course Outcome	**Mapping**
CO1 Solve & analyze the Mathematical problems related to integral calculus ,differential equations and complex functions using Mathematical software	**skill**

LIST OF EXPERIMENTS:

1. MATLAB Fundamentals: Decisions – if statement, if-else, Input and Output.
2. Introduction to Loops in MATLAB.
3. To find the Rank of a matrix, Inverse of a Square matrix and to reduce a matrix into Normal Form.
4. To solve the system of simultaneous linear equations.
5. To find the Eigen values and Eigenvectors of a square matrix.
6. To solve ODE & LDE & plot the graph of the solution of LDE.
7. To solve & plot solutions the system of two & three ordinary differential equations.
8. To solve the linear differential equations with variable coefficients (Cauchy & Legendre Differential equations) and plot the graph of the solution.
9. To find the Fourier series expansion of a given periodic functions and plot the same
10. To find the Fourier Transform of given function.

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(iii) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

(iv) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
(v) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
(vi) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
(vii) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
(viii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
(ix) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3										2		
CO2	3	3										2		
CO3	3	3										2		
CO4					3									

Course Title/ Code	Physics-I/ PHH103B-T
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(3-1-0)
Credit	4

Course Outcome	Mapping
CO1: Students solve various scalar & Vector quantities	Employability
CO2: solve problems in non-inertial frame of reference	Employability
CO3: To understand 3d rigid body motion	Employability

SECTION A

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

SECTION B

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

SECTION C

Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance. Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

SECTION D

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a

coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Suggested Reference Books

(i) Engineering Mechanics, 2nd ed. — MK Harbola
(ii) Introduction to Mechanics — MK Verma
(iii) An Introduction to Mechanics — D Kleppner& R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Griffiths
(v) Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii) Mechanical Vibrations — JP Den Hartog
(viii) Theory of Vibrations with Applications — WT Thomson

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	1									3		
CO2	3	3	1									2		
CO3	2	2	1									2		

MECHANICAL ENGINEERING

Course Title/ Code	Physics-I LAB/ PHH103B-P
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: To understand spectrometer & diffraction	Employability
CO2: To understand RC ciruits	Employability

List of Experiments

- Dispersive power of the material of a prism – Spectrometer
- Determination of wavelength of a source – Diffraction Grating.
- Newton's Rings – Radius of curvature of plano convex lens.
- Melde's experiment – Transverse and longitudinal modes.
- Time constant of an R-C circuit.
- Torsional pendulum.
- Wavelength of light –diffraction grating – using laser.
- Characteristics of a solar cell

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	1									3		
CO2	3	3	1									2		

MECHANICAL ENGINEERING

Course Title/ Code	PROGRAMING FOR PROBLEM SOLVING USING C/ CSH101B-T
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(3-1-0)
Credit	4

Course Outcome	Mapping
CO1: Analyze and apply Test Driven Development approach to design programs.	Employability/Skill
CO2: Understand and Apply basic Structure of C-Programming, declaration and usage of variables, iteration, selection and use of functions on open-source platform	Employability/Skill
CO3: Analyze problems by breaking them down into component parts and understand the concept of arrays, structures, union and enumeration.	Employability/Skill
CO4: Implement Programs using pointers with structures, arrays and perform pointer arithmetic.	Employability/skill

SECTION-A

Programming and UNIX: Students will learn the basics of programming using Scratch, they will learn to use statements, expressions, conditions, selection, iteration, variables, functions, arrays, threads and events. In addition, they will be introduced to basic UNIX commands under Bash.

Introduction to Programming, test driven development

Scratch: Introduction, statements, expressions, conditions, selection, iteration, variables, functions, arrays.

UNIX: Basic commands- pwd, ls, cd, rm, cat, less, mkdir, rmdir; permissions, root

C language: statements, expressions, conditions, selection iteration, variables, functions, arrays.

SECTION-B

Applying programming constructs: Students will learn how to write programs that satisfy unit tests. The instructor will build the unit tests, demonstrating how to break a problem down into smaller components. In the labs and homework, students will construct programs that satisfy the unit tests. Students become familiar with the constructs of the C programming language.

Moving to C: Data Types, constants, and variables, Statements, Expressions, Conditions, Selection, iteration, Functions and recursion

Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming

Arrays; One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Null terminated strings as array of characters, Standard library string functions

Introduction to Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments .

SECTION-C

Practical programming: During the third quarter of the class, students will begin building their own programs by decomposing problems into smaller tasks and writing unit tests that will check to see that the program accurately accomplishes the task using Test Driven Development. They will then write the program that satisfies their own unit tests. Students will learn to apply the constructs of the C programming language to create programs. Students will learn to apply these programming techniques: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions, Break, Continue and Goto, Type Conversion; Enumerations; Macros. Students will be able to use these techniques to develop programs

SECTION-D

Memory Management and Abstraction: During the final quarter, students will be introduced to dynamic memory allocation and dynamic data structures including: dynamic arrays. They will consolidate their ability to use the C programming techniques they have learned in the earlier sections. Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation,

Software Configuration Management, Modules, C Unit, GIT, SCRUM, MAKE. Dynamic Memory Allocation.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	-	-	-	-	- -	-	1	-	2	2
CO2	3	2	3	2	3	-	-	-	-	-	2	-	3	3
CO3	3	1	3	3	3	-	-	-	-	-	2	-	3	2
CO4	2	2	1	3	3	-	-	-	-	-	2	--	3	3

MECHANICAL ENGINEERING

Course Title/ Code	PROGRAMING FOR PROBLEM SOLVING USING C LAB/ CSH101B-P
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcomes (COs)	Mapping
CO1: Analyze and apply Test Driven Development approach to design programs.	Skill Development
CO2: apply programming language constructs as per given problems	Skill Development
CO3: apply C programming language constructs on open source platform	Skill Development
CO4: learn to work in a team using different online platform for program development	Skill Development

LIST OF EXPERIMENTS:

1. Scratch : Covering Concepts of
    a. Sequential Statements
    b. Variables
    c. Blocks
2. Unix Commands : pwd, mkdir, cd, ls, less, touch, cp,move, cat, rm, rmdir –r etc.
3. Moving to C Using nano and gcc.
4. Project on Calculator Using Agile Methodology, Nano, Cunit, Git, Scrum , Agile Methodology,
    a. Nano, Gcc, Make. Covering Conepts :

b. Statements
c. Functions
d. Arrays
e. Structures Pointers File Handling.

Books

1. The C Programming Language, Brian Kernighan and Dennis Ritchie
2. The Unix Programming Environment
3. Pro Git,

Help Pages

1. Eclipse C/C++ Development Guide

Wikipedia Pages

1. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
2. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

Tool Web Sites

1. Eclipse, https://eclipse.org/users/
2. Git, http://git-scm.com/
3. GCC, https://gcc.gnu.org/onlinedocs/gcc-4.9.3/gcc/
4. Make
5. Unix

Web tutorials

1. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

CO PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	2	2	-	-	-	-	-	2	-	1	-
CO3	2	3	2	2	2	-	-	-	-	-	-	2	1	2
CO4	2	2	2	2	2	-	-	-	-	-	-	2	1	2

MECHANICAL ENGINEERING

Course Title/ Code	MANUFACTURING PROCESSES / MEH103B-T
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: Fabricate basic parts and assemblies using machine shop equipment	Employability
CO2: Ascertain product and process quality levels through the use of precision measurement tools and statistical quality control charts.	Employability
CO3: Practice basic welding and forming techniques and modern improvements for sophisticated metal works.	Employability

SECTION A

Conventional Manufacturing processes: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

SECTION B

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Additive manufacturing: Rapid prototyping and rapid tooling.

SECTION C

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters.

SECTION D

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

CO-PO Mapping

Course Outcomes													PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	1	2											1
CO2	1	3		2		1				1				1
CO3	1	2		2		2				1				2

Course Title/ Code	MANUFACTURING PROCESSES LAB/ MEH103B-P
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: The student will be having the capability of selecting suitable manufacturing processes to manufacture the products optimally.	Employability
CO2: Understand the basics of metal cutting and working of different types of machine tools	Employability
CO3: Explain the conventional and advanced metal forming processes and composite fabrication	Employability
CO4: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application	Employability

LIST OF EXPERIMENTS:

Study and Practice of Orthogonal & Oblique Cutting on a Lathe.

1. Machining time calculation and comparison with actual machining time while cylindrical turning on a Lathe and finding out cutting efficiency.
2. Study of Tool Life while Milling a component on the Milling Machine.
3. Study of Tool Wear of a cutting tool while Drilling on a Drilling Machine.
5 Machining and machining time estimation for taper turning
6 Machining and machining time estimation for thread cutting (external & internal)
7 Machining and machining time estimation for knurling
8 Machining and machining time estimation for eccentric turning
9 Machining of hexagon in shaping machine
10 Machining of square in shaping machine

Text Books:

1. Manufacturing Engineering Technology, K. Jain, Pearson Education
2. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, TMH.
3. Manufacturing science by Ghosh and Mallik

Reference Books:

1. Fundamentals of Metal Cutting and Machine tools by Boothroyd
2. Production Technology by R.K. Jain
3. Production Engineering Science by P.C. Pandey
4. Modern Machining Processes by P.C. Pandey & H.S. Shan
5. Advanced Machining Process - VK Jain

CO-PO Mapping

Course Outcomes													PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3		3				2						1
CO2	3	3		3			3							1
CO3	3			2										1
CO4	3	3		3					2					2

MECHANICAL ENGINEERING

Course Title	**PROFESSIONAL ENGLISH-BASIC/ HLS104B**
Course Type	**CORE**
Course Nature	**SOFT**
L-T-P structure	**2-0-2**
Credits	**3**

Course Outcomes (COs)		**Mapping**
1	**To demonstrate the basic skills of effective communication**	**Employability, Skill development**
2	**To build an elementary understanding of form, meaning and use of words in varied disburses.**	**Employability, Skill development**
3	**To equip with fundamental writing skills.**	**Employability, Skill development**
4	**To show the essentials of debating skills.**	**Employability, Skill development**
5	**To exhibit creative thinking.**	**Employability, Skill development**

SECTION-A

Communication: What is communication? Introduction to Business Communication, Basic forms of communication – Verbal & Non-Verbal Communication, Process of Communication, Principles of Effective Communication, 7 Cs of Communication, Media of Communication, Types of Communication, Barriers of Communication, Formal and Informal Communication Network, Grapevine Communication, Miscommunication, Steps for improving communication.

SECTION-B

Grammar and Semantics: Parts of Speech, Modifiers, Subject-Verb Agreement, Tenses, Sentence: Kinds & Parts, The Phrase, The Clause; Simple, Complex and Compound Sentences, Synthesis of Simple Sentence, Active & Passive Voices, Direct & Indirect Narration, Spotting the Errors.

SECTION-C

Technical Writing-I: ABC of Writing, 7 Cs of Writing Skills, Précis Writing, Report Writing, Email Writing & Email Etiquettes, Paraphrasing, Comprehension, Punctuation, Essay Writing. Agenda & Minutes of Meeting.

SECTION-D

Literature: Scientists and Engineers Need Literature- Troy Camplin, Some Hints on Public Speaking by James Bryce, Ozymandias by John Keats, Macbeth by William Shakespeare.

Lab Exercises/Activities:

1. Exercises based on Grammar
2. Exercises based on Sentence
3. Exercise on Communication
4. Spotting the Errors
5. Reading/Listening Comprehension
6. Essay Writing Session
7. Report Writing and Email Writing
8. Direct & Indirect Narration
9. Active & Passive Voices
10. Tense
11. Paraphrasing
12. Movie/Book review

Suggested Text Book Reading:

1. Camplin, Troy. 'Why Scientists and Engineers Need Literature'. www.popecenter.org. Web.
2. A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt.
3. High School English Grammar and Composition. Wren and Martin: S.Chand and Co.
4. A Textbook of English Phonetics for Indian Students. T.Bala Subhrmaniam: Macmillan

CO PO Mapping

Course Outcomes													PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	-	-	-	-	-	2	-	2	2	3	2	-	-	3
CO2	-	-	-	-	-	2	-	2	2	3	3	-	-	3
CO3	-	-	-	-	-	2	-	2	2	3	3	-	-	3
CO4	-	-	-	-	-	2	-	2	2	3	2	-	-	3
CO5	-	-	-	-	-	1	-	1	1	3	1	-	-	3

MECHANICAL ENGINEERING

Course Title/ Code	PROFESSIONAL ENGLISH-ADVANCED/ HLS103B
Course Type:	CORE
Course Nature:	SOFT
L-T-P Structure	(2-0-2)
Credit	3

Course Outcomes (COs)		Mapping
1	To communicate articulately.	Employability, Skill development
2	To show the basics of presentation skills.	Employability, Skill development
3	To exhibit substantive writing skills.	Employability, Skill development
4	To demonstrate the procedure of debating skills.	Employability, Skill development
5	To display the developed critical aptitude.	Employability, Skill development

SECTION-A

Lexis: The Concept of Word Formation, Homonym, Homophones, Root Words of Foreign Languages & their use in English, Foreign Words, Phrasal Verbs & Idioms and Phrases.

SECTION-B

Oral Communication: Importance of Speech Sounds, Organs of Speech, Vowel Sounds, Consonant Sounds, IPA Symbols, Phonetic Transcription, Phoneme and Syllables, Intonation, Word Stress, Sentence Stress, Connected Speech, Indianism, Question Tags.

SECTION-C

Presentation Skills: Body Language and Paralanguage, Gestures and Postures, Kinesics, Proxemics, Importance of Body Language in Presentation, Etiquette of the Telephone Handling and Business Meetings, Professional Presentation, Hearing and Listening, Essentials of Effective Listening, Importance of Effective Listening, Visual Presentation – How to prepare slide presentation.

SECTION-D

Technical Writing-II: Business Letters, Job Application and Resume Writing, Paraphrasing, Developing Outlines, Circular, Memos, Essay Writing. Blog Writing and Comments on Social Media.

Lab Exercises/Activities 1.

Exercise on Lexis-I.

2. Exercise on Lexis-II
3. One- Man Task
4. Exercise on Business Quiz
5. Role-Play Activities
6. Organs of Speech
7. IPA Symbols
8. Intonation
9. Phonetic Transcription
10. Hearing vs Listening
11. Telephonic and Face-to-Face Communication
12. Presentation

Suggested Text Reading:

1. A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt. 2. A Textbook of English Phonetics for Indian Students. T.Bala Subhrmaniam: Macmillan

3. English Vocabulary in Use. MaCarthy: Foundation Books, OUP. Print.
4. English Grammar, Competition and Correspondenc. M.A. Pink and A.C. Thomas: S. Chand and Co. Print.
5. Reading between the Lines: Students Book. MacRae: Foundation Books. CUP, New Delhi.

CO PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	-	-	-	-	-	2	-	2	2	3	2	-	-	3
CO2	-	-	-	-	-	2	-	2	2	3	3	-	-	3
CO3	-	-	-	-	-	2	-	2	2	3	3	-	-	3
CO4	-	-	-	-	-	2	-	2	2	3	2	-	-	3
CO5	-	-	-	-	-	1	-	1	1	3	1	-	-	3

MECHANICAL ENGINEERING

Course Tittle/Code	**ENVIRONMENTAL SCIENCE / CHH137**
Course Type	**University Compulsory**
Course Nature	**AUDIT**
L-T-P Structure	**2-0-2**
Credit	**0**

Course Outcomes (COs)		**Mapping**
1	**Explain the multidisciplinary dimensions of environmental issues and suggest potential solutions**	**Employability, Skill development, Entrepreneurship**
2	**Discuss about the various types of organisms and draw inferences about their interactions in different e systems**	**Employability, Skill development, Entrepreneurship**

SECTION-A

Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness (OC)

Renewable and Non-Renewable Resources: Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

SECTION-B

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies (OC). Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. (OC) Equitable use of resources for sustainable lifestyle

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem., Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (OC)

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values (OC), Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity (OC).

SECTION-C

Environmental Pollution: Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management : Causes, effects and control measures of urban and

Industrial wastes. (OC), Role of an individual in prevention of pollution. (OC), Pollution case studies. (OC), Disaster management: floods, earthquake, cyclone and landslides.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions.

SECTION-D

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies (OC): Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act (OC), Water (Prevention and control of Pollution) Act (OC), Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation (OC), Public awareness (OC).

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights (OC), Value Education (OC), HIV/AIDS (OC), Women and Child Welfare (OC), Role of Information Technology in Environment and human health, Case Studies (OC).

*OC = Outcome component

Field work

- Visit to a local area to document environmental assets river/ forest/grassland/hill/mountain • Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

- Any socially relevant problem identification and proposing its possible solution

NOTE: Manav Rachna has adopted five villages, where students would be visiting, will identify the socially relevant issues and work on to provide possible solution.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	3	-	-	-	-	-	-	-	-
CO2	-	-	3	3	3	-	3	-	-	-	-	-	-	-

MECHANICAL ENGINEERING

Course Title/Code	**Summer Training Post 2nd Semester / MEO104B**
Course Type	**Core**
Course Nature	**Hard**
Credit	**2**

Course Outcome	**Mapping**
CO1: Identify the problem, define objectives and scope of the project.	**Employability**
CO2: Analyse the problem from state of the art for arriving at feasible solutions.	**Employability**
CO3: Prepare an organized report employing elements of technical writing & critical thinking.	**Employability**
CO4: Summarize and communicate the content to audience in an effective manner.	**Employability**

CO-PO Mapping

Course Outcomes	**PO's**												**PSO1**	**PSO2**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
CO1	3	1					2	3	2		1	1		1
CO2		3	2	2							2	2	2	2
CO3						3	2	3	2	2	2	1	1	2
CO4						1	2	2	3	3		2	1	1

MECHANICAL ENGINEERING

SEMESTER 3

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/WORKSHOP/NTCC	COURSE TYPE (CORE/ELECTIVE/UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
EDS288/EDS289/EDS290	APPLIED PHILOSOPHY/APPLIED PSHYCHOLOGY/APPLIED SOCIOLOGY	ED	SOFT	CORE	1	0	2	0	3	2
PHH204B-T/P	PHYSICS-II (Quantum Mechanics)	PHY	HARD	CORE	3	1	0	0	4	4
MAH203B	MATHEMATICS-III	MA	HARD	CORE	3	1	0	0	4	4
MEH201B	THERMODYNAMICS	ME	HARD	CORE	3	1	0	0	4	4
MEH202-T/P	MATERIALS SCIENCE	ME	HARD	CORE	3	1	2	0	6	5
MEW203B	3D CAD SOFTWARE	ME	WORKSHOP	CORE	0	0	2	0	2	1
RDO501	INTRODUCTION TO RESEARCH	RESEAR CH	OUTCOME BASED	CORE	0	0	0	1	1	0.5
FLS101/FLS102/FLS103	FOREIGN LANGUAGE	FL	AUDIT	ELECTIVE	1	1	0	0	2	0
CDO201	PROFESSIONAL COMPETENCY ENHANCEMENT-I	CDC	OUTCOME BASED	CORE	0	0	0	1	1	0.5
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					14	5	6	2	27	21

Course Title/Code	APPLIED PHILOSOPHY (EDS 288)	
Course Type	Soft Elective	
L-T-P Structure	0-2-0	
Credits	2	
Course Outcomes (COs)		Mapping
1	Examine the philosophical problems implicit in the experience of self, others and the society	Entrepreneurship
2	Explore the philosophy of influential philosophers with respect to society, Science and success in life	Entrepreneurship
3	Demonstrate the understanding of the concepts and theories of moral philosophy.	Entrepreneurship
4	Reflect philosophically and ethically on one's own personal, professional and civic lives.	Entrepreneurship

SECTION-A

Introduction to Philosophy: Philosophy: Meaning, Nature and Scope, Uses of Philosophy, Branches of Philosophy, Philosophical and Sociological Overview of Vocational Technical Education, focusing on a few key philosophers, namely Francis Bacon and Martin Heidegger. Philosophy of Plato, John Dewey, Swami Vivekananda and Mahatma Gandhi with respect to aims of life, morality, ideals and social principles.

SECTION-B

Philosophical perspectives of Socio-Political scenario in India: Nature of Democracy and its implications. Secularism—its nature and implications, Moral Philosophy of religion with special reference to Hinduism, Jainism, Buddhism, Islam, Christianity, Sikhism Religious pluralism and Religious tolerance, Meaning and requirements of National Integration, Universal Human Rights

Practical Activities:

1. Prepare and present a report on ‘philosophy of life’ from the perspective of a young adult.

2. Organization of and participation in street plays /dramas/ declamation/debates/ any other suitable activity on any theme of Philosophical perspectives of Socio-Political scenario in India.
3. Group discussions on any suitable topics concerning contemporary society like aggression among youth, Over-ambitiousness in young generation, misuse of democracy, implications of secularism etc. and to reflect upon different viewpoints.
4. Preparation of quotation boards to display quotes of great philosophers in the college premises.
5. Any other suitable activity.

Suggested Readings:

1. Bhatia, K. & Bhatia, B.(1974) The Philosophical and Sociological Foundations of Education. Delhi: Doaba House.
2. Brubacher, John. S. (1969).Modern Philosophies of Education, New Delhi.
3. Dewey, J. (1966). Democracy in Education, New York, Macmillan 4. Gandhi, M. K. (1956). Basic Education. Ahmedabad, Navajivan.
5. Goel, A. & Goel S.L. (2005). Human values and Education. New Delhi: Deep and Deep Publications Pvt. Ltd.
6. Palmer, Joy A. et.al.(2001). Fifty major thinkers on education from confucious to Dewey.Routledge. New Delhi.
7. Rajput, J.S. (2006). Human Values and Education. New Delhi: Pragun Publications
8. Walia, J.S. (2011). Philosophical, Sociological and Economic Bases of Education, Jalandhar: Ahim Paul Publishers.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	-	-

Course Title/Code	**APPLIED PSYCHOLOGY (EDS 289)**	
Course Type	**Soft Elective**	
L-T-P Structure	**0-2-0**	
Credits	**2**	
Course Outcomes (COs)		**Mapping**
1	**Develop critical thinking to understand the application of psychology**	**Entrepreneurship**
2	**Identify the impact of Stereotyping, prejudice and discrimination in formation of attitude**	**Entrepreneurship**
3	**Identify major attributes of Personality.**	**Entrepreneurship**
4	**Understand social psychology and able to solve the inflicts among the group**	**Entrepreneurship**

SECTION-A

Psychology: Attitude and Personality Development: Psychology: Meaning, nature, and scope

Role of psychology across multi-disciplinary aspects, Introduction: Attitude, Stereotypes, Prejudice, and Discrimination, Formation of attitude and attitude change, Definition of personality and personality development, State/ Trait approach to personality, Bandura's Social- Cognitive theory of personality

SECTION-B

Social Psychology and Organizational Psychology: Introduction to social identity, social cognition, social influence, social conflicts and its resolutions, Group dynamics: Introduction, formation, types of groups,cooperation, competition, and conflict in groups, Organizational Psychology: Definition, fundamental concepts and importance, Introduction to job satisfaction, work motivation, and organizational commitment , Introduction to participation, empowerment, and team work

PRACTICAL ACTIVITIES:

1. How could knowledge of psychology be proved as an asset in professional development?

2. Give a brief account of your personality before and after the transaction of course content.
3. Suppose you are captain of your football team. Draw out inputs to motivate your team, and maintain the team- spirit.
4. Write a brief note on any one attitude you want to change in yourself and the strategies to accomplish it.
5. The psychometric tests to be conducted by learners:
   a. Sociometry test
   b. Personality testing (16PF)
   c. Vineland Social Maturity Scale
   d. Rorschach inkblot test
   e. Thematic Appreciation Test

Suggested Readings

1. Arrow, K. J. (1995). Barrier to Conflict Resolution. NY: W. W. Norton.
2. Bandra, A., & Walters, R. H. (1963).Social Learning and Personality Development. New York: Holt, Rinehart, & Winston.
3. Bandra, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice- Hall, Inc.
4. Baron, R. A., Byrne, D. (1997).Social Psychology (8th ed.). Boston, MA: Allyn& Bacon.
5. Baron, R. A. (2001).Psychology (5th ed.). London: Pearson.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	-	-

Course Title/Code	**APPLIED SOCIOLOGY (EDS 290)**	
Course Type	**Soft Elective**	
L-T-P Structure	**0-2-0**	
Credits	**2**	
Course Outcomes (COs)		**Mapping**
1	**analyze the social cultural dynamics that ntribute to transformation of Indian Society**	**Entrepreneurship**
2	**develop the necessary skills of social processes which affect our everyday lives.**	**Entrepreneurship**
3	**study and analyse various ntemporary issues of society and able to provide solutions of social barrier and benefiting the masses.**	**Entrepreneurship**
4	**develop basic research skills in the area of sociology and help to find possible solution of specific social barriers of the society**	**Entrepreneurship**

SECTION-A

Introduction: Sociology: Meaning, Nature and Scope, Relationship of Sociology with other subject, Application of Sociology in corporate world

SECTION-B

Social change and social processes: Social Change: Meaning, Concept and nature of Social Change, Processes: Urbanization, Modernization, Globalization, Industrialization, Liberalization

SECTION-C

Theories and Approaches of Sociology: Different Theories and approaches: Positivist Approach, Labeling Theory, Structural Function Theory, Social /Conflict Theory, Social Darwinism Theory

SECTION-D

Fundamental Concepts: Fundamental Concepts in Sociology: Social Stratification, Social Control, Equality, Equity, Co-operation and Conflict, Association, Social Structure: Family, Caste, Ethnicity

LIST OF EXPERIMENTS:

1. Prepare and present a report on "importance of sociology in relation with the corporate sector'' with the perspective of a young adult.
2. Preparation of quotation board with the help of displaying the pictures and quotes of famous sociologists 3. Case study
4. Discuss the impact of modernization, industrialization and globalization on the day-today life.
5. Showing Videos on the life and philosophies of Famous sociologists to tell the students about their different theories 6. Field Study
7. Any other suitable activity

REFERENCES:

1. Aron.Raaymond.19567 (1982 reprint). Main currents in sociological thought (2 volumes).Harmondworth. Middlesex:Penguin Books
2. Barnes, H.E.1959. Introduction to the history of sociology, Chicago: The University of Chicago Press.
3. Coser, Lewis A 1979. Masters of sociological thought. New York: Harcourt Brace Jovanovich.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	-	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	-	-

Course Title/ Code	Physics-II/ PHH204B-T
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(3-1-0)
Credit	4

Course Outcome	Mapping
CO1: Students solve various various quantum mechanical features by solving various potentials: example, Finite and infinite well, Harmonic oscillator	Employability
CO2: Learn Quantum theory of Hydrogen atoms, solution of Schrodinger equation under central force, Orbital angular momentum and spin angular momentum	Employability
CO3: To know generalized angular momenta, Electron's magnetic moment, Energy of a magnetic dipole, Stern-Garlach experiment	Employability

SECTION-A

Simple harmonic motion, damped and forced simple harmonic oscillator: Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

SECTION-B

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion: Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

SECTION-C

The propagation of light and geometric optics : Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Wave optics: Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

SECTION-D

Lasers: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Reference Books

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. E. Hecht, Optics
4. Ghatak, Optics
5. O. Svelto, Principles of Lasers

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	1									3		
CO2	3	3	1									2		
CO3	2	2	1									2		

Course Title/ Code	Physics-II LAB/ PHH204B-P
Course Type:	CORE
Course Nature:	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: To study Fine structure of hydrogen atoms, atoms in presence of electric and magnetic fields--application of Quantum mechanics for atomic systems	Employability
CO2: To learn Many electron atoms, identical particles, Pauli principle.	Employability

List of Experiments

Experiment 1: Propagation of Errors
Experiment 2: Quantum yard stick – measurement of Planck's constant
Experiment 3: Diffraction of light by a double-slit – one photon at a time
Experiment 4: Photoelectric effect: waves behaving as particles
Experiment 5: Atomic spectra; hydrogen Balmer lines; sodium D-doublet
Experiment 6: Photoluminescence from InP quantum dots
Experiment 7: Introduction to Atomic Force Microscopy (AFM)
Experiment 8-9: Study of InAs quantum dots and Si nanowires using AFM

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	1									3		
CO2	3	3	1									2		

MECHANICAL ENGINEERING

Course Title/Code	MATHEMATICS-III / MAH203B
Course Type	CORE
Course Nature	Hard
L-T-P structure	3-1-0
Credits	4

Course Outcome	Mapping
CO1 Use the mathematical tools needed in evaluating partial differential equations	Skill
CO2 Understanding the basic concepts of Probability distribution	Skill
CO3 Understanding basic tool of polynomial and transcendental equations	Skill
CO4 Solve & analyze the Mathematical problems related ordinary differential equations	skill

SECTION –A

Partial Differential Equations: Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

SECTION –B

Probability Theory: Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables. Continuous random variables and their properties, distribution functions and densities, normal distribution.

SECTION –C

Numerical Methods – 1: Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators. Interpolation using Newton’s forward and backward difference formulae. Interpolation with unequal intervals: Newton’s divided difference and Lagrange’s formulae

Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.

SECTION –D

Numerical Methods – 2: Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
5. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
6. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
7. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3										2		
CO2	3	3										2		
CO3	3	3										2		
CO4					3									

MECHANICAL ENGINEERING

Course Title/ Code	THERMODYNAMICS / MEH201B
Course Type	Core
Course Nature	Hard
L-T-P Structure	3-1-0
Credits	4

Course Outcome	Mapping
CO1: To solve the problems related to Engg. Thermodynamics laws.	Employability
CO2: To calculate heat, work, thermal efficiency and the difference between various forms of energy.	Employability/Skill
CO3: To be able to apply ideal cycle analysis to heat engine, to estimate thermal efficiency and work output.	Employability/Skill

SECTION A

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

SECTION B

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

SECTION C

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

SECTION D

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

CO PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	3	-	2	-	3	-	-	-	3	-	-	3	2	-
CO2	2	-	3	-	2	-	-	-	2	-	-	3	2	-
CO3	3	-	3	-	3	-	-	-	-	-	1	3	2	-

Course Title/Code	MATERIALS SCIENCE/ MEH202B-T
Course Type	CORE
Course Nature	Hard
L-T-P structure	3-0-0
Credits	3

Course Outcome	Mapping
CO1: Analyze the structure of materials and basic concepts of materials like unit cell, FCC, BCC, HCP, etc.	Employability
CO2: Describe and discriminate concept of mechanical behavior of materials.	Employability/Skill Development
CO3: Construction and identification of phase diagrams and reactions to create desired microstructure.	Employability
CO4: Suggest the heat treatment process for engineering application and its impact on microstructure and material properties.	Employability/Skill Development

SECTION A

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

SECTION B

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified MohrCoulomb; Fracture mechanics:

Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT).

SECTION C

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

SECTION D

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

Text Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

CO-PO Mapping

Course Outcomes	PO’s												PSO’s	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	2											
CO2	3	2	2											
CO3	3	2	2											
CO4	3	2					1						1	

Course Title/Code	MATERIALS SCIENCE LAB/ MEH202B-P
Course Type	CORE
Course Nature	Hard
L-T-P structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1: Determine the grain size and microstructure in different Ferrous alloys by means of experiments.	Employability
CO2: Learn about microstructures of different Non-Ferrous alloys by means of experiments.	Employability/Skill Development
CO3: Understand heat treatment processes through experiments.	Employability
CO4: Analyze microstructure of Heat-treated specimens and perform Fatigue and creep test on different materials.	Employability/Skill Development

LIST OF EXPERIMENTS:

1. Preparation of mild steel specimen and metallographic examination of the prepared specimen
2. To study solidification curve for a given specimen.
3. Determine the hardness of given sample before & after the Heat Treatment (Hardening (water as quenching media), Annealing & Normalizing)
4. Study the effect of different quenching media on the hardness (Rockwell Hardness) of given mild steel samples.
5. Study of microstructure of welded component and HAZ (Heat Affected Zone) macro and micro examination
6. Determine the izod impact strength of given acrylic sheets and study the effect of thickness of the sheet on the impact strength

7. To study the creep behavior of a given specimen
8. To measure the hardness of the sample by varying distance from quenching medium by Jominy end quench test apparatus.
9. To illustrate the effects of fatigue on a metal.
10. To study effect of different media on the rate of corrosion.

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3	3	–	–	–	–	3	2	–	–	2	3
CO2	3	2	–	–	–	–	–	–	3	3	–	–	–	–
CO3	3	3	3	3	2	3	3	1	3	1	2	1	2	3
CO4	3	–	–	3	–	–	–	–	3	3	–	–	–	–

Course Tittle/Code	3D CAD SOFTWARE / MEW203B
Course Type	CORE
Course Nature	Workshop
L-T-P Structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1: Demonstrate the Concept of CAD software.	Employability/Skill
CO2: Create the basic Engineering Drawings in the Sketcher Module.	Employability/Skill
CO3: Measure the 3D CAD Models in the CAD Software.	Employability/Skill
CO4: Design the 3D Model of Components as per the Engineering Drawings.	Employability/skill

SECTION-A

Introductory Concept: line, infinite line, bi-tangent line, bisecting line and line normal to curve. Constraint, contact constraint, fixes together, auto constraint, animate constraint and edit multi constraint.

Circle: three point circle, circle using coordinates, tri-tangent circle, arc, three point arc and three point arc starting with limits.

SECTION-B

Profile: rectangle, oriented rectangle, parallelogram, elongated hole, cylindrical elongated hole, keyhole profile, hexagon, centered rectangle and centered parallelogram.

Axis and Point: axis, point, point using coordinates, equidistant points, intersection point and projection point.

Operation: corner, chamfer, trim, break, quick trim, close, complement, mirror, symmetry, translate, rotate, scale and offset and sketch analysis.

SECTION-C

Sketch Based Feature: pad, pocket, drafted filleted pad, drafted filleted pocket, shaft, groove, hole, rib, slot, stiffener, multi-sections solid, remove multi-sections solid, multiple pad, multiple pocket, solid combine.

Dress-Up Feature: edge fillet, variable fillet, chordal fillet, face-face fillet, tri-tangent fillet, chamfer, draft, drafted reflect line, variable angle draft, shell, thickness, thread/tap, remove face, replace face.

SECTION-D

Transformation Features: translation, rotation, symmetry, mirror, rectangular pattern, circular pattern, user pattern, Scaling. Boolean Operation: add, remove, intersect and draft both sides.

TEXT BOOK & REFERENCE BOOK:

1. CATIA for Engineers and Designers by Sham Tickoo, Dreamtech Press
2. CATIA V5 Design Fundamentals by Jaecheol Koh

CO PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	1	-	2	2	-
CO2	3	-	2	-	2	-	-	-	-	1	-	2	2	-
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	-
CO4	2	-	2	-	3	-	-	-	-	1	1	2	2	-

Course Tittle/Code	**FRENCH-I / FLS103**
Course Type	**University Compulsory**
Course Nature	**NTCC**
L-T-P Structure	**1-1-0-0**
Credit	**0**

Course Outcomes (COs)		**Mapping**
1	**Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.**	**Employability, Skill Development**
2	**Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary.**	**Employability**
3	**Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.**	**Employability, Skill Development**
4	**Students will be able to understand audio text and comprehend to the same. They will be able to form paragraph using auxilary verb and basic verbs.**	**Employability, Skill Development**

SECTION-A

Les Salutations & forms of politeness, Alphabets, Taking leave expression

SECTION-B

Les pronoms sujets, Les verbes ER, Self introduction

SECTION-C

Les noms, Verbes Avoir, Etre, Aller & Faire, Les articles define et indefinite

SECTION-D

Les moin de l'annee, les jours de la semain, Repondez aux questions

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2

MECHANICAL ENGINEERING

Course Tittle/Code	**SPANISH-I / FLS101**
Course Type	**University Compulsory**
Course Nature	**NTCC**
L-T-P Structure	**1-1-0-0**
Credit	**0**

CO	Course Outcomes (COs)	Mapping
1	Students will be able to greet each other.	Employability, Skill Development
2	Students will be able to make sentences with the verb ser. They will be able to use verb ser with nationality and professions.	Employability
3	Students will be able to learn cardinal and ordinal numbers.	Employability, Skill Development
4	Students will be able to recognize masculine and feminine words in Spanish. They will be learning the articles and its usages with nouns.	Employability

SECTION-A

Presentation on Spanish language, Greetings and goodbye's

SECTION-B

Introduction cntd, Alphabets, Numbers 1-20

SECTION-C

Personal pronouns, Hobbies and Professions

SECTION-D

Café related vocabulary and dialogues, Revision personal pronouns, Common verbs and their conjugations, Introduction of VerboSER

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2

Course Tittle/Code	**GERMAN-I/ FLS102**
Course Type	**University Compulsory**
Course Nature	**NTCC**
L-T-P Structure	**1-1-0-0**
Credit	**0**

Course Outcomes (COs)	**Mapping**
Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.	**Employability, Skill Development**
Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary.	**Employability**
Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.	**Employability, Skill Development**
Students will be able to understand audio text and comprehend to the same. They will be able to form paragraph using auxilary verb and basic verbs.	**Employability, Skill Development**

SECTION-A

Salutations/Greetings, Introduction

SECTION-B

Uses of Verbo SER, Introduction of Nationality, Professions and vocabulary related to professions, Adjectives related to Verbo SER, Counting till number 20.

SECTION-C

Introduction of Articles and Indefinite articles, Interrogatives, Adjectives to describe things and place and Counting till number 90

SECTION-D

Introduction of Verbo ESTAR, Uses of Verbo ESTAR with respect to positioning of objects, Prepositions related to the positioning of an object.

C-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2

Course Title/Code	PROFESSIONAL COMPETENCY ENHANCEMENT-I / CDO201	
Course Type	Soft	
L-T-P Structure	(0-0-1-0)	
Credits	0.5	
Course Outcomes (COs)		Mapping
1	Students will become better at analytics and problem solving	Employability, Skill Development
2	Students will be able to solve aptitude problems quickly utilizing the short cuts	Employability
3	Students will have enhanced level of reasoning, numerical skills and speed	Employability, Skill Development
4	Students will have the ability to 'quickly think on their feet'	Employability
5	Students will have enhanced concentration & thinking ability.	Employability, Skill Development

SECTION-A – Reasoning Ability

Unit 1: Mental Ability

1.1 Mental Ability Test

1.2 Direction Sense Test
1.3 Blood Relations Test
1.4 Cubes
1.5 Cuboids
1.6 Dice
1.7 Word Problems
1.8 Puzzles
Unit 2: Verbal & Non Verbal Reasoning
2.1 Letter Series
2.2 Set Theory
2.3 Venn Diagram
2.4 Syllogism
2.5 Missing Value in figure
2.6 Practice Test
SECTION-B
Unit 3: Logical Reasoning & Word Puzzles
3.1 Logical Reasoning I
3.1.1. Row Arrangement
3.1.2. Circular Arrangement
3.2 Logical Reasoning II
3.2.1. Arrangement
3.2.2. Puzzles
3.3 Logical Reasoning III
3.4 Practice Test
Personality Development
Unit 4: Personality Development
4.1 Concept of personality
Concept of personality

Bringing out the best in one's personality
4.2 Self awareness
Different learning styles
Areas of Self awareness
Developing self-awareness
4.3 Goal Setting
Five principles of goal setting
Setting "SMART" goals
6P's of goal setting
SWOT analysis
Short term& Long term goals

SECTION-C

Unit 5: Resume Writing
What, why and how of Resume
Building different sections of the Resume through projects and activities during the course

Unit 6 : Presentation Skills
Designing the presentation
Audience and content analysis
Delivering the presentation- Preparation, Practice, Performance

SECTION-D

Unit 7: Professional Communication
Email writing
Diction and Speech Clarity
LSRW & Introduction to verbal ability as an assessment tool for employability

Unit 8: Professional Grooming and Etiquette
Professional grooming
Personal Grooming
Professional Etiquette

Courtesy and communication discipline

Text Books/Reference Books:

1. A Modern Approach to Logical Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd
2. A Modern Approach to Non Verbal Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd
3. Developing Management Skills by *David A Whetten, Kim S Cameron*
4. Personality and Soft Skills Development by *Rajeev Kumar*
5. English for business, 100 tips foe effective communication,*By: Dignen, Bob; McMaster, Ian. Planegg: Spotlight Verlag GmbH. 2016. eBook.*

*6.*Presentation Skills for technical professionals: Achieving Excellence,*By: Karten, Naomi; Gottesdiener, Ellen. Series: Soft Skills for IT Professionals. Ely, Cambridgeshire, United Kingdom :IT Governance Publishing. 2010. eBook., Database: eBook Collection (EBSCOhost)*

Weblinks:

http://www.indiabix.com/aptitude/questions-and-answers/

http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO5	3	3	2	2	-	-	-	2	-	3	2	2	-	1

Course Title/Code	**INTRODUCTION TO RESEARCH/ RDO501**	
Course Type	**Soft Core**	
L-T-P Structure	**0-0-1**	
Credits	**0.5**	
Course Outcomes (COs)		**Mapping**
1	**The student shall be able to describe research and its impact.**	**Employability, Skill Development**
2	**The student shall be able to identify broad area of research, analyze, the processes and procedures to Carryout research**	**Employability**
3	**The student shall be able to use different tools for literature survey**	**Employability, Skill Development**
4	**The student is able choose specific area of research and supervisor/mentor is finalized**	**Employability**

SECTION-A

Unit 1: What is Research and its impact?

1.1 Capturing the current research trends

1.2 Insight about scientific research performed by renowned experts in the related field(case studies)

1.3 Do's and Don'ts pertaining to research

SECTION-B

Unit 2: Identification of Broad Area of research

2.1 Identification of thrust area of research for deciding broad area

2.2 Framing the research questions and hypothesis

2.3 Identification of the research gap based on feasibility of problem

2.4 Exploration of in-house and commercially available facilities related to broad area

SECTION-C

Unit 3: Understanding the tools for Literature Survey

3.1 Finding research papers related to a topic

3.2 Understanding the different aspects of Literature search

3.3 Usage of different sources like Google scholar, WoS, SCI/ SCIE, PubMed, Scopus, ABDC, EBSCO etc.

3.4 Search for online journals relevant to research area

3.5 Indexing of Journals

3.5 Usage of scholarly networking sites like Research Gate, Mendeley, and Academia.edu etc.

3.6 Demo sessions on the usage of above mentioned sources

SECTION-D

Unit 4: Review of research papers pertaining to broad area and specific area of research

4.1 Selection of relevant papers

4.2 Finding specific research problem from broad area of research

4.3 Literature survey and justification of specific research problem

4.4 Experimentation and data cleaning and verification

4.5 Understanding and selection of the research domain

4.6 Seeking information through published work w.r.t the problem

4.7 Reading & categorizing the downloaded/referred papers and structuring of the idea

4.8 Model design about framing the research questions

Unit 5: Report Writing and Presentation skill Development

5.1 Report making on the surveyed literature to cater the basic idea of the research papers

5.2 Compiling and analyzing the published results to justify and understand the proposed ideas

5.3 Usage of MS-PowerPoint and other technical resources for the presentation

5.4 Development of presentation skills and group addressing

5.5 Scientific/technical writing and ethical practice, project report

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2	2	2	3	3	3	3	3
CO2	3	3	3	3	2	2	2	2	2	3	3	3	3	3
CO3	3	3	3	3	2	2	2	2	2	3	3	3	3	3
CO4	3	3	3	3	2	2	2	2	2	3	3	3	3	3

MECHANICAL ENGINEERING

SEMESTER 4

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC)	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
MEH204B-T/P	APPLIED THERMODYNAMICS	ME	SOFT	CORE	3	1	2	0	6	5
MEH205B-T/P	STRENGTH OF MATERIALS-I	ME	HARD	CORE	3	1	2	0	6	5
MEH206B-T/P	KINEMATICS & THEORY OF MACHINES	ME	HARD	CORE	3	1	2	0	6	5
MEH207B-T/P	FLUID MECHANICS & MACHINES	ME	HARD	CORE	3	1	2	0	6	5
LWS323/LWS325	CYBER LAW/ LAW RELATING TO INTELLECTUAL PROPERTY RIGHTS	LW	HARD	CORE	1	0	2	0	3	2
RDO502	RESEARCH INNOVATION-I	RESEAR CH	OUTCOME BASED	CORE	0	0	0	1	1	0.5
FLS105/FLS 106/FLS107	FOREIGN LANGUAGE	FL	AUDIT	ELECTIVE	1	1	0	0	2	0
CDO202	PROFESSIONAL COMPETENCY ENHANCEMENT-II	CDC	OUTCOME BASED	CORE	0	0	0	1	1	0.5
	TOTAL (L/T/P/O/CONTACT HOURS/CREDITS				14	5	10	2	31	23
MEO208B	SUMMER TRAINING			2 Credits (60 Hrs.)						

Course Title / Code	APPLIED THERMODYNAMICS / MEH204B-T
Course Type	CORE
Course Nature	Hard
L-T-P Structure	(3-0-0)
Credit	3

Course Outcome	Mapping
CO1: To understand the concept of boiler function and estimation of performance of boiler and heat balance sheet.	Employability/Skill Development
CO2: Understand the concept of vapor power cycles and calculation its efficiency	Employability/Skill Development
CO3: To understand the concept of application of nozzle used in steam power plant and calculate the nozzle efficiency	Employability
CO4: To calculate the work input required by an air compressor as well as the function of compressor.	Employability

SECTION-A

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

SECTION-B

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

SECTION-C

Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

SECTION-D

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Analysis of steam turbines, velocity and pressure compounding of steam turbines

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3	2	3		3			3				3	
CO2	3	3	2	3	3		3						3	2
CO3	3	3	2	3		2		3			2		3	
CO4	3	3	2	3	3					1	2		3	2

Course Title / Code	APPLIED THERMODYNAMICS LAB / MEH204B-P
Course Type	CORE
Course Nature	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: Differentiate various thermodynamic relations and the process of combustion of fuels.	Employability/Skill Development
CO2: Explain the working and practical importance of boilers and condensers.	Employability/Skill Development
CO3: Demonstrate and apply steam engines and steam nozzles fundamentals.	Employability
CO4: Analyze different vapour power cycles and steam turbines relationship.	Employability

LIST OF EXPERIMENTS:

1. Study of working of some of the high pressure boilers like Lamont or Benson.
2. Determination of Calorific value of fuel
3. Determination of efficiency of steam Nozzles.
4. Determination of efficiency of condenser
5. Determination of efficiency of Boiler
6. To perform Heat Balance Analysis on Boiler
7. Determination of thermal efficiency of steam power plant
8. To find out efficiencies of a reciprocating air compressor and study of multistage Compressors

CO-PO Mapping

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3	3	-	-	1	1	-	-	-	-	1	2	2
CO2	3	3	2	-	-	1	2	-	-	-	-	1	2	3
CO3	3	2	3	-	-	1	1	-	-	-	-	1	2	2
CO4	3	2	3	-	-	1	1	-	-	-	-	1	2	2

Course Title / Code	STRENGTH OF MATERIALS –I/ MEH205B-T
Course Type	CORE
Course Nature	Hard
L-T-P Structure	(3-1-0)
Credit	4

Course Outcome	Mapping
CO1: Determine different types of simple and compound stress, strains. Draw Mohr's Circle of stresses.	Employability
CO2: Draw Shear Force and Bending Moment diagrams for different types of beams with different types of loads and their significance	Employability/Skill
CO3: Solve engineering problems related to design of different types of shafts under loads causing bending, torsion and end thrust.	Employability
CO4: Analyze beams with different cross sections for bending and shear stresses under different load conditions.	Employability/Skill

SECTION A

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

SECTION B

Beams and types transverse loading on beams- shear force and bend moment diagrams Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

SECTION C

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

SECTION D

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

CO-PO Mapping

Course Outcomes													PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3											3	3	3
CO2	3				2				2			3	3	3
CO3			3		2				2			3	3	
CO4	3				2				2			3	3	

Course Title / Code	STRENGTH OF MATERIALS –I LAB/ MEH205B-P
Course Type	CORE
Course Nature	Hard
L-T-P Structure	(0-0-2)
Credit	1

Course Outcome	Mapping
CO1: To understand the basics of material properties, stress and strain.	Employability/Skill Development
CO2: To design and conduct experiments, as well as to analyze and interpret data	Employability/Skill Development
CO3: To design and conduct experiments, as well as to analyze and interpret data	Employability/Skill Development
CO4 : To identify, formulate, and solve engineering & real life problems	Employability/Skill Development

LIST OF EXPERIMENTS:

1. To perform tensile and compression tests on UTM.
2. To perform bending test on UTM
3. To determine spring stiffness of open and closed coiled spring on spring testing machine.
4. To determine the Rockwell hardness of a given specimen.
5. To determine the Brinell hardness of a given specimen.
6. To determine the flexural rigidity of the material of SSB under different load conditions.
7. To compare the deflection of different types of columns, and estimate equivalent length.
8. To find out slope and deflection of SSB with Mohr's Moment area method.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3											3	3	3
CO2	3											3	3	3
CO3			3		2				2			3	3	
CO4	3				2				2			3	3	

Course Title / Code	KINEMATICS & THEORY OF MACHINES /MEH206B-T
Course Type	CORE
Course Nature	Hard
L-T-P Structure	(3-1-0)
Credits	4

Course Outcome	Mapping
CO1: Students will have the ability to explain the different types of mechanisms.	Employability
CO2: Students will have the ability to explain and develop competency in drawing the cam profile and understand the follower motion.	Employability
CO3: Students will have the ability to develop competency in understanding of theory of all types of gears and gear train.	Employability
CO4: Students will have the ability to select Suitable Drives and Mechanisms for balancing and Vibration application.	Employability

SECTION A

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains, Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

SECTION B

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics, Coincident points- Coriolis component of acceleration- introduction to linkage synthesis, three position graphical synthesis for motion and path generation

SECTION C

Classification of cams and followers- Terminology and definitions- Displacement diagrams, Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

SECTION D

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes.

Text Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East West Pvt. Ltd, New Delhi, 1988.

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2	3		1			1					2	3
CO2	1	2	3		1			1					1	2
CO3	1	3	3		1			2					2	
CO4	1	3	3		1							2	2	

Course Title / Code	**KINEMATICS & THEORY OF MACHINES LAB/MEH206B-P**
Course Type	**CORE**
Course Nature	**Hard**
L-T-P Structure	**(0-0-2)**
Credits	**1**

Course Outcome	Mapping
CO1: Illustrate the student conversant with commonly used mechanism for industrial application.	**Employability**
CO2: Analyze the velocity and acceleration of a mechanisms analytically and synthesis of problems.	**Employability**
CO3: Construct the cam profile and analyze effect of friction in different mechanisms.	**Employability**
CO4: Determine the static and dynamic forces for mechanical systems and flywheels.	**Employability**

LIST OF EXPERIMENTS:

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To study various type of cam and follower arrangements.
5. To plot follower displacement vs cam rotation for various Cam Follower systems.
6. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
7. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.
8. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
9. To study gyroscopic effects through models.
10. To determine gyroscopic couple on Motorized Gyroscope.
11. To perform the experiment for static balancing on static balancing machine.
12. To perform the experiment for dynamic balancing on dynamic balancing machine

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3	3										1	3
CO2	3	3	3		1								1	3
CO3	3	3	3		1								1	3
CO4	3	3	3		1								1	3

Course Title/Code	FLUID MECHANICS & MACHINES / MEH207B-T
Course Type	Core
Course Nature	Hard
L-T-P structure	3-1-0
Credit	4

Course Outcome	Mapping
CO1 :To Identify different fluid properties & Illustrate the types of flow & solve the problems based on continuity equation	Employability
CO2: To Analyse fluid flow problems with the application of the momentum equation and Distinguish between major & minor losses in pipes	Employability
CO3: To calculate efficiencies of various types of pumps and compare their performances	Employability
CO4: To calculate efficiencies of various types of turbines and compare their performances	Employability

SECTION A

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

SECTION B

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.

SECTION C

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps Reciprocating pump – working principle.

SECTION D

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of Turbines.

Text Books:

1- Bansal R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications

2. Hydraulics & Fluid Mechanics – Modi& Seth, Pub. - Standard Book House, N.Delhi

3. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons

Reference Books:

1. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill

2. Hydraulic Machines – Jagdish Lal, Metropolitan

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			2	2		2	2	2		3	3	2
CO2	3	3			2	2		2	2	2		3	3	2
CO3	3	3			2	2		2	2	2		3	3	2
CO4	3	3			2	2		2	2	2		3	3	2

Course Title/Code	FLUID MECHANICS & MACHINES LAB/ MEH207B-P
Course Type	Core
Course Nature	Hard
L-T-P structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1 :Calculate Fluid properties and losses in pipes	Employability
CO2: Characteristics of Pumps and turbines and evaluation of their performances	Employability
CO3: Calculate different parameters of Hydraulic Machines	Employability

List of Experiments:

1. To determine the coefficient of discharge of orifice meter
2. To determine the coefficient of discharge of venturimeter
3. To determine the coefficient of discharge, contraction and velocity of an orifice
4. To determine the friction factor for the pipes
5. To verify the Bernoulli's theorem
6. To determine the Meta centric height of a floating body
7. To explain the constructional detail of a Pelton wheel turbine and draw its fluid flow circuit
8. To explain the constructional detail of a Francis turbine and draw its fluid flow circuit
9. To explain the constructional detail of a Kaplan turbine and draw its fluid flow circuit
10. To explain the constructional detail of a Centrifugal pump and draw its characteristics curves
11. To explain the constructional detail of a Reciprocating pump and draw its characteristics curves
12. To explain the working and constructional detail of Hydro power plant and draw its layout

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3			2	2		2	2	2		3	3	2
CO2	3	3			2	2		2	2	2		3	3	2
CO3	3	3			2	2		2	2	2		3	3	2

Course Title/ Code	Law Relating to Intellectual Property Rights / LWS325
Course Type	ELECTIVE
Course Nature	SOFT
L-T-P Structure	1-0-2
Credit	2

Course Outcomes (COs)		Mapping
1	Describe the basics of Intellectual Property Rights	Employability/Skill Development
2	Categorize different types of intellectual properties	Employability/Skill Development
3	Recognize the crucial role of intellectual property in different industries	Employability/Skill Development
4	Explain the procedural aspect pertaining to application and grant of patent, trademark, geographical indication etc	Employability/Skill Development

SECTION A

The Concept of patents: objective of patents, theories of patent protection: economic and moral justifications for patent, Historical development of patent law in India, International instruments dealing with patent protection: Paris Convention for Protection of Industrial Property, Patent Cooperation Treaty (PCT) , TRIPS Agreement Budapest Treaty for Microorganisms.

SECTION B

Patentable Subject matter, Patentability of Computer Programs, Algorithms and Mathematical Formulae, Pharmaceutical Patent, Patentability of diagnostic method, Patentability of Traditional Knowledge

Cases: Novartis A.G. v. Union Of India & Others, AIR 2012, Diamond V. Chakrabarty (447 U.S. 303 (1980). Criteria for patent: novelty, inventive step, and industrial application.

SECTION C

Procedure for filing of patents: national filing , International filing of patents: PCT ,Revocation of patents , Opposition to patents

SECTION D

Infringement of patents, Remedies for infringement of patents, Exceptions/defenses to infringement of patents, Licensing of patents: basics, and statutory provisions, Traditional Knowledge: Meaning and basics, Traditional Knowledge Digital Library (TKDL), interaction with patent law, case studies on TK: patenting of turmeric, neem, and basmati rice.

Tutorial Exercises (2 hours per week)

1. Drafting exercises on patent drafting and filing 2. Drafting exercises on licensing of patents.

TEXT BOOKS & REFERENCES:

1. B.L. Wadhera, B.L. Wadhera, Law Relating to Intellectual Property, Universal Publishing Company, 5th Edition.
2. Narayanan, P., Patent Law (Kolkata: Eastern Law House, 1998.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	2	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	1	-	-	-	-	-	-		-	-	-	-	3
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	1

Course Title/ Code	CYBER LAWS / LWS323
Course Type	ELECTIVE
Course Nature	SOFT
L-T-P Structure	1-0-2
Credit	2

Course Outcomes (COs)	Mapping
Describe the concept of Cyber crimes and cyber Law	Employability/Skill Development
Critically analyses the problems arising out of online transactions and find solutions	Employability/Skill Development
Analyze Intellectual Property issues in the cyber space and apply relevant laws to protect or fight infringement	Employability/Skill Development
Explain Information Technology Act 2000 and critically analyze various sections to apply such laws appropriately	Employability/Skill Development

SECTION A

Introduction: Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level

SECTION B

Cyber Crimes & Legal Framework: Cyber Crimes against Individuals, Institution and State, Hacking: Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud Cyber Terrorism, Different offences under IT Act, 2000

SECTION C

Digital signature and Electronic Signature and Data Protection , Concept of public key and private key, Certification authorities and their role, Creation and authentication of digital signature, Concept of electronic signature certificates, electronic records and electronic signatures.

SECTION D

E Contracting: Salient features of E-contract, Formation of E-contract and types: E-mail Contracting, Indian Approach on E-contracts, E-commerce: Salient Features and advantages, Models of E-commerce.

TEXT BOOKS & REFERENCES:

1. Vishwanathan Suresh T., "The Indian Cyber Law" Second Edition 2001:- Bharat Law House.
2. Prasad T.V.R. Satya, : "Law Relating to Information Technology (Cyber Laws)" 1st edition 2001:- Asia Law House.
3. Syed Shakil Ahmed and Reheja Rajiv, " A Guide to Information Technology" (Cyber Laws & Ecommerce) Edition 2001:- Capital Law House.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	2	-	-	1	-	3		
CO2	3	2	-	-	-	-	-	-	2	-	-	1		
CO3	3	1	2	-	-	-	-	1	-	-		2		
CO4	3	1	-	-	-	-	-	-	-	-	-	3		

Course Title/ Code	**RESEARCH & INNOVATION-I / RDO502**
Course Type:	**Research Type**
Course Nature:	Hard
L-T-P Structure	(0-0-1)
Credits	0.5

Course Outcome		**Mapping**
CO1	**Describe the work done by various researchers relevant to the research topic**	**Skill Development**
CO2	**Compare the relevant theory and practices followed in a logical way and draw appropriate conclusions**	**Skill Development**
CO3	**Describe the research methodologies/approaches/techniques used in the literature**	**Skill Development**
CO4	**Create a research article based on collected information or findings through an appropriate abstract, headings, reference citations and smooth transitions between sections**	**Skill Development**

Section A

Unit-1 Literature Survey (LS)/Design of Experiment

1.1 Collection of research papers related to previously identified gap/problem (15 papers or more)

1.2 Comprehend and arrange the literature based on the idea framed

1.3 Presenting the collected data and inferring it with the further scope of expansion and Designing the experiment wherever applicable.

Section B

Unit-2 Structuring of Review Paper and setting up of experimental facility

2.1 Analysis of different approach/methodology adopted by various researchers

2.2 Listing out the components of the paper/ setting up experimental facility w.r.t the problem
2.3 Identification of suitable Journal or Conference
2.4 Formatting/Styling the paper according to the respective template
Section C
Unit-3 Departmental Presentation in the Mid Term Exam
3.1 Structuring and preparation of PPT
3.2 Mock presentation
3.3 Review on presentation skills and content delivered both
3.4 Incorporating the review comments in the slides

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	3
CO2	3	2	2	1	2	2	-	-	-	-	-	-	3	3
CO3	3	2	2	1	2	-	-	-	-	-	-	-	3	3
CO4	3		2	1	1	-	2	-	-	3	-	2	3	3

Course Title/Code	**SPANISH-II (FLS105)**	
Course Type	**Elective**	
L-T-P Structure	**1-1-0**	
Credits	**0**	
Course Outcomes (COs)		**Mapping**
1	**Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.**	**Employability, Skill Development**
2	**.Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed.**	**Employability, Skill Development**
3	**Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.**	**Employability, Skill Development**
4	**Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic**	**Employability, Skill Development**

	information about familiar situations and topics of interest.	
5	**Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the Spanish-speaking world and the student's native culture.**	**Employability, Skill Development**
6	**Describe various places, location, themselves using simple sentences and vocabulary.**	**Employability, Skill Development**

SECTION-A

Unit 1- Mi famila

1.1 Describe your family

1.2 Adjectives to describe a person

1.3 Short essay on family & friend

Unit 2- Gustar

2.1 Likes and dislikes

2.2 Conjugation

2.3 Comprehension

SECTION-B

Unit 3- Verbos Irregulares y reflexivos

3.1 Conjugation

3.2 Routina diaria

3.3 Sentence formation

SECTION-C

Unit 4- El horario

4.1 Timings

4.2 Colours

Unit 5- Estar+gerundio

5.1 Conjugation

5.2 Prepositions

5.3Picture description

SECTION-D

Unit 6- Ser y estar

6.1 Direction

6.2 Comprehension

Text Books/Reference Books:

1. ¡Ole!-Langers
2. ¡Uno, dos, tres……

Weblinks:

http://studyspanish.com/

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO5	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO6	2	3	3	2	-	-	2	-	-	2	-	2	2	2

Course Title/Code	GERMAN-II (FLS106)	
Course Type	Elective	
L-T-P Structure	1-1-0	
Credits	0	
Course Outcomes (COs)		Mapping
1	Students will be able to write short essays on family and friends.	Employability, Skill Development
2	They will have knowledge of tenses.	Employability, Skill Development
3	Students will be able to identify classroom vocabulary in the German language	Employability, Skill Development
4	Students will be able to speak ordinal and cardinal numbers and they will also learn months, days in German	Employability, Skill Development
5	They will be able to express or/and justify opinions using equivalents of different verbs	Employability, Skill Development
6	They will be able to express or/and justify opinions using equivalents of different verbs.	Employability, Skill Development

MECHANICAL ENGINEERING

SECTION-A

Unit 1

1.1 Ordinal & Cardinal numbers

1.2 Months, days, Feiertage and dates

SECTION-B

Unit 2

2.1 Verbs: to be and to have

2.2 helping verbs practice worksheets

2.3 Vocabulary (Family) short essay on family, friends etc.

SECTION-C

Unit 3

3.1 Vocabulary (classroom)

3.2 Definite and indefinite articles

SECTION-D

Unit 4

4.1 Countries, languages, directions

4.2 Past of the verb 'to be'

Text Books/Reference Books:

1. Rita Maria Niemann, Cornelsen, 2005, Studio d A1: Deutsch als Fremdsprache, Volume 6
2. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch als Fremdsprache Tangram aktuell 1 - Lektion 1-4: Deutsch als. (Hueber Verlag, 2005).
3. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch als Fremdsprache Tangram aktuell 1 - Lektion 5-8: Deutsch als. (Hueber Verlag, 2005)
4. Paul Rusch, 2015: Langenscheidt and Klett

Weblinks:

http://www.nthuleen.com/

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO5	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO6	2	3	3	2	-	-	2	-	-	2	-	2	2	2

Course Title/Code	**FRENCH-II (FLS107)**	
Course Type	**Elective**	
L-T-P Structure	**1-1-0**	
Credits	**0**	
Course Outcomes (COs)		**Mapping**
1	**Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.**	**Employability, Skill Development**
2	**Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed.**	**Employability, Skill Development**
3	**Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.**	**Employability, Skill Development**
4	**Describe themselves, other people, familiar places and objects in short discourse using simple sentences and**	**Employability, Skill Development**

	basic vocabulary. Provide basic information about familiar situations and topics of interest.	
5	**Express Gorand justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.**	**Employability, Skill Development**
6	**Describe various places, location, themselves using simple sentences and vocabulary.**	**Employability, Skill Development**

SECTION-A

Unit 1- Se présenter (1)

1.1 Les pluriels

1.2 Adjectives to describe a person

Unit 2- Se présenter (2)

2.1 Professions

2.2 Short essay on family & friend

2.3 Comprehension

SECTION-B

Unit 3- Parler de ses habitudes quotidiennes

3.1 Les verbes pronominaux

3.2 Décrivez votre journée

SECTION-C

Unit 4- Nommez et localiser des lieux dans la ville

4.1 Prepositions

4.2 Asking & telling the way

Unit 5- Informations simples sur le climat, la météo

5.1 Les saisons

5.2 Les expressions de la saison

5.3 Comprehension

SECTION-D

Unit 6- Demander/ indiquer les horaires et les couleurs

6.1 Timings

6.2 Colours

Text Books/Reference Books/ Suggested Readings:

1. Alter Ego Level One Textbook, Annie Berthet, Catherine Hugot, Veronique M Kizirian,Hachette Publications
2. Apprenons Le Francais II & III, Mahitha Ranjit, 2017, Saraswati Publications

Weblinks:

www.bonjourfrance.com

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO5	2	3	3	2	-	-	2	-	-	2	-	2	2	2
CO6	2	3	3	2	-	-	2	-	-	2	-	2	2	2

Course Title/Code	**PROFESSIONAL COMPETENCY ENHANCEMENT-II (CDO202)**	
Course Type	**Soft**	
L-T-P Structure	**0-0-1**	
Credits	**0.5**	
Course Outcomes (COs)		**Mapping**
1	**To improve students basic knowledge about Arithmetic Aptitude**	**Employability, Skill Development**
2	**To make students solve aptitude problems quickly utilizing the short cuts**	**Employability**
3	**To make students have the ability to 'quickly think on their feet'**	**Employability, Skill Development**
4	**To strengthen students communication skills**	**Employability**

Section A – Quantitative Aptitude

Unit 1: Arithmetic I

.1 Simplification

1.1.1 Use of BODMAS rule and Formulas for solving equations.

1.1.2 Simple Fractions and Decimal Fractions.

1.1.3 Surds and Indices.

1.2 Ratio and Proportion

1.2.1 Changes in Ratios, Combined Ratio and Continued Proportion.

1.2.2 Application in different questions.

1.2.3 Variations and Partnership.

1.3 Percentage

1.3.1 Basic Conversion, Consumption & Expenditure, Successive changes and Errors.
1.3.2 Application in Areas and Volumes.
1.4 Profit and Loss
1.4.1 Sales and Purchase Transactions.
1.4.2 MRP and Discount, Equivalent discounts.
1.4.3 Errors in weight (Dishonest Dealer).
1.5 Average
1.5.1 Combined and Mistaken Averages.
1.5.2 Changes in Average.
1.5.3 Application in Cricket and others.
1.5.4 Practice Exercise.
1.6 Interest
1.6.1 Simple and Compound Interest Formulae.
1.6.2 Relations and their Applications.
1.6.3 Practice Exercise.
Unit 2: Arithmetic II
2.1 Time and work
2.1.1 Combined work, Work & Wages, Work & Efficiency.
2.1.2 Working Alternatively, Work and Equations.
2.1.3 Pipes and Cisterns, Inlet and Outlet pipes, Capacity of Tank and Leakage.
2.2 Alligations & Mixtures
2.2.1 Formula Based
2.2.2 Successive Displacement
2.2.3 Mixtures
2.2.4 Error in Measurement
2.2.5 Profit on False Weight
2.3 Revision & Practice
2.3.1 Problems on Ages & Numbers
2.3.2 Calendar
2.3.3 Coding & Decoding
2.3.4 Data Sufficiency

Section B – Verbal Ability Test

Unit 3. Communication Skills in English

1.1 Relevance of Verbal Ability AND PREPARATORY GUIDELINES
1.2 Functional Grammar – Subject Verb Agreement
1.3 Tenses – Perfect, Simple , Continuous
1.4 Common Errors and rectification

Unit 4: Word Power Building Skills

2.1 Words: Antonyms, Synonyms, Analogies,
2.2 Compound words: Homophones, Homonyms, Word Families
2.3 Root Word Technique for Prefixes & Suffixes
2.4: Word Power: 7 Tips for Learning New Words
2.5 Practice Vocabulary Exercises

Section C

Unit 5: Writing Skills

3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing
3.2 Sentences, Phrases, Types of Sentences, Parts of Sentences
3.3 Paragraph Writing: Construction, Linkage & Cohesion
3.4 Practice Exercises: Writing Skills

Section D

Unit 6: Reading Skills

4.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading
4.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed
4.2 Practice Exercises: Short & Medium Passages

Text Books/Reference Books:

1. Quantitative Aptitude : R S Aggarwal, S Chand & Company Pvt Ltd
2. Quantitative Aptitude for CAT: Arun Sharma
3. Verbal Ability and Reading Comprehension: MVN Enterprises

Web links:

http://www.indiabix.com/aptitude/questions-and-answers/
http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	2	2	-	2	-	2
CO2	3	2	3	2	-	-	-	2	2	3	-	2	3	1
CO3	3	3	2	2	-	-	-	2	-	3	2	2	-	1
CO4	2	3	3	2	-	-	2	-	-	2	-	2	2	2

MECHANICAL ENGINEERING

Course Title/Code	Summer Training Post 4th Semester / MEO208B
Course Type	Core
Course Nature	Hard
Credit	2

Course Outcome	Mapping
CO1: Apply Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals in the industry	Employability
CO2: Understand possible opportunities to learn, understand and sharpen the real time technical/managerial skills required at the job.	Employability
CO3: Apply the current technological developments relevant to the subject area of training.	Employability
CO4: Apply the experience gained from the 'Industrial Internship' in discussions held in the classrooms.	Employability

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	1	1	1				1	3	3	1	3	1	1
CO2	1	1	1	1				1	3	3	1	3	1	1
CO3	1	1	1	1				1	3	3	1	3	1	1
CO4	1	1	1	1				1	2	3	1	3	1	1

MECHANICAL ENGINEERING

SEMESTER 5

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/NTCC)	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
MEH301B-T/P	MANUFACTURING TECHNOLOGY	ME	SOFT	CORE	3	0	2	0	5	4
MEH302B	MACHINE DESIGN-I	ME	HARD	CORE	3	1	0	0	4	4
MEH303B-T/P	HEAT TRANSFER	ME	HARD	CORE	3	1	2	0	6	5
MEH304B-T/P	INTERNAL COMBUSTION ENGINE & GAS TURBINES	ME	HARD	CORE	3	1	2	0	6	5
MEH305B/MEH306B/MEH307B/MEH308B-T/P	ROBOTICS/STRENGTH OF MATERIALS-II/TOOL ENGINEERING DESIGN/PRODUCT DESIGN & DEVELOPMENT	ME	HARD	CORE	3	0	2	0	5	4
CHS234/CSS325/ECS306B	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/GREEN COMPUTING/E-WASTE MANAGEMENT	CH/CS/ECE	SOFT	ELECTIVE	1	0	2	0	3	2
EDS240	ESSENCE OF TRADITIONAL KNOWLEDGE	ED	AUDIT	CORE	1	0	2	0	3	0
CDO301	PROFESSIONAL COMPETENCY ENHANCEMENT-III	CDC	OUTCOME BASED	CORE	0	0	0	1	1	0.5
RDO601	**RESEARCH INNOVATION-II**	RESEARCH	OUTCOME BASED	CORE	0	0	0	1	1	0.5
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					17	2	10	2	31	25

Course Title/ Code	MANUFACTURING TECHNOLOGY/ MEH301B-T
Course Type	CORE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Analyze and selection of various types and allowances of pattern used in casting process	Employability
CO2: Understand the phenomenon of arc, gas and solid-state welding	Employability
CO3: Analyze the principle and concept of metal forming and sheet metal processes	Employability
CO4: Explain principle and applications of advanced machining processes	Employability

Section-A

Metal Casting Process: Introduction, Foundry: Introduction to Casting Processes, Basic Steps in Casting Processes. Pattern: Types of Pattern and Allowances. Sand Casting: Sand Properties, Constituents and Preparation. Mould & Core making with assembly and its Types. Gating System. Melting of Metal, Furnaces and Cupola, Metal Pouring, Fettling. Casting Treatment, Inspection and Quality Control, Sand Casting Defects & Remedies.

Section-B

Welding: Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG & MIG Welding, Submerged arc welding (SAW), resistance welding principles, electrode types and selection, thermit welding, electro slag welding, electron beam welding, laser beam welding, forge welding, friction welding, Welding Defects and remedies, brazing & soldering.

Section-C

Forming Processes: Basic Principle of Hot & Cold Working, Hot & Cold Working Processes, Rolling, Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, Impact extrusion, Hydrostatic extrusion.

Sheet metal forming: Spring back effect, Stamping, Blanking, Bending, Drawing, Piercing, Coining, Embossing, Stretch forming, Hot and cold spinning. Special forming: Hydro forming, High energy rate forming, Drawing, Wire Drawing and Spinning.

Forging: Principles of forging, Tools and dies, Types: Smith forging, Drop Forging, Forging hammers, Rotary forging, forging defects.

Section-D

Unconventional Machining Processes: Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro-chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications. Introduction to 3D Printing & its applications.

Text Books

1. Manufacturing Technology – Vol. - 2, P.N. Rao, T.M.H, New Delhi
2. Computer Aided Manufacturing: S Kumar & B Kant Khan, SatyaPrakashan, New Delhi

Reference Books

1. Principles of Machine Tools – G.C. Sen& A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg. & Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey& H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand& Sons.
5. Production Engineering by KC Jain & AK Chilate, PHI, New Delhi

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3			2			1	1				3		2
CO2	3			2			1	1				3		2
CO3	3			2			1	1				3		2
CO4	3			2			1	1				3		2

Course Title/ Code	MANUFACTURING TECHNOLOGY LAB/ MEH301B-P
Course Type	CORE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects	Employability/Skill Development
CO2: Select appropriate Joining Processes to join the Work piece.	Employability/Skill Development
CO3: Design different sheet metal working processes	Employability/Skill Development

LIST OF EXPERIMENTS:

1. Analysis of flat rolling for an aluminum sheet
2. To study the effects of material properties (ductility, types, strength) on the bend radius, spring-back and bending force.
3. To study Heat flow in Welding (Equipment for use-Gas Welding equipment)
4. To study Bead Geometry, Hardness of Bead, Micro structure of welding Bead in case of: i). MIG Welding
   ii). SAW Welding
   iii). FCAW Welding (By changing electrode diameter & carriage speed)
5. Prepare mould and measure of mould hardness by mould hardness tester and Measure fluidity of casting metals
6. Part Programming and Proving for Milling a Rectangular Slot

7. Electrical Discharge Machining (EDM): Measurement of MRR, TWR and surface finish 8. Ultrasonic Machining (USM): Measurement of MRR, TWR and surface finish

Text Books

1. Manufacturing Technology – Vol. - 2, P.N. Rao, T.M.H, New Delhi
2. Computer Aided Manufacturing: S Kumar & B Kant Khan, SatyaPrakashan, New Delhi

Reference Books

1. Principles of Machine Tools – G.C. Sen& A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg. & Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey& H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand& Sons.
5. Production Engineering by KC Jain & AK Chilate, PHI, New Delhi

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	1			2				2			3		3
CO2	3	1			2				2			3		2
CO3	3	1			2				2			3		2

Course Title/ Code	**MACHINE DESIGN-I/ MEH302B**
Course Type	**CORE**
Course Nature	**HARD**
L-T-P Structure	**3-1-0**
Credit	**4**

Course Outcome	Mapping
CO1: Understand and identify the failure modes for mechanical parts.	**Employability**
CO2: Design shafts to withstand the loads and deformations for a given conditions.	**Employability**
CO3: Design bolted, riveted and welded joints to withstand the loads and deformations for a given application.	**Employability**
CO4: Analyze design considerations for different types of clutches, brakes and pulleys.	**Employability**

SECTION A

Introduction: Types of design, General considerations and procedures of machine design, Types of loading, selection of materials and its designation, Design stress & factor of safety, selection of FOS. Application of theories of failure to design, tolerance, fits & limits.

Design for fatigue strength; S-N diagrams, Low & High Cycle fatigue, Endurance limit modifying factors, Fatigue strength under fluctuating stresses, Cumulative damage, surface strength.

SECTION B

Design of solid and hollow shafts subjected to torsion, bending and axial load for strength and stiffness. Shafts subjected to dynamic loading .Design of Keys, Spines, pins, cutters and shaft couplings.

SECTION C

Design of Screws, bolts and their types, bolted joints including eccentrically loaded joint, riveted joint, welded joint, welded joint in eccentrically loaded condition, welded joint in cylindrically vessels and power screws.

SECTION D

Belt Drives: flat and V-belt drives, effect of centrifugal tension, initial tension, maximum power, Design of flat and V-belt, design of ropes. Description of Clutches and Brakes, Performance Parameters, design & characteristics of clutches & brakes.

TEXT BOOK & REFERENCE BOOK:

1. Sharma & Aggarwal, Machine Design, Kataria Publications.
2. V. B Bhandari: Design of Machine Elements, McGraw Hill
3. Joseph E. Shigley; Mechanical Engineering Design, McGraw Hill.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	-	-	-	-	-	-	- -	-	-		2	-
CO2	2	2	3	-	-	-	-	-	-	-	-		2	-
CO3	2	2	3	-	-	-	-	-	-	-	-		2	-
CO4	2	2	3	-	-	-	-	-	-	-	-		2	-

Course Title/ Code	**HEAT TRANSFER/ MEH303B-T**
Course Type	**CORE**
Course Nature	**HARD**
L-T-P Structure	**3-1-0**
Credit	**4**

Course Outcome	Mapping
CO1: Explain the basic modes and laws of heat transfer.	**Employability**
CO2: Develop and analyze general conduction equations in Cartesian, cylindrical and spherical coordinates.	**Employability**
CO3: Develop and analyze temperature distribution and heat dissipation rate equations for different types of fins.	**Employability**
CO4: Illustrate the concept of free and forced convection and discuss the dimensional analysis.	**Employability**
CO5: Classify the concept of boundary layer and develop the related equations.	**Employability**
CO6: Summarize the laws of thermal radiation and the concept of black body.	**Employability**

SECTION A

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

SECTION B

Heat convection,basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

SECTION C

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

SECTION D

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve Introduction mass transfer, Similarity between heat and mass transfer

Text Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2												
CO2	3	3	2	3									2	
CO3	3	3	2	3										
CO4	3	3		2									2	
CO5	3	3												
CO6	3	2												

Course Title/ Code	HEAT TRANSFER LAB/ MEH303B-P
Course Type	CORE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Design and conduct experiments, acquire data, analyze and interpret data	Employability
CO2: Measure the thermal conductivity of metal rod, insulating material and liquids.	Employability
CO3: Understand the concept of composite wall and determine its thermal resistance.	Employability
CO4: Plot the temperature profile in free and forced convection.	Employability
CO5: Measure the performance of a heat exchanger.	Employability
CO6: Understand the concept of solar heating and measure the performance of solar equipment.	Employability

LIST OF EXPERIMENTS:

1. To analyze the Heat Transfer from a Pin-Fin Apparatus
2. To analyze the Heat Transfer through Composite Wall.
3. To determine the Critical Heat Flux
4. To measure the emissivity using Emissivity Measurement Apparatus.
5. To analyze the Heat Transfer through the Lagged Pipe.
6. To determine the Thermal Conductivity of Insulating Powder.
7. To determine the Thermal Conductivity of Metal Rod
8. To analyze the Heat Transfer in Natural Convection.
9. To explain the Parallel Flow / Counter Flow Heat Exchanger
10. To determine the Heat Transfer in Forced Convection.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2	3	3					3	2				
CO2	3	2							3	3				
CO3	3	2							2	3				
CO4	3	3							3	2				
CO5	3	3							2	3				
CO6	3	2							2	3				3

Course Title/ Code	INTERNAL COMBUSTION ENGINES & GAS TURBINES/ MEH304B-T
Course Type	CORE
Course Nature	HARD
L-T-P Structure	3-1-0
Credit	4

Course Outcome	Mapping
CO1: Discuss the operating characteristics, performance measurement and thermodynamic analysis of common internal combustion engine cycles through evaluation.	Employability/Skill Development
CO2: Analyze the combustion process of common fuels and interpret their side effect on human being	Employability/Skill Development
CO3: Demonstrate knowledge of modern development and enhancement in IC engine with their application	Employability
CO4: Evaluate gas turbine performance through the use of accessories to improve their efficiency.	Employability/Skill Development

SECTION-A

Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

SECTION-B

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

Combustion in I.C. Engines: S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

SECTION-C

Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

SECTION-D

Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems.

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	2	1	1	2							2	2	1
CO2	1	3			2							2	2	
CO3		3					2					3	2	
CO4	1	3	2				2					3	2	

Course Title/ Code	INTERNAL COMBUSTION ENGINES & GAS TURBINES LAB/ MEH304B-P
Course Type	CORE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: To calculate performance of Internal combustion engine	Skill Development
CO2: To draw and analyses of performance characteristics curves	Employability/Skill Development
CO3: To Prepare Heat Balance sheet for IC Engines	Skill Development

LIST OF EXPERIMENTS:

1. I.C. Engine valve timing diagram
2. I.C. Engine port timing diagram
3. I.C. Engine performance test on single cylinder 4 stroke diesel engine
4. Performance test on single cylinder 2 – stroke petrol engine
5. Morse test on 4 - cylinder 4 - stroke petrol engine
6. Evaluation of engine friction by conducting motoring/retardation test on single cylinder 4 stroke diesel engine
7. Heat balance test on single cylinder 4 stroke diesel engine.
8. Determination of air/fuel ratio and volumetric efficiency on 4-stroke diesel engine
9. Disassembly /assembly of I.C. engine

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

CO-PO Mapping

Course Outcomes	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
CO1	2	3	2		2	2							2	1
CO2	1	3				2						3		
CO3	2	3				2								

Course Title/ Code	**ROBOTICS / MEH305B-T**
Course Type	**ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**3-0-0**
Credit	**3**

Course Outcome	Mapping
CO1: Students will have the ability to describe different types of robot configurations, mechanisms and transmission.	**Employability**
CO2: Students will have the ability to apply the concept of homogeneous transformation matrices and inverse Kinematics in Robotics.	**Employability**
CO3: Students will have the ability of dynamic analysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots.	**Employability**
CO4: Students will have the ability to select Sensors and controllers for robotic applications.	**Employability**

SECTION-A

Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

SECTION-B

Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.

Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, and Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks.

SECTION-C

Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots, , Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, Computed torque control, force control, hybrid control.

SECTION-D

Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder. Robot vision: image processing fundamentals With effect from 2015 - 16 for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features

Text Books:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
4. Harry Asada & Slottine "Robot Analysis& Control" , Wiley Publications, 2014
5. S K Saha, "introduction to Robotics ", 2 nd edition, TMH, 2013

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2	3					1					2	3
CO2	1	2	3					1					1	2
CO3	1	3	3					2					2	
CO4	1	3	3		1								2	

Course Title/ Code	**ROBOTICS LAB/ MEH305B-P**
Course Type	**ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**0-0-2**
Credit	**1**

Course Outcome	**Mapping**
CO1: Outline the fundamentals of robotics and its components.	**Employability**
CO2: Solve the forward and inverse kinematics problems of robotics.	**Employability**
CO3: Outline the various trajectory planning algorithms and control techniques.	**Employability**
CO4: Solve the forward and inverse dynamics problems of robotics.	**Employability**

List of experiment:

1. To study components of a real robot and its DH parameters.
2. To study forward kinematics and validate using a software (Robo analyser)
3. To study inverse kinematics of a real robot and validation using any software
4. Use of open source computer vision programming tool open CV
5. To perform image processing using open CV
6. To perform image processing for share/color detection
7. To perform positioning and orientation of robot arm.
8. To perform control experiment using available hardware and software.
9. To perform integration of assorted sensors (IR, potentiometer, strain gages etc.) in a robotic system
10. Project work

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3	3										1	3
CO2	3	3	3		1								1	3
CO3	3	3	3		1								1	3
CO4	3	3	3		1								1	3

Course Title/ Code	STRENGTH OF MATERIALS-II / MEH306B-T
Course Type	Elective
Course Nature	Hard
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Understand theories of failure and design components for safe operation.	Employability
CO2: Perform thin wall pressure vessel design calculations .	Employability
CO3: Analyze the bending stress in different section.	Employability
CO4: Analyze the hoop and radial stresses in rotating disc	Employability

SECTION A

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2-dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numerical.

SECTION B

Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numerical. Thin Walled Vessels: Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire would cylinders, Numerical.

SECTION C

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castiglione's theorem stresses in simple chain link, deflection of simple chain links, Theories of Failures. Numerical.

SECTION D

Thick Cylinders & Spheres: Derivation of Lame's equations, radial & hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numerical.

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength

Stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders

TEXT BOOKS & REFERENCES:

1. Strength of Materials- GH Ryder

2. Vibration and Control- SS Rao

CO PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	2	-	-	-	- -	-	-	-	-	3
CO2	3	1	2	1	2	-	-	-	-	-	-	-	-	3
CO3	3	1	2	1	2	-	-	-	-	-	-	-	-	3
CO4	3	1	2	1	2	-	-	-	-	-	-	-	-	3

Course Title/ Code	STRENGTH OF MATERIALS-II LAB / MEH306B-P
Course Type	Elective
Course Nature	Hard
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Analyze thin & Thick wall pressure vessel.	Employability
CO2: Analyze the bending stress in different section.	Employability
CO3: Analyze the hoop and radial stresses in rotating disc.	Employability

LIST OF EXPERIMENTS

Experiment One, Thin pressure vessel
Experiment Two, Thick pressure vessel
Experiment Three, Bending stress in different sections
Experiment Four, hoop stress in radial disc
Experiment Five, Radial stress in radial disc

TEXT BOOKS & REFERENCES:

1. Strength of Materials- GH Ryder
2. Vibration and Control- SS Rao

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO2	3	1	2	1	2	-	-	-	-	-	-	-	-	3
CO3	3	1	2	1	2	-	-	-	-	-	-	-	-	3
CO4	3	1	2	1	2	-	-	-	-	-	-	-	-	3

Course Title/ Code	TOOL ENGINEERING DESIGN / MEH307B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Calculate the forces and stresses in tools.	Employability/Skill Development/Entrepreneurship
CO2: Classify the different types of tools in Industry.	Employability/Skill Development/Entrepreneurship
CO3: Justify the materials of various components of tools.	Employability/Skill Development/Entrepreneurship
CO4: Design the different types of tools in Industry.	Employability/Skill Development/Entrepreneurship

SECTION-A

Introduction: Tool design practice, procedure of tool design, process planning and tool design

Mechanics of Machining: Place of machine in production , classification of material removal processes, orthogonal and oblique cutting, merchant's circle diagram-force and velocity relationship, types of cutting tool mechanics, their characteristics and selection criteria, mechanics of metal cutting-effect of tool-geometry and other cutting parameters, mechanisms of formation of chips-types of chips formed, concept of specific cutting pressure, types of tool wear, Factors causing wear, tool life, variables affecting tool life, economical cutting speed, machinability of metals, economics of machining

SECTION-B

Thermal Aspects in Machining: Sources of heat generation in machining and its effects, temperature measurement techniques in machining, types of cutting fluids, Functions of cutting fluid, Characteristics of cutting fluid, Application of cutting fluids.

Design of Single Point Cutting Tools: Tool geometry for single point cutting tool, tool signature , Design of single point cutting tools such as solid tools , tipped tools, coated tipped tools, throw away type tools and diamond tools.

SECTION-C

Design of Multipoint Tools: Design of milling cutters, gear milling cutters, hobs gear shaping tools, broaches, drills, reamers, taps & dies for thread cutting, boring tools, flat form tools, circular form tools. Standard tool holders & standard tooling and their design for turrets and automates.
Cutting Tool Materials: Types of cutting tool materials, their selection and Applications.

SECTION-D

Design of Press Tools: Introduction to press tools and related terminology, effect of clearances, theory of deformation, stages of cutting operation, center of pressure, strap strip layout , die and punch design, design of simple, compound and progressive dies, methods of mounting punches and dies, design of drawing dies, bend allowances, bending and forming dies, Dies for diecasting and forging operations.

Jigs and Fixture: Essential requirements of jigs & fixtures, economics of jigs and fixtures, principles of location and clamping, location and clamping devices, types of drill bushes, types of jigs and fixtures- such as fixtures for milling, welding, heat treatment, grinding, assembly and inspection processes; standardization in jigs and fixtures, principle of work holders, common work holders for production like vises, chucks, arbors, mandrels & collets.

Text Books

- Ostergaard, “Basic Die Making”, MGH, New York, 1993.
- P.H. Joshi, “Press Tool Design and Construction”, Wheeler Publishing, Delhi, 2000.
- R.J.W. Pye, “Injection Mould Design”, Affiliated East West Press, Delhi, 2000.

Reference Books

- Joshi, “Machine Tools Handbook : Design and Operation”, McGraw Hill, 2008
- J.R.Paquin, Die Design Fundamental", Industrial Press, Inc. New York, NY, USA, 2005
- Vukota Boljanovic,"Sheet Metal Stamping Dies: Die Design and Die-Making Practice", Industrial Press, Inc. New York, NY, USA
- Oehler, “Hydrualic Presses”, Arnold Press, 1968.
- Ghosh and Mallik,”Manufacturing Science”, East West Publications.
- Rosato, “Injection Molding HandBook”, CBS Publishers, Delhi, 1987.
- Irvin I Rubin, “Injection Moulding Theory & Practice”, John Willey, 1972.

CO-PO Mapping

Course Outcomes	Program Outcomes (POs)												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO2	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO3	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO4	1	-	3	-	1	-	-	-	1	2	1	-	1	2

Course Title/ Code	**TOOL ENGINEERING DESIGN LAB/ MEH307B-P**
Course Type	**ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**0-0-2**
Credit	**1**

Course Outcome	Mapping
CO1: Design of a Punching Tool	**Employability/Skill Development/Entrepreneurship**
CO2: Manufacturing of a Punching Tool	**Employability/Skill Development/Entrepreneurship**
CO3: Design of a Blanking Tool	**Employability/Skill Development/Entrepreneurship**
CO4: Manufacturing of a Blanking Tool	**Employability/Skill Development/Entrepreneurship**

List of Experiments

1. Design of Blanking Die with fixed stripper having lower plan view, upper plan view given any blank shape.
2. Sections of assembly of Blanking Die with fixed stripper for given blank shape
3. Design of Piercing Die having lower plan view, upper plan view given any piercing shape component.
4. Design of 'V' Bending Die having lower plan view, upper plan view given any V shape bend component.
5. Sections, Detailing, Ballooning and BOM of the same V Bending Die
6. Design of 'U' Bending Die having lower plan view, upper plan view, section given any U shape bend component BOM of the parts.
7. Design of Two Plate Mould
8. Study the working principle of ejector plate assembly
9. Study and design the layout of gate and runner balancing
10. Design of Drill Jig

11. Design of Milling Fixture
12. Design of Plug and Ring Gauges

CO-PO Mapping

	Program Outcomes (POs)												PSO1	PSO2
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
CO1	**2**	**3**		**2**	**3**	**2**		**3**		**2**		**3**	**2**	**3**
CO2	**3**			**3**		**3**	**2**	**2**	**3**		**3**	**2**	**2**	
CO3	**2**	**3**			**2**	**3**	**2**		**3**			**2**	**3**	**2**
CO4	**3**		**3**		**3**	**2**	**3**		**2**			**2**		**2**

Course Title/ Code	PRODUCT DESIGN & DEVELOPMENT / MEH308B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1 Knowledge of all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc	Employability/Skill Development
CO2: To create new product based on mechanical design engineering	Employability/Skill Development
CO3: Ability to solve open-ended problem belongs to design engineering that meet the requirements.	Employability
CO4: Ability to understand contemporary issues and their impact on provided solution	Employability/Skill Development

SECTION-A

Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis, Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function.

SECTION-B

Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies, Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design.

SECTION-C

DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc.

SECTION-D

Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS.

Text Books:

- Engineering Design , George E.Dieter, Fourth Edition, McGraw Hill
- Chitale, A K, Product Design & Manufacturing, 2013, 6th Edition, PHI publication, India

Reference Books/ Material :

- Dassault Systemes Companion Learning Space Material on Product Design
- Dassault Systemes Companion Learning Space Material on Function Generative Design
- Dassault Systemes Companion Learning Space Material on Virtual Ergonomics Simulation Fundamentals- Delmia Ergonomics at Work

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2		3	1	2		2					3	2	
CO2	2	3	2	2		2						2	1	
CO3	3	3	3	2	2							2	2	
CO4		3	2	3	2	2			1				2	1

Course Title/ Code	**PRODUCT DESIGN & DEVELOPMENT LAB/ MEH308B-P**
Course Type	**ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**0-0-2**
Credit	**1**

Course Outcome	Mapping
CO1: To study the types of design and engineering design process	**Skill Development**
CO2 To evaluate the any existing simple product through process selection criteria.	**Employability/Skill Development**
CO3: Apply different techniques for Product design	**Skill Development**

LIST OF EXPERIMENTS

1. Working principle and application – Brief note
2. Disassembly plan
3. Parts and function
4. Design concept
5. Product modules/assembly/sub assemblies
6. Functional decomposition
7. Geometrical layout
8. Product architecture
9. Design synthesis
10. Design embodiment
11. Include details of sub assemblies
12. Suggest an alternative design of the product for the same function

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2		3	3	2	2		3	3	2		2	2
CO2	2		3	2	2		2		3	3	2		3	3
CO3	3		2	3	3			2	3		2		2	3

Course Title/ Code	ENVIRONMENTAL ETHICS & SUSTAINABLE MANAGEMENT / CHS234
Course Type	CORE
Course Nature	SOFT
L-T-P Structure	1-0-2
Credit	2

CO	CO STATEMENT	Mapping
CO1	Develop an inter-disciplinary understanding of sustainable development concerns and challenges	Employability/Skill
CO2	Propose and implement sustainable solutions to environmental issues (grow oyster mushrooms, develop a composting bin)	Employability/Skill
CO3	Understand the concept of sustainability initiatives & sustainability reporting and defend, criticize or compare the sustainability initiatives adopted by different enterprises	Employability/Skill
CO4	Discuss the importance of contemporary issues like consumption, indigenous knowledge, gender issues, population in achieving sustainable development	Employability/Skill

SECTION A

Introduction to Sustainable Development: Definition of Sustainable Development; Triple Bottom Line, Components of TBL, Changing Perspective & Debates in Sustainable Development - Need for Sustainable Development, Evolution of the concept of Sustainable Development: Stockholm Conference, The Brundtland Commission, Earth Summit, Agenda 21; Millennium Development Goals

SECTION B

Challenges to Sustainable Development and Sustainable Development Goals (SDGs): Challenges to Sustainable Development - Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change Sustainable Development Goals (SDGs) - Introduction, Challenges to SDGs, Indian Scenario.

SECTION C

Sustainability Strategies & Reporting: Sustainability Strategies & Reporting - Introduction, Rationale and Mechanisms, Key Principles, Sustainability Strategies Adopted by Different Enterprises – Case Studies

SECTION D

Sustainable Development and Contemporary Issues: Sustainable Consumption, Indigenous Knowledge, Gender Issues, Population & Sustainable Agriculture, Sustainable Tourism.

TEXT BOOKS & REFERENCES:

1. Environmental Management for Sustainable Development; C.J. Barrow; Routledge Publishers Roberts, J.T., and Hite, A., 2000.

2. Modernization to Globalization - Perspectives on Development and Social Change, Blackwell Publishing. 3. Sachs, J., 2004, Stages of Development, Speech at the Chinese Academy of Arts and Sciences

LIST OF EXPERIMENTS:

1. Survey- Business and non-business students' perception towards TBL (based on the readings listed above); inferences on the basis of survey; http://www.aabri.com/manuscripts/121249.pdf 2.Workshop based - Sustainable agriculture- Mushroom farm
2. Workshop based - Back to nature - DIY composting bin
3. Review - Sustainable Consumption in India: Challenges and Opportunities; Divesh Kumar,Praveen Goyal, Zillur Rahman, Ishwar Kumar; IJMBs Vol. 1, Issue 3, September 2011; http; ://www.ijmbs.com/13/devesh.pdf
4. Calculate Carbon Footprint/Ecological footprint
5. Stimulus Activity (Piece of writing) - Sustainable Consumption
6. CSR - Workshop for Village school children
7. Simulation Activity - Challenges to Sustainable Development
8. Case Studies - Sustainability initiatives @ TATA Motors, CAIRN INDIA, Mahindra & Mahindra, Subaru Isuzu, Disney, Novo Nordisk, etc.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	3	3	-	3	-	-
CO2	-	-	-	-	-	-	3	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	3	-	3	3	-	3	-	-
CO4	-	-	-	-	-	-	2	-	3	3	-	3	-	-

Course Title/ Code	E-WASTE MANAGEMENT / ECS306B
Course Type	CORE
Course Nature	SOFT
L-T-P Structure	1-0-2
Credit	2

CO	CO STATEMENT	Mapping
CO1	Analyze and demonstrate the scale of the e-waste problem and the legal framework for managing e-waste in your geographical or professional context.	Employability/Skill
CO2	Identify the environmental, health and climate-related risks posed by e-waste as well as the potential value of e-waste.	Employability/Skill
CO3	Develop a project proposal to address an e-waste problem or opportunity that demonstrates some positive impact on environment, health, and climate change	Employability/Skill
CO4	Apply practical actions from your learning of the course into the real world and help to raise public awareness.	Employability/Skill

SECTION A

Introduction: E-Waste, Indian and global scenario of e-Waste, Growth of Electrical and Electronics industry in India, E-waste generation in India, Composition of e-waste, Possible hazardous substances present in e-waste, Environmental and Health implications.

SECTION B\

E-Waste Legislation: Regulatory regime for e-waste in India, The hazardous waste (Management and Handling) rules 2003, E- waste management rules 2015, Regulatory compliance including roles and responsibility of different stakeholders – producer, manufacturer, consumer etc., Proposed reduction in the use of hazardous substances (RoHS) & REACH, Extended producer responsibility (EPR).

SECTION C

End Of Life Management Of E-Waste: Historic methods of waste disposal – dumping, burning, landfill; Recycling and recovery technologies – sorting, crushing, separation; Life cycle assessment of a product – introduction; Case study – optimal planning for electronic waste.

SECTION D

Environmentally Sound E-Waste Management: Emerging recycling and recovery technologies, Guidelines for environmentally sound management of e-waste, Environmentally sound treatment technology for e-waste, Guidelines for establishment of integrated e-waste recycling and treatment facility, Case studies and unique initiatives from around the world.

REFERENCE BOOKS:

1. Electronic Waste Management, R E Hester, R M Harrison, RSC publishing.
2. E Waste: Implications, Regulations and Management in India and current global practices, Rakesh Johri, TERI PRESS.

LAB EXPERIMENTS:

1. Identify the hazardous materials present in printed circuit boards.
2. Extraction of copper of printed circuit boards in etching solution.
3. Demo of recycling process through videos.
4. Extraction of precious metal from e Waste.
5. Invited guest lecture.
6. Field visit to a waste management initiative in NCR.
7. Activity based learning: survey of the household practice of e-waste disposal and awareness.
8. Case study – presentation and group discussion.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	--	3	3	3	1	2	--	2	1	1
CO2	3	3	2	2	--	3	3	3	3	2	--	2	1	1
CO3	3	3	2	2	--	3	3	3	3	2	--	2	1	1
CO4	3	3	2	2	-	3	3	3	3	3	-	2	1	1

MECHANICAL ENGINEERING

Course Title/ Code	**Green Computing / CSS325B**
Course Type:	**Elective**
Course Nature:	**Soft**
L-T-P Structure	**(1-0-2)**
Credit	**2**

CO	CO STATEMENT	Mapping
CO1	**Acquire and remember knowledge of basic green computing concepts**	**Employability/Skill**
CO2	**Understand environmental problems being caused by computers and their solutions**	**Employability/Skill**
CO3	**Learn and apply power management techniques in computers and datacenters**	**Employability/Skill**
CO4	**Learn techniques of how to follow an environment-friendly lifestyle at work**	**Employability/Skill**
CO5	**Understand techniques of recycling e-waste**	**Employability/Skill**
CO6	**Analyze how to make information systems green**	**Employability/Skill**

SECTION A

Overview and Issues: Problems: Toxins, Power Consumption, Equipment Disposal; Company's Carbon Footprint: Measuring; Plan for the Future; Cost Savings: Hardware, Power.

Initiatives and Standards: Global Initiatives: United Nations, Basel Action Network, Basel Convention; WEEE Directive, Restriction on Hazardous Substances Directive, the Paris Climate Agreement.

SECTION B

Minimizing Power Usage: Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Low Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software.

Green Data Centers: The benefits of a green data center, Developing a strategy, Energy optimization with IT equipment.

SECTION C

Changing the Way of Work: Old Behaviours, starting at the Top, Process Reengineering with Green in Mind, Analysing the Global Impact of Local Actions, Recycling, Energy, Pollutants, Teleworkers, Telecommuting, Outsourcing, how to Outsource.

Recycling: Problems: China, Africa; Materials, Means of Disposal, Recycling, Refurbishing, Recycling Life Cycle, Life of a Product, Cost, Green Design, Recycling Companies, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CDs and DVDs disposal, Change the mind-set.

SECTION D

Greening Your Information Systems: Initial Improvement Calculations, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.

Text books:

1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.
2. Green Data Center: Steps for the Journey Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributers, 2011.

Reference Books:

1. Green Computing and Green IT Best Practice, Jason Harris, Emereo.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	3	-	-	-	-	-	-	-	-	-	-	-	-

MECHANICAL ENGINEERING

Course Title/ Code	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE/ EDS240
Course Type	CORE
Course Nature	AUDIT
L-T-P Structure	1-0-2
Credit	0

Course Outcome	Mapping
CO1: Imparting basics of Indian Traditional Knowledge from modern perspective.	Entrepreneurship
CO2: Developing deeper understanding of various Indian Schools of Philosophy.	Entrepreneurship
CO3: Appreciating the contribution of prominent Indian thinkers in shaping Indian Culture	Entrepreneurship
CO4: Realizing the importance of Indian Traditional Knowledge in bringing a holistic and meaningful worldview.	Entrepreneurship

SECTION-A

Basic Structure of Indian Knowledge System (i) वेद, (ii) उऩवेद (आयुवेद, धनुवेद, गन्धवेद, स्थाऩत्य आदद) (iii) वेदाांग (शिक्षा, कल्ऩ, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उऩाइग (धर्म िास्र, र्ीर्ाांसा, नुराण, तकमिास्र) ·

SECTION-B

Modern Science and Indian Knowledge System

SECTION-C

Yoga and Holistic Health care

SECTION-D

Case Studies.

Reference Books

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritzof Capra, Tao of Physics & The wave of Life
4. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am 5. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016
5. P R Sharma (English translation), Shodashang Hridayam.

CO PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	…	…	…	…	…	3	2	2	3	…	…	2	…	…
CO2	…	…	…	…	…	3	2	2	3	…	…	2	…	…
CO3	…	…	…	…	…	3	2	2	3	…	…	2	…	…
CO4	…	…	…	…	…	3	2	2	3	…	…	2	…	…

Course name/ code	**PROFESSIONAL COMPETENCY ENHANCEMENT-III/ CDO301**	
Course Type	**Core (Allied)**	
L-T-P Structure	**0-0-1**	
Credits	**0.5**	
Course Outcomes (COs)		**Mapping**
1	**To improve student's basic knowledge about Arithmetic Aptitude**	**Employability**
2	**Solve aptitude problems quickly utilizing the short cuts, quick thinking and good communication skills**	**Employability**

Section A – Quantitative Aptitude

Unit 1: Arithmetic I

.1 Simplification

1.1.1 Use of BODMAS rule and Formulas for solving equations.

1.1.2 Simple Fractions and Decimal Fractions.

1.1.3 Surds and Indices.

1.2 Ratio and Proportion

1.2.1 Changes in Ratios, Combined Ratio and Continued Proportion.

1.2.2 Application in different questions.

1.2.3 Variations and Partnership.

1.3 Percentage

1.3.1 Basic Conversion, Consumption & Expenditure, Successive changes and Errors.

1.3.2 Application in Areas and Volumes.

1.4 Profit and Loss

1.4.1 Sales and Purchase Transactions.

1.4.2 MRP and Discount, Equivalent discounts.

1.4.3 Errors in weight (Dishonest Dealer).

1.5 Average

1.5.1 Combined and Mistaken Averages.

1.5.2 Changes in Average.

1.5.3 Application in Cricket and others.

1.5.4 Practice Exercise.

1.6 Interest

1.6.1 Simple and Compound Interest Formulae.

1.6.2 Relations and their Applications.

1.6.3 Practice Exercise.

Unit 2: Arithmetic II

2.1 Time and work

2.1.1 Combined work, Work & Wages, Work & Efficiency.

2.1.2 Working Alternatively, Work and Equations.

2.1.3 Pipes and Cisterns, Inlet and Outlet pipes, Capacity of Tank and Leakage.

2.2 Alligations & Mixtures

2.2.1 Formula Based

2.2.2 Successive Displacement

2.2.3 Mixtures

2.2.4 Error in Measurement

2.2.5 Profit on False Weight

2.3 Revision & Practice

2.3.1 Problems on Ages & Numbers

2.3.2 Calendar

2.3.3 Coding & Decoding

2.3.4 Data Sufficiency

Section B – Verbal Ability Test

Unit 3. Communication Skills in English

1.1 Relevance of Verbal Ability AND PREPARATORY GUIDELINES

1.2 Functional Grammar – Subject Verb Agreement

1.3 Tenses – Perfect, Simple , Continuous

1.4 Common Errors and rectification

Unit 4: Word Power Building Skills

2.1 Words: Antonyms, Synonyms, Analogies,

2.2 Compound words: Homophones, Homonyms, Word Families

2.3 Root Word Technique for Prefixes & Suffixes

2.4: Word Power: 7 Tips for Learning New Words

2.5 Practice Vocabulary Exercises

Section C

Unit 5: Writing Skills

3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing

3.2 Sentences, Phrases, Types of Sentences, Parts of Sentences

3.3 Paragraph Writing: Construction, Linkage & Cohesion

3.4 Practice Exercises: Writing Skills

Section D

Unit 6: Reading Skills

4.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading

4.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed

4.2 Practice Exercises: Short & Medium Passages

Text Books/Reference Books:

1. Quantitative Aptitude : R S Aggarwal, S Chand & Company Pvt Ltd
2. Quantitative Aptitude for CAT: Arun Sharma
3. Verbal Ability and Reading Comprehension: MVN Enterprises

Web links:

http://www.indiabix.com/aptitude/questions-and-answers/

http://www.indiabix.com/non-verbal-reasoning/questions-and-answers

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1						1					3	
CO2	3	3	3									3	2	1

Course Title/ Code	**Research & Innovation-II /RDO601**
Course Type:	**Research Type**
Course Nature:	**Hard**
L-T-P-O Structure	**(0-0-1)**
Credits	**0.5**

Course Outcome	**Mapping**
CO1: The students will be able to apply the contextual knowledge to describe techniques and technologies	**Employability/Skill**
CO2: To analyze and interpret the research outcomes	**Employability/Skill**
CO3: To describe new techniques/technologies/methodologies	**Employability/Skill**
CO4: To describe current research available in the literature	**Employability/skill**

SECTION-A

Unit-1 Setting up the simulation/experiment environment

1.1 To conceptualize simulation/verifying experimental set up

1.2 Measurements on experimental system/simulations of the model

1.3 Choosing the appropriate research methodology

1.4 Finding the resources for performing experiments/simulations

SECTION-B

Unit-2 Planning of experiments

2.1 Formulate experimental procedures with Modification of the experimental set-up, if required

2.2 Procurement of materials

SECTION-C

Unit-3 Execution of experiments/simulations

3.1 Conduct experiments/ build prototype

3.2 Tabulating and recording data

3.3 Analysis and interpretation of the data

3.4 Comparison of the results with other reported experiments

3.5 Interpretation of observations

SECTION-D

Unit-4 Documentation and presentation

4.1 Integration of relevant theory, findings in a structured way and draw appropriate conclusions

4.2 Review and modification of the draft

4.3 Seminar presentation

4.4 Communication to conference/Journal

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	3
CO2	0	3	3	3	2	2	-	-	-	-	-	1	3	3
CO3	0	3	3	3	2	2	-	-	-	-	-	-	3	3
CO4	0	0	3	3	2	-	2	-	-	3	-	-	3	3

MECHANICAL ENGINEERING

SEMESTER 6

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/ NTCC	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
MEH311B-T/P	REFRIGERATION & AIR CONDITIONING	ME	HARD	CORE	3	1	2	0	6	5
MEH312B/MEH313B/MEH314B/MEH314B-T/P	MECHANICAL VIBRATIONS/AUTOMOBILE ENGINEERING/ COMPOSITE MATERIALS	ME	HARD	CORE	3	0	2	0	5	4
ESW204B/CSW317B	ELECTRONIC DESIGN WORKSHOP/AGILE TECHNOLOGIES	ME	HARD	CORE	0	0	2	0	2	1
ECW310B/CSW318B	SENSORS & IOT/ R PROGRAMMING	ME	HARD	CORE	0	0	2	0	2	1
CDO302	PROFESSIONAL COMPETENCY ENHANCEMENT-IV	CDC	OUTCOME BASED	CORE	0	0	0	1	1	0.5
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					9	1	10	5	25	16
MEO317B	SUMMER TRAINING				3 Credits (60 Hrs.)					

Course Title/ Code	REFRIGERATION & AIR CONDITIONING / MEH311B-T
Course Type	CORE
Course Nature	HARD
L-T-P Structure	3-1-0
Credit	4

Course Outcome	Mapping
CO1: Understand the concept of different refrigeration processes.	Employability
CO2: Understand and apply the concept of air-conditioning system in aircraft.	Employability
CO3: Learn about refrigerants, their properties and evaluate the COP of VCR and VAR systems.	Employability
CO4: Understand the basics of Psychometry and its implementation in air conditioning systems.	Employability
CO5: Understanding of standards for human comforts.	Employability
CO6: Implement the knowledge of air conditioning systems in different heating load calculations.	Employability

SECTION-A

Classification of refrigeration systems, advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues

SECTION B

System components: Compressors, Condensers, Expansion devices and Evaporators -Performance matching of components of refrigeration systems

SECTION C

Advanced sorption refrigeration systems and their components. Review of Psychometry and Air-conditioning processes - Comfort air conditioning and Cooling load calculations.

SECTION-D

Applications of AC systems - Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

Text Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3													
CO2	3													
CO3	3	3		3										
CO4	3	3		2										
CO5	3													
CO6	3	2	3	3										

Course Title/ Code	REFRIGERATION & AIR CONDITIONING LAB/ MEH311B-P
Course Type	CORE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Understand about the basics and working principle of water cooler.	Employability
CO2: Understand about the basics and working principle of cooling tower	Employability
CO3: Identify the different cycle of operation in air-conditioning	Employability
CO4: Analyze the humidity measurement and its importance in air-conditioning	Employability
CO5:Learn about the various control devices and parts of refrigeration and air-conditioning systems	Employability
CO6: Learn about the various parts of refrigeration and air-conditioning systems	Employability

LIST OF EXPERIMENTS:

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
2. To Study the Mechanical heat pump and find its C.O.P.
3. To study the Air and Water heat pump and find its C.O.P.
4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor
5. To study the various controls used in Refrigerating & Air Conditioning systems.
6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.
8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychometric Charts on different inlet condition.
9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3								2	3				
CO2	3								2	3				
CO3	3	3		2					3	2				
CO4	3	3	2	3					3	2				
CO5	3								2	3				
CO6	3								2	3				

Course Title/ Code	AUTOMOBILE ENGINEERING/ MEH313B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1 : To classify and identify different Automobiles bodies based on their styles	Employability
CO2: To differentiate different types of power transmission devices in automobiles such as gear, clutches etc	Employability
CO3: To classify and analyze working of different types of suspension systems and steering geometry of automobile vehicle	Employability
CO4: - To differentiate different types of brakes, wheels and compare between different tyre geometries and also to understand charging, emission control systems of automobile body	Employability

Section A

Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles. Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Section B

Power Transmission: Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases. Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal

Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

Section C

Suspension Systems: Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs. Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toein/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

Section D

Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes. Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Text Books:

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

Reference Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automotive Technology – H.M. Sethi, TMH, New Delhi.
3. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
4. Automotive Mechanics – Joseph Heitner, EWP.
5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
6. The Motor Vehicle – Newton steeds Garrett, Butter Worths. ME- 304 F MECHANICAL MACHI

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2							2	2	2	1	3	2
CO2	3	2							2	2	2	1	3	2
CO3	3	2							2	2	2	1	3	2
CO4	3	2							2	2	2	1	3	2

Course Title/ Code	AUTOMOBILE ENGINEERING LAB/ MEH313B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: To Compare and understand performance of different types of power transmission devices in automobiles such as gear, clutches etc	Employability/Skill Development
CO2: To classify & understand working of different types of suspension systems and also demonstrate working of manual, hydraulic steering of automobile vehicle	Employability/Skill Development
CO3: To demonstrate working of different types of brakes and compare between different tyre geometries & wheels	Employability/Skill Development

LIST OF EXPERIMENTS:

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems. (a) Multi-cylinder: Diesel and Petrol Engines. (b) Engine cooling & lubricating Systems. (c) Engine starting Systems. (d) Contact Point & Electronic Ignition Systems.
2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems: (a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems.
3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels. (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels. 9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes.

10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.
11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2							2	2	2	1	3	2
CO2	3	2							2	2	2	1	3	2
CO3	3	2							2	2	2	1	3	2

Course Title/ Code	MECHANICAL VIBRATIONS / MEH312B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Understand and identify the problems in vibrating systems with single degree of freedom.	Employability
CO2: Students can calculate the natural frequencies for free damped and un damped vibration and forced vibration systems.	Employability
CO3: Students can evaluate the frequencies of two degree and multi degree freedom systems	Employability
CO4: Understand the different modes of vibrations and applications of numerical methods.	Employability

SECTION A

Vibration: Scope of vibration, important terminology and classification, Degrees of freedom one dimensional longitudinal, transverse and torsional vibrations with and without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy.

Free and Damped Force Vibration Damped vibrations of single degree of freedom systems. Viscous damping; under damped, critically damped and over damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped and Hysteretic damped systems.

SECTION B

Undamped Force Vibration: System with two degrees of freedom; principle mode of vibration. Undamped forced vibrations of two degrees of freedom system with harmonic excitation. Vibration Absorber; Undamped dynamic vibration absorber and centrifugal pendulum absorber. Forced Vibration: Forced vibrations of single degree of freedom systems. Forced vibration with constant harmonic excitation. Frequency response curves and phase angle plot. Forced vibration due to excitation of support. Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating unbalance. Materials used in vibration isolation.

SECTION C

Two Degrees of Freedom Systems : Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

Multi degrees of Freedom Systems and Numerical Methods Introduction: Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Many degrees of freedom systems: approximate methods; Rayleigh's, Dunkerley's, Stodola's and Holzer's methods. Geared and Branched Systems, Beams, computer programs for solutions.

SECTION D

Normal Mode Vibration of Continuous System (Closed form solutions): Vibrating String, Longitudinal and Torsional Vibrations of Rod, Transverse vibration of beams: equations of motion and boundary conditions, Transverse vibration of beams: natural frequencies and mode shapes

Normal Mode Vibration of Continuous System (Approximate solutions): Rayleigh's energy method, Rayleigh-Ritz method, Assumed modes and Galerkin's method.

TEXT BOOKS & REFERENCES:

1. Mechanical Vibration : G.K. Grover and S.P. Nigam, Nem Chand and Sons

2. Mechanical Vibration: V.P.Singh, Dhanpat Rai Publishers

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	-	-	-	-	-	-	- -	-	-		2	-
CO2	2	2	3	-	-	-	-	-	-	-	-		2	-
CO3	3	2	3	-	-	-	-	-	-	-	-		2	-
CO4	2	2	3	-	-	-	-	-	-	-	-		2	-

Course Title/ Code	MECHANICAL VIBRATIONS LAB/ MEH312B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Understanding the vibration fundamentals for a single degree of freedom (D.O.F.) system under free and damped vibrations.	Employability
CO2: Analyze different types of forced vibration system in single degree of freedom (D.O.F.) and damped, undamped, free and forced systems with two D.O.F.	Employability
CO3: Understand the principal modes of vibrations using different methods for various combinations of spring-mass and rotor-shaft systems.	Employability
CO4: Understand transverse, longitudinal and torsional vibration for beams, bars and shafts respectively.	Employability

LIST OF EXPERIMENTS:

1. Determination of the time period of a thread pendulum having different lengths and material.
2. Determination of the time period of a Rod pendulum with a length of 800mm.
3. Determination of the time period of a rod and thread pendulum with same centre of gravity distance.
4. Determination of the reduced pendulum length of a reversible pendulum.
5. Determination of the time period of a pendulum with bifilar suspension, having different suspended mass.
6. Determination of spring constants.
7. Determination of Natural Frequencies of Free Un-Damped Oscillations.
8. Determination of Natural Frequencies of Free Damped Oscillations.
9. Determination of the Amplitude of Forced Un-Damped Oscillations.
10. Determination of the Amplitude of Forced Damped Oscillations.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	-	-	-	-	-	-	- -	-	-		2	-
CO2	2	2	3	-	-	-	-	-	-	-	-		2	-
CO3	3	2	3	-	-	-	-	-	-	-	-		2	-
CO4	2	2	3	-	-	-	-	-	-	-	-		2	-

Course Title/ Code	COMPOSITE MATERIALS/ MEH314B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Define and Identify the different types of Fibers, Matrix and Composite Materials.	Employability/Skill Development/Entrepreneurship
CO2: Calculate and Analyze the Elastic Modulus of Composites.	Employability/Skill Development/Entrepreneurship
CO3: Justify the applications of Composites.	Employability/Skill Development/Entrepreneurship
CO4: Integrate the Fibers and Matrix to get the desired Composites.	Employability/Skill Development/Entrepreneurship

SECTION-A

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

SECTION-B

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

SECTION-C

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, TsaiHill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

SECTION-D

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

CO-PO Mapping

	Program Outcomes (POs)												PSO1	PSO2
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
CO1	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**
CO2	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**
CO3	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**
CO4	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**

Course Title/ Code	COMPOSITE MATERIALS LAB/ MEH314B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Identify the types of Composites, Fibers and Matrix.	Employability/Skill Development/Entrepreneurship
CO2: Able to fabricate the Glass Fiber Composite.	Employability/Skill Development/Entrepreneurship
CO3: Able to fabricate the Carbon Fiber Composite.	Employability/Skill Development/Entrepreneurship
CO4: Able to simulate the Composite in Analysis Software.	Employability/Skill Development/Entrepreneurship

List of Experiments:

1. Preparation of Continuous Fiber reinforced Polymer Composites
2. Preparation of Dis-Continuous Fiber reinforced Polymer Composites
3. Study of Tensile strength and youngs modulus of FRP composites
4. Study of Flexural strength of FRP composites
5. Study of Hardness of FRP composites
6. Study of drop weight impact testing
7. Preparation of Al-SiC composites by stir casting method

8. Study of microstructure, hardness and density of Al-SiC composite
9. Study of Tensile strength of Al-SiC composites
10. Environmental Testing (Humidity and temperature)

CO-PO Mapping

Course Outcomes	Program Outcomes (POs)												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO2	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO3	1	-	3	-	1	-	-	-	1	2	1	-	1	2
CO4	1	-	3	-	1	-	-	-	1	2	1	-	1	2

Course Title	**ELECTRONIC DESIGN WORKSHOP/ ECW204B**
Course Type	**OPEN ELECTIVE**
Course Nature	**Workshop**
L-T-P structure	**0-0-2**
Credits	**1**

Course Outcome	Mapping
CO1: Design the circuits in orcad.	**Employability/Skill**
CO2: Simulate the circuits.	**Employability/Skill**
CO3: Analyze the results.	**Employability/Skill**
CO4: Implement the circuit & Test it.	**Employability/skill**

Experiment List: Using Eagle 8.3.2 version/ PCB Design Hardware Lab

1. Design & Analysis of low pass & high pass filter using Resistance & capacitance
2. Design & Analysis of band pass & band stop filter using Resistance & capacitance
3. Design & Analysis of half-wave rectifier with effects of variable capacitance 4. Design & Analysis of full-wave rectifier with effects of variable capacitance
5. Project: Design & Analysis of 5V power supply.
6. Project: Design & Analysis of Mobile Phone Charger.
7. Project: Design & Analysis of Water Level Indicator.
8. Project: Design of FM receiver for Radio Manav Rachna.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	2	1	3	3	2	2	3	-	2
CO2	3	2	3	2	3	2	2	3	2	2	3	3	-	2
CO3	3	2	2	3	3	2	3	3	3	3	3	2	-	2
CO4	3	2	3	3	2	3	3	2	3	3	3	2	-	2

Course Title/ Code	Agile Technologies/ CSW317B
Course Type	OPEN ELECTIVE
Course Nature	Workshop
L-T-P Structure	(0-0-2)
Credits	1

Course Outcome	Mapping
CO1: Students should be able to describe Agile Methodology with two frameworks: SCRUM, Extreme Programming (XP) and Test Driven Development (TDD) Practice of XP and other Agile Models: Feature Driven Development and Lean Software Development.	Employability/Skill
CO2: Students should be able to apply TDD approach using JUnit Tool in IDE Eclipse and Git for Software Configuration Management in Agile Software Development	Employability/Skill
CO3: Students should be able to design Use Cases, Agile Stories, Acceptance tests for Agile Stories, User Interface with Specification by Example approach, Product Backlog out of Requirement Analysis and task breakdown structure for Agile stories based on Agile Story Estimation.	Employability/Skill
CO4: Students should be able to apply the approach of Continuous Integration & Continuous Development with Jenkins & Mavens tools for Agile software design & development in iterative way and approach of Behavior Driven Development for acceptance tests required for End to End Testing with Cucumber tool	Employability/skill
CO5: Students should be able to perform Agile Process Management, Project Management, Backlog Management using Agile ant Tool through release planning, Agile story estimation, Agile project effort and progress tracking through Burn down Charts creation.	Employability/skill

Section-A

Agile Programming Tools: UNIX, Eclipse, Git, jUnit,

Processes: Stories, End-to-end Testing, Unit Testing, TDD, Refactoring

Reading: Scrum, Extreme Programming, Features Driven Development, Lean Software Development

Section-B

Agile Architecture/Design and Continuous Integration Tools: Jenkins, Maven, Cucumber Processes: Scrum, Architecture, Iterative Refinement, Agile Design.

Section-C

Agile DesignTools: Use Cases, PowerPoint Design, Requirements/Story Extraction, Test Case Management

Processes: Use cases to Design, Design to Backlog, Backlog to Tasks, End to End Testing, Estimation

Section-D

Agile Process ManagementTools: Agilefant

Processes: Agile Process Management, Estimation, Burn-down, Release Planning, Multi-team coordination, Distributed teams

List of Experiments

1. Test Driven Development on Eclipse using jUnit
2. Software Configuration Management using Git
3. Backlog development from use cases and user interface designs using Specification by Example
4. End-to-end/Acceptance tests using Cucumber
5. Continuous Integration using Jenkins 6. Agile Process Management using Agilefant.

Text Books:

1. Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, available at http://www.it-ebooks.info/book/1441/.

Reference Links:

4. Agile software development, http://en.wikipedia.org/wiki/Agile_software_development
5. Scrum, http://en.wikipedia.org/wiki/Scrum_%28software_development%29
6. Extreme Programming, http://en.wikipedia.org/wiki/Extreme_programming
7. Feature-drive development, http://en.wikipedia.org/wiki/Feature-driven_development
8. Lean Software development, http://en.wikipedia.org/wiki/Lean_software_development
9. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
10. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

11. Specification by example, http://en.wikipedia.org/wiki/Specification_by_example
12. Behavior-driven development, http://en.wikipedia.org/wiki/Behavior-driven_development
13. Code refactoring, http://en.wikipedia.org/wiki/Code_refactoring
14. User Experience, http://en.wikipedia.org/wiki/User_experience

Tool Web Sites:

1. Ubuntu, http://www.ubuntu.com/desktop
2. Eclipse, https://eclipse.org/users/
3. jUnit, http://junit.org/
4. Git, http://git-scm.com/
5. Jenkins, https://jenkins-ci.org/
6. Ant, http://ant.apache.org/
7. Maven, https://maven.apache.org/
8. Cucumber, https://cukes.info/
9. Fitnesse, http://www.fitnesse.org/

Agilefant, http://agilefant.com/

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	3	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	1	-	-	-	2	2	-	-	3	3
CO4	3	-	3	-	3	-	-	-	2	-	-	2	3	3
CO5	3	2	2	-	3	-	-	-	2	2	2	2	3	3

Course Title/ Code	R Programming/ CSW318B
Course Type	OPEN ELECTIVE
Course Nature	Workshop
L-T-P Structure	(0-0-2)
Credits	1

Course Outcome	Mapping
CO1: Describe the basics of R programming concepts and Business Analytics	Employability/Skill
CO2: Demonstrate the concepts of Data Analytics	Employability/Skill
CO3: Analyze the results using various Data Visualization Techniques in R	Employability/Skill
CO4: Apply concepts to perform predictive analysis using R and utilize the learned techniques to evolve further	Employability/skill

Section-A

Introduction to R, Understand the use of 'R' in the industry, Compare R with other software in analytics, Install R and the packages useful for Business Analytics,Using the R console, Getting help, Learning about the environment, Saving your work. R Vectors, Data Frames

Section-B

Variables: Variables and Assignment, Decision Making, Loops in R, Classes & Objects in R, Reading CSV, Excel and Text files. Writing and saving data objects to file, the various steps involved in Data Cleaning, Functions used in Data Inspection.

Section-C

Tackling the problems faced during Data Cleaning, Uses of the functions like grepl(), grep(), sub(),Packages installation used for database import, Connect to RDBMS from R using ODBC and basic SQL queries in R.

Section-D

Understanding Data Visualization, Graphical functions present in R, Plot various graphs like tableplot, Scatter Plot, Histogram, Box plot,Line graph,Bar charts,Pie charts. Customizing Graphical Parameters to improvise the plots, R Mean, Median, Mode, Linear Regression, Logistic

Regression,Poission Regression, Normal Distribution and Binomial Distribution.Time Series Analysis, Decision Tree, Random Forest, Dimensionality reduction of Data: PCA, SVD, Predictive Analysis. Time series Decomposition, Time series clustering and classification.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	1	1	1	2	1	-	-	-	-	-	-	-	-	-
CO3	1	1	1	1	1	-	-	-	-	1	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	2	-	-	-	-

Course Title	IOT & SENSORS WORKSHOP / ECW310B
Course Type	OPEN ELECTIVE
Course Nature	Workshop
L-T-P structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1: Apply App Inventor as a tool within the design process and to apply concepts & skills that will eventually allow building out of an app idea.	Employability/Skill
CO2: Demonstrate the concepts of Arduino as IDE, programming language & platform using different Sensors.	Employability/Skill
CO3: Build projects using Raspberry Pi.	Employability/Skill

LIST OF EXPERIMENTS

1. IOT and Acoustic and Sound Sensors.
2. IOT and Chemical Sensors
3. IOT and Optical Sensors
4. IOT and Mechanical Sensors
5. IOT and Electromechanical Sensors
6. IOT and Thermal Sensors
7. IOT and Proximity Sensors
8. IOT and Pressure Sensors 9. IOT and Magnetic Sensors
9. Mini Project.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO2	2	2	2	-	2	-	-	-	1	1	1	2	1	1
CO3	2	2	2	3	2	-	-	-	1	1	1	1	1	1

Course Title/Code	PROFESSIONAL COMPETANCY RNHANCEMENT-IV/CDO302	
Course Type	CORE	
L-T-P Structure	0-0-1	
Credits	0.5	
Course Outcomes (COs)		Mapping
1	To strengthen students Modern Math concepts	Skill Development
2	To help students perform well during placements	Skill Development
3	To help students get proficient with problem solving at various levels like basic, intermediate and advanced	Skill Development
4	To help students with shortcuts to problem solving	Skill Development
5	To improve students communication skills	Skill Development

Section A – Quantitative Aptitude

Unit 1: Modern Math

1.1 Permutation and Combination

1.1.1 Principal of counting and basic formulas

1.1.2 Arrangements, Selection and Selection + Arrangement.

1.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

1.2 Probability

1.2.1 Events and Sample Space, Basic Formulas.

1.2.2 Problems on Coins, Cards and Dices.

1.2.3 Conditional Probability, Bayes' Theorem and their Applications.

Unit 2: Advanced Math

2.1 Mensuration 1- Areas

2.1.1 Different types of Triangles and their area and perimeter.

2.1.2 Different types of Quadrilateral and their area and perimeter.

2.1.3 Circumference and Area of Circle, Area of Sector and length of Sector.
2.1.4 Mixed Figures and their Applications.

2.2 Mensuration 2- Surface Areas and Volumes

2.2.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
2.2.2 Prism and Pyramid.
2.2.3 Mixed Figures and their Applications.

Unit 3: ALGEBRA :

3.1 Linear and Quadratic equations.
3.2 Inequalities.
3.3 Integral Solutions and Max and Min values.

Section B – Soft Skills

Unit 4:Professional Writing

4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram
4.2. Cover Letter/Emails
4.3. Resume Writing

Unit 5: Group Discussions

5.1. Do's and Dont's of a Group Discussion
5.2. Roles played in a Group Discussion
5.3. Tips for Cracking a Group Discussion

Unit 6: Managing Interviews

6.1. Developing the employability mindset
6.2. Preparing for Self -Introduction
6.3. Researching the employer
6.4. Portfolio Management
6.5. Answering Questions in an Interview

Text Books/Reference Books:

1. Quantitative Aptitude : R S Aggarwal, S Chand & Company Pvt Ltd
2. Quantitative Aptitude for CAT: Arun Sharma
3. Verbal Ability and Reading Comprehension: MVN Enterprises

Weblinks:

MECHANICAL ENGINEERING

http://www.indiabix.com/aptitude/questions-and-answers/
http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				2			2	2	2	3	2	2		2
CO2				2			2	2	2	3	2	2		2
CO3				2			2	2	2	3	2	2		2
CO4				2			2	2	2	3	2	2		2
CO5				2			2	2	2	3	2	2		2

MECHANICAL ENGINEERING

Course Title/Code	**Summer Training Post 6th Semester / MEO317B**
Course Type	**Core**
Course Nature	**Hard**
Credit	**3**

Course Outcome	Mapping
CO1: Apply technical knowledge to the students to cope with industrial environment, which cannot be simulated in the classroom and hence creating competent professionals in the Industry.	**Employability**
CO2: Understand possible opportunities to learn, understand and sharpen the real time technical /managerial skills required at job.	**Employability**
CO3: Apply the current technological developments relevant to subject area of training	**Employability**
CO4: Apply the experience gained from the industrial internship in the discussion held in the classrooms	**Employability**

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	1	1	1	1				1	3	3	1	3	1	1
CO2	1	1	1	1				1	3	3	1	3	1	1
CO3	1	1	1	1				1	3	3	1	3	1	1
CO4	1	1	1	1				1	2	3	1	3	1	1

MECHANICAL ENGINEERING

SEMESTER-7

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/ NTCC	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
MEH401B/ MEH402B/ MEH403B/ MEH404B	RENEWABLE ENERGY SOURCES/MACHINE DESIGN-II/POWER PLANT ENGINEERING/LEAN MANUFACTURING	ME	HARD	ELECTIVE	3	0	0	0	3	3
MEH405B/ MEH406B/ MEH407B/ MEH408B-T/P	COMPUTATIONAL FLUID DYNAMICS/OPTIMIZATION TECHNIQUES/DESIGN OF HEAT EXCHANGERS/ENERGY CONSERVATION & MANAGEMENT	ME	HARD	ELECTIVE	3	0	2	0	5	4
ECH403B/CSH414B-T/P	WIRELESS SENSORS/INFORMATION RETREIVAL	ME	ALLIED	ELECTIVE	3	1	2	0	6	5
MEH409B/ MEH410B/ MEH411B	HEATING, VENTILATION & AIR CONDITIONING /FINITE ELEMENT ANALYSIS/NANOCOMPOSITES	ME	HARD	ELECTIVE	3	0	2	0	5	4
MCS368B	ENTREPRENEURSHIP	ME	SOFT	CORE	1	0	2	0	3	2
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					15	1	8	0	22	18

Course Title/ Code	RENEWABLE ENERGY SOURCES/ MEH401B
Course Type	CORE
Course Nature	HARD
L-T-P Structure	4-0-0
Credit	4

Course Outcome	Mapping
CO1: To categorize different type of renewable energy sources and to perform theoretical analysis of solar radiation.	Employability/Entrepreneurship
CO2: To analyze of aerodynamic forces acting on wind mill blades and estimation of power output and to able consider various factors in digester design.	Employability
CO3: To calculate energy estimation within different types of geothermal energy sources and to understand the prospect of wave energy in India.	Employability
CO4: To understand the construction and working various types of MHD and be able to categorize them.	Employability

SECTION A

Introduction to Energy Sources: Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.

Solar Energy : Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaics - solar cells & its applications.

SECTION B

Wind Energy : Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.

SECTION-C

Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India

Energy from the ocean: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

SECTION-D

Magneto Hydro Dynamic (MHD) Power Generation: Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects. 8. Fuel Cells: Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells.

Hydrogen Energy: Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles. Energy Management: Energy economics, energy conservation, energy audit, general concept of total energy system, scope of alternative energy system in India. Term work is based on above mentioned syllabus

Reference Books:

1. Non-conventional energy sources by G.D. Rai, Khanna Publishers
2. Solar Energy: Fundamentals and Applications by H.P. Garg & Jai Prakash, Tata McGraw Hill
3. Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill
4. Alternative Energy Sources by B.L. Singhal Tech Max Publication
5. Non-Conventional Energy Resources by S.Hasan Saeed and D.K.Sharma
6. Fuel Cells by Bockris and Srinivasan; McGraw Hill
7. Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison
8. Solar Engineering of Thermal Processes by Duffic and Beckman, John Wiley

CO-PO Mapping

Course Outcomes	Program Outcomes												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	2						2		2			2		2
CO2	3	2		1			2		2			2		2
CO3	3	2		1			2		2			2		2
CO4	3						2		2			2		2

Course Title/ Code	MACHINE DESIGN-II /MEH402B
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	4-0-0
Credit	4

Course Outcome	Mapping
CO1: Understand and identify creep failure for mechanical parts.	Employability
CO2: Design Bearings to withstand the loads and deformations for a given conditions.	Employability
CO3: Design springs to withstand the loads and deformations for a given application.	Employability
CO4: Analyze design considerations for different types of gears	Employability

SECTION A

Introduction: Problems in Engineering Design, Division of Design Project, testing models, patents and agreements.

Modeling of concurrent engineering design, real time constraints checking in design process, life design cycle.

Introduction to creep, Mechanisms of Creep Deformation, Deformation Mechanism Maps Creep Fracture, Material Design Against Creep.

SECTION B

Bearings & Lubrication: Types and laws of friction, Types of Lubrication Hydrodynamic and Hydrostatic bearings, Ball and Roller bearings, Method of load estimation and Selection of bearings. Concept of Air bearing

SECTION C

Springs: Design of helical springs subjected to static and dynamic loads, design of torsion and leaf springs, elementary idea of rubber springs. Pressure vessel classification, Design of thick, thin & compound cylindrical shell, and design of head covers.

SECTION D

Power Transmission with Toothed Gears: Selection of Gears and Gear Materials, Tooth Forces, Design of Spur Gear, Design of Helical, Bevel and Worm Gears.

TEXT BOOKS & REFERENCES:

1. Sharma & Aggarwal; Machine Design, Kataria Publications.
2. V. B Bhandari: Design of Machine Elements, McGraw Hill

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	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
CO1	2	2	-	-	-	-	-	-	- -	-	-		2	-
CO2	2	2	3	-	-	-	-	-	-	-	-		2	-
CO3	2	2	3	-	-	-	-	-	-	-	-		2	-
CO4	2	2	3	-	-	-	-	-	-	-	-		2	-

Course Title/ Code	POWER PLANT ENGINEERING/ MEH403B
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	4-0-0
Credit	4

Course Outcome	Mapping
CO1: Categorize the different types of power plants and also understand the need of hydro-electric power plant.	Employability
CO2: Analyze the working of steam power plant working under combined power cycles and estimate its thermodynamic efficiency.	Employability/Skill Development
CO3: Understand the need and working of nuclear power plants and estimate its economics under various thermal and electrical conditions.	Employability
CO4: Understand the working of various non-conventional power generation and analyze the principle of thermoelectric and thermionic power generation.	Employability

SECTION-A

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants. Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

SECTION-B

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator. Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants steam & gas turbine

power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

SECTION-C

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal. Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input output curves, efficiency, heat rate, economic load sharing, Problems.

SECTION-D

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants. Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Text Books:

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Campany Ltd., New Delhi

2. Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition 2001.

Reference Books:

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2							1					3	
CO2	2	1		2				1					3	
CO3	2	1		2				1					3	
CO4	2	1	1	2			1	1					3	

Course Title / Code	LEAN MANUFACTURING/ MEH404B
Course Type	Elective
Course Nature	Hard
L-T-P Structure	(4-0-0)
Credit	4

Course Outcome	Mapping
CO1 : - To Understand basics of Lean manufacturing	Employability
CO2:- To Identify and apply Lean Manufacturing Tools and Methodologies in Industry	Employability
CO3:-To Understand and analyze concept of just in time manufacturing	Employability
CO4: - To Apply and analyze Six Sigma, Lean and ERP technique in Industry	Employability

SECTION A

Introduction to Lean Manufacturing: Objectives of Lean Manufacturing, Key Principles And Implications Of Lean Manufacturing, Traditional Vs Lean Manufacturing.

Lean Manufacturing Concepts: Value creation and waste elimination, Main kinds of waste, Pull Production, Different models of Pull Production, Continuous flow, Continuous improvement (Kaizen), Worker involvement, Cellular layout, Administrative lean.

SECTION B

Lean Manufacturing Tools and Methodologies: Standard work, Communication of standard work to employees, Standard work and flexibility, Visual controls, Quality at the source, 5S principles.

Preventive maintenance, Total quality management, Total productive maintenance, Changeover/setup time, Batch size reduction, Production leveling.

Value Stream Mapping: The current state diagram, the future state map, Application to the factory simulation scenario, Line Balancing, Poka-Yoke, Kanban, Overall equipment effectiveness.

SECTION C

Just In Time Manufacturing: Introduction, Elements of JIT, Uniform production rate, Pull versus push method, Kanban system, Small lot size, Quick & Inexpensive set-up, Continuous improvement, Optimized production technology. One-Piece Flow: Process Razing Techniques, Cells for assembly line, Case studies

SECTION D

Implementing Lean: Roadmap, Senior Management Involvement, Best practices.

Reconciling Lean with Other Systems: Toyota production system, Lean & Six Sigma, Lean and ERP, Lean with ISO9001:2000.

TEXT BOOKS & REFERENCES

1. Lean Manufacturing by By Aza Badurdeen

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		3	2	2		2							2	
CO2		2	3	2		3							2	
CO3		2	2	3		3							2	
CO4		2	2	3		2							2	

Course Title/ Code	COMPUTATIONAL FLUID DYNAMICS/ MEH405B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: To understand and apply the basic concept to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.	**Employability/Skill Development**
CO2: Apply and analyze the diffusion problems using finite difference and finite volume methods.	**Employability/Skill Development**
CO3: Apply and analyze the typical convection diffusion problems using finite volume method.	**Employability**
CO4: Use various algorithms to analyze the flow field & Select the right turbulence models for the given problem	**Employability/Skill Development/Entreprenureship**

SECTION-A

GOVERNING EQUATIONS AND BOUNDARY CONDITIONS - Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD – Elliptic, Parabolic and Hyperbolic equations.

SECTION-B

FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION - Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

SECTION-C

FINITE VOLUME METHOD FOR CONVECTION DIFFUSION - Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

FLOW FIELD ANALYSIS - Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

SECTION-D

TURBULENCE MODELS AND MESH GENERATION - Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

References:

1. Ferziger, J. H. and Peric, M.(2003). Computational Methods for Fluid Dynamics. Third Edition,SpringerVerlag,Berlin.
2. Versteeg, H.K. and Malalasekara, W.(2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method.Second Edition (Indian Reprint) Pearson Education.
3. Anderson, D.A., Tannehill, J.C. and Pletcher, R.H.(1997). Computational Fluid Mechanics and Heat Transfer. Taylor & Francis.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		3								3	3	2
CO2	3	2		3								3	3	2
CO3	3	2		3								3	3	2
CO4	3	2		3								3	3	2

Course Title/ Code	COMPUTATIONAL FLUID DYNAMICS LAB/ MEH405B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: To study laminar flow and simulate it on Hyperworks CFD.	Employability/Skill Development
CO2: To study turbulent model in mixing of fluid and simulate it on Hyperworks CFD.	Employability/Skill Development
CO3: To study convergent divergent nozzle for sonic, subsonic and hypersonic flow through plotting pressure and velocity contour	Employability /Skill Development

List of Experiments

1. Evaluation of CFD Sub-Models for the Intake Manifold Port Flow Analysis
2. Evaluation of CFD to predict smoke movement in complex enclosed spaces
3. CFD analysis of a simple convergent flow using ANSYS
4. CFD analysis of supersonic exhaust in a scramjet engine
5. Flow simulation (CFD) and Wind tunnel Experiment of Cricket ball
6. Numerical study of different types of fins
7. Numerical solution and visualization of two blast wave interaction
8. Design and analysis of fuel system for velocity XL
9. Flow analysis of aerofoil using ICM CFD
10. Design and simulation of a jet engine nozzle using ANSYS ICEM CFD
11. CFD Analysis of a car

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	3	2	2							3	3	3
CO2	3	2	3	2	2							2	3	
CO3	3	2	3	2	2							2	3	

Course Title/ Code	OPTIMIZATION TECHNIQUES / MEH406B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Understand the basic theory and some advanced topics in linear optimization, integer optimization, and convex optimization	Skill development
CO2: Identify the proper optimization technique(s) to attempt when problems are too large or too complicated to solve in a straightforward way	Skill development
CO3: Use optimization software and implement solution algorithms involving large scale optimization techniques	Skill development
CO4: Handle large data sets that accompany real-world optimization problems.	Skill development

SECTION A

Engineering Economy and Costing: Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements.

Facility Design: Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; assembly line balancing; materials handling systems.

Production Planning and Inventory Control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; concept of JIT manufacturing system;

SECTION B

Inventory: functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

Linear programming: problem formulation, simplex method, duality and sensitivity analysis;

SECTION C

Transportation and assignment models; network flow models, simple queuing models; dynamic programming; simulation – manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

SECTION D

Quality Management: Quality – concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments – Taguchi method.

Management Information System: Value of information; information storage and retrieval system database and data structures; knowledge based systems.

TEXT BOOK & REFERENCES:

1. Production Systems: Planning, Analysis and Control by J.L. Riggs
2. Production, Planning and Inventory Control by S. Narasimhan, D. W. McLeavey, and P. J. Billington
3. Operation Research by D.S.Heera, S. Chand Publication

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1				1				3	2	3
CO2	3	3	1	2				1				2	2	3
CO3	3	3	1	1				1				3	2	3
CO4	3	3	1	2			1	1				2	2	3

Course Title/ Code	OPTIMIZATION TECHNIQUES LAB/ MEH406B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Apply linear programming, dynamic programming and related optimization theories to solve real life / simulated problems.	Skill development
CO2: Apply Network analysis concept in Software Project Management.	Skill development
CO3: Understand application of decision making tools in various business strategy making.	Skill development

LIST OF EXPERIMENTS:

1. To prepare a case study for producing a product on shop floor covering areas of PPC, design, Methods Engineering, Operations and Quality Control.
2. To prepare a project report for calculating the total cost (direct and indirect cost) of a product being developed for manufacturing.
3. To prepare a flow chart identifying main steps to be followed by methods engineering in manufacturing a product.
4. To prepare a bar chart for producing a generator/turbine identifying the main sub-assemblies along with their completion schedule.
5. To prepare a document for quality policy, quality systems and procedures required to be followed in the manufacture of a turbine/generator.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1				1				3	2	3
CO2	3	3	1	2				1				2	2	3
CO3	3	3	1	1				1				3	2	3

Course Title/ Code	DESIGN OF HEAT EXCHANGERS / MEH407B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Outline common types of heat exchangers.	Employability
CO2: Analyze heat exchangers.	Employability
CO3: Design double pipe heat exchangers	Employability
CO4: Design Shell & tube heat exchangers.	Employability
CO5: Design of compact heat exchangers.	Employability

SECTION-A

DIFFERENT CLASSIFICATION OF HEAT EXCHANGERS: Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass; once through steam generators etc;

PROCESS DESIGN OF HEAT EXCHANGERS: Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube, heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

SECTION-B

Mechanical Design Of Shell And Tube Type, Thickness calculation, Tube sheet design using TEMA formula, concept of equivalent plate for analyzing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tube sheet joint design, buckling of tubes, thermal stresses

SECTION-C

Compact And Plate Heat Exchanger, Types – Merits and Demerits – Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations

SECTION-D

Condensers And Cooling Towers, Design of surface and evaporative condensers – cooling tower –performance characteristics

TEXT BOOKS / REFERENCES:

1. T.Taborek, G.F.Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co.1980.
2. Walker, Industrial Heat Exchangers- A Basic Guide, Mc Graw Hill Book Co. 1980
3. Nicholas Cheremistoff, Cooling Tower, Ann Arbor Science Pub 1981
4. Arthur, P. Frass, Heat Exchanger Design, John Wiley and Sons, 1988

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	2												
CO2	3	3	2	3									2	
CO3	3	3	2	3										
CO4	3	3		2									2	
CO5	3	3												

Course Title/ Code	DESIGN OF HEAT EXCHANGERS LAB/MEH407B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Analyze double pipe heat exchangers	Employability
CO2: Analyze Shell & tube heat exchangers.	Employability
CO3: Analyze of compact heat exchangers.	Employability
CO4: Evaluate the performance of heat exchangers.	Employability

List of Experiments

1. Double pipe heat exchanger procedure for parallel flow
2. Double pipe heat exchanger procedure for Counter flow
3. Shell & Tube heat exchanger procedure for parallel flow
4. Shell & Tube heat exchanger procedure for Counter flow
5. Plate heat exchanger procedure for parallel flow
6. Plate heat exchanger procedure for counter flow

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO3	3	3	2	3										
CO4	3	3		2									2	
CO5	3	3												
CO6	3	2												

Course Title/ Code	ENERGY CONSERVATION & MANAGEMENT/ MEH408B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy management.	Employability
CO2: Ability to analyze the viability of energy conservation projects.	Employability/Skill Development
CO3: Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy management.	Employability/Entrepreneurship.
CO4: Advocacy of strategic and policy recommendations on energy conservation and energy management.	Employability/Skill Development

SECTION-A

Energy conservation: Principles of energy conservation, Energy Conservation Act 2001 and its features, Electricity Act-2003 & its features, Energy consumption pattern, Resource availability, Energy pricing, Energy Security, Estimation of energy use in a building. Heat gain and thermal performance of building envelope -Steady and non-steady heat transfer through the glazed window and the wall -Standards for thermal performance of building envelope, Evaluation of the overall thermal transfer

SECTION-B

Energy efficiency in thermal & electrical utilities: Energy efficiency in boilers, furnaces, steam systems, cogeneration utilities, waste heat recovery, compressed air systems, HVAC&R systems, fans and blowers, pumps, cooling tower Energy efficiency for electric motors, lighting systems, Characteristics of Light, Types of Lighting, Incandescent Lighting, Fluorescent Lighting, Vapor Lighting, Street Lighting, LED Lighting, Lighting Design, Light Dimming, Tips for Energy Conservation, Products for Energy Conservation in lighting system

SECTION-C

Energy Audit: Definition, objective and principles of Energy Management, Need of Energy Audit and Management, types of energy audit, audit process, Guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations and energy audit report, energy audit of building system, lighting system, HVAC system, Water heating system, heat recovery opportunities during energy audit, Industrial audit opportunities, Instruments for Audit and Monitoring Energy and Energy Savings

SECTION-D

Energy Economics: Simple Payback Period, Time Value of Money, Internal Rate of Return, Net Present Value, Life Cycle Costing, Equivalent uniform annual cost (EUAC), Life cycle cost, Discounting factor, Capital recovery, Depreciation, taxes and tax credit, Impact of fuel inflation on life cycle cost, Cost of saved energy, cost of energy generated, Energy performance contracts and role of Energy Service Companies (ESCOs). Climate Policy: Kyoto protocol, Clean development mechanism (CDM), Geopolitics of GHG control; Carbon Market.

Text Books:

1. Barney L. Capehart, Wayne C. Turner and William J. Kennedy, "Guide to Energy Management", Seventh Edition, The Fairmont Press Inc., 2012.
2. Albert Thumann, "Handbook of Energy Audits", Sixth Edition, The Fairmount Press, 2003.
3. G. G. Rajan, "Optimizing Energy Efficiencies in Industry", Tata McGraw Hill, 2001
4. Wayne C. Turner, "Energy Management Hand Book", The Fairmount Press, Inc., 2001.

Reference Books:

1. Charles M. Gottschalk, "Industrial Energy Conservation", John Wiley and Sons, 1996.
2. Craig B. Smith, "Energy Management Principles", Pergamon Press, 2015.
3. IEEE Recommended "Practice for Energy Management in Industrial and Commercial Facilities", IEEE std 739 – 1995. (Bronze book).
4. Hamies, "Energy Auditing and Conservation; Methods, Measurements, Management and Case Study", Hemisphere Publishers, Washington, 1980.
5. C.W. Gellings and J.H. Chamberlin, "Demand-Side Management Planning", Fairmount Press, 1993.
6. Wayne C Turner, "Energy Management Handbook", The Fairmount Press, 2006.
7. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.
8. S. Pabla, "Electric Power Systems Planning", Mac Millan India Ltd., 1998.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3				2	2					1	3	3	
CO2	3					2			2			3	3	
CO3	3	3							2			3	3	
CO4	3	3					3		2			3	3	

Course Title/ Code	**ENERGY CONSERVATION & MANAGEMENT LAB/ MEH408B-P**
Course Type	**ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**0-0-2**
Credit	**1**

Course Outcome	Mapping
CO1: Conduct tests and determine the properties of fuels and oils	**Employability**
CO2: Conduct performance tests on IC engines and draw characteristics plots	**Employability/Skill Development**

List of Experiments

1. Lab layout, Location of instruments and Panels for carrying out experiments
2. List of Instruments with specifications
3. Calibration of instruments and standards to be discussed.
4. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martin (closed) Apparatus.
5. Determination of Calorific value of solid, liquid and gaseous fuels.
6. Determination of Viscosity of a lubricating oil using Redwood and Saybolt Viscometers.
7. Valve Timing diagram of an I.C. Engine. 6. Use of Planimeter – Computation of area of irregular shapes.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3				2	2					1	3	3	
CO2	3					2			2			3	3	

Course Title/ Code	**WIRELESS SENSOR NETWORK/ ECH403B-T**
Course Type:	**Elective (Departmental)**
Course Nature:	**Hard**
L-T-P Structure	**(3-1-0)**
Credit	**4**

Course Outcomes (COs)		**Mapping**
1	**Explain the concept of Wireless Sensor Networks by studying the architecture of a single node**	**Employability, Skill Development**
2	**Differentiate and understand the various routing protocols for ad-hoc wireless networks**	**Employability, Skill Development**
3	**Describe the concept of MAC protocols in Wireless Sensor Networks and identify devices based on these MAC standards**	**Employability, Skill Development**
4	**Analyse design constraints and challenges in WSN like network lifetime, security, and analysing a few networks through simulations.**	**Employability, Skill Development**

SECTION A

Introduction and Overview of WSN: Introduction, Brief historical survey of sensor networks, Challenges for wireless sensor networks, Enabling technologies for wireless sensor networks, Ad-Hoc networks, Applications of wireless sensor networks: Sensor and robots, Reconfigurable sensor networks, Highway monitoring, Military applications, Civil and environmental engineering applications, Wildfire instrumentation, Habitat monitoring, Nanoscopic sensor applications, Wireless Network Standards: IEEE 802.15.4.

SECTION B

Architecture: Basic sensor network architectural elements, Single node architecture, Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, Network architecture, Sensor network scenarios, Optimization goals and figures of merit, Gateway concepts.

SECTION C

Medium Access Control for WSN: Physical layer and transceiver design Considerations, MAC protocols for wireless sensor, Networks, Low duty cycle protocols and wakeup concepts -Box-MAC, Bit-MAC, H-MAC, I-MAC, O-MAC, S-MAC , The mediation device protocol, Wakeup radio concepts, Address and name management, Assignment of MAC addresses, Routing protocols- Energy efficient routing, Geographic routing, Flooding and its variants.

SECTION D

Infrastructure Establishment: Topology control, Clustering, Time synchronization, Localization and positioning, Sensor tasking and control, Examples of operating systems: Tiny OS, Mate, Magnet OS.

Text Books:

1. Holger Karl & Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier

Reference Books:

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Network, John Wiley.
2. Murthy, Adhoc Wireless Networks: Architectures and Protocols, Pearson Education.
3. C. S. Raghavendra, Wireless sensor networks, Springer.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	-	1	1	-	-	3	1
CO2	3	3	2	1	1	1	1	-	1	1	-	-	3	1
CO3	3	3	3	2	1	1	1	-	1	2	-	-	3	2
CO4	3	3	2	2	2	1	1	-	1	1	-	-	3	3

Course Title/ Code	**WIRELESS SENSOR NETWORK LAB/ ECH403B-P**
Course Type:	**Elective (Departmental)**
Course Nature:	**Hard**
L-T-P Structure	**(0-0-2)**
Credit	**1**

Course Outcomes (COs)		**Mapping**
1	**Data sensing and analysis using platform like MKR1000**	**Employability, Skill Development**
2	**Demonstrate data exchange for MKR1000**	**Employability, Skill Development**
3	**Demonstrating audio data and analysing the parameters.**	**Employability, Skill Development**
4	**Analysing a few networks through simulations and implementing for real time problems.**	**Employability, Skill Development**

List of Experiments:

1. Optimum Placements of sensors in wireless sensor network.
2. Sensor placement for effective diagnosis of multiple faults.
3. To generate a random matrix.
4. Generate a data matrix of the designated pattern vectors
5. Find the Fisher Information matrix associated to this matrix
6. Calculate the determinant for the Gram matrix for each sensor. This is done by deleting the rows and columns of matrix corresponding to the sensor reading with lowest interference, thus providing effective independence for the chosen sensor location
7. Remove the sensor which has least determinant from the data matrix by obtaining the matrix,

8. Add the next column from the matrix of data in order to update the Gram matrix with a new sensor. This procedure is repeated until an optimum matrix is obtained with all optimum sensor location sets.

Text Books:

1. Holger Karl & Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier

Reference Books:

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Network, John Wiley.
2. Murthy, Adhoc Wireless Networks: Architectures and Protocols, Pearson Education.
3. C. S. Raghavendra, Wireless sensor networks, Springer.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	-	1	1	-	-	3	1
CO2	3	3	2	1	1	1	1	-	1	1	-	-	3	1
CO3	3	3	3	2	1	1	1	-	1	2	-	-	3	2
CO4	3	3	2	2	2	1	1	-	1	1	-	-	3	3

Course Title/ Code	Information Retrieval/ CSH414B-T
Course Type	Elective
Course Nature	Hard
L-T-P Structure	(3-0-0)
Credits	3

Course Outcome	Mapping
CO1: Assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving particular particular engineering problems	Employability/Skill
CO2: Students would be able to understand concepts related to information retrieval models, retrieval performance evaluation.	Employability/Skill
CO3: Students would be able to Apply different indexing techniques in data Base systems	Employability/Skill

Section-A

Knowledge representation - Basics of Prepositional logic- Predicate logic-reasoning using first order logic-unification-forward chaining-backward chaining-resolution- -Production rules-frames-semantic networks- scripts.

Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

Section-B

Information Retrieval Modeling - Information retrieval – taxonomy-formal characterization classic information retrieval-set theoretic modelalgebraic model-probabilistic model structured text retrieval models-models for browsing-.retrieval performance evaluation keyword based querying-pattern matching-structural queries-Query operations.

Section-C

Index construction : Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes Index compression: Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression.

Ontology Development - Description logic-taxonomies-Topic maps-Ontology-Definition expressing ontology logically-ontology representations-XML-RDF-RDFS-OWL-OIL ontology development for specific domain-ontology engineering-Semantic web services

Parallel and distributed IR- multimedia IR- data modeling-query languages-.Web Searching Basics-Characterizing the Web-Search Engines-Web crawling and in dexex-link analysis

Section-D

Language models, Finite automata and language models, Types of language models, Multinomial distributions over words, The query likelihood model, Using query likelihood language models in IR, Estimating the query generation probability, Language modelling versus other approaches in IR, Naïve bayes-vector space classification-support vector machines and machine learning on documents-flat clustering hirarchical clustering

Text Books:

1. Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2003.

Reference Books:

1. Stuart Russell-Peter Norvig, “Artificial Intelligence – A modern Approach”, Pearson Education, 2nd Edition, 2003. (Unit I)
2. Michael c.Daconta,leo J. Obart and Kevin J Smith,”Semantic Web – A guide to the future of XML,Web Services and Knowledge Management”,Wiley Publishers 2003.
3. Christopher D. Manning, PrabhakarRaghavan and HinrichSchutze, “Introduction to Information Retrieval”, Cambridge University press, 2008.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	-	-	3	1	2	-	2	2
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2	3

Course Title/ Code	Information Retrieval lab/ CSH414B-P
Course Type	Elective
Course Nature	Hard
L-T-P Structure	(0-0-2)
Credits	1

Course Outcome	Mapping
CO1: Students would be able to Analyze language models.	Employability/Skill
CO2: Acquire Solid foundation in the field of Information retrieval and Language model	Employability/Skill

List of Experiments:

1. Rapid Miner tool will be explorer in the lab.

Text Books:

1. Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2003.

Reference Books:

1. Stuart Russell-Peter Norvig, “Artificial Intelligence – A modern Approach”, Pearson Education, 2nd Edition, 2003. (Unit I)
2. Michael c. Daconta, leo J. Obart and Kevin J Smith,”Semantic Web – A guide to the future of XML,Web Services and Knowledge Management”,Wiley Publishers 2003.
3. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University press, 2008.

CO-PO Mapping

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2	3

Course Title/ Code	HEATING, VENTILATION & AIR-CONDITIONING/ MEH409B-T
Course Type	OPEN ELECTIVE
Course Nature	Hard
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Illustrate the fundamental principles and applications of refrigeration and air conditioning system.	Employability
CO2: Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems.	Employability/Skill Development
CO3: Present the properties, applications and environmental issues of different refrigerants.	Employability
CO4: Calculate cooling load for air conditioning systems used for various system.	Employability/Skill Development
CO5: – Operate and analyze the duct size and ventilation area cycles	Employability/Skill Development/Entrepreneurship

SECTION A

Introduction: Purpose, applications, definition and components of air conditioning - Need and methods of ventilation - Course outline. Psychometric: Evolution of air properties and psychometric chart - Basic processes such as sensible heating/cooling, humidification/dehumidification and their combinations, steam and adiabatic humidification, adiabatic mixing, etc. - Bypass factor and Sensible heat ratio. Method of heat load calculation.Summer and Winter AC: Simple summer AC process, Room sensible heat factor, Coil sensible heat factor, ADP - Precision AC - Winter AC.

SECTION B

Human Comfort: Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort - Thermal response - comfort factors - Environmental indices - Indoor air quality.AC Equipment - Filters, types, efficiency - Fans basic

equations, parallel and series configurations - Air washer, adiabatic, heated and cooled - Cooling tower, enthalpy potential, types, tower efficiency, NTU and characteristics, sizing and off design performance - Cooling and dehumidifying coil, dry and wet, sizing, performance.

Sound Control- Definitions of various terms like level, pitch, attenuation, frequency, sources of noise in air conditioning plants, design procedure for noise prevention, noise and vibration study and elimination techniques

SECTION C

Heat Transfer - Heat transfer in wall and roof, sol-air temperature, insulation, cooling load temperature difference - Fenestration, types of glass, sun shade, shading coefficient, maximum radiation, cooling load factor. Direct and Indirect Evaporative Cooling: Basic psychometric of evaporative cooling, types of evaporative coolers, design calculations, indirect evaporative cooling for tropical countries. Cooling Load Estimation: Design conditions, outdoor, indoor - External load, wall, roof, glass - Internal load, occupancy, lighting, equipment - Ventilation, air quantity, loads - Load estimation methods

SECTION D

Heating load estimation: Vapour transfer in wall, vapour barrier, load estimation basics Air Distribution - Ducts, types, fittings, air flow, friction chart, methods of sizing, balancing. Air Diffusion - Isothermal jet, throw, drop, types of outlets, ADPI, outlet/inlet selection. Basics of Ventilation- Need, threshold limits of contaminants, estimation of ventilation rates, decay equation, air flow round buildings. Methods of Ventilation - Natural, wind effect, stack effect, combined effect - Mechanical, forced, exhaust, combined - Displacement ventilation, Industrial Ventilation - Steel plants, car parks, plant rooms, mines, etc

Ventilation System Design - Exhaust ducts, filters, blowers, hoods, chimney, etc

TEXT BOOKS & REFERENCES:

1. Arora, C.P., Refrigeration and Air Conditioning, Tata-McGraw- Hill, New Delhi, 2003.

2.Hainer R. W., Control System for Heating, Ventilation and Air conditioning, Van Nastrand Reinhold Co., New York, 1984.

CO-PO Mapping

Course Outcomes	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1:	3	2	2		2	2			2			3	3	2
CO2:	3	3	2		2	2			2			3	3	2
CO3:	3	3	2		2	2			2			3	3	2
CO4:	3	3	2		2	2	3		2			3	3	2
CO5:	3	2	3		3	2	3		2			3	3	2

Course Title/ Code	HEATING, VENTILATION & AIR-CONDITIONING LAB/ MEH409B-P
Course Type	OPEN ELECTIVE
Course Nature	Hard
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: To calculate heat load calculation for different application.	Employability/Skill Development
CO2: Application of eQuest Software for HVAC System	Employability/Skill Development/Entrepreneurship
CO3: Duct Designing	Employability/Skill Development/Entrepreneurship

LIST OF EXPERIMENTS:

1. To use the Psychometrics chart and human comfort chart and calculation of air velocity/distribution to best conditions.
2. To do the energy audit of building and heat load calculations of non-insulated and insulated building.
3. To explain the chilling plant and its working cycle.
4. To calculate the performance factor of split A.C and commercial air conditioning units
5. To design of duct system for a load calculated building.
6. To calculate noise and study the elimination techniques in air conditioning system.
7. To explain different types of cooling system in air conditioning system.
8. To explain different insulating materials in buildings.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P0 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	3	3			3		2		2	1		3
CO2	3	3	3	2			3		2		2			3
CO3	3	3	3	3			3		3		2			3

Course Title/ Code	FINITE ELEMENT ANALYSIS /MEH410B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credits	3

Course Outcome	Mapping
CO1: Understand the fundamental concepts of finite element method to solve engineering problems	Employability/Skill Development
CO2: Formulate finite element models using appropriate element selection, development ofstiffness & force matrices, and application of boundary conditions	Employability/Skill Development/Entrepreneurship
CO3: Solve structural, thermal, and dynamic problems using the developed finite element formulations	Employability/Skill Development/Entrepreneurship

SECTION A

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

SECTION B

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

SECTION C

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

SECTION D

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, and introduction to FE software.

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P0 10	PO 11	PO 12	PS O1	PS O2
CO1	3	1	2	2								3	3	
CO2	3	1	2	1								1	3	
CO3	3	1	3	1					2			1	3	

Course Title/ Code	FINITE ELEMENT ANALYSIS LAB/MEH410B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credits	1

Course Outcome	Mapping
CO1: Demonstrate the ability to create models for structural, thermal, and fluid flow applications using commercial finite element packages	Employability/Skill Development
CO2: Interpret the analysis results to improve product and system design	Employability/Skill Development/Entrepreneurship

List of Experiments

1. Study of a FEA package and analysis of;
    a. Trusses
    b. Bars of constant cross section area, tapered cross section area and stepped bar.
    c. Beams -Simply supported, cantilever, beams with UDL, and beams with varying load etc.
    d. Stress analysis of a rectangular plate with a circular hole, axisymmetric problems.
    e. Dynamic Analysis 1) Fixed -fixed beam for natural frequency determination
        i. Bar subjected to forcing function
        ii. Fixed -fixed beam subjected to forcing function

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P0 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2	2	2				2			2	3	

CO2	**3**	**3**	**3**	**3**	**3**				**3**			**3**	**3**	

Course Title/ Code	NANOCOMPOSITES /MEH411B-T
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	3-0-0
Credit	3

Course Outcome	Mapping
CO1: Understanding the different top down and bottom-up approaches for nanoparticles	Employability/Skill Development
CO2: Get to know the different applications of nanoparticles in chemical engineering field.	Employability/Skill Development
CO3: Learning the characterization techniques for nanoparticles.	Employability/Skill Development

SECTION-A

Introduction Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of Constituents Nomenclature, Status of Nanocomposites past and present. Core-shell nanocomposite, super hard Nanocomposites.

SECTION-B

Fabrication of Various Types of Nanocomposites Ceramic Metal Nanocomposite Systems. Nanocomposites based on polymer matrix: Carbon carbon- Carbon-metal nano-composites- Natural nano-composites: Biomimetic nano-composites and biologically inspired nanocomposites. Nanocomposites synthesized biologically; Nanocomposite materials modeling: green nanocomposites.

SECTION-C

Processing and Characterizations Processing of nanocomposites: Characterization of electrical and optical properties of nanocomposites: electrical and thermal conductivity- Detection of trace amounts of functional materials in metal nanocomposites by ICP-AES; Characterization of nanocomposites by XPS and XAS. Characterization of porous structures. Characterization of quasi-static and dynamic elastic properties. Mechanical testing.

SECTION-D

Applications of Nanocomposites Hybrid composite materials for therapy and food packaging- Functional graphene- carbon nanotube and polymer composite applications- Nano-composites for solar cells Nano-composites catalysts for Fischer-Tropsch synthesis- methane oxidation and biofuels Nano-composites films for gas sensing. Nanocomposites for electrodes and electrolyte applications.

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
3. Mechanics and Analysis of Composite Materials, V.V.Vasiliev and E.V. Morozov, (2001), Elsevier 4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P0 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2		2							2	3	
CO2	3	3	3		3							3	3	
CO3	3	3	3		3							2	2	

Course Title/ Code	NANOCOMPOSITES LAB/MEH411B-P
Course Type	ELECTIVE
Course Nature	HARD
L-T-P Structure	0-0-2
Credit	1

Course Outcome	Mapping
CO1: Understand applications of nanoparticles in chemical engineering field.	Employability/Skill Development
CO2: understand techniques for nanoparticles to create nanocomposites	Employability/Skill Development

List of Experiments

1. Preparation of epoxy polymer and montmorillonite (MMT)/epoxy polymer specimenEpoxy
2. Tensile Stress Testing of Epoxy Specimen
3. Tensile Stress Testing of Nanocomposite Specimens

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2		2							2	3	
CO2	3	3	3		3							3	3	

Course Title/Code	Entrepreneurship / MCS368B	
Course Type	Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Outcomes (COs)		Mapping
1	Understand the fundamental concepts and applicable processes of Entrepreneurship	Employability
2	Examine the innovative & entrepreneurial models & their design/actualization for viability & applicability	Employability
3	Understand Self discovery and entrepreneurial fervor	Employability
4	Analyse the entrepreneurial acumen towards mapping & application	Employability

SECTION-A

Decision to become an entrepreneur

Introduction to entrepreneurship- Defining entrepreneurship, characteristics of successful entrepreneurs, importance of entrepreneurship, Myths about entrepreneurs, Corporate entrepreneurship, Self Discovery & SWOT analysis, Effectuation –Meaning , Five principles of effectuation, , Defining a Start-up, 4 Ps of a Start up, Reasons of Start-up failure, Basic Model of entrepreneurial process.

SECTION-B

Opportunity discovery

Recognizing opportunities and generating Ideas, Validating the market need, Identify problem worth solving using Jobs to be done(JTBD) methodology, design Thinking- Meaning, Design Thinking Values, Design Thinking Process, Double diamond approach in design thinking

SECTION-C

Customer and Solution-

Customer Vs. Consumer, different market types and their specific requirements, estimate the market size, identify your customer Segment (through STP), Switching costs and psychological biases, understanding Market research for start ups, Customer profile ,Value proposition Canvas-

understanding the jobs, pains and gains.

SECTION-D

Business Model & Validation and Business Plan

Business Model- Concept, Elements of Business Model and Lean Approach, Lean canvas template, , Blue Ocean Strategy, difference between Solution Demo and MVP, Business plan- definition and importance, components of Business plan- market, technical and financial, legal and ethical aspects in a Start-Up.

Text book:

Entrepreneurship: Successfully Launching New Ventures, 6th edition, Bruce R. Barringer and R Duane Ireland, Published by Pearson Copyright © 2019, 6th edition

Reference Book:

Hispanic-Latino Entrepreneurship

e-Resources:eBooks about or by Drucker

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1			2	2		2	2	3	3	3	3	3		
CO2			3	3		3	2	2	3	3	3	3	2	2
CO3			2	3		2	2	2	3	3	3	3	2	2
CO4	2		3	2		3	3	2	3	3	3	3	2	2

MECHANICAL ENGINEERING

SEMESTER-8

SUBJECT CODE	SUBJECT NAME	OFFERING DEPARTMENT	COURSE NATURE (HARD/SOFT/ WORKSHOP/ NTCC	COURSE TYPE (CORE/ELECTIVE/ UNIVERSITY COMPULSORY	L	T	P	O	No. of Contact Hours per week	Credits
MEN411B	PROJECT/INDUSTRIAL TRAINING	ME	NTCC	CORE	0	0	0	16	16	8
TOTAL (L/T/P/O/CONTACT HOURS/CREDITS					0	0	0	16	16	8

Course Title/Code	Project/Industrial Training / MEN411B
Course Type	Core
Course Nature	Hard
Credit	8

Course Outcome	Mapping
CO1: Participate in the projects in industries during his or her industrial training.	Employability
CO2: Describe use of advanced tools and techniques encountered during industrial training and visit.	Employability
CO3: Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.	Employability
CO4: Develop awareness about general workplace behavior and build interpersonal and team skills.	Employability
CO5: Prepare professional work reports and presentations.	Employability

CO-PO Mapping

Course Outcomes	PO's												PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	2				2		3	3	3	2		2		
CO2	2				2		3	3	3	2		2		
CO3	2				2		3	3	3	2		2		
CO4	2				2		3	3	3	2		2		
CO5	2				2		3	3	3	2		2		