PROPOSED COURSE STRUCTURE AND SYLLABUS

B. Tech. Automobile Engineering

DEPARTMENT OF MECHANICAL ENGINEERING
DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY
LONERE 402 103

DIST – RAIGAD, MAHARASHTRA, INDIA

Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology for the overall development of students.

Mission

Imparting quality education, looking after holistic development of students, and conducting need-based research and extension activities.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex 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.
11. **Project management and finance:** Demonstrate knowledge and understanding of the 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.
12. **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.

Program Educational Objectives

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

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

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of mechanical engineering including thermal, manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate mechanical systems and processes considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer based methods and tools to develop mechanical systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	Lecture
T:	Tutorial
P:	Practical
C:	Total number of credits (per week)
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Program Core Course
POE:	Program Open Elective
PCE:	Program Core Elective
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
NCC:	National Cadet Corps
NSS:	National Service Scheme

B. Tech. Automobile Engineering

Scheme of Syllabus

Semester-I

Effective from 2017-2018

Code	Subject	L	T	P	C
BSH 101	Engineering Mathematics	3	1	0	4
BSH 102	Communication Skills	3	0	2	4
BSH 103	Engineering Physics	3	1	2	5
ME 104	Engineering Graphics	2	0	4	4
EE 105	Basic Electrical Engineering	3	0	2	4
ME 106	Basic MECHANICAL Engineering	3	0	0	3
ME 107	Energy and Environmental Engineering	2	0	0	2
IX 108	NCC/NSS/SPORTS/ARTS*	0	0	0	0
		19	**2**	**10**	**26**

*****Mandatory extra-curricular activities

Semester-II

Code	Course	L	T	P	C
BSH 201	Engineering Mathematics-II	3	1	0	4
ME 202	Engineering Mechanics	3	0	2	4
BSH 203	Engineering Chemistry	3	1	2	5
EX 204	Basic Electronics Engineering	3	0	2	4
CE 205	Basic Civil Engineering	3	0	0	3
CO 206	Programming in C	2	0	4	4
ME 207	Workshop Practices	0	0	2	1
IX 208	NCC/NSS/SPORTS/ARTS	0	0	0	0
		17	**2**	**12**	**25**

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Semester-III

Effective from 2018-2019

Code	Course	L	T	P	C
BSH 301	Engineering Mathematics III	3	1	0	4
AE302	Automotive Component Drawing and Computer Aided Drafting	2	0	0	2
AE303	Strength of Materials	3	1	0	4
AE 304	Material Science and Metallurgy	3	1	0	3
AE 305	Engineering Thermodynamics	3	0	0	3
BSH 306	Basic Human Rights	2	0	0	2
BSH 307	Elective – I	3	0	0	2
AE 308	Material Science and Metallurgy Lab	0	0	2	1
AE 309	Automotive Component Drawing and Computer Aided Drafting Lab	0	0	2	2
AE 310	Strength of Materials Lab	0	0	2	1
AE 311	Engineering Thermodynamics Lab	0	0	2	1
IX 311	NCC/NSS/Sports/Arts	0	0	0	0
		19	**3**	**6**	**24**

Elective-I (From Humanities and Basic Sciences)

BSH 307A Physics of Engineering Materials
BSH 307B Interpersonal Skills
BSH 307C Value Education

Semester-IV

Code	Subject	L	T	P	C
AE 401	Theory of Machine	4	0	0	4
AE 402	Theory of Automotive Engines	4	0	0	4
AE 403	Fluid Mechanics and Machines	3	1	0	4
AE 404	Manufacturing Processes	3	0	0	3
AE 405	Automobile Engineering	3	0	0	3
AE 406	Elective – II	3	0	0	3
AE 407	Theory of Automotive Engines Lab	0	0	2	1
AE 408	Fluid Mechanics and Machines Lab	0	0	2	1
AE 409	Theory of Machine Lab	0	0	2	1
AE 410	Manufacturing Processes Lab	0	0	2	1
IX 411	NCC/NSS/Sports/Arts	0	0	0	0
		20	**1**	**8**	**25**

Elective - II

AE 406A	NSS- I
AE 406B	Biology for Engineers
AE 406C	Renewable Energy Sources

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Semester-V
Effective from 2019-2020

Code	Course	L	T	P	C
AE 501	Alternative Fuels for IC Engines	3	0	0	4
AE 502	Automotive Transmission System	3	1	0	4
AE 503	Automotive Chassis and Suspension	3	0	0	3
AE 504	Heat Transfer	3	1	0	4
AE 505	Automobile Electricals and Electronics	3	0	0	3
AE 506	Elective – III	3	0	0	3
AE 507	Automobile Electricals and Electronics Lab	0	0	2	1
AE 508	Heat Transfer Lab	0	0	2	1
AE 509	Automotive Transmission System Lab	0	0	2	1
AE 510	Automotive Chassis and Suspension Lab	0	0	2	1
		18	**2**	**8**	**25**

Elective – III

AE 506A	NSS – II
AE 506B	Knowledge Management
AE 506C	Sustainable Developments
AE 506D	Automotive Materials

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Semester-VI
Effective from 2019-2020

Code	Course	L	T	P	C
AE 601	Vehicle Safety	3	0	0	4
AE 602	Automotive Body Engineering	3	0	0	4
AE 603	Design of Machine Element	3	1	0	3
AE 604	Vehicle dynamics	3	1	0	4
AE 605	Elective – IV	2	0	0	2
AE 606	Elective – V	3	0	0	3
AE 607	Automotive Body Engineering Lab	0	0	2	1
AE 608	Design of Machine Element Lab	0	0	2	1
AE609	Technical Project for Community Services	0	0	3	2
AE 610	Summer Vacation Training *	0	0	0	0
IX 611	NCC/NSS/Sports/Arts	0	0	0	0
		17	**2**	**7**	**24**

*Six weeks in Industry

Elective –IV

AE 605A	Entrepreneurship Developments
AE 605B	Quantitative Techniques in Project Management
AE 605C	Energy Conservation and Management
AE 605D	Development Engineering

Elective –V

AE 606A	Manufacturing Automation
AE 606B	Computer Integrated Manufacturing Systems
AE 606C	Finite Element Method and its Applications
AE 606D	Computer Simulation of IC Engine Processes

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Semester-VII
Effective from 2020-2021

Code	Course	L	T	P	C
AE 701	Special Purpose Vehicle	3	0	0	3
AE 702	Automobile Air conditioning	2	1	0	3
AE 703	Vehicle Performance and Testing	3	0	0	3
AE 704	Vehicle Maintenance Management	3	0	0	3
AE 705	Automotive Emission and Control	3	0	0	3
AE 706	Automobile Air conditioning Lab	0	0	2	1
AE 707	Vehicle Maintenance Management Lab	0	0	2	1
AE 708	Vehicle Performance and Testing Lab	0	0	2	1
AE 709	Seminar	0	0	3	2
AE 710	Summer Vacation Training *	0	0	0	2
AE 711	Project Stage – I	0	0	4	2
		14	**1**	**13**	**24**

*Evaluation of Six weeks Summer Vacation Training

**In case of students opting for Internship in the eighth semester, the Project must be industry-based

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Semester-VIII
Effective from 2020-2021

Code	Course	L	T	P	C
AE 801	Elective – VI*	3	0	0	3
AE 802	Elective – VII*	3	0	0	3
AE 803	Elective – VIII*	3	0	0	3
AE 804	Elective – IX*	3	0	0	3
AE 805	Elective – X*	3	0	0	3
AE 806	Project Stage-II	0	0	8	4
	Total	**15**	**0**	**8**	**19**

* In lieu of these Electives, Six months Internship in the industry including project

Elective –VI

AE 801A	Transport Management
AE 801B	Automobile Tribology
AE 801 C	Electric and Hybrid Vehicles

Elective –IX

AE 804A	Actuation System
AE 804B	Product Life Cycle Management (PLM)
AE 804C	Tractor and Farm Equipment

Elective –VII

AE 802A	Robotics
AE 802B	Fundamentals of Computational Fluid Dynamics
AE 802C	Ergonomics in Automotive Design

Elective –X

AE 805A	Operation Research
AE 805B	Motor Insurance Practices
AE 805C	Material Handling Systems

Elective –VIII

AE 803A	Vehicle Aerodynamics
AE 803B	Virtual Reality
AE 803C	Noise and Vibration

Semester I

Engineering Mathematics–I

BSH 101	Engineering Mathematics–I	BSC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Linear Algebra- Matrices

Elementary row and column transformations on a matrix; Rank of a matrix-normal form; Inverse of a matrix by using elementary transformations; Consistency and solutions of systems of linear equations using elementary transformations; Eigen values and Eigen vectors; Properties of Eigen values and Eigen vectors; Cayley-Hamilton's theorem (without proof) and its applications.ma

Unit 2: Differential Calculus and Its Applications

Successive differentiation – standard results; Leibnitz's theorem; Expansions of functions: Maclaurin's series, Taylor's series; indeterminate forms.

Unit 3: Partial Differentiation

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem; Total derivative; Change of variables.

Unit 4: Applications of Partial differentiations

Jacobians properties; Taylor's theorem for functions of two variables; Errors and approximations; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers.

Unit 5: Multiple Integrals and Their Applications

Double integrals and their evaluation; Change of order for integration; Double integrals in polar coordinates; Triple integrals; Application of multiple integrals to find area, volume, surface area, moment of inertia and centre of gravity.

Unit 6: Infinite Series

Definition of an infinite series; Types of infinite series - convergent, divergent and oscillatory; Positive term series - Comparison test, Integral test, D'Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's Root test; Alternating series - Leibnitz's rule; Absolute and conditional convergence; Power series – interval of convergence.

Texts/References:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. P. N. Wartikar, J. N. Wartikar, "A Text Book of Applied Mathematics (Vol I & II)", Pune Vidyarthi Griha Prakashan, Pune.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.
4. Dr. B. B. Singh, "A course in Engineering Mathematics (Vol I & II)", Synergy Knowledge ware, Mumbai.
5. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.
6. N. P. Bali, N. Ch. Narayana Iyengar, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi.
7. Peter O' Neil, "A Text Book of Engineering Mathematics", Thomson Asia Pte Ltd., Singapore.
8. C. R. Wylie & L. C. Barrett, "Advanced Engineering Mathematics", Tata McGraw Hill Publishing Company Ltd., New Delhi.

Communication Skills

BSH 102	Communication Skills	BHC	3-2-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Communication and Communication Processes

Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication, ways of Effective Communication.

Unit 2: Oral Communication

Use of Language in Spoken Communication, Features of Good Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Telephonic Etiquettes, Extempore, Elocution, Describing Experiences and Events**.**

Unit 3: Study of Sounds in English

Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English, Stress Mark.

Unit 4: English Grammar

Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors, Sentence Formation and Sentence Structures, Use of Appropriate Diction.

Unit 5: Writing Skills

Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Business Writing, Advertisements, Essay Writing, (Technical, Social, and Cultural Topics), Technical Reports: Report Writing: Format, Structure and Types, Writing Memorandum, Circulars, Notices, Agenda and Minutes, Technical Manuals, Brochures

Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

Unit 6: Reading Skills & Listening Skills

Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension.

Listening: Importance of Listening, Types of Listening, Barriers to Listening.

Texts/References:

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication", Oxford University Press, New Delhi, 2008.
2. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill, New Delhi, 2005.
3. Golding S.R, "Common Errors in English Language", Macmillan, 1978.
4. Christopher Turk, "Effective Speaking", E and FN Spon, London, 1985.

Engineering Physics

BSH 103	Engineering Physics	BSC	3-2-1	5 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Oscillation and Ultrasonic

Free oscillation, damped oscillation, Forced oscillation and Resonance, differential wave equation, Ultrasonic waves, production of ultrasonic's (Piezoelectric effect, Magnetostriction effect) and its applications.

Unit 2: Optics, Fibre Optics and Laser

Interference of light in thin film, wedge shaped film , Newton's rings, polarization of light, methods for production of polarized light, Huygens's theory of double refraction, Laurent's half shade Polarimeter, Diffraction of light, Introduction, diffraction grating Principle of laser, Einstein's coefficients, Types of laser – Ruby and He-Ne laser and their applications. Principle and structure of optical fibre, acceptance angle, acceptance cone, numerical aperture, types of optical fibre and its applications.

Unit 3: Electron Optics, Nuclear Physics and Quantum Mechanics

Motion of a charged particle in electric and magnetic field, C.R.O., Millikan's oil drop method, Bainbridge mass spectrograph, Q- value of nuclear reactions, G.M. counter, Davisson and Germer's electron diffraction experiment, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent wave equations, physical significance of wave function.

Unit 4: Crystal Structure and X-rays

Unit cell, Bravais lattice, cubic system, number of atoms per unit cell, coordination number, atomic radius, packing density, relation between lattice constant and density, lattice planes and Miller indices, Interplanar spacing for cubic system, Bragg's law, X-ray diffraction, Determination of Crystal Structure by X-ray diffraction, Line and Continuous Spectrum of X-ray, Mosley's law.

Unit 5: Magnetic and Superconducting Materials

Magnetic dipole moment, Types of magnetic materials, B-H curve, Classical free electron theory-electrical conductivity, resistivity and its temperature dependence, microscopic Ohm's law, Superconductivity, types of superconductors, Meissner effect and Applications.

Unit 6: Semiconducting, Dielectric and Electrodynamics

Band theory of solids, Fermi level in Intrinsic and Extrinsic Semiconductors (Only Concepts), conductivity of semiconductors, Hall effect, Dielectric parameters (Dielectric constant, Electric displacement, Polarization & Polarizability), Types of polarization and dielectric materials, temperature and frequency dependences of dielectric materials, Introduction of Maxwell equations, Electromagnetic wave in free space.

Texts/References:

1. M.N. Avadhanulu and P.G. Kshirsagar, "Engineering Physics".
2. R.K. Gaur and S. L. Gupta, "Engineering Physics".
3. Halliday and Resnik, "Fundamental of Physics".
4. David R. Griffiths, "Introduction to Electrodynamics".
5. Arthur Beizer, "Concept of Modern Physics".
6. Ghatak, "Optics".
7. C.M. Srivastava and C. Srinivasan, "Science of Engineering Materials".
8. A.J. Dekker, "Solid State Physics".

Engineering Graphics

ME 104	Engineering Graphics	PCC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Drawing standards and geometrical construction
Drawing standard SP: 46, Type of lines, lettering, dimensioning, scaling conventions.
Geometrical construction: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and a hexagon.

Unit 2: Orthographic Projections and Projections of Points
Introduction to orthographic projection, drawing of orthographic views of objects from their isometric views. Projection of points lying in four quadrants.

Unit 3: Projections Lines and Planes and their Traces
Projection of lines parallel and perpendicular to one or both planes, projection of lines inclined to one or both planes. Traces of lines. Projection of planes parallel and perpendicular to one or both planes, projection of planes inclined to one or both planes.

Unit 4: Projections of Solids Types of solids, projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes. Projection of spheres touching each other.

Unit 5: Sectioning of Solids, Isometric Projections
Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projection: Isometric scale, drawing of isometric projections from given orthographic views.

Unit 6: Development of surfaces and Introduction to Computer Aided Drafting
Development of surfaces: Development of cylindrical and conical surfaces Development of prisms. Introduction to computer aides: Introduction to computer aided drafting, drafting packages and tools to make drawings.

Engineering Graphics Lab

ME 104A	Engineering Graphics Lab	PCC	0-4-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents

List of Practical's/Experiments/Assignments:

Sr. No.	Sheet No.	Drawing Sheet Titles
1	01	Lines, lettering and dimensioning
2	02	Geometrical Constructions
3	03	Orthographic projections

4	04	Projections of points
5	05	Projections of lines
6	06	Projections of planes
7	07	Projections of solids
8	08	Section of solids
9	09	Isometric Projections
10	10	Development of Surfaces

Texts/References:

1. N.D. Bhatt, "Engineering Drawing", Charotar publishing House, 46th edition, 2003.
2. K. V. Nataraajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal, V. Prabhu Raja, "Engineering Graphics", New Age International (P) Ltd, 2008.

Basic Electrical Engineering

ME 105	Basic Electrical Engineering	PCC	3-2-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Elementary Concepts

Prerequisite: Concept of Potential difference. Current and resistance. Ohm's law, effect of temperature on resistance, resistance temperature coefficient, insulation resistance.SI units of work Power and Energy. Conversion of energy from one form to another in electrical and thermal systems.

Unit 2: D. C. Circuits (Only Independent sources)

Kirchhoff's law, ideal and practical voltage and current sources. Mesh and Nodal analysis (Super node and super mesh excluded). Source transformation. Star delta transformation. Superposition theorem, Thevevnins's theorem Norton's theorem, maximum power transfer theorem (Source transformation not allowed for superposition theorem, Mesh and Nodal analysis.

Unit 3: A.C. Fundamentals

Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor , and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Study of S.C circuits of pure resistance, inductance and capacitance and corresponding voltage- current phasor diagrams, voltage – current and power waveforms.

Unit 4: Single phase and poly phase A. C. circuits

A. Single phase AC Circuits: Study of series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active, reactive, apparent, complex power and power factor, resonance in series and parallel RLC circuit. Q-factor and band with
B. Polyphase AC circuits: Concept of three phase supply and phase sequence. Balanced and unbalanced loads voltage current and power relations in three phase balance star and delta loads and their phasor diagrams.

Unit 5: Electromagnetism

A. Magnetic effect of electrical current cross and dot convention, right hand thumb rule and cork screw rule, nature of magnetic field of long straight conductor, concepts of solenoid and torrid. Concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, their units and relationship. Simple series and parallel magnetic circuits, comparison between electrical and magnetic circuits, force on current carrying conductor placed in magnetic field, Fleming's left hand rule.
B. Faraday's law of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced EMF's self and mutual inductance coefficient of coupling, energy stored in magnetic field.
C. Introduction to electrical AC DC Machines: Principles of operation and applications.

Unit 6: Single phase transformer and electrostatics:

A. Single phase transformers: Construction, principle of working, e.m.f equations, voltage and current ratios, losses, definition of regulation and efficiency, determination of these by direct loading method. Descriptive treatment of autotransformer.

B. Electrostatics: electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and concept of time constant.

Term Work:

Term work shall consists of a record of minimum of eight experiments, out of which Group A is compulsory and five experiments from Group B be carried out.

Group-A

1. Wiring exercises:
   i. study of wiring components(Wires, Switches, Fuses, sockets, plug, lamps and lamp holders, rating of different accessories)
   ii. Control of two lamps from two switches (looping system)
   iii. Stair case wiring
   iv. Use of megger for insulation testing and continuity test of wiring installation and machines
2.
   i. Study of fluorescent tube circuit
   ii. Study of compact Fluorescent lamps(CFL) and Light Emitting Diode(LED) lamps
   iii. Study of sodium and mercury vapour lamps
3.
   i. Study of safety precautions while working on electrical installations and necessity of earthing
   ii. Introduction to energy conservation
   iii. Study of single line diagram of power system.

Group B: List of laboratory experiments (Minimum six)

1. Mesh and nodal analysis
2. Verification of super position theorem
3. Verification of Thevevnins's theorem
4. Study of R-L series and R-C series circuit
5. R-L=C series resonance circuit
6. R-L- -C parallel resonance circuit
7. Relationship between phase and line currents and voltages in 3-phase system (Star-Deltas)
8. Power and phase measurements in three phase system by two wattmeter methopd
9. OC and SC test on single phase transformer

Texts/References:

1. V. N. Mittal, Arvind Mittal, "Basic Electrical Engineering", Tata McGraw Hill.
2. Vincent DelToro, "Electrical engineering Fundamentals", PHI 2nd edition, 2011.
3. Bolestaad, "Electronics Devices and Circuits Theory", Pearson Education India.
4. Edward Hughes, "Electrical Technology", Pearson Education.
5. D.P. Kothari, Nagrath, "Theory and Problems in electrical Engineering", PHI edition, 2011.

Basic Mechanical Engineering

ME 106	Basic Mechanical Engineering	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Introduction to Mechanical Engineering

Thermal Engineering, Design Engineering, Manufacturing Engineering. Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, concept of thermal reservoir, irreversibility, Carnot cycle, Introduction to Heat Engine, Heat pump and refrigerator, efficiency.

Unit 2: IC Engines

Classification, Applications, 2 Stroke and 4 Stroke systems in IC Engines.

Unit 3: Mechanical's
Transmission systems, Suspension system, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, nuclear power plant

Unit 4: Design
Design basics, Mechanisms, Factor of safety, materials and metallurgical considerations

Unit 5: Engineering materials, machine elements, Transmission, Fasteners, support systems

Unit 6: Manufacturing
Classification, introduction to Lathe machine, Drilling machine, Milling machine, metal joining, Metal forming, casting (A visit to Workshop for demonstration)

Texts/References:

1. Lecture notes prepared by Department of MECHANICAL Engineering

Energy and Environmental Engineering

ME 107	Energy and Environmental Engineering	PCC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Conventional Power Generation

Steam power station, Nuclear power plant – Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo-electric and thermionic generators, Environmental aspects for selecting the sites and locations of power plants

Unit 2: Renewable Power Generation

Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Fuel cell, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantages and disadvantages

Unit 3: Energy conservation

Scope for energy conservation and its benefits Energy conservation Principle – Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers., lighting techniques

Unit 4: Air Pollution

Environment and Human health - Air pollution: sources- effects- control measures - Particulate emission, air quality standards, measurement of air pollution

Unit 5: Water Pollution

Water pollution- effects- control measures- Noise pollution –effects and control measures, Disposal of solid wastes, Bio-medical wastes-Thermal pollution – Soil pollution -Nuclear hazard

Unit 6: Environmental Laws and Sustainable development

Environmental protection act- Air act- Wildlife protection act – Forest conservation act- Disaster management – urban problems related to energy, watershed management, rainwater harvesting, and water conservation

Texts/References:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, "A Text book of Power System Engineering", Dhanpat Rai Publication.
2. Rai. G. D., "Non-Conventional Energy Sources", Khanna Publishers, Delhi, 2006.
3. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Prentice Hall, 2003.
4. Rao S., Parulekar B.B., "Energy Technology-Non conventional, Renewable and Conventional", Khanna Publishers, Delhi, 2005.
5. Glynn Henry J., Gary W. Heinke, "Environmental Science and Engineering", Pearson Education, Inc., 2004.
6. J. M. Fowler, "Energy and the Environment", McGraw Hill, 2nd edition, New York, 1984.

Semester II

Engineering Mathematics – II

BSH 201	Engineering Mathematics – II	BSC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Complex Numbers

Definition and geometrical representation; De-Moivre's theorem (without proof); Roots of complex numbers by using De-Moivre's theorem; Expansion of $\sin n\theta, \cos n\theta$ and $\tan n\theta$ in powers of $\sin\theta, \cos\theta$ and $\tan\theta$; Circular functions of complex variable – definition; Hyperbolic functions; Relations between circular and hyperbolic functions; Real and imaginary parts of circular and hyperbolic functions; Logarithm of Complex quantities.

Unit 2: Ordinary Differential Equation of First Order and First Degree

Introductory remarks - Order, degree and formation of differential equations; Solutions - variables separable, homogeneous equations, equations reducible to homogeneous form, linear equations, Bernoulli's equation, exact differential equations, equations reducible to exact equations; Application to physical and electrical systems.

Unit 3: Linear Differential Equations with Constant Coefficients

Introductory remarks - complementary function, particular integral; Rules for finding complementary function and particular integral; Method of variation of parameters; Cauchy's homogeneous and Legendre's linear equations.

Unit 4: Fourier Series

Introductory remarks- Euler's formulae; Conditions for Fourier series expansion - Dirichlet's conditions; Functions having points of discontinuity; Change of interval; Odd and even function- expansions of odd and even periodic functions; Half -range series, Harmonic analysis.

Unit 5: Vector Calculus

Differentiation of vectors – general rules of differentiation: Velocity and acceleration; Relative velocity and acceleration; Radial and transverse components of velocity and acceleration; Law of central orbits – orbital motion; Tangential and normal components of velocity.

Unit 6: Applications of Vector Calculus

Scalar and vector fields; Gradient, divergence and curl; Solenoidal, irrotational vector fields; Vector identities; Integrals – line, surface and volume; Green's theorem, Gauss' divergence theorem and Stokes' theorem (without proofs).

Texts/References:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. P. N. Wartikar, J. N. Wartikar, "A Text Book of Applied Mathematics (Vol I & II)", Pune Vidyarthi Griha Prakashan, Pune.
3. N. P. Bali & N. Ch. NarayanaIyengar, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi.
4. Dr. B. B. Singh, "A course in Engineering Mathematics (Vol I & II)", Synergy Knowledgeware, Mumbai.
5. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.
6. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.
7. Peter O' Neil, "A Text Book of Engineering Mathematics", Thomson Asia Pte. Ltd., Singapore.
8. C. R. Wylie & L. C. Barrett, "Advanced Engineering Mathematics", Tata McGraw Hill Publishing Company Ltd., New Delhi.

Engineering Mechanics

ME 202	Engineering Mechanics	PCC	3-2-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Basic Concepts

Idealization of Engineering Problems, Basis of Assumptions, Objectives of Engineering Analysis and Design, Fundamental principles, free body diagram, Newton's laws, gravitation, force, resolution and composition of a forces, resultant, parallelogram law, triangle law, transmissibility, couple, moment, Varignon's theorem, co-planner concurrent and non-concurrent forces, vectorial representation of forces and moments.

Unit 2: Equilibrium of Forces

Static equilibrium, 2-D and 3-D statics, analytical and graphical conditions of equilibrium, types of supports, types of load, Lami's theorem, frames, beams, support reactions, force systems in space, concurrent forces in space, couples in space, parallel forces in space, general case of forces in space, Simple trusses (plane and space), method of joints, method of sections.

Unit 3: Centroid, Friction

Centre of gravity, centroid, centroid of composite area, moment of inertia of sections, radius of gyration. Coulomb law, surface contact problems, friction angles, wedge friction, sliding friction and rolling resistance. **Dynamics**

Unit 4: Kinematics

Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, relative and constrained motion, motion under gravity, angular motion, relation between angular motion and linear motion, tangential and radial acceleration;

Relative velocity, centrifugal and centripetal forces, projectile motion, kinematics of rigid bodies, instantaneous center of rotation.

Unit 5: Kinetics

Center of mass, mass moment of inertia, kinetics of particle, Newton's laws, D'Alembert's principle, problems on linear motion and centroidal rotation, kinetics of rigid bodies, translation, fixed axis rotation, super elevation of road and railway curves, general planar motion.

Unit 6: Work, Power, Energy

Principle of virtual work, virtual displacements for particle and rigid bodies, work done by a force, spring, potential energy, kinetic energy of linear motion and rotation, work energy equation, conservation of energy, power, impulse momentum principle, collision of elastic bodies.

Students are expected to satisfactorily complete at least eight experiments listed below.
List of Practical's/Experiments/Assignments

1. Polygon law of coplanar forces.
2. Centroid of irregular shaped bodies.
3. Bell crank lever.
4. Support reaction for beam.
5. Problems on beam reaction by graphics statics method.
6. Simple / compound pendulum.
7. Inclined plane (to determine coefficient of friction).
8. Collision of elastic bodies (Law of conservation of momentum).
9. Moment of Inertia of fly wheel.
10. Verification of law of Machine using Screw jack / Worm and Worm Wheel / Single and Double Gear Crab.
11. Application of Spreadsheet Program for simple applications such as law of moments, beam reactions, problems in kinematics, etc.

Any other experiment based on syllabus of Engineering Mechanics**.**

Texts/References:

1. S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill, 1995.
2. Tayal A. K., "Engineering Mechanics", Umesh Publications, 2010.
3. Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2nd Edition.
4. Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw Hill Company Publication, 7th edition, 1995.
5. Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourth edition, 2003.
6. McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, New Delhi, Publication.

7. Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub. York.

Engineering Chemistry

BSH 203	Engineering Chemistry	PCC	3-2-1	5 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Water Treatment

Introduction, hard and soft water, softening of water – Zeolite process, Ion exchange process, Hot Lime –Soda process, water characteristics- Hardness, Dissolve oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD).

Unit 2: Phase Rule

Phase Rule, statement, Explanation of the terms – Phase, Components, Degrees of freedom. One component system – Water and Sulphur. Reduced phase rule equation, Two components alloy system- Phase diagram of Silver- Lead alloy system.

Unit 3: Metallurgy

Introduction, Occurrence of metals, types of ores, concentration of ores by physical methods- Crushing and Sizing, Froth- Flotation, Magnetic Separation, Gravity separation method.

Chemical methods-Calcination, Roasting, Reduction of Ore- by Pyrolysis, Chemical reductions, Refining of Metals.

Unit 4: Fuels and Lubricants

Fuels: Introduction, classification of fuel, essential properties of fuel, characteristics of good fuel, solid fuel- Coal, Various types of Coal, Analysis of coal- Proximate and Ultimate analysis, liquid fuel- Refining of Petroleum

Lubricants: Introduction, function of lubricants, types of lubrication – Thick film, Thin film and Extreme pressure lubrication, classification of lubricants - Solid, Semi –solid and Liquid Lubricants, properties of lubricants, Physical properties – Viscosity, Viscosity index, surface tension, Oiliness, Flash point and Fire point, Pour point and Cloud point. Chemical properties – Acidity, Emulsification, Saponification.

Unit 5: Study of Organic Compounds

Introduction and study of aromatic compounds. Naphthalene: Introduction, Haworth synthesis, manufacture, physical and chemical properties, uses. Anthracene: Introduction, Haworth synthesis, manufacture, physical and chemical properties, uses. Pyridine: Structure determination, Synthesis, Manufacture, physical and chemical properties, uses. Manufacture of alcohol by Fermentation process.

Unit 6: Electrochemistry

Introduction - basic concepts, Transport number and its determination by Moving Boundary method, Debye- Huckel theory, Conductometric titrations, Ostwald's theory of acid- base indicator, Quinonoid theory, Electrodes – Glass electrode, Quinhydrone electrode.

Tests/References:

1. Bhal and Bhal, "Advance Organic Chemistry", S. Chand & Company, New Delhi, 1995.
2. Jain P.C., Jain Monica, "Engineering Chemistry", Dhanpat Rai & Sons, Delhi, 1992.
3. Bhal & Tuli, "Text book of Physical Chemistry", S. Chand & Company, New Delhi, 1995.
4. Finar I. L., "Organic Chemistry (Vol. I & II)", Longman Gr. Ltd & English Language Book Society, London.
5. Barrow G.M., "Physical Chemistry", McGraw-Hill Publication, New Delhi.
6. Shikha Agarwal, "Engineering Chemistry- Fundamentals and applications", Cambridge Publishers - 2015.
7. O. G. Palanna, "Engineering Chemistry", Tata McGraw-Hill Publication, New Delhi.
8. WILEY, "Engineering Chemistry", Wiley India, New Delhi 2014.

Basic Electronics Engineering

ME 204	Basic Electronics Engineering	PCC	3-2-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Basic Concepts

Electronics and its evolution, atomic structure, permitted orbits, Quantum Numbers, periodic table, electrons in solids, bonding in solids: ionic bond, covalent bond, metallic bond, secondary bonds, atom arrangement in materials, crystalline structure of metals, classification of engineering materials: metals and alloys, ceramics, organic polymers, composite materials, classification of solids: Conductors, Dielectric materials, Magnetic materials, semiconductors, Energy band description of materials.

Unit 2: Semiconductors

Conductivity of insulators, metals and semiconductors in terms of energy bands, the chemical bond in *"Si"* and *"Ge",* conductivity of intrinsic semiconductors, extrinsic semiconductors: *n-type and p-type* semiconductors, Hall Effect in semiconductors, Mechanism in current flow: drift and diffusion, Einstein relation, semiconductor materials: Element semiconductor, II-VI compound, III-V compounds, ternary and quaternary compounds. The junction diode: diode breakdown and current equation, diode equivalent circuit, diode as a switch, diode testing, other diodes.

Unit 3: Diode Applications and Transistors

V-I characteristics of PN-junction diode, Rectifiers: Half wave, centre tapped and bridge full wave. Zener diode regulator, voltage multiplier, clipping and clamping circuits.

Transistor:Introduction,classification, configurations, transistor as an amplifier, testing of transistor, load line analysis, biasing of the transistor, bias compensation, transistor as a switch.

Unit 4: Circuit Components

Resistors: colour code, material used for resistors, spools for resistance coils, resistance wires, resistance standards, sheet metal resistors, frequency errors in resistors.

Capacitors: colour code, capacitance standards, variable capacitors, frequency errors in capacitors. loss angle and power factor of capacitors

Inductors: standards of inductance, standards of mutual inductance, standards of self-inductance, variable inductance, inductors for high and low frequency work, frequency errors in inductors.

Unit 5: Measuring Instruments and Transducers

Introduction, PMMC instrument, ohmmeter, galvanometer, potentiometers, power factor meter, frequency meters.

Classification of transducers, characteristics and choice of transducers, strain gauges, thermistors, thermocouples, LVDT, Capacitive transducers, Piezo-electric transducers, opto-electronic transducers.

Unit 6: Introduction to Digital Electronics

Introduction, number system, number base conversions, basic logic gates, Universal logic gates, Boolean postulates, De-Morgan Theorems. Introduction to sequential and combinational logic circuits.

Texts/References:

1. B. L. Theraja, "Basic Electronics", S. Chand Limited, 2007
2. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGraw Hill, 2000.
3. Donald Neaman, "Electronic Circuit Analysis and Design", 3rd edition, Tata McGraw Hill.
4. David A. Bell, "ElectronicDevicesandCircuits",5th edition, Oxford press
5. R. L. Boylstad, L. Nashlesky, "Electronic Devices and circuits Theory", 9th Edition, Prentice Hall of India, 2006.
6. Anil K. Maini, Varsha Agarwal, "Electronic Devices and Circuits", Wiley India
7. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", 2nd edition, Oxford.
8. K. R. Botkar, "Integrated Circuits", 5th edition, Khanna Publication.

Basic Civil Engineering

ME 205	Basic Civil Engineering	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Introduction to civil engineering

Branches, role of civil engineer in various construction activities, important national projects, properties and uses of engineering materials: earth, bricks, timber, stones, aggregates, cement, steel, bitumen, glass, roofing and flooring materials, mortar, concrete.

Unit 2: Building Components:

Foundation and superstructure. Bearing capacity, functions of foundation, shallow and deep foundations, suitability in different situation, plinth, footings, raft foundation, pile foundation, machine foundation, walls, lintels, beams, columns, slabs, roofs, staircases, floors, doors, windows, sills, weather sheds, and utility fixtures.

Unit 3: Building Planning & Construction

Building plans, principles of planning, site selection for buildings, typical plan of a residential building, plinth area, carpet area, cost of building, FSI, building bye laws, ventilation and lighting, loads on structure, load bearing, framed construction, steel structures, function of lintel, types of tiles, materials used for plastering & painting.

Unit 4: Surveying

Principles of survey, selection of stations, location sketches, site plan, triangulations and traversing, chain and tape surveying, base line and offsets, ranging and reciprocal ranging, field book, cross staff, prismatic compass, Plane table surveying, dumpy level, Levelling staff, bench marks, reduced level, contours, planimeter, total station, remote sensing, GIS, GPS, photogrammetry.

Unit 5: Transportation engineering

Modes, classification of roads, general cross section of road, elements of road structure and their functions, rigid and flexible pavements, traffic signs and signals, road markings. Basics of railways, airport, harbour and docks.

Unit 6: Environmental engineering:

Environment and its components, importance and sources of water, dams, storage reservoirs, irrigation methods, watershed management and structures, ground water potential, rainwater harvesting, ground water recharge, IS specifications for drinking water, water treatment plant, need of sewage treatment & reuse of wastewater, sewage treatment plant, air pollution and its sources, air pollutants, air pollution control measures.

Students are expected to satisfactorily complete at eight experiments listed below.
List of Practical's/Experiments/Assignments

1. Study of basic building materials
2. Sketching Basic Components of Building
3. Study of Detailed Building Drawings
4. Distance Measurement by Chain, Tape and EDM
5. Offset marking by Cross-Staff, Optical Square or Compass
6. Demonstration of Basic Operations in Simple Levelling
7. Study of Detailed Survey Maps such as Contour Plans, Toposheets, etc.
8. Traffic survey during peak traffic period/hours
9. Study on standards of drinking water and various treatment processes
10. Demonstration on Compressive strength of concrete

Any other experiment based on syllabus of Engineering Mechanics.

Texts/References:

1. Anurag Kandya, "Elements of Civil Engineering", Charotar Publishing, Anand
2. M. G. Shah, C. M. Kale, and S. Y. Patki, "Building Drawing", Tata McGraw Hill
3. Sushil Kumar, "Building Construction", Standard Publishers Distributors
4. M. S. Palani Gamy, "Basic Civil Engineering", Tata Mc-Graw Hill Publication
5. Kanetkar T. P. and Kulkarni S. V., "Surveying and Levelling", Vols. I, II and III, Vidyarthi Gruh Prakashan, Pune
6. S. P. Chandola, "Transportation Engineering", S. Chand Publications
7. S.C. Rangwala, "Building Materials", Charotar Publishing House
8. J. K. McKay, "Building Construction- Volume I to IV", Orient Longman Publication
9. Satya Narayana Murty Challa, "Water Resources Engineering", New Age Intl. Publishers
10. B. C. Punmia, "Surveying", Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
11. G. K. Hiraskar, "Basic Civil Engineering", Dhanpat Rai Publications
12. Chudley. R., "Construction Technology", Vol.1, 2, 3, 4. ELBS Publisher
13. C. E. Justo, and Khanna, "Highway Engineering",
14. NBC 2005, "National Building Code of India", Parts III, IV, VII and IX, B.I.S. New Delhi

15. SP 7- National Building Code Group 1 to 5, B.I.S. New Delhi
16. I.S. 962 - 1989 Code for Practice for Architectural and Building Drawings, B.I.S. New Delhi
17. Garg S. K., "Irrigation Engineering', Khanna Publications, New Delhi
18. C B I & P, River Behaviour, "Management and Training"
19. Rao and Rao, "Air Pollution", Tata McGraw Hill Publications, New Delhi
20. Garg S. K., "Water Supply Engineering", Khanna Publishers, New Delhi
21. G. S. Birdi, "Environmental Engineering".

Programming in C

ME 206	Programming in C	PCC	2-4-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Process of programming

Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms.

Unit 2: Types, Operators and Expressions

Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

Unit 3: Control Flow
Statements and Blocks. If else, else-if switch Loops while and for, do-while break and continue got and Labels.

Unit 4: Functions and Program Structure
Basic of functions, functions returning non-integers external variables scope rules, header files, static variables, register variables block structures initialization.

Unit 5:
Arrays in C Initializing arrays, Initializing character arrays multidimensional arrays, command line arguments.

Unit 6: Structures in C
Basics of structures, structures and functions arrays of structures, self-referential structures table lookup. Input and Output C Standard Library.

List of Practical's/Experiments/Assignments

1. Assignment on Flow chart.
2. Hello world example (display message to user)
3. Program to take input from user and display its value.
4. Basic example for performing different operations using operator. (with and without using scanf).
5. Basic Program on Operator. (using scanf)
    - Program to find and print area, perimeter and volume of geometric objects.
    - Program to check Perfect number.
6. Program to find maximum and minimum between two entered numbers (using if-else and conditional statement).
7. Program to swap two entered numbers.
    - Using function
    - without function
8. Program to print square and factorial of an entered number (while loop).
    - Program to find sum of digits of entered number.
9. Program to check Palindrome number.
10. Program to check Armstrong number.
11. Program to check and generate prime numbers up to n.
12. Program to find GCD of two entered numbers.
13. Program to find maximum and minimum from n entered numbers.
14. Program to print alternate numbers from n entered numbers.
15. Program to search an element in an Array using linear and binary search.
16. Program to print entered numbers in ascending order using sorting.
17. Program to print addition, subtraction and multiplication of Matrices.
18. Program to find length of string. (with and without using library function).

19. Programs demonstrating use of Structures, Arrays of Structures and Structure containing arrays.
20. Pattern (pyramid) printing
    - Pascal triangle.
    - Floyds triangle.
    - Number patterns.
    - Star (*) patterns.

Texts/References:

1. Brain W Kernighan, Dennis Ritchie, "The C Programming Language", 2nd edition, Prentice Hall, 1988.
2. R. S. Bichkar, "Programming with C", Orient Blackswan, 1st edition, 2012.
3. Herbert Schildit, "C the Complete Reference", Osborne, McGraw Hill, 2000

SEMESTER III

Engineering Mathematics-III

BSH 301	Engineering Mathematics-III	BSC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions (K2, A2)
CO2	Apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients (K3, A4)
CO3	Conceptualize the definitions and properties of Fourier transforms (K2, A4)
CO4	Solve boundary value problems using Fourier transforms (K3, A3)
CO5	Find the series solutions of the linear differential equations using Frobenius method (K2, A2, S3)
CO6	Find the solutions of partial differential equations governing real-world problems (K2, A4)
CO7	Conceptualize limit, continuity, derivative and integration of complex functions (K2, A4)
CO8	Evaluate complex integrals useful in real-world problems (K5, A4, S4)

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1	2		1			1		1
CO2	3	2		2	2		2	1	2	1	1	2
CO3	2	1		1	2		1			1		1
CO4	3	2		2	2		2	1	1	1	1	2
CO5	3	1		1	2		1					1
CO6	3	2	1	2	2	1	2	1	3	1	1	2
CO7	2				1							1
CO8	3				1					1	1	2

Course Contents:

Unit 1: Laplace Transform

Definition: conditions for existence; Transforms of elementary functions; Properties of Laplace transforms: Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions: periodic function, error function, unit step function .

Unit 2: Inverse Laplace Transform

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform

Definitions: integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Convolution theorem for Fourier Transforms; Application to boundary value problems.

Unit 4: Series Solutions of Differential Equations and Special Functions

Validity of series solution; Series solutions about ordinary and singular point; Frobenius method; Series solution of Bessel equation; Recurrence relations for Bessel function; Generating function for Bessel function; Orthogonality of Bessel function.

Unit 5: Partial Differential Equations and Their Applications

Formation of Partial differential equations; Solutions of Partial differential equations – direct integration, linear equations of first order (Lagrange's linear equations), homogeneous linear equations with constant coefficients; Method of separation of variables – application to find solutions of wave equation, one dimensional heat equation and Laplace equation.

Unit 6: Calculus of Complex Functions

Limit and continuity of f(z); Derivative of f(z) – Cauchy-Riemann equations; Analytic functions; Harmonic functions - orthogonal system; Conformal transformations; complex integration –Cauchy's theorem, integral formula; Residue theorem.

Texts:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. P. N. Wartikar & J. N. Wartikar, "A Text Book of Applied Mathematics (Vol. I & II)", Pune Vidyarthi Griha Prakashan, Pune.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.
4. Dr. B. B. Singh, "A course in Engineering Mathematics (Vol. III)", Synergy Knowledgeware, Mumbai.

References:

1. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.
2. N. P. Bali & N. Ch. Narayana Iyengar, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi.
3. Peter O' Neil, "A Text Book of Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore.
4. C. R. Wylie & L. C. Barrett, "Advanced Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Dr. B. B. Singh, "Integral Transforms and their Engineering Applications", Synergy Knowledge ware, Mumbai.

Automotive Computer Drawing &Computer Aided Drafting

AE 302	Automotive Computer Drawing & Computer Aided Drafting	PCC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump, machine tool part etc.
CO5	Represent tolerances and level of surface finish on production drawings
CO6	Understand various creating and editing commands in Auto Cad

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Sectional Views

Full section, half section, partial section, off-set section, revolved sections, removed sections, auxiliary section, guidelines for hatching, examples on all above types of sections of machine elements.

Unit 2: Study of Machine Elements

Study of simple machine elements and components such as screwed fasteners, shaft couplings, pipe joints, riveted and welded joints, bearings, gears, etc.

Unit 3: Interpenetration of surfaces (emphasis on applied cases)

Line or curve of intersection of two penetrating cylinders, Cone and cylinder, prism and a cylinder, cone and prism, Forged ends, etc.

Unit 4: Drawing of Assembly and Details

Part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.

Unit 5: Production Drawing

Types of production drawings, size, shape and description; limits, fits and tolerances, surface roughness and surface roughness symbols,

Unit 6: Computer Aided Drafting

Introduction to Computer Aided Design and Drafting, Advantaged of CADD, study of preliminary AutoCAD commands like drawing, dimensioning, viewing commands. Drawing 3D views in AutoCAD, Introduction to Auto LISP programming.

Text:

1. N.D. Bhatt, Panchal, "Engineering Drawing", Charotar Publishing House, Anand, India.
2. N.D. Bhatt, Panchal, "Machine Drawing", Charotar Publishing House, Anand, India
3. Ajeet Sing, "WorkingwithAutoCAD2000", Tata McGraw Hill, New Delhi.
4. George Omura, "ABC of Autolisp", BPB Publications,New Delhi.

References:

1. Narayana, Kannaiah, Reddy, "Machine Drawing", New Age International Publishers.
2. AutoCAD and AutoLISP manuals from Autodesk Corp. U.S.A.
3. ISCode: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Strength of Materials

AE 303	Strength of Materials	PCC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, etc.
CO2	Recognise the stress state (tension, compression, bending, shear, etc.) and calculate the value of stress developed in the component in axial/eccentric static and impact load cases.
CO3	Distinguish between uniaxial and multiaxial stress situation and calculate principal stresses, max. shear stress, their planes and max. normal and shear stresses on a given plane.
CO4	Analyse given beam for calculations of SF and BM
CO5	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's, Area-moment and superposition methods
CO6	Differentiate between beam and column and calculate critical load for a column using Euler's and Rankine's formulae

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1:

Simple Stresses and Strains

Mechanical properties of materials, analysis of internal forces, simple stress and strain, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.

Unit 2:

Principal Stresses and Strains

Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principle stresses and principal planes, principal strains, shear strains, strain rosettes, Mohr's circle for stresses and strains.

Strain energy and resilience: Load deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, strain energy in terms of principal stresses.

Unit 3:

Combined Stresses

Combined axial and flexural loads, middle third rule, kernel of a section, load applied off the axes of symmetry.

Shear and Moment in Beams: Shear and moment, interpretation of vertical shear and bending moment, relations among load, shear and moment.

Unit 4:

Stresses in Beams

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections- rectangular, solid circular, I-section, other sections design for flexure and shear.

Unit 5:

Beam Deflections

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of area-moment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Unit 6:

Torsion

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation in determinate solid/homogeneous/composite shafts, torsional strain energy.

Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Texts:

1. S. Ramamrutham, "Strength of Materials", Dhanpat Rai & Sons, New Delhi.
2. F.L. Singer and Pytle, "Strength of Materials", Harper Collins Publishers, 2002.

3. S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

1. E. P. Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
2. S. H. Crandall, N.C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
3. S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.
4. B. C. Punmia, Ashok Jain, Arun Jain, "Strength of Materials", Laxmi Publications.

Material Science and Metallurgy

AE 304	Material Science and Metallurgy	PCC	3-1-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Analyze the structure of materials at different levels
CO2	Understand concept of mechanical behaviour of materials and calculations of same using appropriate equations
CO3	Explain the concept of phase and phase diagram and understand the basic terminologies associated with metallurgy
CO4	Understand and suggest the heat treatment process and types
CO5	Prepare samples of different materials for metallography
CO6	Understand the strengthening mechanisms and suggest appropriate NDT technique

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Structure of Materials

Crystal structures, indexing of lattice planes, Indexing of lattice directions, Imperfections in crystals - point defects, line defects, surface and bulk defects, Mechanism of plastic deformation, deformation of single crystal by slip, plastic deformation of polycrystalline materials

Unit 2: Mechanical Properties and their Testing

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, bend test, torsion test, formability, hardness testing, different hardness tests- Vickers, Rockwell, Brinnel, Impact test. Fatigue test, creep test

Unit 3: Equilibrium Diagrams

Definitions of terms, rules of solid –solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, property variation with microstructures, classification and application of steels,, specification of steels, transformation products of austenite, TTT diagram, critical cooling rate, CCT diagram

Unit 4: Heat Treatment

Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes- nitriding, carbo-nitriding, flame hardening, induction hardening

Unit 5: Metallography

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, macroscopy, sulphur printing, flow line observations, examination of fractures, spark test, electron microscope

Unit 6: Strengthening Mechanisms and Non-destructive Testing

Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye penetrant inspection, ultrasonic inspection, radiography, eddy current testing, acoustic emission inspection.

Texts:

1. V. D. Kodgire and S.V. Kodgire, "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 24th edition, 2008.
2. W. D. Callister, Jr., "Materials Science and Engineering: An Introduction", John Wiley and Sons, 5th edition, 2001.
3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.
4. S. H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill, 2nd edition, 1997.
5. R. A. Higgins, "Engineering Metallurgy: Part I", ELBS, 6th edition, 1996.

References:

1. V. B. John, "Introduction to Engineering Materials", ELBS, 6th edition, 2001.
2. G. F. Carter and D. E. Paul, "Materials Science and Engineering", ASM

International, 3rd edition, 2000.
3. T. E. Reed-Hill and R. Abbaschian, "Physical Metallurgy Principles", Thomson, 3rd edition, 2003.

Engineering Thermodynamics

AE 305	Engineering Thermodynamics	PCC	3-0-0	3 Credits

Pre-Requisites: Basic Mechanical Engineering, Engineering Mathematics, Engineering Chemistry

Course Outcomes: At the end of the course, students will be able to

CO1	Illustrate the ideal gas, real gas, its deviation with compressibility chart.
CO2	Explain the use of Maxwell's relations.
CO3	Analysis thermodynamic second law for various processes.
CO4	Analyze gas turbine cycles.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit1: Fundamental Concepts and Definitions

Thermodynamic systems; properties, processes and cycles. Thermodynamic equilibrium, Quasi-static process, Macroscopic vs. Microscopic viewpoint, Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.) Zeroth law of thermodynamics, specific heat and latent heat, point function, path function.

Unit2: First Law of Thermodynamics

First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume, application of first law of steady flow processes (nozzle, turbine, compressor pump, boiler, throttle valve etc.

Unit-3: Second Law of Thermodynamics

Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

Unit-4: Entropy
Clausius inequality, entropy as a property of system. entropy of pure substance. T-s and h-s planes, entropy change in a reversible and irreversible processes, increase of entropy principle, calculation of entropy changes of gases and vapours. Introduction to Available and unavailable energy:
Pvt relations, equation of state, relation between Cp and Cv, other equations of state

Unit 5: Properties of Steam:
Dryness fraction, enthalpy, internal energy and entropy, steam table and Mollier chart, first law applied to steam processes.
Vapour Power Cycles:
Carnot vapour cycle, Rankine cycle, Ideal reheat, Rankine cycle, Introduction to cogeneration. **Introduction to Gas Power Cycles:**
Air standard assumptions, Otto cycle, Diesel cycle, dual cycle, Stirling cycle, Ericsson cycle, Atkinson cycle, Brayton cycle.

Unit 6: Fuels and Combustion
Types of fuels, calorific values of fuel and its determination, combustion equation for hydrocarbon fuel, determination of minimum air required for combustion and excess air supplied conversion of volumetric analysis to mass analysis, fuel gas analysis. Stoichiometric A/F ratio, lean and rich mixture, products of combustion, properties of engine fuels.

Texts:

1. P. K. Nag, " Engineering Thermodynamics", Tata McGraw Hill, 3rd edition, New Delhi, 2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics–An Engineering Approach", Tata McGraw Hill, 5th edition, 2006.

References:

1. G. J. Van Wyle, R. E. Sonntag, " Fundamental of Thermodynamics", John Wiley & Sons, 5th edition, 1998.
2. M. J. Moran, H. N. Shaprio, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

Basic Human Rights

BSH 306	Basic Human Rights	PCC	2-0-0	2 Credits

Pre-Requisites: None
Course Outcomes: At the end of the course, students will be able to

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: The Basic Concepts
Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

Unit 2: Fundamental rights and economic program
Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Unit 3: Workers and Human Rights
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 4: NGOs and human rights in India
Land, Water, Forest issues.

Unit 5: Human rights in Indian constitution and law
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 6: Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Texts/References:

1. Shastry, T. S. N., "India and Human rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives (Law in India)", Oxford India.

Elective-I

Physics of Engineering Materials

BSH 307A	Physics of Engineering Materials	PEC	3-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												
CO8												

Course Contents:

Unit 1: Crystallography

Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction.

Unit 2: Magnetic Materials

Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferromagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.

Unit 3: Metals and Alloy Systems:

Alloy formation by crystallization, solidification, cooling curves, Solid solutions and intermediate, phases, Phases and phase rule, Construction of equilibrium diagrams from cooling curves, components of different solubility in liquid and solid state.

Eutectic, Eutectoid, Peritectic, transformations. Lever arm principles, Long and short-range freezing, dendritic structure and coring.

Unit 4: Polymers

Types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)-Engineering Ceramics –Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites-Classifications- Metal Matrix and FRP - Applications of Composites**.**

Unit 5: Composite Materials and Rubbers:

Introduction, Types of composite materials, properties, advantages, orthotropic and anisotropic behavior, Micromechanical and macromechanical analysis of composite material, Applications of composite materials. Natural rubber- production and properties-Compounding and Vulcanization of Rubber- Synthetic Rubbers - Buna Rubbers, Butyle Rubbers, Neoprene Thiokols, Polyurethane and a Silicons Rubbers.

Unit 6: Nano Materials

Nano-materials: Introduction and properties, synthesis of nano-materials, Carbon Nano Tubes, Characterization techniques of nano-materials- SEM, TEM, EDAX, FMR, XRD. Applications of Nano-materials.

Texts:

1. C. Kittle, "Introduction to Solid State Physics", 8th edition, John Wiley and Sons Eds, 2004.
2. C.M. Srivastava and C. Srinivasan, "Science of Engineering Materials and Carbon Nanotubes", 3rd edition, New Age International Publication,2010.
3. A.J. Dekker, "Solid State Physics", Pan Macmillan & Co. Ltd., London, 01st July, 1969.

References:

1. V. Raghavan, "Material Science and Engineering", Prentice-Hall Publication,5th edition,2007.
2. A.J. Dekker, "Electrical Engineering Materials", Prentice-HallPublication,1st Edition, 1959.

Interpersonal Skills

BSH 307B	Interpersonal skills	PEC	3-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Acquire interpersonal communication skills
CO2	Develop the ability to work independently.
CO3	Develop the qualities like self-discipline, self-criticism and self-management.
CO4	Have the qualities of time management and discipline.
CO5	Present themselves as an inspiration for others
CO6	Develop themselves as good team leaders

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1:

Development of Proficiency in English

Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups). 5 Ws & 1 H 7 Cs for effective Communication. Imbibing Etiquettes and manners. Study of different pictorial expressions of non-verbal communication and their analysis

Unit 2:

Self-Management

Self-Management, Self-Evaluation, Self-discipline, Self-criticism; Recognition of one's own limits and deficiencies, dependency, etc.; Self-Awareness, Self-Management, identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride. Leadership & Team Dynamics

Unit 3:

Time Management Techniques

Practice by game playing and other learning strategies to achieve the set targets Time Management Concept; Attendance, Discipline & Punctuality; Acting in time, Quality /Productive time.

Unit 4:

Motivation/ Inspiration

Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation.

Motivation techniques: Motivation techniques based on needs and field situations

Unit 5:

Interpersonal Skills Development

Positive Relationship, Positive Attitudes, Empathise: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills.

Unit 6:

Presentation Skills

Designing an effective Presentation; Contents, appearance, themes in a presentation, Tone and Language in a presentation, Role and Importance of different tools for effective presentation.

Texts/References:

1. Mitra, Barun, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. Ramesh, Gopal swamy, "The Ace of Soft Skills: Attitude, Communication and Etiquette for Success", Pearson Education, 2013.
3. Stephen R. Covey, "Seven Habits of Highly Effective People: Powerful Lessons in Personal Change", Free Press Publisher, 1989.
4. Rosenberg Marshall B., "Nonviolent Communication: A Language of Life" 3rd edition, Puddledancer Press, 1stSeptember, 2003.

Value Education

BSH 307C	Value Education	PEC	3-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Give an understanding of life in all its complexities and to provide practical opportunities and mould students to meet the needs of the people
CO2	Sharpen the capacity of the students in enabling them to make right moral and ethical choices
CO3	Develop professionals with social concern reaching out to the nation as leaders and serving the needy with divine grace and power
CO4	Analyze the economic, political and social situations with respect to values
CO5	Identify the changes that must be done to thrust the society towards moral recovery

Mapping of course outcomes with program outcomes

Course Outcomes	Program 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
CO1						1						
CO2						2	1	3				
CO3						2			3			
CO4							1					
CO5								3				

Course Contents:

Unit 1: Introduction

Definition, definition of values, why values? Need for inculcation of values, object of value education, sources of value, types: personal values, social values, professional values, moral and spiritual values, behavioural (common) values.

Unit 2: Personal values

Definition of person, self-confidence, self-discipline, self-assessment, self-restraint, self-motivation, determination, ambition, contentment humility and simplicity, sympathy and compassion, gratitude, forgiveness, honesty, courtesy.

Unit 3: Social values

Definition of society, units of society, individual, family, different groups, community, social consciousness, equality and brotherhood, dialogue, tolerance, responsibility, co-operation, freedom repentance and magnanimity.

Unit 4: Professional values

Definition, competence, confidence, devotion to duty, efficiency, accountability, respect for learning/learned, willingness to learn, open and balanced mind, team spirit, professional ethics, willingness for discussion, aims, efforts, avoidance of procrastination and slothfulness, alertness.

Unit 5: Moral values

Detachment, Faith, Loyalty, Non-violence, Obedience, Prayer, Purity, Renuciation, Truthfulness; Inculcation of values: Direct and indirect approaches; process of inculcation: Being sensitive, identifying the appropriate values, internalizing the values, practicing the values.

Unit 6: Behavioural values

Individual values and group values, good manners at home and outside, equality, purity of thoughts, speech and action, understanding the role of religion, faith, understanding commonness of religions, respect for other faiths, unity, diversity, living together, tolerance, non-violence, truthfulness, common aim, unified efforts towards peace, patriotism.

References:

1. Dr. S. Ignacimuthu, S. J., "Values for life", better yourself books, Bandra, Mumbai, 1999.
2. R. P. Dhokalia, "Eternal Human Values", NCRT Campus, Sri Aurobindo Marg, New Delhi.
3. Ramakrishna Math, "Values: Collection of Essays", Chennai, 1996.

Material Science and Metallurgy Lab

AE 308	Material Science and Metallurgy Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Select a heat treatment process required for change in material properties.
CO2	Apply powder metallurgy method for production of metals with advance properties
CO3	Select appropriate material for a particular application.
CO4	Identify a place of external or internal defect present in a material.

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments (any eight):

1. Brinell Hardness Test
2. Rockwell Hardness test
3. Erichson Cupping Test
4. Magnaflux Test
5. Dye Penetrant Test
6. Specimen Preparation for Microscopy
7. Sulphur Print Test
8. Spark Test
9. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
10. Study and drawing of microstructures of heat treated steels
11. Jominy End Quench Test

12. Study and drawing of microstructures of cast irons
13. Study and drawing of microstructures of non-ferrous alloys
14. Hardening of steels of varying carbon percentage

Automotive Component Drawing & Computer Aided Drafting Lab

AE 309	Automotive Component Drawing & Computer Aided Drafting Lab	PCC	0-0-2	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Draw Conventional representation of standard machine components, welds, materials etc.
CO2	Draw sectional view of a given machine component.
CO3	Develop Assemble view from details of given component i.e. valve, pump, machine tool part, etc.
CO4	Combine details of given machine component and draw assembled view.
CO5	Use various Auto-Cad commands to draw orthographic projection
CO6	Draw sectional view from pictorial view of given machine component using Auto-Cad

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	1	1		1				1			
CO2	2	1	1		1				1			1
CO3	3	1	1		1				2	1		2
CO4	3	1	1		1				2	1		1
CO5	2	1	1		2				2	2		1
CO6	1	1	1		1				1	1		1

List of Practical's/Experiments/Assignments:

1. One full imperial drawing sheet consisting the drawing/ sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.
2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignment of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model at least one simple machine component.

Strength of Materials Lab

AE 310	Strength of Materials Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Perform tension, compression, shear and torsion tests for various metals and alloys
CO2	Perform flexure, impact and deflection tests for various materials such as timber, cast iron, etc.
CO3	Measure stress and strain experimentally using photo-elasticity, strain gauges, etc.
CO4	Carry out experiments to demonstrate thermal stresses.

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments (any 8 experiments from the list)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminium, etc.
2. Compression test on mild steel, aluminium, concrete, and wood
3. Shear test on mild steel and aluminium (single and double shear tests)
4. Torsion test on mild steel and cast iron solid bars and pipes
5. Flexure test on timber and cast iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminium, and cast iron specimens
9. Experiments on thermal stresses

Semester –IV

Theory of Machines

AE 401	Theory of Machines	PCC	4-0-0	4 Credits

Pre-Requisites: Applied Mechanics and Engineering Graphics

Course Outcomes: At the end of the course, students will be able to

CO1	Select appropriate mechanism to design and develop a machine for an application
CO2	Analyze the mechanisms to determine velocity and acceleration of various links of the mechanism
CO3	Design and draw profile of the cam to obtain specified follower motion for an application
CO4	Analyze the governor to determine its height for the corresponding change in speed and sleeve displacement
CO5	Explain lower pair mechanisms and select them to meet the need where they are suitable
CO6	Explain and apply friction concepts in automotive and mechanical applications.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1
Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom, Study of various mechanisms, Steering system & mechanism, suspension.

Unit 2
Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method, Corioli's component of acceleration
Classification of gears, Terminology of spur gears, Conjugate action, Involute and cycloidal profile.

Unit 3
Path of contact, contact ratio, Interference, Undercutting, Internal gears.
Helical gear terminology, Normal and transverse module, Torque transmitted by helical gears, Spiral gears, Efficiency of spiral gears, Worm and Bevel gear terminology.
Gear Trains: Velocity ratios, Types of gear trains, Tooth load, Torque transmitted and holding torque.

Unit 4
Cams and Followers: Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion
Flywheel: Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of prime movers and machines.

Unit 5
Friction and Lubrication: Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Frication at pivot and collars, Friction in turning pair,
Lubrication, Viscosity, Viscous flow, Boundary lubrication, Thick film lubrication, Hydrostatic and hydrodynamic lubrications.
Friction Clutches: Single plate and multiplate clutch, Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanism.

Unit 6
Brakes: Shoe brake, Internal and external shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torque.
Belt and Rope Drives: Flat belts, Effect of slip, Centrifugal tension, Crowing of pulley, Initial tension in belts. V- Belts

Text Books:
1. A. Ghoshand, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata-McGraw Hill, New Delhi.

Reference Books:
1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors", Delhi.
2. J. E. Shigely and J.J. Uicker, "Theory of Machines and Mechanisms", McGraw Hill, New York, International Student Edition,1995

Theory of Automotive Engines

AE 402	Theory of Automotive Engines	PCC	4-0-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Perform a primary thermodynamic analysis of Otto and Diesel cycle.
CO2	Select appropriate engine for specific application.
CO3	Select proper fuel system and subsystems for I C Engine. Compare mechanisms for variable valve timing.
CO4	Conduct performance testing of the I C Engine and portray operating characteristics of I C Engines.
CO5	Select proper lubricant and lubrication system for engine
CO6	Understand the latest developments in IC Engines and alternate fuels.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Fundamentals of IC Engines
Nomenclature, engine components, Engine classification, firing order and four stroke cycle engines; fundamental difference between SI and CI engines; valve timing diagrams.
Power Cycles: Air standard Otto, Diesel and Dual cycles; Valve timing diagrams, Fuel-Air cycles, deviation of actual cycles from ideal cycles.

Unit 2: Combustion
Introduction, important qualities and ratings of SI and CI Engines fuels; Combustion in S.I. Engines, flame speed, ignition delay, normal and abnormal combustion, effect of engine variables on flame propagation and ignition delay, Combustion in C.I. Engines, combustion of a fuel drop, stages of combustion, ignition delay, combustion knock; types of SI and CI Engine combustion chambers.

Unit 3: Engine Valve Mechanism
Theoretical and actual valve timing diagram for 2 stroke/ 4 stroke and Petrol/Diesel Engines, Conventional Valve Mechanisms, Mechanisms for variable valve timings.

Unit 4: Various Engine Systems
Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems.

Unit 5: Engine Testing and Performance of SI and CI Engines
Parameters, Type of tests and characteristic curves, Effect of load and Speed on mechanical, indicated thermal, break thermal and volumetric efficiencies, Heat balance sheet.
Super charging in IC Engine: Effect of attitude on power output, types of supercharging.

Unit 6: Alternative Potential Engines: Stratified charge engine, VCR engine, Dual fuel engines, HCCI Engine, Green Engine
Engine Emissions & its effect on human being and environment. EURO and BHARAT emission norms,
Modern Trends in I C Engines.

Texts:
1. V. Ganeshan, "Internal Combustion Engines", Tata McGraw-Hill Publications, New Delhi, 3rd edition.

References:

1. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988.
2. ASHRAE Handbook, "Fundamentals and Equipment", 1993.
3. ASHRAE Handbook – Applications, 1961.
4. ISHRAE Handbook
5. Prof. Ram Gopal, NPTL Lectures, www.nptel.com, IIT Kharagpur.
6. Carrier Handbook
7. R.C. Jordan and G. B.Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Ltd., New Delhi, 1969.
8. J. L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, New York, 1970.

Fluid Mechanics and Machines

AE 403	Fluid Mechanics and Machines	PCC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Define fluid, define and calculate various properties of fluid
CO2	Calculate hydrostatic forces on the plane and curved surfaces and explain stability of floating bodies
CO3	Explain various types of flow. Calculate acceleration of fluid particles
CO4	Apply Bernoulli's equation and Navier-Stokes equation to simple problems in fluid mechanics
CO5	Explain laminar and turbulent flows on flat plates and through pipes
CO6	Explain and use dimensional analysis to simple problems in fluid mechanics
CO7	Understand boundary layer, drag and lift
CO8	Evaluation of performance of compressors/turbines/pumps.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	1	2										
CO3	2	2			1							
CO4	1	2			2							
CO5	2	1										
CO6	1	2			1		1					
CO7	2											
CO8	2	1										

Course Contents:

Unit1: Basics

Definition of fluid, fluid properties such as viscosity, vapour pressure, compressibility, surface tension, capillarity, Mach number etc., pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression.

Fluid Statics

Hydrostatic forces on the plane and curved surfaces, centre of pressure, Buoyancy, centre of buoyancy, stability of floating bodies, metacentre and meta centric height its application in shipping.

Unit2: Fluid Kinematics

Velocity of fluid particle, types of fluid flow, description of flow, continuity equation, Coordinate freeform, acceleration of fluid particle, rotational & irrotational flow, Laplace' equation in velocity potential and Poisson's equation in stream function, flow net.

Unit3: Fluid Dynamics

Momentum equation, development of Euler's equation, Introduction to Navier-Stokes equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's, venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices etc.

Unit 4: Types of Flow

a) **Laminar Flow:** Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, loss of head due to friction in viscous flow.
b) **Turbulent Flow:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses, HGL and TEL, flow through series and parallel pipes.

Unit 5: Dimensional Analysis

a) **Dimensional Analysis:** Dimensional homogeneity, Raleigh's method, Buckingham's theorem, Model analysis, similarity laws and dimension less numbers.
b) **Introduction** to boundary layer theory and its analysis.
c) **Forces on Submerged bodies:** Drag, lift, Drag on cylinder, Development of lift in cylinder, Problems on submerged body.

Unit 6: Introduction to Fluid Machinery

Principles of operations of centrifugal and axial pumps. Turbo blowers and turbines. Principles and working of gear, vane and reciprocating pumps.

Texts:

1. Modi and Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10^{th}edition,1991.

2. Robert W. Fox and Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile andSons,5th edition.

References:

1. V.L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9th edition, 1998.
2. S. K. Somand G. Biswas, "Introduction to Fluid Mechanics and Fluid Machines", TataMc Graw-Hill,2nd editienon,2003.

Manufacturing Processes

AE 404	Manufacturing Processes	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Understand the various sheet metal processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand milling, drilling, boring, shaping and broaching operations
CO6	Describe the mechanical measurements techniques

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Introduction to Manufacturing

What is manufacturing? Examples of manufacturing products, Classification of manufacturing processes, Selection of materials, Types of manufacturing strategies. Importance of sheet metal engineering, materials used, desirable properties of materials in sheet metal products. Shearing processes like blanking, piercing, and punching.

Unit 2: Metal Casting Processes

Patterns, allowances, moulding sand properties and preparation, Cores, core prints, sand moulding procedure, Gating and riser design, melting practice and furnaces, solidification of metals, casting defects and inspection, Specialized casting processes such as shell mould casting, die casting, centrifugal casting, investment casting and permanent mould casting.

Unit 3: Joining Processes

Gas welding, gas cutting, Electric arc-welding with consumable and non-consumable electrodes (MMAW, GMAW, TIG, and SAW); solid state welding: resistance welding, spot and seam welding, thermit welding, friction welding, welding defects, Brazing and soldering.

Unit 4: Turning, Shaping, Milling and Planing

Lathe and its types, constructional features, lathe operations, taper turning, methods of taper turning, work holding and cutting tool, thread cutting, machining time and power estimation, shaper, Milling machine and its types, construction, milling operations, milling cutters, Planing machine sand their types and operations.

Unit 5: Drilling, Boring, Broaching

Drilling machine, its types, construction, twist drill, drilling time and power estimates, counter boring, spot facing, boring, reaming, tapping, and broaching, broach tool, broaching machine types, construction and operations.

Unit 6: Mechanical Measurements

Introduction to measurements, Errors in measurements, Measurement of temperature, pressure, velocity, Measurement of heat flux, volume/mass flow rate, , Measurement of thermo-physical properties, radiation properties of surfaces, vibration and noise, Measurement of length, measurement of angle, Measurement of geometric forms, straightness, flatness, roundness

Texts:

1. P. N. Rao, "Manufacturing Technology, Foundry, Forming and Welding", Vol. 1, 3rd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2004.
2. P. N. Rao, "Manufacturing Technology, Metal Cutting and Machine Tools", Vol. 2, 2nd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2002.
3. Gayler J.F. and Shotbolt C.R. Metrology for Engineers, ELBS, Fifth Edition 1990

References:

1. M. P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes and Systems", Prentice Hall, Upper Saddle River, New Jersey, 1999.
2. S. Kalpakjian and S. R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 4th edition, 2000.

Automobile Engineering

AE 405	Automobile Engineering	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify the different parts of the automobile.
CO2	Explain the working of various parts like engine, transmission, clutch, brakes etc.,
CO3	Demonstrate various types of drive systems
CO4	Apply vehicle troubleshooting and maintenance procedures.
CO5	Analyze the environmental implications of automobile emissions and suggest suitable regulatory modifications.
CO 6	Evaluate future developments in the automobile technology

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I: Vehicle layout: Based on engine position and live axle position, advantages and limitations.

Transmissions: Clutch-its function, construction and working. Necessity of gear box- its function, construction and working,

Live axle and differential: its function, construction and working, Types of live axles, semi, three quarter and full floating axles. Necessity of differential, its function, construction and working.

Unit II:Brakes

Requirement of brake, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Electro and vaccum brakes. Disc brakes and drum brake. Introduction to antilock braking system (ABS).

Steering and Front axles
Steering requirements, Steering system layout, Steering geometry, Steering linkages and steering gears, Reversibility of steering gears, Types of front axles and their constructions.

Unit III: Suspension
Objects of suspension, Basic requirements, Air suspension and its features, Independent suspension, spring Shock absorbers-function, construction and working principle.
Wheels and Tyres
Requirements of wheels and tyres, Constructional features, Types of tyres, Inflation Pressure and its importance, Application to ride and stability,

Unit IV: Electrical system
Battery: Types of battery, Lead-Acid, Alkaline, ZEBRA, Sodium Sulphur and Swing, Ratings, charging, Maintenance and testing of Lead-Acid battery.
Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix, Flow through, Barrel.
Alternator: Principle of operation, Construction, Working, Rectification from AC to DC.

Unit V: Body Engineering
Importance of Body, its function and requirement, Materials for body construction-Styling forms- Coach and bus body layout, layouts of passenger cars, Bus and truck bodies.
Chassis types and structure types: Open, Semi integral and integral vehicle structures.

Unit VI: Introduction to engine management
Engine fuel and air control system
Recent trends in Automobiles
Electronic Control module (ECM), operating modes of ECM (closed loop and open loop) Inputs required and output signals from ECM, Electronic Spark control, Air Management system, Idle speed control.

Text Book:

1. "Automobile Engineering", Kirpal Singh Vol I & II, Standard publishers Distributors, Delhi
2. "Automobile Engineering", R. K. Rajput, Laxmi Publication

References:

1. "Automotive Mechanics", William Cruose & Donald L. Anglin, Tata Mcgraw Hill
2. "Automotive Mechanics", Joseph Heitner, East-West press Pvt. Ltd
3. "The Automobile Engineering", T. R. Banga&Nathu Singh, Khanna Publishers
4. "The Automobile", Harbans Singh Reyat, S. Chand & Co.
5. "Basic Automobile Engineering", C.P.Nakra, DhanpatRai Publishing CO.
6. "Automobile Engineering", K. K. Jain & R.B. Asthana, Tata Mcgraw Hill
7. "Automotive Mechanics", S. Srinivasan, Tata Mcgraw Hill
8. "Automobile Engineering", Vol I & II, R.K. Mohanty, Standard Book House
9. "Automobile Electrical and Electronics", Tom Denton
10. "Vehicle Body Engineering", J Pawlowski, Century publisher.
11. "Computerised Engine Control", Dick King, Delmar publisher.
12. "System Approach to Automobile Technology", Jack Erjavec, Cengage Learning
13. "Light & Heavy Vehical technology", M. J. Nunney, Elsevier.

Elective – II

NSS- I

AE 406A	NSS-I	PEC	3-0-0	3 Credits

Pre-Requisites: Computer programming

Course Outcomes: At the end of the course, students will be able to

CO1	Understand features of Indian constitution, fundamental rights and duties of citizens
CO2	Explain importance of Health, Hygiene & Sanitation
CO3	Summarize yoga a tool for healthy lifestyle
CO4	Conclude environmental issues and organize its management
CO5	Classify the disasters and youth role in its management

Mapping of course outcomes with program outcomes

Course Outcomes	Program 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
CO1			1			1	1	1	1	2	1	
CO2			1				2	1	1	1	1	1
CO3			1			1		1	1	1	1	1
CO4			2			1	1	1	1	1	1	1
CO5	1		1			1	1	1	1	1	1	1

Course Contents:

Unit 1: Introduction and Basic Concepts of NSS

History, Philosophy, Aims & objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption village/slums, Methodology of conducting Survey

Unit 2: Youth and Community Mobilization

Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, identifying methods of mobilization, Needs & importance of volunteerism

Unit 3: Importance and Role of Youth Leadership

Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership

Unit 4: Life Competencies and Skill

Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management

Unit 5: Social Harmony and National Integration

Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building

Unit 6: Youth Development Programs in India

National Youth Policy, Youth development programs at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations

Elective – II

Biology for Engineers

AE 406B	Biology for Engineers	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain origin of life and Evolution, Cells, Biomolecules-Lipids
CO2	Understand Biomolecules
CO3	Understand Cell structure and function and cell cycle
CO4	Explain Mendelian genetics
CO5	Understand and Explain DNA structure, DNA replication, Transcription, Translation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	2	3		1		1			1		1
CO2	1	2	3		1		1			1		1
CO3	1	2	3		1		1			1		1
CO4	1	2	3		1		1			1		1
CO5	1	2	3		1		1			1		1

Course Contents:

Unit 1:

Introduction, Origin of life and Evolution, Cells, Biomolecules-Lipids

Unit 2:

Biomolecules, Carbohydrates, water, Amino acids and proteins, Enzymes, Nucleotides

Unit 3:

Cell structure and function, Prokaryotes, Eukaryotes

Unit 4:

Cell cycle, cell division, mitosis, meiosis, culture growth,

Unit 5:

Mendelian genetics, genetic disorders, Mendelian inheritance principle, pedigree analysis, Non- Mendelian inheritance

Unit 6:

Chromatin, DNA structure, DNA replication, Transcription, Translation.

Texts/References:

1. N. A. Campbell and J. B. Reece, "Biology", International edition, Benjamin Cummings, New York, 7th edition or later, 2007 or later.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", Wiley, New York, 7th edition, 2013.

Elective – II

Renewable Energy Sources

AE 406C	Renewable Energy Sources	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the difference between renewable and non-renewable energy
CO2	Describe working of solar collectors
CO3	Explain various applications of solar energy
CO4	Describe working of other renewable energies such as wind, biomass

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	1	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1

Course Contents:

Unit1: Introduction

Energy resources, Estimation of energy reserves in India, Current status of energy conversion technologies relating to nuclear fission and fusion, Solar energy.

Unit2: Solar Radiations

Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.

Unit3: Solar Collectors

Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC.

Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.

Solar Energy Applications

Air/Water heating, Space heating/cooling, solar drying and solar still, Photo-voltaic conversion.

Unit 4: Biomass

Evaluation of sites for bio-conversion and bio-mass, Bio-mass gasification with special reference to agricultural waste.

Unit5: Wind Energy

Types of windmills, Wind power availability, and wind power development in India.

Unit6: Introduction to Other Renewable Energy Sources

Tidal, Geo-thermal, OTEC; Mini/micro hydro-electric, Geo-thermal, Wave, Tidal. System design, components and economics.

Texts:

1. Chetan singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, 2008.

References:

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publications, NewDelhi,1992.
2. G. D. Rai, "Solar Energy Utilization", Khanna Publisher, Delhi,1992.

Automotive Engines Lab

AE 407	Automotive Engines Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Demonstrate the construction and working of fuels supply system and its components, lubrication, cooling systems.
CO2	Handle instruments like tachometer, thermometer, digital temperature indicator etc.
CO3	Conduct the test on single cylinder and multi cylinder petrol & diesel engines (Constant Speed & Variable Speed Tests) plot the engine performance characteristics curves and interpret the curves.
CO4	Calculate B.P., I.P., F.P., air/fuel ratios and various engine efficiencies. Conduct the test and prepare heat balance sheet

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments

A. Demonstration of physical systems in terms of constructional details and functions

1. 2 Stroke and 4 Stroke Engines
2. Carburetor.
3. Ignition system.
4. Fuel injection system.
5. Cooling System
6. 2 stage / 3 stage pressurised gas supply system. (LPG/CNG/Biogas/Hydrogen)
7. Visit to Industry related to automotive service station.

B. I C Engines (Any **Five** experiments from the list)

1. Trial on Diesel engine- variable speed/load test and energy balance.
2. Trial on Petrol engine- variable speed/load test and energy balance.
3. Trial on Petrol Engine- Morse Test.
4. Measurements of exhaust emissions of Petrol engine / Diesel engine.
5. Heat Balance test on diesel or petrol engines.
6. Experimental determination of Air fuel ratio.

Fluid Mechanics and Machines Lab

AE 408	Fluid Mechanics and Machines Lab	PCC	0-0-2	1 Credits

Pre-Requisites: Mathematics, physics and Basic Mechanical Engineering.

Course Outcomes: At the end of the course, students will be able to

CO1	Understand laminar and Turbulent flow and determine Critical Reynolds number using Reynolds Apparatus
CO2	Verify Bernoulli's theorem
CO3	Determine pressure drop in flow though pipes and pipe fittings
CO4	Verify momentum equation using impact of jet apparatus
CO5	Determine viscosity using viscometer
CO6	Do calibration of pressure gauges, rotameter
CO7	Use manometers for pressure measurement

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	1	1	3	1				1	2		1
CO2	1	1	1	3	1				1	2		1
CO3	1	1	1	3	1				1	2		1
CO4	1	1	1	3	1				1	2		1
CO5	1	1	1	3	1				1	2		1
CO6	1	1	1	3	1				1	2		1
CO7	1	1	1	3	1				1	2		1
CO8												

List of Practical's/Experiments/Assignments (any eight)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli's theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determinations of pressure drop in pipes of various cross-sections
5. Determinations of pressure drop in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer (at least one type)
7. Verification of momentum equation using impact of jet apparatus
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Gauge and differential pressure measurements using various types of manometers, Bourdon type pressure gauge. Demonstration of measurement using these instruments Lab.

Theory of Machine Lab

AE 409	Theory of Machine Lab	PCC	0-0-2	1 Credit

Pre-Requisites: Engineering mathematics, Engineering graphics

Course Outcomes: At the end of the course, students will be able to

CO1	Comprehend gyroscopic principle and effect of gyroscopic couple.
CO2	Apply balancing methods to balance rotating and reciprocating components
CO3	Identify and analyze vibrations of single degree of freedom systems.
CO4	Plot and interpret the polar diagram based on the experimental readings on Hooks joint.
CO5	Use principles of kinematics and dynamics in operation of various mechanisms and equipments.

Mapping of course outcomes with program outcomes

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

List of Practical's /Experiments/Assignments

1. **Four sheets** (half imperial size)
   Graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous centre of rotation method and Klein's construction. At least one problem containing Coriolis component of acceleration.
2. **Experiments(any2)**
   a) Experimental determination of velocity and acceleration of Hooke's joint.
   b) Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
   c) Experiment on Coriolis component of acceleration.
3. **Assignment**
   Develop a computer program for velocity and acceleration of slider crank mechanism.

Manufacturing Processes Lab

AE 410	Manufacturing Processes Lab	PCC	0-0-2	1 Credit

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

List of Practical's/Experiments/Assignments

SEMESTER V

Alternative Fuels for IC Engines

AE 501	Alternative Fuels for IC Engines	PCC	3-0-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Modify automotive engine to operate by using various alternative fuels.
CO2	Analyze engine performance and emission characteristics by using alternative fuels.
CO3	Suggest advance engine technology for alternative fuels.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:

Conventional Fuels and Need for alternative fuels

Need for alternative fuels, applications, various alternate fuels etc.

Comparison of properties of fuels, quality rating of SI and CI engine fuels, fuel additives for SI and CI engines,

Unit-II:

Alternative Fuels I – Gaseous Fuels

Introduction to CNG, LPG, Study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/vehicle modifications required.

Unit- III:

Biofuels

Biodiesel, Biogas, ethanol, Methanol. Study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/vehicle modifications required.

Unit–IV:

Hydrogen

Study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/vehicle modifications required.

Unit-V:

Fuel Cell Technology

Operating principles, Types, construction, working, application, advantages and limitations.

Unit-VI:

Layout of Electric vehicle and Hybrid vehicles

Advantages and drawbacks of electric and hybrid vehicles, System components, Electronic control system – Different configurations of Hybrid vehicles, Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Texts:

1. Ayhan Demirbas, "*Biodiesel A Realistic Fuel Alternative for Diesel Engines"***,** Springer-Verlag London Limited 2008, ISBN-13: 9781846289941

References:

1. "Alternative Fuels", Dr. S. S. Thipse, Jaico publications.
2. "Engine Emission", B.P Pundir, Narosa publication.
3. "Internal Combustion Engines", V. Ganesan, Tata McGraw Hill.
4. "Automotive Emission Control", Crouse, W.M. and. Anglin, A.L, McGraw Hill.
5. "IC Engines", Dr. S. S. Thipse, Jaico publications.
6. "Engine Emissions, pollutant formation", G. S. Springer and D.J. Patterson, Plenum Press.
7. ARAI vehicle emission test manual.
8. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, "The Biodiesel Handbook", AOCS Press Champaign, Illinois 2005.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997, ISBN 0-76-80-0052-1.
10. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
11. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
12. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.

Automotive Transmission System

AE 502	Automotive Transmission System	PCC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Demonstrate the need of transmission and its classification.
CO2	Describe the construction and working of various types of clutches and gear boxes
CO3	Explain the working of advanced transmission systems.
CO4	Describe the working of final drive.
CO5	Select appropriate transmission system.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit – I
Clutches
Principle, Functions, General requirements, Torque capacity, Types of clutches, Cone clutch, Single-plate clutch, Diaphragm spring clutch, Multi-plate clutch, Centrifugal clutch, Electromagnetic clutch, Lining materials, Over-running clutch, Clutch control systems.

Unit – II
Gear Box
Gear Box: Necessity of gear box, Resistance to motion of vehicle, Requirements of gear box, Functions of gear box, Types- Sliding mesh, Constant mesh, Synchromesh. Principle, construction and working of synchronizing unit, Requirements & applications of helical gears, Gear selector mechanism, Two-wheeler gear box, Lubrication of gear box, Overdrive gears,
Performance characteristics.

Unit – III
Drive Lines
Propeller shaft-universal joints, hooks and constant velocity U.J., Drive line arrangements – Hotchkiss drive & torque tube drive, Rear wheel drive, front wheel drive and four-wheel drive layouts and its advantages & limitations.

Unit – IV

Final Drive & Rear Axle

Purpose of final drive & drive ratio, Different types of final drives, need of differential, Constructional details of differential unit, Differential lock, Differential housing, Function of rear axle, Construction, Types of loads acting on rear axle, Axle types - semi-floating, full floating, three quarter floating.

Unit – V

Fluid Flywheel, Torque convertor, Epicyclic Gear Boxes

Fluid Flywheel, Torque convertor: Operating principle, Construction and working of fluid flywheel, Characteristics, Advantages & limitations of fluid coupling, Torque convertor, and construction and working of torque converter, Performance characteristics, Comparison with conventional gear box. Epicyclic Gear Boxes: Simple epicyclic gear train, Gear ratios, Simple & compound planet epicyclic gearing, Epicyclic gear boxes, Wilson epicyclic gear train - Construction and operation, Advantages, Clutches and brakes in epicyclic gear train, compensation for wear, performance characteristics.

Unit – VI

Automatic Transmission

Principle of semi-automatic & automatic transmission, Hydromantic transmission, Fully automatic transmission, Semi-automatic transmission, Hydraulic control system, Continuous variable transmission (CVT) – operating principle, basic layout and operation, Advantages and disadvantages.

Text Books:

1. Dr. Kripal Singh, "Automobile Engineering-Vol. 1", 13th Edition, Standard Publishers Distributors
2. N. K. Giri, "Automotive Mechanics", Khanna Publishers, Delhi, Eighth Edition

Reference Books:

1. Newton, Steed & Garrot, "Motor Vehicles", 13th Edition, Butterworth London
2. A. W. Judge, "Modern Transmission", Chapman & Hall Std., 1989
3. Chek Chart, "Automatic Transmission", A Harper & Raw Publications
4. J. G.Giles, "Steering, Suspension & Tyres", – Lliffe Book Ltd., London
5. W. Steed, "Mechanics of Road Vehicles", Lliffe Book Ltd
6. Heisler, "Vehicle and Engine Technology", Second Edition, SAE International Publication

Automotive Chassis and Suspension

AE 503	Automotive Chassis and Suspension	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Elaborate the constructional details and operations of chassis systems like steering system, suspension system etc.
CO2	Interpret the underlying mechanics of the chassis systems.
CO3	Apply steering geometry for a given vehicular application.
CO4	Select/Configure components or subsystems for integration into main chassis system.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I: Front Axle and Steering System

Functions of front axle, Types of front axle, Construction, Stub axle and Wheel bearing, Front wheel steering Geometry – castor, Camber, King pin inclination, toe-in, toe-out, Centre point Steering, Self-returning property, Adjusting and checking of front wheel geometry, Ackerman and Davis steering linkages, Steering system layout, Steering gear boxes.

Unit-II: Vehicle Suspension Systems

Road irregularities and need of suspension system, Types of suspension system, Sprung and unspring mass, Suspension springs – requirements, types and characteristics of leaf spring, coils spring, rubber spring, air and torsion bar springs, Independent suspension for front and rear, Types, Hydro-elastic suspension, roll centre, use of anti-roll bar and stabilizer bar, Shock absorbers – need, operating principles and types, Active suspension.

Unit-III: Wheels and Tyres

Basic requirements of wheels and tyres, Types of road wheels, Construction of wheel assembly, wheel balancing, Tyre construction, material, types, tubeless, cross ply radial type, tyre sizes and designation, Aspect ratio, tyre trade pattern, tyre valve, Tyre inflation pressure, safety precautions in tyres, Tyre rotation and matching, Types of Tyre wear and their causes, Selection of tyres under different applications, tyre retreating hot and cold, factors affecting tyre performance.

Unit-IV: Braking Systems

Function and requirements of braking system, Types of brakes, Elementary theory of shoe brake, drum brake arrangement, disc brake arrangement, self-energizing, brake friction material. brake linkages, hydraulic brake system and components, hydraulic brake fluids, air brakes, vacuum servo assisted brake, engine exhaust brake, parking brakes, dual power brake system, regenerative brake system, fail-safe brake, anti – lock brakes, anti-skid brakes, brake efficiency and testing, weight transfer, braking ratio.

Unit-V: Vehicle Safety Systems

Introduction, Electronic stability program system operation, overview, rollover mitigation system overview, active safety and passive safety, latest trends in traffic system for improved road safety, head restraints, introduction to the type of safety glass and their requirements, types of different mirrors and their location.

Unit-VI: Vehicle Chassis

Introduction To chassis, chassis operating condition, chassis frame, vehicle components location. Manufacturing processes for chassis, causes of chassis failure

Text Book:

1. "Automobile Engineering" R. B. Gupta Satya Prakashan New Delhi.
2. "Basic Automobile Engineering" C. P. Nakra Dhanpat Rai Publishing Company (P) Ltd-New Delhi
3. "Automotive Mechanics" N.K. Giri 8th Edition Khanna Publishers New Delhi.

References:

1. "Motor Vehicles", Newton, Steed and Garrot, 13th Edition, Butterworth London
2. "Vehicle and Engine Technology", Heisler, Second Edition SAE International Publication.
3. "Advanced Vehicle Technology", Heisler,Second Edition SAE International Publication.
4. "The Automotive Chassis", J. Reimpell H. Stoll, J.W. Betzler, SAE International Publication.

Heat Transfer

AE 504	Heat Transfer	PCC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

Course Contents:

Automobile Electricals and Electronics

AE 505	Automobile Electricals and Electronics	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Describe the role of the electrical and electronics in controlling various automotive functions and subsystems.
CO2	Select automotive electrical components like battery, alternator and starting motor for particular application.
CO3	Apply concept to design automotive electrical systems.
CO4	Select and justify sensors and actuators used for automotive systems.
CO5	Explain the roll of engine and vehicle management system to control enhance the performance for minimum emission.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I: Introduction to automotive electrical systems

Automotive electricity generation, storage & distribution systems, wiring harness, circuit diagrams and symbols, 12/24/42 volt system, positive earth and negative earth, earth return and insulated return systems, Multiplexed wiring systems, Electromagnetic compatibility & interference, Introduction of Controlled Area Networks (CAN) protocols.

Battery:

Principle of lead acid battery, Types, Constructional details, Recharging the battery, Battery ratings, Battery Performance, Battery capacities, Battery efficiency, Battery tests, Battery failures, Alkaline battery, maintenance free batteries, hybrid batteries.

Unit II: Charging, Starting & Ignition System

Magnetos Constant current & voltage systems, Current & voltage regulator, Semiconductor type regulator, Alternator with regulator, starting system with layout, selection of motor, matching battery, Drive mechanisms, Ignition coil, Distributor, Cam angle & Contact angle gap, Advance mechanisms, Ballast Resistance, Limitations of coil ignition, Transistorized Ignition systems, Spark plugs, types, construction.

Unit III: Automotive Accessories & Lighting Systems

Vehicle lighting System: Head, Indicator, Fog lamps, Brake lights, Gas discharge, LED lighting, Dash board Indicators: Fuel gauge, oil pressure gauge, Temperature gauges,

Speedometer, Warning Lights, Electric horn, Horn relay, Wind shield wipers, and Power window.

Unit IV: Automotive Sensors & Actuators
Working principle of sensors, Types of sensors, Airflow rate sensor, angular position sensor, Throttle angle sensor, Temperature sensor, MAP sensors, sensors feedback control, Principle of actuator, Types of actuators, engine control actuators, Solenoid actuators, motorized actuators.

Unit V: Engine Management Control System (EMS)
Layout and working (open loop and closed loop control), ECU and microcontroller, group and sequential injection techniques, fuel system components, cold and warm start system, idle speed control, acceleration / deceleration and full load enrichment and fuel cut-off, fuel control MAPs. Electronic Ignition system and spark timing control.

Unit VI: Vehicle Management System
ABS system with layout and working, Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system, crash sensor, seat belts, Cruise control, Vehicle security systems alarms, vehicle tracking system, Collision avoidance, Radar warning system, Introduction to Global Positioning Systems.

Text Books:
1. P. L. Kohli, "Automotive Electrical Equipments", Tata McGraw Hill Pub. Co. Ltd.
2. Tom Denton, "Automobile Electrical & Electronic Systems", SAE International.

Reference Books:
1. Bechfold SAE 1998, "Understanding Automotive Electronics".
2. V. A. W. Hilliers, "Fundamentals of Automotive Electronics", Hatchin, London
3. Tomwather J. R., Cland Hunter, "Automotive Computer & Control System", Prentice Inc. NJ
4. Robert N. Brandy, "Automotive Computers & Digital Instrumentation", Prentice Hall Eaglewood, Cliffs, NJ
5. Young, Griffithe, "Automobile Electrical & Electronic Equipment's", The English Language Book Co., London.

ELECTIVE III
NSS – II

AE 506A	NSS – II	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand features of Indian constitution, fundamental rights and duties of citizen
CO2	Explain importance of Health, Hygiene & Sanitation
CO3	Summarize yoga a tool for healthy lifestyle
CO4	Conclude environmental issues and organize its management
CO5	Classify the disasters and youth role in its management

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1			1			1	1	1	1	2	1	
CO2			1				2	1	1	1	1	1
CO3			1			1		1	1	1	1	1
CO4			2			1	1	1	1	1	1	1
CO5	1		1			1	1	1	1	1	1	1

Course Contents:

Unit I: Citizenship

Basic Features of Constitution of India, Fundamental Rights and Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

Unit II: Health, Hygiene & Sanitation

Definition, Needs and scope of health education, Food and Nutrition, Safe drinking water, Water borne diseases and sanitation, National Health Programmed, Reproductive health, Healthy Lifestyles, HIV AIDS, Drugs and Substance abuse, Home Nursing , First Aid.

Unit III: Youth and Yoga

History, Philosophy and concept of Yoga, Myths and misconceptions about yoga, Different Yoga traditions and their Impacts, Yoga as a preventive, promotive and curative method, Yoga as a tool for healthy lifestyle.

Unit IV: Environment Issues

Environment conservation, Enrichment and Sustainability, Climate change, Waste management, Natural resource management, Rain water harvesting, Energy conservation, Waste land development, Soil conservations and forestation.

Unit V: Disaster a Management

Introduction to Disaster Management, Classification disaster, Role of youth in Disaster Management

Unit VI: Youth and crime

Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crime, Awareness about anti-ragging, Cybercrime and its prevention, Juvenile justice.

Knowledge Management

AE 506B	Knowledge Management	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Define KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
CO2	Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.
CO3	Identify and select tools and techniques of KM for the stages of creation, acquisition, transfer and management of knowledge.
CO4	Analyze and evaluate tangible and intangible knowledge assets and understand current KM issues and initiatives.
CO5	Evaluate the impact of technology including telecommunications, networks, and internet/intranet role in managing knowledge.
CO6	Identify KM in specific environments: managerial and decision making communities; finance and economic sectors; legal information systems; health information systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1						1						3
CO2												3
CO3												3
CO4								2				3
CO5					3				2			3
CO6												3

Course Contents:

Unit I: Introduction
Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge;

Unit II: Learning organization
Five components of learning organization, knowledge sources and documentation.

Unit III: Essentials of Knowledge Management
Knowledge creation process, knowledge management techniques, systems and tools.

Unit IV: Organizational knowledge management
Architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization.

Unit V: Knowledge management system
Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies.

Unit VI: Knowledge Based Engineering
Knowledge engineering, Knowledge based engineering Theory of computation, data structure.

Texts:
1. Thohothathri Raman, "Knowledge Management–A resource book", Excel, 2004.
2. M. Elias, Awad Hasan, M. Ghazri, "Knowledge Management", Pearson Education.

References:
1. Amrit Tiwana, "Strategy & Knowledge Platforms", The KM Toolkit–Orchestrating IT, Pearson, PHI, 2nd edition.
2. Peter Senge et al., "The Fifth Discipline Field Book–Strategies & Tools for Building A Learning Organization", Nicholas Brealey, 1994.
3. Sudhir Warier, "Knowledge Management", Vikas Publications.
4. Madanmohan Rao, "Leading with Knowledge", Tata McGraw Hill Publications.

Sustainable Development

AE 506C	Sustainable Development	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the difference between development and sustainable development
CO2	Explain challenges of sustainable development and climate change
CO3	Explain sustainable development indicators
CO4	Analyze sustainable energy options
CO5	Understand social and economic aspects of sustainable development

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1
CO5			3			2	3	2				1

Course Contents:

Unit I:
Introduction
Status of environment – Environmental, Social and Economic issues – Need for sustainability – Nine ways to achieve sustainability – population, resources, development and environment.

Unit II:

Challenges of Sustainable Development and Global Environmental Issues:

Concept of sustainability – Factors governing sustainable development – Linkages among sustainable development- Environment and poverty – Determinants of sustainable development – Case studies on sustainable development – Population, income and urbanization – Health care – Food, fisheries and agriculture – Materials and energy flows**.**

Unit III:

Sustainable Development Indicators

Need for indicators – Statistical procedures – Aggregating indicators – Use of principal component analysis – Three environmental quality indices.

Unit IV:

Environmental Assessment

National environmental policy act of 1969 – Environmental Impact Assessment – Project categories based on environmental impacts – Impact identification methods – Environmental impact assessment process.

Unit V: Environmental Management and Social Dimensions

Revisiting complex issues – Sector policies concerning the environment – Institutional framework for environmental management – Achievements in environmental management – People's perception of the environment – Participatory development – NGOs – Gender and development – Indigenous peoples – Social exclusion and analysis.

Unit VI:

Carbon footprints and ISO 14000

Texts:

1. Sayer, J. and Campbell, B., "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.
2. Kirkby J., O"Keefe P. and Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.
3. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008.

References:

1. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis group, 2001.
2. Low, N. Global, "ethics and environment", London: Routledge. 1999.
3. Douglas Muschett, "Principles of Sustainable Development", St. Lucie Press, 1997.

Automotive Materials

AE 506D	Automotive Materials	PEC	3-0-0	3 Credits

Pre-Requisites: Engineering Metallurgy, Material science

Course Outcomes: At the end of the course, students will be able to

CO1	The student shall gain appreciation and understanding Material properties chart and all parameters of chart.
CO2	Shall be able to know different types of electric and magnetic materials also non-metallic materials.
CO3	Student shall gain knowledge of various surface treatment used in automobile industries
CO4	Student shall gain knowledge of modern materials comes such as shape memory alloy etc.
CO5	Ability to select material of material from the material properties chart with considering such parameter modulus density, strength density and modulus strength.
CO6	Ability to select material for the automotive components

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I: Material Property Charts and Selection Criteria
Material Property Charts: Modulus-density, strength-density, modulus strength, specific stiffness and specific strength, fracture toughness, modulus fracture.
Selection Criteria- Shape factor, elastic extrusion, elastic body and twisting, failure, bending and twisting, efficiency of standard sections, material limits and shape factors.

Unit-II: Polymers
Physical and Mechanical properties of polymers and their composites, effect of processing on properties. Applications in engineering.

High Polymers: Classification of High polymers- production of high polymers- general methods- Some important plastics, their production, properties and uses- Polyethylene PVC, Polystyrene, Teflon, Acrylics, Nylon, Polyesters, Phenol Formaldehyde Resins, Urea Formaldehyde Resins and silicones-compounding and moulding of High polymers.

Unit-III: Composite Materials

Composite Materials: Introduction, Types of composite materials, properties, advantages, orthotropic and anisotropic behaviour, Micromechanical and micromechanical analysis of composite material, Applications of composite materials

Unit-IV: Surface Modification of Materials

Mechanical surface treatment and coating - case hardening and hard facing, thermal spraying, vapor deposition, ion implantation, diffusion coating, electroplating and electro-less, conversion coating, ceramic and organic coatings, diamond coating.

Unit-V: Modern Materials and Alloys

Super alloys, refractory metals, shape memory alloys, dual phase steels, micro alloyed, high strength low alloy steel, transformation induced plasticity (trip) steel, merging steel, smart materials, metallic glass, quasi crystal and Nano crystalline materials., metal foams.

Unit–VI: Materials selection for automotive components

Criteria of selecting materials for automotive components viz cylinder block, cylinder head, piston, piston ring, gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel, clutch plate axle, bearings, chassis, spring, body panel - radiator, brake lining etc. application of non-metallic materials such as composite, ceramic and polymers in automobile.

Reference Books:

1. "Material Science and Engineering- An introduction", Callister W.D. (2006), Wiley – Eastern.
2. "Physical Metallurgy", Raghavan, V., (2003), Prentice Hall of India.
3. "Materials Selection in Mechanical Design", Michael F. Ashby, Butterworth Heinemann,2005.
4. "Mechanical Behavior of Materials", Thomas H. Courtney, (2000) McGraw Hill.
5. "Engineering Materials and their Applications", Flinn R. A. and Trojan P. K. (1999), Jaico.
6. "Surface Engineering for wear resistance", Kenneth Budinski– (1988) Prentice Hall.
7. "Introduction to physical metallurgy", Avner S.H., (2006) –Tata McGraw Hill.
8. "Materials Science and Metallurgy", DanielYesudianC, Scitech Publications (Indian ,2004.)

Automobile Electricals and Electronics Lab

AE 507	Automobile Electricals and Electronics Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Demonstrate the construction and working of various automotive electrical systems.
CO2	Test automotive batteries, alternators, starting motors, auto electric components and carryout head light beam alignment.
CO3	Diagnosis the automotive electrical faults with the help of ECU diagnostic systems.

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments
(Minimum eight out of which Experiment No. 10 is compulsory.)

1. Demonstration of automotive electrical and electronic systems layout.
2. Study/Demonstration and testing of battery performance parameter.
3. Demonstration and testing of alternators.
4. Demonstration and testing of starting motors & Electronic ignition system.
5. Demonstration of dash board panel instruments & controls.
6. Demonstration of headlight beam alignment.
7. Testing of auto electrical components on multifunctional tester.
8. Testing of CDI coil, spark plug and armature.
9. Study of ECU diagnostic system for fault finding.
10. Visit to any authorized service station for On Board Diagnosis.

HEAT TRANSFER LAB

AE 508	Heat Transfer Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments

Automotive Transmission System Lab

AE 509	Automotive Transmission System Lab	PCC	0-0-2	1 Credits

Pre-Requisites: Automotive Transmission

Course Outcomes: At the end of the course, students will be able to

CO1	Identify and list elements of various transmission systems.
CO2	Draw sketches /schematics of transmission systems.
CO3	Describe the operating principles, functions, constructional details and working of transmission systems.
CO4	Compare various configurations/subtypes of transmission systems.
CO5	Select appropriate configuration/types for transmission system requirements in automotive applications

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments (Any 8 Experiment)

1. Demonstration of garage, garage equipment's & tools, preparation of different garage layouts.
2. Demonstration of washing & greasing of vehicle.
3. Engine oil change & periodic maintenance of vehicle.
4. Dismantling & assembly of Clutch (light / heavy duty vehicle).
5. Dismantling & assembly of Constant mesh gearbox and synchromesh gearbox.
6. Dismantling & assembly of Drive line (universal joint, propeller shaft, slip joint).
7. Dismantling & assembly Final drive & differential.
8. Rear axle hub greasing.
9. Dismantling & assembly of automatic transmission.
10. Dismantling & assembly of fluid flywheel & torque converter.

Automotive Chassis and Suspension Lab

AE 510	Automotive Chassis and Suspension Lab	PCC	0-0-2	1 Credits

Pre-Requisites: Automotive Chassis Systems.

Course Outcomes: At the end of the course, students will be able to

CO1	Identify and list elements of various chassis systems.
CO2	Draw sketches /schematics of chassis systems.
CO3	Describe the operating principles, functions, constructional details and working of chassis systems.
CO4	Compare various configurations/subtypes of chassis systems.
CO5	Select appropriate configuration/types for chassis system requirements in automotive applications

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments

1.Demonstration of front wheel steering geometry
2.Demonstration of steering system layout
3.Experiment on Ackerman steering geometry
4.Demonstration of power steering
5.Demonstration of hydraulic brake and air brake systems
6.Demonstration of conventional & independent suspensions
7.Demonstration of suspension dampers
8.Demonstration of wheel and tyre assembly

SEMESTER VI

Vehicle Safety

AE 601	Vehicle Safety	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Comprehend application of passive and active safety for vehicle.
CO2	Describe importance of ergonomics in automotive safety and human response to impact
CO3	Design vehicle safety systems
CO4	Describe various regulations of vehicle safety and safety testing methods.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I: Introduction
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Unit II: Safety Concepts
Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: Exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT III: Safety Equipments
Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

Unit IV: Collision Warning and Avoidance
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

Unit V: Comfort and Convenience System
Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system

Unit VI: Safety
Safety: Motor vehicle safety standards, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety, Occupants safety systems – seat belts, head retrain, air bags, roll-over protection system, Electronic stability program.

Text Books

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.

Reference Books:

1. J. Y. Wong, "Theory of Ground Vehicles", A wiley Interscience Publications
2. Hans Herman Braess, Ulrich Seiffert, Handbook of Automotive Engineering, SAE Publications.
3. Rao V. Dukkipati, Jian Pang, "Road Vehicle Dynamics", SAE Publications.
4. Wolt, Heinrich Hucho, "Aerodynamics of road vehicles", SAE Publications.
5. Bosch, Automotive Handbook, SAE Publications
6. George Pieters Barbara Pieters, "Automotive Vehicle Safety".
7. Michel Plint "Engine Testing Theory and Practice".
8. Gousha H. M., "Engine performance Diagnosis & Tune Up Shop Manual"
9. J. G. Giles, "Vehicle Operation & Performance".
10. W. H. Crouse & D. L. Anglin, "Motor Vehicle Inspection".
11. SAE Transaction Papers – 831814/820346/820367/820371/820375

Automotive Body Engineering

AE 602	Automotive Body Engineering	PCC	3-0-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply various concepts of vehicle aerodynamics while designing a car body.
CO2	Identify and draw various types of body designs.
CO3	Apply various concepts of aesthetics and ergonomic while designing a vehicle body.
CO4	Apply design concepts while designing driver and passenger seating arrangement

Mapping of course outcomes with program outcomes

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

Course Contents

Unit I: Car Body Details

Types of car bodies, evolution of body shapes, body components, Visibility: driver's visibility, tests for visibility, methods of improving visibility and space in cars.

Safety: safety design, safety equipments for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and instrumentation, Design of welded joints.

Unit II: Vehicle Aerodynamics
Objectives, vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing.

Unit III: Body Details
Types of bus bodies, classification, Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction, Design of riveted joints.

Unit IV: Commercial Vehicle Details
Types of commercial vehicle body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Ergonomics of driver seat position. Driver's cab design. Specialist commercial vehicles: Refrigerated vehicle, Paramedic ambulances, Half car/van pickup.

Unit V: Body Materials, Trim and Mechanisms
Various body materials: Steel sheet, timber, plastic, BIW, Advanced body materials: GRP, Carbon fiber, fiberglass, Shape-Memory Polymers (SMP's), technologies to reduce the noise vibration & harshness (NVH) properties of materials; corrosion & anticorrosion methods. Selection of paint and painting process, Body trim and Body mechanisms. Repair of vehicle body: hand & power tools, major and minor accident damage, damage assessment,

Unit VI: Body Loads
Different loading situations, chassis frame design, idealized structure, structural surface, shear panel method, symmetric and asymmetrical, vertical loads in car, longitudinal load.

Text Books:

1. Powloski.J., Vehicle Body Engineering, Business Books Ltd., 1989

Reference Books:

1. Giles J. C., "Body construction and design", lliffe Books Butterworth & Co., 1971.
2. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg Publication Ltd., London, 1982.
3. Wolf Heinrich Hucho, "Aerodynamics of Road Vehicles", SAE International, USA
4. Lorenzo Morello, Lorenzo Rosti, Rossini, Giuseppe Pia, Andrea Tonoli, "The Automotive Body component design", Volume I & Volume II, Springer ISBN 978-94-007-0512-8
5. W.A. Livesay, A. Robinson, "The repair of vehicle body", 5th edition, Elsevier.

Design of Machine Elements

AE 603	Design of Machine Elements	PCC	3-1-0	4 Credits

Pre-Requisites: Applied Mechanics and Strength of Materials

Course Outcomes: At the end of the course, students will be able to

CO1	Discuss steps of design and steps of machine design elements.
CO2	Design joints for different loading conditions.
CO3	Design shafts keys and couplings to transmit required amount of torque.
CO4	Design four types of gears namely spur, helical, bevel and worm by using different considerations
CO5	Design basic components like spring and levers.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I

Mechanical engineering Design Process: Traditional design methods, general industrial design procedure, design considerations, phases in design, creativity in design, use of standardization, preferred series, introduction to ISO 9000, use of design data book, aesthetic and ergonomic considerations in design.

Unit II

Design of Machine Elements against Static Loading: Theories of Failure (Yield and Fracture Criteria) - Maximum normal stress theory, Maximum shear stress theory, Maximum distortion energy theory, comparison of various theories of failure, Direct loading and combined loading, Joints subjected to static loading e.g. cotter and knuckle joint, turnbuckle, etc. introduction to fluctuating loads.

Unit III

Design of Shafts Keys and Couplings: Various design considerations in transmission shafts, splinted shafts, spindle and axles strength, lateral and torsional rigidity, ASME code for designing transmission shaft.

Types of Keys: Classification and fitment in keyways, Design of various types of keys.

Couplings: Design consideration, design of rigid, muff and flange type couplings, design of flexible couplings.

Unit IV

Design of Threaded joints: Stresses in screw fasteners, bolted joints under tension, torque requirement for bolt tightening, preloading of bolt under static loading, eccentrically loaded bolted joints.

Power Screws: Forms of threads used for power screw and their applications, torque analysis for square and trapezoidal threads, efficiency of screw, collar friction, overall efficiency, self-locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw, re-circulating ball screw.

Unit V

Welded Joints: Type of welded joints, stresses in butt and fillet welds, strength of welded joints subjected to bending moments.

Unit VI

Mechanical Springs: Stress deflection equation for helical spring, Wahl's factor, style of ends, design of helical compression, tension and torsional spring under static loads, construction and design consideration in leaf springs, nipping, stain energy in helical spring, shot peening.

Text Books:

1. V.B. Bhandari, Design of Machine Elements, Tata McGraw Hill, New Delhi, 2008.
2. R.L. Nortan, Machine Design: An Integrated Approach, Pearson Education Singapore, 2001.

Reference Books:

1. R. C. Juvinall and K.M. Marshek, "Fundamental of machine component design", John Wiley & Sons, Inc, New York, Third Edition 2002
2. B.J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, Second Edition 1999
3. A.S. Hall, A.R. Holowenko and H.G. Langhlin, "Theory and Problems of Machine".

Vehicle Dynamics

AE 604	Vehicle Dynamics	PCC	3-1-0	4 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Appreciate significance of vehicle dynamics for a typical road vehicle.
CO2	Calculate dynamic longitudinal and transverse axle load transfer for a vehicle in motion.
CO3	Determine the acceleration and braking performance of a vehicle when provided with specifications.
CO4	Evaluate handling characteristics of a vehicle for given set of data.
CO5	Apply ride concepts while designing a suspension system for a vehicle.
CO6	Evaluate the tire performance.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	1	1	1	1		1					
CO2	2	2	2		1							
CO3	1	2	2		1							
CO4	2	2	2	1		1	1					
CO5	1	2	2		1							

Course Contents:

Unit I: Concept of Vibration

Definitions, Modelling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments.

Unit II: Performance Characteristics of Road Vehicles

Steady State Operation: Various external forces acting on vehicle, Nature of the forces and factors affecting the forces, Tractive effort & Power available from the engine, Equation of motion, Maximum tractive effort, Weight distribution, Stability of vehicle on slope, Road performance curves, Acceleration, Gradibility & Drawbar Pull.

Transient Operation: Inertia effect, Equivalent mass, Equivalent moment of inertia, Equivalent ungeared system, Time to produce synchronizing during gear change, Effect of engine flywheel on acceleration, Dynamics of vehicles on Banked tracks, Gyroscopic Effects, Net driving power.

Unit III: Tyre

Importance of rubber tyre in automobile vehicle, Tubbed tyre & tubeless tyre, Cross ply tyre, Radial ply tyre, Tyre tread design, Aspect ratio, Ply rating, Rolling resistance of tires.

Unit IV: Braking Performance

Basic equations, Braking forces, Tyre road friction, Brake proportioning, ABS systems, Braking efficiency, Rear wheel lock up, Pedal force gain

Unit V: Handling Characteristics

Low speed cornering, High speed cornering, Cornering equations, Understeer gradient, Static margin, Suspension effects on cornering, Experimental measurements of understeer gradient

Unit VI: Ride Characteristics

Ride dynamic system, Excitation sources, Vehicle suspension properties, Suspension isolation, Suspension stiffness, Suspension damping, Suspension non linearities, Active control, Wheel hop resonances, Rigid body bounce/pitch motions, bounce/pitch frequencies, Olley criterion, dynamic index.

Text Books

1. Gillespie T. D. (1992), Fundamentals of Vehicle Dynamics, SAE International.
2. Wong J. Y. (1979), Theory of Ground Vehicles, Willey & Sons.

Reference Books

1. Pacejka H. B. (2012), Tyre and Vehicle Dynamics, Butterworth Hienmann
2. N. K. Giri (2004), Automotive Mechanics, Khanna Publishers, 9th Edition.
3. G. Genta (1997), Motor Vehicle Dynamics, World Scientific.
4. Rajamani Rajesh (2011), Vehicle Dynamics and Control, Springer.

ELECTIVE IV

Entrepreneurship Developments

AE 605A	Entrepreneurship Developments	PEC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	To enlarge the supply of entrepreneurs for rapid industrial development
CO2	To develop small and medium enterprises sector which is necessary for generation of employment
CO3	To industrialize rural and backward regions
CO4	To provide gainful self-employment to educated young men and women
CO5	To diversify the sources of entrepreneurship.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1									2			
CO2									2			
CO3											2	
CO4											2	3
CO5												3

Course Contents:

Unit I: Introduction to Entrepreneurship

Evolution of the Concept of Entrepreneur Functions of Entrepreneur, Characteristics of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship, Growth of Entrepreneurship, Barriers of Entrepreneurship, Role of Entrepreneurship in India, Entrepreneurial Motivation, Major Entrepreneurial Competencies.

Unit II: Small Scale Industries (SSI)

Characteristics of Small Scale Industry, Basis for Classification of Small Scale Industry: Resource Based, Demand Based, Ancillary, Subsidiary Based or Sub-Controlled Type, Technology Based etc. Government Policy for Small Scale Industry, Growth of SSI in Developing Countries, Role of National and State Agencies Providing Assistance to SSI's, Relationship between Small and Big Industries, Ownership Structure, Registration of SSI.

Unit III: Project Identification and Project Formulation

Meaning of Project, Project Identification and Selection, Elements of Project Formulation, Concept and Significance of Project Formulation, Meaning, Significance and Contents of Project Report.

Accounting for Small Enterprises: Objective of Accounting, Accounting Process, Journal, Ledger, Preparation of Balance Sheet and Assessment of Economic Viability

Unit IV: Project Appraisal

Concept of Project Appraisal, Project Appraisal Methods, Cash Flows as Costs and Benefits, Payback Period, Average Rate of Return. Discounted Cash Flow Techniques, Working Capital Management, Cost of Capital, Financing of Enterprises, Project Sickness & Corrective Measures.

Unit V: Marketing Management

Market Segmentation, Marketing Mix, and Packaging, Pricing Policy, Distribution Channels, and Govt. Purchases from SSIS.

Laws Concerning Entrepreneur: Income Tax Laws, Excise Duty, The Central Sales Tax Act, Professional Tax, Value Added Tax (VAT), Service Tax, The Workmen Compensation Act, The Minimum Wages Act, The Maternity Benefit Act, The Payment of Bonus Act

Unit VI: Institutional Support

Government Policies for Small Scale Entrepreneurs, Institutional Setup, District Industries Centers, Industrial Estates, SIDCO, NSIC, Directorate of Industries, Commercial Banks, New Entrepreneurial Development Agencies.

Women Entrepreneurship: Growth, Problems, Recent Trends.

Texts/References:

1. S. S. Khanka, "Entrepreneurial Development", S. Chand & Company Ltd.
2. C. B. Gupta, N. P. Srinivasan, "Entrepreneurship Development in India", S. Chand & Sons.
3. B. Badhai, "Entrepreneurship Development Programme", Mansell Publishing Ltd.
4. V. Desai, "Dynamics of Entrepreneurial Development & Management", Hindustan Publishing House.
5. David H. Holt, "Entrepreneurship", PHI Learning.
6. Roy Rajeev, "Entrepreneurship", Oxford University Press

Quantitative Techniques in Project Management

AE 605B	Quantitative Techniques in Project Management	PEC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Define and formulate research models to solve real life problems for allocating limited resources by linear programming.
CO2	Apply transportation and assignment models to real life situations.
CO3	Apply queuing theory for performance evaluation of engineering and management systems.
CO4	Apply the mathematical tool for decision making regarding replacement of items in real life.
CO5	Determine the EOQ, ROP and safety stock for different inventory models.
CO6	Construct a project network and apply CPM and PERT method.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	1	1	3	2				3	1	3	1
CO2	3	1	1	3	2				3	2	3	1
CO3	3	1	1	3	2				3	2	3	1
CO4	3	1	1	3	2	1			3	2	3	1
CO5	3	1	1	3	2	1			3	2	3	1
CO6	3	1	1	3	2	2			3	2	3	1

Course Contents:

Unit I: Introduction to OR

Introduction to Operations Research, Stages of Development of Operations Research, Applications of Operations Research, Limitations of Operations Research Linear programming problem, Formulation, graphical method, Simplex method, artificial variable techniques.

Unit II: Assignment and Transportation Models

Transportation Problem, North west corner method, least cost method, VAM, Optimality check methods – Stepping stone, MODI method, Assignment Problem, Unbalanced assignment problems, Travelling salesman problem.

Unit III: Waiting line Models & Replacement Analysis

Queuing Theory: Classification of queuing models, Model I (Birth and Death model) M/M/I (∞, FCFS), Model II - M/M/I (N/FCFS).

Replacement Theory, Economic Life of an Asset, Replacement of item that deteriorate with time, Replacement of items that failed suddenly.

Unit IV: Inventory Models

Inventory Control - Introduction to Inventory Management, Basic Deterministic Models, Purchase Models, Manufacturing Models without Shortages and with Shortages, Reorder level and optimum buffer stock, EOQ problems with price breaks.

Unit V: Project Management Techniques

Difference between project and other manufacturing systems. Defining scope of a project, Necessity of different planning techniques for project managements, Use of Networks for planning of a project, CPM and PERT.

Unit VI: Time and Cost Analysis

Time and Cost Estimates: Crashing the project duration and its relationship with cost of project, probabilistic treatment of project completion, Resource allocation and Resource leveling.

Texts:

1. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand and Company Ltd., New Delhi,1996.
2. L. C. Jhamb, "Quantitative Techniques for managerial Decisions", Vol. I and II, Everest Publishing House, Pune, 1994.
3. N. D. Vohra, "Operations Research", Tata McGraw Hill Co., New Delhi.

References:

1. H. Taha, "Operations Research–An Introduction", Maxwell Macmillan, New York.
2. J. K. Sharma, "Operations Research–An Introduction", Maxwell Macmillan, New Delhi.
3. Harvey M. Wagner, "Principles of Operations Research with Applications to Managerial Decisions", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd edition, 2005.
4. Rubin and Lewin, "Quantitative Techniques for Managers", Prentice Hall of India Pvt. Ltd., New Delhi.

Energy Conservation and Management

AE 605C	Energy Conservation and Management	PEC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand energy problem and need of energy management
CO2	Carry out energy audit of simple units
CO3	Study various financial appraisal methods
CO4	Analyse cogeneration and waste heat recovery systems
CO5	Do simple calculations regarding thermal insulation and electrical energy conservation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	1	2	3		2	3			2	2		2
CO2	1	1	3	1	2	3			2	2		2
CO3	2	1	1							1		2
CO4	3	3			2	3						1
CO5			3			2						1

Course Contents:

Unit I: Introduction
General energy problem, Energy use patterns and scope of conservation. Energy Management Principles: Need, Organizing, Initiating and managing an energy management program.

Unit II: Energy Auditing
Elements and concepts, Types of energy audits, Instruments used in energy auditing. Economic Analysis: Cash flows, Time value of money, Formulae relating present and future cash flows - single amount, uniform series.

Unit III: Financial appraisal methods
Payback period, Net present value, Benefit-cost ratio, Internal-rate of return, Life cycle costs/benefits. Thermodynamics of energy conservation, Energy conservation in Boilers and furnaces, Energy conservation in Steam and condensate system.

Unit IV: Cogeneration
Concept, Types of cogeneration systems, performance evaluation of a cogeneration system. Waste Heat Recovery: Potential, benefits, waste heat recovery equipment's. Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building, Transfer of heat, Space heating methods, Ventilation and air conditioning, Heat pumps, Insulation, Cooling load, Electric water heating systems, Electric energy conservation methods.

Unit V: Insulation and Heating
Industrial Insulation: Insulation materials, Insulation selection, Economical thickness of insulation. Industrial Heating: Heating by indirect resistance, direct resistance heating (salt bath furnace), and Heat treatment by induction heating in the electric arc furnace industry.

Unit VI: Energy Conservation in Electric Utility and Industry
Energy costs and two-part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illumination systems, Importance of Power factor in energy conservation, Power factor improvement methods, Energy conservation in industries

Texts/References:

1. Callaghan, "Energy Conservation".
2. D. L. Reeg, "Industrial Energy Conservation", Pergamon Press.
3. T. L. Boyen, "Thermal Energy Recovery", Wiley Eastern.
4. L. J. Nagrath, "System Modeling and Analysis", Tata McGraw Hill Publications.
5. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publications.

Development Engineering

AE 605D	Development Engineering	PEC	2-0-0	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Elective V

Manufacturing Automation

AE 606A	Manufacturing Automation	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand the concept of automation
CO2	Design a Pneumatic and Hydraulic system for a given application
CO3	Demonstrate the use of different sensors for automation
CO4	Design an AGV system
CO5	Understand the transfer mechanisms in automation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	2	2		1						2
CO2	1	1	3	3		2						1
CO3	2	2	2									1
CO4	2	2	3	3								1
CO5	3	3	2	1		1						1

Course Contents:

Unit I: Introduction

Concept of automation, mechanization and automation, Concept of automation in industry, mechanization and automation, classification Types of automation, Degree of automation, Technical, economic and human factors in automation,

Unit II: Automation using Hydraulic systems

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis. Servo valves, electrohydraulic valves, proportional valves and their applications.

Unit III: Automation using pneumatic systems

Pneumatic fundamentals, control elements, position and pressure sensing, logic circuits, switching circuits, fringe conditions modules and these integration, sequential circuits, cascade methods, mapping methods, step counter method, compound circuit design combination circuit design, Pneumatic equipment's, selection of components, design calculations, application, - fault finding, hydro pneumatic circuits, use of microprocessors for sequencing PLC, Low cost automation, Robotic circuits.

Unit IV: Automation using electronic systems
Introduction, various sensors, transducers, signal processing, servo systems, programming of microprocessors using 8085 instruction, Industrial logic control systems Logic diagraming, programmable logic controllers.

Unit V: Automation in work handling
Working principles and techniques, job orienting and feeding devices, Transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including AGV and its various guiding technologies

Unit VI: Applications of automation
Development of small automation systems using mechanical devices, Circuit optimization techniques, Illustrative examples of the above types of systems as well as hybrid systems

Texts/References:

1. Kay, F., "Pneumatics for Industry", The Machining Publication Co., London, 1959.
2. Asphal Ray, "Robots and Manufacturing Automation", John Wiley, New York, 1985.
3. Andrew Parr, "Hydraulic and Pneumatics(HB)", Jaico Publishing House, 1999.

Computer Integrated Manufacturing Systems

AE 606B	Computer Integrated Manufacturing Systems	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I:
Introduction
Brief introduction to CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance– Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

Unit II:
Planning and Control and Computerized Process Planning
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems

Unit III
Cellular Manufacturing
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Unit IV
Guided Vehicle System (Agvs)
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application Vehicle Guidance technology – Vehicle Management & Safety.

Unit V
Industrial Robotics
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Text Books:
1. Mikell. P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

References:
1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India,2003.

2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tiwari &T. K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill, Publishing Company, 2000.

Finite Element Method and its Application

AE 606C	Finite Element Method and its Application	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural, thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two and three dimensional problems

Mapping of course outcomes with program outcomes

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

Course Contents

Unit I: Introduction
Finite element analysis and its need; Advantages and limitations of finite element analysis (FEA); FEA procedure.

Unit II: Elements of Elasticity
Stress at a point; Stress equation of equilibrium; 2-D state of stress; Strains and displacements; Stress-strain relationship for 2-D state of stress; Plane stress and plane strain approach.

Unit III: Relevant Matrix Algebra
Addition, subtraction and multiplication of matrices; Differentiation and integration of matrices; Inverse of a matrix; Eigen values and eigen vectors; Positive definite matrix; Gauss elimination.

Unit IV: One-dimensional Problems
Introduction; FE modelling; Bar element; Shape functions; Potential energy approach; Global stiffness matrix; Boundary conditions and their treatments; Examples.

Unit V: Trusses and Frames
Introduction; Plane trusses; Element stiffness matrix; Stress calculations; Plane frames; examples.

Unit VI: Two-dimensional Problems
Introduction and scope of 2-D FEA; FE modelling of 2-D problem; Constant strain triangle; Other finite elements (no mathematical treatment included); Boundary conditions.

Texts:

1. T. R. Chandrupatla, A. D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.
2. P. Seshu, "A Textbook of Finite Element Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc.

References:

K. J. Bathe, "Finite Element Procedures", Prentice Hall of India Pvt. Ltd., 2006.

Computer Simulation of IC Engine

AE 606D	Computer Simulation of IC Engine	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

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

Course Contents:

UNIT-I:

Computer Simulation and Thermodynamics of Combustion

Introduction, Heat of Reaction, Complete Combustion In C/H/O/N Systems, Constant Volume Adiabatic Combustion, Constant Pressure Adiabatic Combustion. Calculation of Adiabatic Flame Temperature.

UNIT-II:

SI Engine Simulation with Fuel-Air as Working Medium

Deviation Between Actual and Air Standard Cycles of Operation- Problems, SI Engine Simulation with Adiabatic Constant Volume Combustion with Fuel and Air Being Considered, Calculation of Temperature Drop Due to Fuel Vaporization, Calculation of Mean Effective Pressure, Torque and Thermal Efficiency at Full Throttle, Part Throttle and Supercharged Conditions

UNIT-III:

Actual Cycle Simulation in SI Engines

Progressive Combustion; Gas Exchange Process, Heat Transfer Process, Friction. Procedure of Validating Computer Code with Experimental Data Based on Performance Parameters and Pressure Crank Angle Diagram.

UNIT-IV:

Simulation of 2-Stroke SI Engine Simulation of the Process, Determination of the Pressure-Crank Angle Variation, Computation of Performance Parameters

UNIT-V:

Diesel Engine Simulation

Main Difference between SI and CI Engine Simulation, Differences Between Ideal and Actual Cycles, Mathematical Combustion Model for Diesel Engine, Heat Transfer and Gas Exchange Processes

REFERENCES:

1.Ganesan, V., "*Computer Simulation of Spark Ignition Engine Process",* Universities Press (I) Ltd, Hyderabad, 1996.

2.Ganesan. V., *"Computer Simulation of Compression Ignition Engine Process",* Universities Press (I) Ltd, Hyderabad, 2000.

3.Ashley Capbel, "*Thermodynamic Analysis of Combustion Engine",* John Wiley and Sons, New York - 1986.

4.Benson.R.S., Whitehouse. N.D., "*Internal Combustion Engines",* Pergamon Press, oxford, 1979.

5.Ramoss.A.L., "*Modelling of Internal Combusion Engines Processes",* McGraw-Hill Publishing Co., 1992.

Automotive Body Engineering Lab

AE 607	Automotive Body Engineering Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the concept of car body design, passenger safety, crumple zone and crash testing.
CO2	Identify the concepts of wind tunnel testing and vehicle body optimization techniques to reduce drag.
CO3	Demonstrate the various types of bus body construction, seating layout, regulations and comfort.
CO4	Correlate the various heavy vehicle bodies, driver's visibility and cabin design.
CO5	Distinguish the different types of materials and painting techniques for vehicle body

Mapping of course outcomes with program outcomes

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

List of Experiment: (Any 8)

1. Typical Car - body construction with sketches.
2. To study the construction of typical truck body and draw sketches.
3. To study passenger seat position, requirement and construction by using standard dimension of bus.
4. Study of effect of different shapes, styles and exterior objects on drag force
5. Calculation of aerodynamic forces and pitching, rolling, yawing moments.
6. Measurement of drag, lift force of a scaled model in wind tunnel.
7. To demonstrate constructional and operational features of mechanical and power window mechanism.
8. Design of intercity bus and prepare a sheet by using any drafting software.
9. Design a Luxury bus structure with seating layout and prepare sheet by using any drafting software.
10. Study and analysis of flow conditions over the vehicle with the help of CFD software.
11. Visit to Automotive body building workshop.

Design of Machine Element Lab

AE 608	Design of Machine Element Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain aesthetic and ergonomics to design machine components
CO2	Design shafts and couplings for specific requirements.
CO3	Design against static Loads for specific requirements
CO4	Design against Fluctuating Loads for specific requirements.
CO5	Design different machine components.
CO6	Design and selection of standard components for specific requirements

Mapping of course outcomes with program outcomes

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

List of Experiment: (Any 8)

1. Exercise on engineering material selection
2. (Students are required to prepare a chart/table on A3 size sheet which will comprise of various engineering materials, composition, properties for given applications)
3. Design and drawing of welded and bolted joints subjected to eccentric loading
4. Design of Shaft
5. Design and drawing of rigid or flexible coupling
6. Design and Drawing of screw jack
7. Design against Fluctuating Loads
8. Design of helical compression spring
9. Design of leaf spring
10. Selection of standard components like belts, chains, electric motors for given application.

Technical Project on Community Services

ME 609	Technical Project for Community Services	PCC	0-0-3	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Visit nearby places to understand the problems of the community
CO2	Select one of the problems for the study, state the exact title of the project and define scope of the problem
CO3	Explain the motivation, objectives and scope of the project
CO4	Evaluate possible solutions of the problem
CO5	Design, produce, test and analyze the performance of product/system/process
CO6	Modify, improve the product/system/process

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1						2	1	1		2		1
CO2		2								2	1	
CO3						1				2	1	
CO4		1	2				1	2				
CO5	1	1	2	3	1	1	1	2	1	1	1	
CO6			2	1	1		1	1				

Rationale

The role of technical institutes in giving technical and advisory services to the surrounding community need not be emphasized. It is desirable that each faculty member and student be involved in rendering services to community and economy. Moreover, as per Section (4) of the Act of this University, technical services to community, particularly the backward areas, is one of the basic objects of the University. In view of this, "Technical Project related to Community Services" has been included in the curriculum. This will ensure the participation of each student as well as faculty in this activity.
The weekly contact hours and the evaluation scheme for this project are as stated above. The nature of project work should be as given below in the course contents.

List of Practical's/Experiments/Assignments

The projects may be of varying nature such as a technical study/survey, design/development of a technology solution for an identified need, infusion/transfer of technology, etc. All this will be within the ambit of technology and expertise available within the University.

The student may form small groups, typically of 2 to 3 students, and carry out the project under the supervision of a faculty member.

Summer Vacation Training

AE 610	Summer Vacation Training	PCC	---	---

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	To make the students aware of industrial culture and organizational setup
CO2	To create awareness about technical report writing among the student.

Mapping of course outcomes with program outcomes

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

SEMESTER VII

Special Purpose Vehicle

AE 701	Special Purpose Vehicle	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Classify the different type of special purpose vehicles with its applications.
CO2	Suggest various types of features for given special purpose vehicle.
CO3	Explain the constructional and working features of various special purpose vehicles.
CO4	Apply the fundamental concepts of automotive engineering related to design of special purpose vehicles.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
Classification and Requirements of Special Purpose Vehicles
Introduction, pre-test, history and overview of an off-road machines, construction layout, capacity and applications, power plants, chassis and transmission, multi-axle vehicles.

Unit-II:
Earth Moving Machines and Tractors
Different types of earth moving equipment's and their applications, Bulldozers, cable and hydraulic dozers, Crawler track, running and steering gears, scrapers, drag and self-powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.
Tractors: General description, Power take off, special implements, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled-bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits.

Unit-III:
Scrappers, Graders, Shovels and Ditchers
Scrappers, elevating graders, motor graders, self-powered scrappers and graders, power shovel, revolving and stripper shovels, drag lines, ditchers, capacity of shovels.

Unit IV:
Cranes and Derricks
Types of Cranes Generally used in the Workplace, Components of cranes, Crane and Derricks configuration, Stability against overturning, Analysis of Eight Hazards, Crane safety programs

Unit-V:
Vehicle Systems and Features
Brake system and actuation – OCDB and dry disc calliper brakes. Body hoist and bucket operational hydraulics, Hydro-pneumatic suspension cylinders, Power steering system, Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

Unit-VI:
Vehicle Evaluation Mobility
Soil-Vehicle Mechanics, characteristics of soils, nominal ground pressure, mean maximum pressure, the mobility index (mi), vehicle cone index (vci) and rated cone index (rci), mobility number, dynamic behaviour and traction on wet soil, traction performance and factors affecting traction performance.

Reference Books:
1. "Construction Equipment and its Management", Sharma, S.C.
2. "Farm Machines and Equipment's", Nakra C.P., Dhanpatrai Publishing company Pvt. Ltd. 2003.
3. "Theory of Ground Vehicles", Wong J Y, John Wiley and Sons, New York, 1978.

4. “Construction Planning and Equipment”, Satyanarayana B., Standard publishers and distributors New Delhi.

Automotive Air Conditioning

AE 702	Automotive Air conditioning	PCC	2-1-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply design concept to develop refrigeration system for refrigerated vehicle.
CO2	Explain psychometric concepts in design of air-conditioning in vehicle.
CO3	Explain effects of various operating parameters on performance of A/C System.
CO4	Explain troubleshooting methods and maintenance of automotive air conditioning system.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:

Introduction to air conditioning and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapor compression cycle, bell Coleman cycle), effects of various operating parameters on performance of A/C System, Vapour absorption refrigeration system (No numerical), Applications of air conditioning.

Unit-II:

Refrigerants and Air Conditioning Components Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping, Future refrigerants, **Automobile Air conditioning components:** Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants. Refrigerant charge capacity determination.

Unit-III:

Psychrometry, Psychometric properties, tables, charts, Psychometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor,

Load analysis Outside and inside design consideration, Factors forming the load on refrigeration and air conditioning systems, Load calculations for automobiles, Effect of air conditioning load on engine performance, Air conditioning electrical and electronic control, pressure switching devices, sensors and actuators.

Unit-IV:
Air distribution system Comfort conditions, Air management and heater systems, air distribution modes (Fresh/Recirculation, Face, Foot, Defrost, and Demist), A/C ducts and air filters, Blower fans, Temperature control systems (manual/semiautomatic, automatic). Vehicle operation modes and Cool-down performance.

Unit-V:
Diagnostics, Trouble Shooting, Service and Repair Initial vehicle inspection, temperature measurements, pressure gauge reading and cycle testing, leak detection and detectors, Sight glass. Refrigerant safety/handling, refrigerant recovery; recycle and charging, system oil, system flushing, odor removal, retrofitting. Removing and replacing components, Compressor service.

Unit-VI:
Refrigerated van:
Functioning, design, classifications, applications, Interior design, temperature and humidity control.

Text Book:
1**.** Textbook of "Refrigeration and Air Conditioning" By R. S. Khurmi and J. K. Gupta S. Chand Publication.
2. Steven Daly: "Automotive air conditioning and Climate control systems" Butterworth-Heinemann publications.

References:
1. "Principles of Refrigeration"; Roy J Dossat, Pearson Education Inc.
2. "Automotive air conditioning" William H Crouse and Donald L Anglin.
3. "Refrigeration and Air Conditioning", Arora and Damkondwar, Dhanpatrai and Company.
4. "Refrigeration and Air Conditioning", C. P. Arora, Tata McGraw Hills Pub.
5. Steven Daly, "Automotive air conditioning and Climate control systems", Elsevier Ltd, 2011.
6. Boyce H Dwiggins, "Automotive Heating and Air Conditioning", Delmar Thomson Learning Ltd, 2001.

Vehicle Performance and Testing

AE 703	Vehicle Performance and Testing	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the performance parameters related to performance analysis of automotive systems.
CO2	Conduct the performance test for components and systems of vehicle.
CO3	Explain the different tracks used for vehicle testing with the testing procedure.
CO4	Apply the knowledge regarding safety systems, EMI and sensors used for automotive functioning.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
Vehicle Performance Parameters:
Fuel economy, acceleration, deceleration, grad ability, top speed, handling, comfort, life durability, EGR systems, Impact of vehicular systems on performance: Suspension system, Steering system, Brakes, Tyres, carriage unit. Catalytic converters function and construction, Lambda close loop control system for gasoline vehicles.

Unit-II:
Drive train and Component testing:
Vehicular transmission performance: comparison of automotive clutches epicyclic transmission, torque converter, final drive and differential. testing of vehicle components: clutch, gear box (for noise and shifting force), brake testing, wheels and tyre testing – tyre wear pattern identification and causes.

Unit-III:
Vehicle testing:
Road test, free acceleration test, coast down test, passer by noise test, road load data acquisition for vehicle, **Test tracks**: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water Laboratory testing: Testing on chassis dynamometer, transition testing (Euro III onwards), accelerated testing, virtual testing, evaporative emission testing, oil consumption testing, endurance test, high speed performance test.

Unit-IV:
Comfort, Convenience and Safety
Seats: types of seats, driving controls accessibility, and driver seat anthropometry. **Steering:** steering column angle, collapsible steering, and power steering. Adaptive cruise control, navigation system, adaptive noise control, driver information system. **Safety:** Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety.

Unit-V:
Collisions and Crash Testing Crash testing:
Human testing, dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition, braking distance test.

Unit-VI:

Noise and vibration:

Mechanism of noise generation, engine noise and vibration, causes and remedies on road shocks, wind noise and measurement. Automobile testing instrumentation: Sensors types and selection, instrumentation for functional tests, model test and full scale testing.

Texts/References: -

1. "Automotive Handbook", Bosch.
2. "Engine Testing Theory and Practice", Michel Plint.
3. "Motor Vehicle Inspection", W. H. Crouse and D. L. Anglin.
4. "Automobile Engineering" (Anna University) Ramlingam.
5. "Automobile engineering", Kripal Singh.
6. "Automotive Mechanics", JosepfHeitner.
7. ARAI vehicle emission test manual Inspection SAE handbook vol. 2 and 3.
9. "Vehicle Operation and Performance", J. G. Giles,
10. "Automobile engineering" Kripal Singh.
11. "Automotive Vehicle Safety", George Pieters, Barbara Pieters.
12. "Aerodynamics of road vehicles", Wolt, Heinrich Hucho.
13. "Engine performance Diagnosis and Tune up Shop Manual", Gousha H. M.
14. "Automobile Engineering", Rangawala.

Vehicle Maintenance and Service Practices

AE 704	Vehicle Maintenance and Service Practices	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand the basic concepts of maintenance &service management
CO2	Apply the automotive knowledge for finding and repair the various system of the vehicle
CO3	Apply a management tools for service sector automobile industry.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

Course Contents:

Unit I:

Maintenance Management

Types of maintenance strategies, Planned and unplanned maintenance, Breakdown, Preventive & Predictive maintenance their comparison, Advantage & disadvantages.

Limitations, Computer aided maintenance, Maintenance scheduling, Spare part management, Inventory control, Organization of maintenance department.

Unit II:

Maintenance, Workshop Practices, Safety and Tools

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures –workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

Unit III:

Engine and Engine Subsystem Maintenance

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls

Unit IV:

Transmission and Driveline Maintenance

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling

transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings servicingdifferential assemblies- fault diagnosis.

Unit V:

Steering, Brake, Suspension, Wheel Maintenance

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steeringlinkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system

Unit VI:

Auto Electrical and Air Conditioning Maintenance

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Text Books:

1. Ed May, "Automotive Mechanics Volume One", McGraw Hill Publications, 2003.
2. Ed May, "Automotive Mechanics Volume Two", McGraw Hill Publications, 2003.
3. Vehicle Service Manuals of reputed manufacturers.

References:

1. “Automotive Technology: A Systems Approach”, 5e Jack Erjavec/Delmar Cengage Learning.
2. “Automotive Mechanics”, William Crouse and Donald Anglin McGraw Hill Publications.
3. “Automotive Technology”, Joseph Heitner.
4. “Automotive Electrical and Electronic Systems”, John F. Kershaw, James D.Halderman.
5. “Automotive Engines: Theory and Servicing by J. D. Halderman & Mitchell, Pearson Education.
6. Gopal Krishnan and Banerji, Maintenance & Spare parts Management, PHI.
7. Mishra and Pathak, “Maintenance Engineering and Management”, PHI.

Automotive Emission and Control

AE 705	Automotive Emission and Control	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify and understand possible harmful emissions and the legislation standards
CO2	Categorize, interpret and understand the essential properties of fuels for petrol and diesel engines influences the emission.
CO3	Analyse Engine parameters that influence engine emission.
CO4	Describe the SI engine and CI engine emission control systems.
CO5	Explain various exhaust after-treatment systems.
CO6	Identify various emission instruments, techniques and the test cycle for emission levels measurement.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I: **Introduction**
Historical background, Pollutants-sources-formation-effects-transient operational effects on pollution. Historical background, Regulatory test procedures.

Unit-II: SI engine Combustion and Pollutant Formation
Chemistry of SI engine Combustion, HC and CO formation in 4 stroke and 2 stroke SI engines, NO formation in SI Engines, Effect of operating variables on emission formation.

Unit-III: **CI engine Combustion and Emissions**
Basic of diesel combustion-Smoke emission in diesel engines-Particulate emission in diesel engines, Colour and aldehyde emissions from diesel engines, Effect of operating variables on emission formation.

Unit-IV: Control Techniques for SI and CI
Design changes, optimization of operating factors, exhaust gas re-circulation, fumigation, air injector PCV system-Exhaust treatment in SI engines-Thermal Reactors-Catalytic converters, Catalysts, Use of unleaded petrol.

Unit-V: Emission Measurement, Test procedures & regulations
Test cycles for light & medium duty vehicles, test procedure for evaporative emissions, Emission standards for light and heavy duty vehicles & motor cycle emission standard. NDIR analyzers, FID, Chemiluminescence, NOx analyzer, oxygen analyzer, smoke measurement, constant volume sampling, and particulate emission measurement

Unit-VI: 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.

Texts/References:
1. Springer and Patterson, Engine Emission, Plenum Press, 1990.
2. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill Co., 1994.
3. SAE Transactions, Vehicle emission, 1982 (3 vol).
4.Obert. E. F., "Internal Combustion Engines", 1982.
5. Taylor C. F., "Internal Combustion Engines", MIT Press, 1972.
6. Heywood. J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1995.
7. Automobiles and Pollution SAE Transaction, 1995.
8. B. P. Pundir, Engine Emissions, Narosa Publications.
9. E. F. Oberts, "Internal Combustion Engine and Air Pollution", Harper & Row Publisher, NY

Automobile Air Conditioning Lab

AE 706	Automobile Air conditioning Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Sketch various components of air conditioning systems with their function.
CO2	Conduct the performance test for air conditioning system of vehicle.
CO3	Prepare a layout of air conditioning system of passenger car, luxury bus.
CO4	Explain the latest trends in automotive refrigeration systems.
CO5	Demonstrate the skill foor fault finding and maintenance of air conditioning systems.

Mapping of course outcomes with program outcomes

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

List of Experiments: - (Experiment 1, 2, 3 and 10 are compulsory and perform any four from remaining)

1. Demonstration of different components with the help of cut sections/models/charts- Compressor, Condenser, Evaporators, Expansion device, Blower fans, Hating systems etc.
2. Test on vapor compression test rig.
3. Test on air conditioning test rig.
4. Demonstration of various methods of goods transport refrigeration systems.
5. Study and demonstration on car and bus air conditioning system.
6. Study of latest trends in automotive refrigeration systems.
7. Study and demonstration of controls in refrigeration.
8. Study of installation/operations/maintenance practices for refrigeration systems.
9. Study of leak testing and leak detection methods.
10. Visit to maintenance shop of automotive air conditioning and prepare report on it.

Vehicle Maintenance Management Lab

AE 707	Vehicle Maintenance Management Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify problems occurred in engine system by performing engine tune up.
CO2	Illustrate the critical inspection parameters for faulty engine operation.
CO3	Carry out wear measurement of different engine components.
CO4	Carry out wheel balancing and wheel alignment.
CO5	Check and adjust valve clearance of four stroke SI engine of a car.
CO6	Prepare layout of gaseous fuel systems with their constructional and operational features.

Mapping of course outcomes with program outcomes

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

List of Practical's/Experiments/Assignments: (Any 8)

1. Visit to Service Station to study computerized wheel alignment.
2. To check and adjust wheel balancing by using computerized wheel balancing machine
3. Demonstration of trouble shooting on multi cylinder petrol/diesel engine
4. Dismantle and assemble of two-wheeler single cylinder four stroke engine.
5. Trouble shooting of braking system.
6. Tune up the four stroke SI engine of a car for best performance.
7. To check and adjust valve clearance of four stroke SI engine of a car.
8. Visit to fuel injection pump testing station.
9. Dismantling and assembly of carburettor.
10. Demonstration of CNG fuel kit.
11. Demonstration of LPG fuel kit

Vehicle Performance and Testing Lab

AE 708	Vehicle Performance and Testing Lab	PCC	0-0-2	1 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Comprehend measurement system for automotive testing.
CO2	Test performance of two and four wheelers.
CO3	Test to measure the noise levels in the vehicle.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

List of Experiment: (Any 8)

1. Estimation of power requirement for vehicle propulsion by taking actual vehicle example.
2. Perform coast down test.
3. On road fuel consumption test at different speeds.
4. Brake efficiency measurement
5. Pass - by noise test.
6. Free acceleration test.
7. Vibration measurement in passenger compartment
8. Laboratory testing of vehicle on chassis dynamometer for performance and emission.
9. Report based on visit to vehicle testing and research organization.
10. Visit for on road emission testing of petrol and diesel vehicles for PUC/RTO.

Seminar/ Self-study Seminar

AE 709	Seminar/ Self-study Seminar	PCC	0-0-3	2 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	State the exact title of the seminar
CO2	Explain the motivation for selecting the seminar topic and its scope
CO3	Search pertinent literature and information on the topic
CO4	Critically review the literature and information collected

Mapping of course outcomes with program outcomes

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

Course Contents:

Before the end of Semester VII, each student will have to deliver a seminar on a subject mutually decided by candidate and his/her guide. The student should select the topic for his/her seminar which is latest and relevant. The student, as a part of the term work, should submit the write-up of the seminar topic in duplicate, typed on A_4 size sheets in a prescribed format and bound at the end of semester. The performance of the student will be evaluated on the basis of the contents, the presentation and discussion during the delivery of seminar before the evaluation committee appointed by the Department.

Project Stage – I

AE 710	Project Stage – I	PCC	0-0-4	2 Credits

Pre-Requisites: None
Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

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

Course Contents:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
5. Software development for particular applications.
6. A combination of the above.

It is expected that the students should complete at least 40% of the total project work in VII Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry. The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format, before the end of VII semester. The report shall be comprehensive and presented typed on A_4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

SEMESTER VIII

Elective – VI

Transport Management

AE 801A	Transport Management	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Describe the motor vehicle act & central motor vehicle rules.
CO2	Illustrate motor vehicle insurance & taxation.
CO3	Analyze the passenger & goods transport operations.
CO4	Identify advanced techniques in traffic management.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit I:
Motor Vehicle Act Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Accidents, Causes & analysis, Liabilities & preventive measures, Rules & regulations, Responsibility of driver, Public & public authorities, Offences, penalties & procedures, Different types of forms, Government administration structure, Personnel, Authorities & duties, Rules regarding construction of motor vehicles.

Unit II:
Taxation Objectives, Structure & methods of laving taxation, Onetime tax, Tax exemption & tax renewal

Unit III:
Insurance types & significance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & Run case, Duty of driver in case of accident, Surveyor & Loss Assessor, Surveyors report

Unit IV:
Passenger Transport Operation Structure of passenger transport organizations, Typical depot layouts, Requirements and Problems on fleet management, Fleet maintenance, Planning - Scheduling operation & control, Personal & training-training for drivers & conductors, Public relations, Propaganda, publicity and passenger amenities, Parcel traffic., Theory of fares-Basic principles of fare charging, Differential rates for different types of services, Depreciation & debt charges, Operation cost and Revenues, Economics & records.

Unit V:
Goods Transport Operation Structure of goods transport organizations, Scheduling of goods transport, Management Information System (MIS) in passenger / goods transport operation, Storage & transportation of petroleum products.

Unit VI:
Advance Techniques in Traffic Management Traffic navigation, Global positioning system

References Books:

1. Motor Vehicle Act - Govt. of India Publications.

2. S.K. Shrivastava, "Economics of Transport"

3. "Transport Development in India", S. Chand & Co. Pvt. Ltd., New Delhi.

4. Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Road Transport Undertakings, New Delhi.

5. P.G.Patankar, "Road Passenger Transport in India", CIRT, Pune

Automotive Tribology

AE 801B	Automotive Tribology	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Analyze the solid surfaces and their interactions
CO2	Apply lubrication, friction and wear theories in practice.
CO3	Compare liquid and gas lubrication.
CO4	Select appropriate surface treatment to reduce the friction.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit -I:

Introduction to tribology:

Friction, wear and lubrication principles of tribology, thick film lubrication, and boundary layer lubrication.

Unit -II:

Friction and wear:

Laws of friction, causes of friction, types of wear and mechanisms of wear, wear properties of friction and anti-friction metallic and non-metallic materials.

Unit -III:

Lubricants:

Solid lubricants, liquid lubricants, properties of lubricants, selection for general applications and special applications such as low temperature, high temperature, extreme pressure, corrosion resistance.

Unit -IV:

Hydrodynamic lubrication:

Basic concepts, Reynolds equation, plane bearings, Design of journal bearings- short and finite bearings, design of bearings with steady load, varying load and varying speed.

Unit -V:

Lubrication of automobile systems:

Engine lubricating systems, lubrication of piston, piston rings and cylinder liners, lubrication of cam and followers, lubrication of involutesgears, hypoid gears and worm gears, friction aspects of clutch, brakes and belt drive.

Unit -VI:

Pneumatic tyres:

Creep and slip of an automobile tyre, functions of tyre, design features of the tyre surface, mechanism of rolling and sliding, tyre performance on wet road surface.

References

1. B. P. Pundir, “Engine Emissions”, Narosa Publications.
2. E. F. Oberts, “Internal Combustion Engine and Air Pollution”, Harper & Row Publisher, NY.
3. J.G. Giles, “Vehicle Operation & Testing” (Automotive Vehicle Technology Vol. 7)
4. C.H. Fisher, “Carburetion”, Vol. 4.
5. A.W. Judge, “Carburetion and Fuel Injection System”, Motor Manual, Vol. 2, The Caxton Pub. Co. Ltd., London.

6. H. H. Willard and Others, “Instrumental Method of Analysis”, CBS Publishers & Distributors, Delhi.

Electric and Hybrid Vehicles

AE 801C	Electric and Hybrid Vehicles	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the need of EVs and HEVs in today’s transportation context.
CO2	Describe and compare EV and HEV technology.
CO3	Suggest factors to design an electric vehicle.
CO4	Comment on significance of fuel cell technology for vehicular application
CO5	Explain nonelectrical hybrid systems for vehicle.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit -I:

Electric Vehicles and Motors

Electric vehicle, introduction, components, advantages, disadvantages, applications, vehicles. DC motors series wound- shunt wound- compound wound and separately excited motors AC motors Induction- synchronous- brushless DC motor- switched reluctance motors.

Unit -II:

Hybrid Vehicles and Propulsion Methods

Introduction to hybrid vehicles performance characteristics of road vehicles; calculation of road load- predicting fuel economy- grid connected hybrids.

Unit -III:

Hybrid Architecture and Power Plant Specifications

Series configuration locomotive drives- series parallel switching- load tracking architecture. Pre transmission parallel and combined configurations Mild hybrid- power assist- dual mode-power split- power split with shift- Continuously Variable transmission (CVT) - wheel motors. Grade and cruise targets- launching and boosting- braking and energy recuperation- drive cycle implications.

Unit -IV:

Sizing the Drive System and Energy Storage Technology

Matching electric drive and ICE, sizing the propulsion motor; sizing power electronics, Battery basics: lead acid battery, different types of batteries, battery parameters, advanced battery technology.

Unit-V:

Fuel Cells

Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra-capacitors- PEM fuel cell vehicles

Unit -VI:

Nonelectric Hybrid Systems

Short term storage systems flywheel accumulators, continuously variable transmissions hydraulic accumulator's hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

Text Books:

1. "The Electric Car: Development and Future of Battery- Hybrid and Fuel Cell Cars", Mike Westbrook- M H Westbrook- British library Cataloguing in Publication Data.
2. "Electric and Hybrid Vehicles", Robin Hardy- Iqbal Husain- CRC Press.
3. "Propulsion Systems for Hybrid Vehicles",John M. Miller Institute of Electrical Engineers- London.
4. "Alternative Fuels", S. S. Thipse, Jaico publications.

Reference Books:

1. Energy Technology Analysis Prospects for Hydrogen and Fuel Cells- International Energy Agency- France.
2. Handbook of Electric Motors- Hamid A Toliyat- Gerald B Kliman- Marcel Decker Inc.

Elective – VII

Robotics

AE 802A	Robotics	PCC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	List the various components of a typical Robot, grippers, sensors, drive system and describe their functions
CO2	Calculate the word to joint and joint to word coordinates using forward and reverse transformations
CO3	Calculate the gripper forces, drive sizes, etc.
CO4	Develop simple robot program for tasks such as pick and place, arc welding, etc. using some robotic language such as VAL-II, AL, AML, RAIL, RPL, VAL
CO5	Evaluate the application of robots in applications such as Material Handling, process operations and Assembly and inspection
CO6	Discuss the implementation issues and social aspects of robotics

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit -I:

Robot definition: Robotic systems - Its role in automated manufacturing; robot anatomy; robot classifications and specifications.

Unit -II:

Robot kinematics, forward and reverse transformation, homogeneous transformations.

Unit-III:

Robot actuators and control; Pneumatic, hydraulic and electrical drives and controls used in robots.

Unit-IV:

Robot end-effectors, mechanical, magnetic and vacuum grippers, gripping forces RCC and design features of grippers.

Unit-V:

Robot sensors, different types of contact and non-contact sensors; Robot vision and their interfaces

Unit-VI:

Technical issues involved in implementing Robotics, its Safety, Training, Maintenance and Quality, Social and Labour Issues, Robotics Technology of the Future

References:

1. Robert Shilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall of India
2. J.J, Craig, “Introduction to Robotics”, Pearson Education
3. Fu, Gonzales and Lee, “Robotics”, McGraw Hill
4. Curtis D. Johnson, “Process Control Instrumentation Technology”, PHI Publication, Eighth Edition
5. Staughard, “Robotics and AI”, Prentice Hall of India
6. Grover, Wiess, Nagel, Oderey, “Industrial Robotics”, McGraw Hill
7. WalframStdder, “Robotics and Mechatronics”,

8. Niku, “Introduction to Robotics”, Pearson Education.
9. Klafter, Chmielewski, Negin, Robot Engineering, Prentice Hall of India
10. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications.
11. George L Balten Jr., “Programmable Controllers”, Tata McGraw Hill publication
12. Handbook of Industrial Robotics: Ed. Shimon Y. Nof, John Wiley. ISBN: 9780471177838.

Fundamentals of Computational Fluid Dynamics

AE 802B	Fundamentals of Computational Fluid Dynamics	Elective	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify applications of finite volume and finite element methods to solve Navier-Stoke equations.
CO2	Evaluate solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly.
CO3	Design and setup flow problem properly within CFD context, performing solid modeling using CAD package and producing grids via meshing tool
CO4	Interpret both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution.
CO5	Use CFD software to model relevant engineering flow problems. Analyse the CFD results Compare with available data, and discuss the findings

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I: Introduction to CFD

CFD – a research and design tool, CFD as third dimension of engineering supplementing theory and experiment, Steps in CFD solution procedure, strengths and weakness of CFD, Flow modelling using control volume - finite and infinitesimal control volumes, Concept of substantial derivative, divergence of velocity, Basic governing equations in integral and differential forms – conservation of mass, momentum and energy (No derivations), Physical interpretation of governing equations, Navier-Stoke’s model and Euler’s model of equations.

Unit- II: Basic Discretization Techniques
Introduction to grid generation (Types of grids such as structured, unstructured, hybrid, multiblock, Cartesian, body fitted and polyhedral etc.), Need to discretize the domain and governing equations, Finite difference approximation using Taylor series, for first order (Forward Difference Approximation, Backward Difference Approximation, Central difference Approximation) and second order (based on 3 node, 4 node and 5 node points),explicit and Implicit approaches applied to 1D transient conduction equation, Couette flow equation () using FTCS and Crank Nicholson's Method, Stability Criteria concept and physical interpretation, Thomas Tri-diagonal matrix solver.

Unit-III: Two Dimensional Steady and unsteady heat conduction
Solution of two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, Robbins and mixed boundary condition – solution by Explicit and Alternating Direction Implicit method (ADI Method), Approach for irregular boundary for 2D heat conduction problems.

Unit-IV: Application of Numerical Methods to Convection – Diffusion system
Convection: first order wave equation solution with upwind, Lax–Wendroff, Mac Cormack scheme, Stability Criteria concept and physical interpretation **Convection –Diffusion:** 1D and 2D steady Convection Diffusion system – Central difference approach, Peclet Number, stability criteria, upwind difference approach, 1 D transient convection-diffusion system

Unit-V: Incompressible fluid flow
Solution of Navier-Stoke's equation for incompressible flow using SIMPLE algorithms and its variation (SIMPLER), Application to flow through pipe, Introduction to finite volume method.

Unit-VI: CFD as Practical approach
Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition types such as no slip, free slip, rotating wall, symmetry and periodic, wall roughness, initialising and solution control for the solver, Residuals, analysing the plots of various parameters (Scalar and Vector contours such as streamlines, velocity vector plots and animation). Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ, k-. Simple problems like flow inside a 2-D square lid driven cavity flow through the nozzle

Texts/References:

1. "Computational Fluid Dynamics", John D Anderson: The Basics with Applications, McGraw-Hill

2. "Computational Fluid Dynamics", J. Tu, G.-H. Yeoh and C. Liu: A practical approach, Elsevier.

3. "Introduction to Computational Fluid Dynamics", A. W. Date: Cambridge University Press

4. "Computer Simulation of Fluid flow and heat transfer", P. S. Ghoshdastidar: Tata McGraw-Hill.

5. “Numerical Simulation of internal and external flows”, Vol. 1, C. Hirsch, Wiley

6. Computational Fluid Mechanics and Heat transfer, Tannehill, Anderson, and Pletcher, CRC Press.

Ergonomics in Automotive Design

AE 802C	Ergonomics in Automotive Design	Elective	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Use an anthropometrics and its application to vehicle ergonomics
CO2	Apply design concepts to develop driver seats for commercial vehicle.
CO3	Apply design concepts to develop driver seats for luxury vehicle.
CO4	Explain significance of visibility with blind region concepts.
CO5	Suggest interior design features to enhance comfort level of the vehicle passenger.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit- I:
Introduction to human body, Anthropometrics and its application to vehicle ergonomics.

Unit-II:
Driver comfort – seat types, visibility, man-machine system, Psychological factors – stress, attention, driver seat design, cockpit / driver worth station design.

Unit-III:
Passenger comfort - Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration.

Unit -IV:
Introduction to filed view, types of filed view, forward field of view and evaluation, mirror design issue, methods of measuring field of view, and other visibility issues

Unit-V:
Interior features and conveniences (legroom, gang way, types of seat, head room, visibility, window rattling)—Use of modern technology for the same.

Unit-VI:
Safety issues, Ergonomic research methods / ergonomic audit

Texts/References:

1. Nikolaos Gkikas, *"Automotive ergonomics Driver vehicle interaction"* CRC Press Publication, 2013
2. Mark R Lehto, James R Buck, *"Introduction to human factors and ergonomics for engineers",* Taylor and Francis Group publication, 2008.
3. Vivek D Bhise, *"Ergonomics in automotive design process"*, CRC Press Publications, 2012.
4. B. Peacock, Waldemar Karwowski, *"Automotive Ergonomics",* Taylor & Francis Publication, 1993.
5. David Meister, *"The History of Human Factors and Ergonomics",* Taylor&Francis Publication, 1999.

Elective – VIII

Vehicle Aerodynamics

AE 803A	Vehicle Aerodynamics	Elective	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply basic principles of aerodynamics for the design of vehicle body.
CO2	Calculate lift and drag of automotive models
CO3	Describe the physics of fluid flow over vehicle body and its optimization techniques.
CO4	Use wind tunnels for testing the vehicles.
CO5	Suggest noise measurement and control techniques of a vehicle.

Mapping of course outcomes with program outcomes

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

Course Contents:

UNIT- I: Introduction
Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics.

UNIT -II: Aerodynamic Drag of Cars
Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic
drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

UNIT- III: Shape Optimization of Cars
Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.

UNIT- IV: Vehicle Handling
The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces
and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics
of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial
vehicles and racing cars.

UNIT -V: Wind Tunnels for Automotive Aerodynamics
Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques

UNIT-VI: **Wind**
Wind noise, measurement techniques, Control techniques. Road testing methods, numerical methods.

Text Books:
1. Hucho W.H., "Aerodynamic of Road Vehicles", Butterworths Co., Ltd., 1997

References:
1. A. Pope, "Wind Tunnel Testing", 2nd Edition, John Wiley & Sons New York, 1974.
2. "Automotive Aerodynamic", Update SP-706, Society of Automotive Engineers Inc, 1987
3. "Vehicle Aerodynamics", SP-1145, Society of Automotive Engineers Inc, 199

Virtual Reality

AE 803B	Virtual Reality	Elective	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply the concept in Automobile industry
CO2	Model and simulate real life problem of Automobile industries.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

Course Contents:

Unit -I: Introduction: A short history of early virtual reality, early commercial VR Technology, VR becomes an Industry, The five classical components of VR Systems.
Input Devices: Trackers, Navigations and Gesture Interfaces.
Three-Dimensional Position Trackers: Tracker performance parameters, Mechanical trackers, Magnetic trackers, Ultrasonic trackers, Optical Trackers and Hybrid Inertial Trackers Navigation and Manipulation Interfaces: Tracker based Navigation/Manipulation Interfaces, Trackballs, and three Dimensional Probes Gesture Interfaces: The Pinch Glove, the 5DT Data Glove, the Dijiglove, Cyberglove.

Unit -II: Output Devices:
Graphical, Three-Dimensional Sound and Haptic Displays:
Graphical Display: The human visual system, personalgraphics displays, large volume displays. Sound displays: the human auditory system, the convolvotron, and Speaker based three-dimensional sound. Haptic Feedback: The human haptic system, Tactile Feedback Interfaces, Force Feedback Interfaces

Unit -III: Computing Architectures for Virtual Reality: The Rendering Pipeline: The graphical rendering pipeline, the haptics rendering pipeline. PC Graphics Architectures: PC Graphics Accelerators, Graphics Benchmarks. Work Station Based Architectures: The Sun Blade 1000 Architecture, The SGI Infinite Reality Architecture, Distributed VR Architectures: Multipipeline Synchronization, Collocated rendering Pipelines, Distributed Virtual Environments.

Unit -IV: Modelling:
Geometric Modelling: Virtual Object Shape, Object Visual Appearance. Kinematics Modelling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, viewing the three-dimensional words. Physical Modelling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing. Behaviour Modelling and Model Management: Level of Detail Management, Cell Segmentation.

Unit -V: Virtual Reality Programming: Toolkits and Scene Graphs. World Toolkit: Model Geometry and Appearance, The WTK Scene Graph, Sensors and Action Functions, WTK Networking, JAVA 3D: Model Geometry and Appearance, Java 3D Scene graph, Sensors and Behaviours, Java 3D Networking, WTK and Java 3D Performance Comparison. General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptic Scene Graph, Collision Detection and response, Graphics and PHANTOM Calibration.
Human Factors in Virtual Reality: Methodology and Terminology: Data Collection and Analysis, Usability Engineering Methodology. User Performance Studies: Test bed Evaluation of universal VR Tasks, Influence of System Responsiveness on User Performance, Influence of Feedback Multimodality.

Unit -VI: Traditional Virtual Reality Applications: Medical Application, Virtual Anatomy, Triage and Diagnostic and Rehabilitation. Education, Arts and Entertainment: VR in Education, VR and, Surgery the Arts, Entertainment Application of VR. Military VR Application: Army use of VR, VR Application in Navy, Air Force use of VR.
Emerging Application of VR: VR Application and Manufacturing: Virtual Prototyping, other VR Application in Manufacturing; Application of VR in Robotics: Robot Programming, Robot Teleoperation. Information Visualization: Oil Exploration and Well Management, Volumetric Data Visualization

References

1. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd edition. Wiley India
2. John vince, "Virtual Reality Systems", Pearson Education Asia
3. "Understanding Virtual Reality", Sherman, Elsever.

Noise and Vibration

AE 803C	Noise and Vibration	Elective	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain basic concepts related to noise and vibration.
CO2	Formulate mathematical model for multi degree of freedom vibration system.
CO3	Select transducers for measurement of vibration in automotive systems
CO4	Select appropriate transducer for measurement of noise in automotive systems.
CO5	Identify different sources and apply methods for noise and vibration control in automobiles

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
Multi Degree of Freedom Vibrations:
Matrix formulation, eigen values and eigen formulation, matrix iteration techniques -normal modes and orthgonality, transient response of multi degree freedom system, mode superposition technique, torsional oscillations of multirotor systems.

Unit-II:
Torsional vibrations:
Simple systems with one or two rotor masses Multi-DOF systems-transfer matrix method Geared system Branched system

Unit-III:
Vibration Instrumentation:
Vibration measurements – Vibration measurement parameters (displacement, velocity & acceleration), instrumentation –electrodynamics exciters – impact hammers, piezoelectric accelerometers, signal conditioning and amplification, filters, preamplifiers and power amplifiers, real time analysis, FFT analysis, structural frequency response measurement, modal testing of beams, Modal parameter (natural frequency, mode shape and damping) estimation techniques

Unit-IV:
Vibration analysis:
Relevance of vibration analysis, introduction to experimental modal analysis**,** Structural Modal analysis, mode shapes, Euler's beam equation for natural frequency, Calculation of natural frequencies - Rayleigh method, Stodala method, machine diagnostics through vibration analysis.

Unit-V:
Noise:
Introduction, causes, effects, basic terms, Noise characteristics, Sources of noise, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises, wave equation, noise standards etc.

Unit-VI:
Noise measurement:
Sound and Noise parameters, propagation of sound & noise in various machinery's, noise measuring parameters, noise level measurement techniques, Noise level interpolation and mapping, noise measuring instruments
Noise Control:
Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management, Road vehicle noise standards, Sound absorption by porous materials, silencer and suppression systems, Sound absorption, sound insulation, acceptance noise levels

Text Books:
1. N. L. Meirovitch, "Elements of vibration Analysis", McGraw Hill New York, 1986.
2. J.P. Den Hartog, "Mechanical Vibration, 4th edition", McGraw Hill, New York 1985.
3. "Industrial Noise & Vibration Control", Irwin & Garf.

4. “Mechanical Vibration”, S. S. Rao, New Age International (P) Ltd., New Delhi.
5. “Mechanical Vibration Analysis”, P. Srinivasan, Tata McGraw Hill Pub. New Delhi.
6. “Mechanical Vibration”, Grover G. K., Nem Chand & Brothers, Roorkee.
7. “Engineering Vibration”, Daniel J. Inman, Prentice Hall, NJ.
8. “Theory of Vibrations”, W. T. Thomson, CBS Publishers, New Delhi.
9. “Noise, Pollution & Control”, S. P. Singal, Narosa Publishing House, New Delhi.
10. “A text book of sound”, L.P. Sharma & H.C. Saxena.
11. “Engineering Noise Control”, D.A. Bies& C.H. Hausen.
12. “Noise & Vibration Control”, Leo N. Beraneck.

Reference Books:

1. Harris, C. M. Handbook of Acoustical Measurements and Noise Control, Acoustical Society of America, 1998.
2. Beranek L. L. & Ver I. L., Noise and Vibration Control Engineering: Principles and Applications, 2nd ed., Wiley 2006
3. Leonard Meirovitch, Fundamentals of Vibrations, McGraw Hill New York.
4. J.S. Rao and K. Gupta, “Advanced Theory of Vibration”,Willey Eastern.1992.
5. R.A. Collacott, “Vibration Monitoring and diagnosis”, John Willey, New York, 1979.
6. M. Petyt, “Introduction to Finite Element Vibration Analysis”, Cambridge University
7. “Fundamentals of Mechanical Vibration”, S. Graham Kelly, Tata McGraw Hill.

Elective – IX

Actuation System

AE 804A	Actuation System	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Acquire characteristics of the fluid and air.
CO2	Design, operation and use of hydraulic machines
CO3	Design, operation and use of pneumatic machines

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit- I:
Types of hydraulic fluids, functions of hydraulic fluids, advantages of a fluid power system, basic components of a hydraulic system, basic components of a pneumatic system, comparison of different power systems. Governing principles and laws: Pascal's law, force power and force displacement relations, practical applications of pascal's law and evaluate the parameters.

Unit- II:
Hydraulic Pumps:
Classification of Pumps based on- displacement, delivery and motion, Differences between positive displacement pumps and non-positive displacement with Performance curves, working and construction of gear, vane and piston pumps, mechanical, volumetric and overall efficiency of pumps (numerical treatment), performance parameters of gear, vane and piston pumps.

Unit-III:
Hydraulic Actuators:
Classification, types of hydraulic cylinders - single-acting cylinders, gravity-return single-acting cylinder, spring-return single-acting cylinder, double-acting cylinder, telescopic cylinder, tandem cylinder, graphical symbols of different linear actuators, classification of dcvs, shuttle valves, two-way valves, three-way valves. Four-way valves. Advantages of a poppet valve and Disadvantages, graphic symbols for various types of direction control valves, and its applications, working principle of solenoid-actuated valves

Unit-IV:
Hydraulics Circuit:
Control of a Single-Acting and Double-Acting Hydraulic Cylinder Hydraulic Cylinder, Regenerative Cylinder Circuit, Load-Carrying Capacity During Extension, Pump-Unloading Circuit, Double-Pump Hydraulic System, Counterbalance Valve Application, Hydraulic Cylinder Sequencing Circuits, Locked Cylinder Using Pilot Check Valves, Cylinder Synchronizing Circuits, Speed Control of a Hydraulic Cylinder.

Unit-V:
Pneumatics:
Principle of Pneumatics: Laws of compression, types of compressors, selection of compressors, Comparison of Pneumatics with Hydraulic power transmissions, Types of filters, regulators, lubricators, mufflers, dryers, Pressure regulating valves, Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, Pneumatic actuators-rotary, reciprocating. Air motors- radial piston, vane, axial piston, Basic pneumatic circuit, Direct and indirect control of single and double acting cylinder.

Unit- VI:
Typical Automotive Applications:
Power steering, fork lift hydraulic gear, hydro-pneumatic suspension (Air suspension), Clutch actuating System, Pneumatic circuit to control the door of vehicle, air brake and maintenance and troubleshooting of pneumatic circuits

Accumulators: Types, applications of accumulators**.** Accumulator as a hydraulic shock absorber.

Texts/References:

1. "Pneumatic Systems", S. R. Majumdar, Tata McGraw Hill 1996.
2. "Oil Hydraulics- Principle and Maintenance", S. R Majumdar, Tata McGraw Hill 2002.
3. "Industrial Hydraulics", J. J. Pipenger, McGraw Hill
4. "Industrial Fluid Power", Pinches, Prentice hall
5. "Basic Fluid Power", D. A. Pease, Prentice hall
6. "Hydraulics and Pneumatics", H. L. Stewart, Industrial Press

Product Life Cycle Management (PLM)

AE 804B	Product Life Cycle Management (PLM)	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand the need and advantages of PLM
CO2	Describe the various PLM strategies
CO3	Describe the various steps in design and development of product
CO4	Understand the technology forecasting
CO5	Describe the importance of innovation in product design and development
CO6	Apply PLM to at least one product

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:

Introduction and strategies to PLM:

Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning, Industrial strategies, strategy elements, its identification, selection and implementation, change management for PLM.

Unit-II:

Product Data Management (PDM):

Human resources in product lifecycle, Information, Standards, Vendors of PLM Systems and Components, PDM systems and importance, reason for implementing a PDM system, financial Justification of PDM, barriers to PDM implementation

Unit-III:

Product Design:

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modelling and simulation in product design.

Unit-IV:

New Product Development:

Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program, Concept of redesign of product.

Unit-V:

Technology Forecasting:

Future mapping, invocating rates of technological change, methods of technology forecasting such as relevance trees, morphological methods and mission flow diagram, combining forecast of different technologies, uses in manufacture alternative.

Unit-VI:

PLM software and tools:

Product data security, Product structure, workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications

Texts/References:

1. Grieves, Michael, "Product Lifecycle Management", Tata McGraw-Hill, 2006, ISBN 007145230330.
2. Antti Saaksvuori, AnselmiImmonen, "Product Life Cycle Management", Springer, 1st edition, 2003.
3. Stark, John, "Product Lifecycle Management: Paradigm for 21stCentury Product Realization", Springer-Verlag, 2004.
4. Fabio Giudice, Guido La Rosa, "Product Design for the environment-A life cycle approach", Taylor & Francis, 2006.
5. Robert J. Thomas, "NPD: Managing & forecasting for strategic processes".

Tractor and Farm Equipment

AE 804C	Tractor and Farm Equipment	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply the fundamental design concepts for design of tractor and farm equipments.
CO2	Describe the important supplementary systems in the tractors.
CO3	Select the different system for particular type of farm application.
CO4	Compare the performance of tractors related to various attachments.
CO5	Describe different engine systems of a farm tractor.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
General Design of Tractors:
Classification of tractors, Main components of tractor, Safety rules.

Unit-II:
Fundamentals of Engine Operation:
Tractor controls and the starting of the tractor engines-Basic notations and definition-Engine cycles–Operation of multi-cylinder engines-General engine design–Basic engine performance characteristics.

Unit-III:
Engine Mechanism of Tractor:
Cylinder and pistons, Connecting rods and crankshafts - Engine balancing – Construction and operation of the valve mechanism - Valve mechanism components -Valve mechanism troubles.

Unit-IV:
Cooling System, Lubrication System and Fuel System of a Tractor Engine
Cooling system -Classification -Liquid cooling system -Components, Lubricating system servicing and troubles - Air cleaner and turbo charger - Fuel tanks and filters –Fuel pumps.

Unit-V:
Farm Tractor Transmission System:
Layout, Load distribution, Transmission & Drive line, Steering, Braking system, Wheels & Tyres, Hydraulic system, Auxiliary Systems, Draw bar.

Unit-VI:
Farm Equipment's:
Working attachments of tractors - Farm equipment - Classification – Auxiliary equipment - Trailers and body tipping mechanism.

Texts/References:
1. E. L. barger, J. B. Liljedahl, W. M. Carleton, E. G. Mckibben "Tractors & their power units".
2. Rodichev and G. Rodicheva, "Tractor and Automobiles ", MIR Publishers, 1987.
3. Kolchin. A., and V. Demidov, "Design of Automotive engines for tractor", MIR Publishers, 1972.

Elective – X

Operation Research

AE 805C	Operation Research	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Use quantities methods and techniques for effective decisions making.
CO2	Model formulation and applications that are used in solving business decision problems.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
Introduction to Operation Research
Definitions, Phases of Operation Research and applications, Linear Programming Problems: mathematical formulation, standard form, basic solutions, feasible solutions, optimal solutions, graphical and simplex methods, two phase and big-M methods.

Unit-II:
Assignment Problem
Formulation, hungarian method, unbalanced problem, assignment for maximization, traveling salesman problem.

Unit-III:
Transportation Problem
Formulation of transportation model, basic feasible solution by new rule, lce method and vogel approximation method, unbalanced problem, degeneracy in transportation

Unit-IV:
CPM and PERT
Network construction, CPM-determination of critical path and total elapsed time, concept of slack and float, PERT-Estimation of project duration and variance analysis about the completion of projects
Sequencing: Processing of 2 jobs on N machines, 3 jobs on N machines and graphical procedure for 2 jobs on M machines

Unit-V:
Queuing Theory
Types and characteristics, steady state analysis of M/M/1 and concept of M/M/K model, Games Theory: formulation of games, characteristics of games, two-person zero sum game, maximin/minimax principle, saddle point, solution for (2x2) game, dominance property, graphical solution for (2xn) and (nx2) games.

Unit-VI:
Replacement Problem
Basic concept of replacement of items that deteriorate with time, costs involved replacement procedure with and without consideration of time value of money, replacement of items that fail suddenly, group replacement.

Texts/References:
1. "Operations Research", S. D. Sharma Kedarnath, Ramnath and co.
2. "Operations Research and Introduction", Taha S. A. McMillian.
3. "Principles of Operations Research, Philips", Ravindran and Soeberg PHI.
4. "Introduction to Operations Research", Hiller and Liberman McGraw Hill V Edition.
5. "Operation Research A.M.Natarajan", P Balasubramani, A. Tamilarawari

Motor Insurance Practices

AE 805B	Motor Insurance Practices	PEC	3-0-0	3 Credits

Pre-Requisites: Automobile Engineering.

Course Outcomes: At the end of the course, students will be able to

CO1	Classify motor vehicle insurances.
CO2	Discuss applications of insurance principles in vehicle insurance.
CO3	Describe various forms in motor vehicle insurance.
CO4	Discuss MACT in detail.
CO5	Analyze fraud management and internal audit in relation with motor vehicle insurance.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Principles of Insurance and Motor Insurance:
History of Insurance, Business of Insurance, Transfer of Risk, Classification of Insurance – Life & General Insurance, Market Role of Specialist (e.g. Surveyor)
History of Motor Insurance: Law and Practice of Motor Insurance in India: Applicability of Principles of Insurance: Total Loss (TL) / Constructive Total Loss (CTL) / Theft Claims: Legal Aspects of Insurance, Act No. 59 of 1988 (The Motor Vehicles Act, 1988) The Motor Vehicles (Amendment) Bill, 2008 – Part B: Key Issues and Analysis.

Unit 2: Type of motor vehicles, documents and policies:
Types of Motor Vehicles – Meaning and classification of motor vehicles – Motor insurance documents – Proposal form – Proposal form for 'Liability Only Policy' – Certificate of Insurance – Cover Note – Policy forms – Endorsement – Renewal notice – E-insurance to come into existence from next year – Types of Motor Policies – Coverage for motor policies – Coverage for Private Car – Coverage for Two Wheeler – Coverage for Commercial Vehicles – Motor trade policies – Motor Trade Internal Risks Policy – New technologies – In-car Technologies – New technology in auto field.

Unit 3: Motor Insurance Claims:
Motor Insurance Claims, Doctrine of cause of Accident, Motor Insurance Claims Procedures, Claim Documents, Types of Losses, Various Causes of Accident, Salvage/Scrap Disposal, Accident Repairing Cost, Compensation for Third Party Injury or Property Damage, The Consensus vs. Scientific Approach, Science of Damage Estimation and the Technology Support – Surveyor and His role in Loss Minimisation – Role of Surveyor – Steps in Motor Survey – Guidelines on Automobile Survey – Role of Motor Surveyor in Loss Minimisation – Role of Road Safety in Insurance – Concerns of Community – Road Safety Promotion by Insurance – Causes of Accident – Role of Fleet Operators – Underwriting in Motor Insurance, Transport Development Council – Roadside Assistance – Exclusions in Road Side Assistance – Frauds in Motor OD Claims – Seamless Claims Management – Frauds in motor insurance – Way to Mitigate Frauds**.**

Unit 4: Marketing in Motor Insurance:

Market practice of Motor Insurance in India – Caveats for filing add-on covers – Guidelines applicable in India – India Motor Tariff 2002 – Amendments subsequent to discontinuance of tariff – Tariff system after detariffing – International practice in motor insurance rating – Underwriting in motor insurance – Principles and practice of premium computation – Introduction – Indian Motor Insurance market – Model wise Risk assessment – Motor Underwriting.

Motor Third Party Pool – Dysfunctional Motor Market – Motor Third Party Pool – Review of Pool – Knock for Knock Agreement – International Issues in Insurance Markets – International Translation of Driver's License – Some Market Practices.

Unit 5: IT Applications in Motor Insurance:

Importance of Analytics and IT Intervention – IT Intervention and Competition – IT Intervention and Data Analytics – Need for and Importance of Statistics – TAC as Data Depository – TAC as National Repository for Statistical Data.

Unit 6: Fraud Management and Internal Audit:

Frauds in TP Claims – Frauds in Motor Insurance – Types of Fraud – Underwriting Frauds – Methods of Detection of underwriting fraud – Frauds Committed with Internal Support – Preventive Management of Fraud Cases – Issues to be Audited**.**

Text Books:

1. Handbook on Motor Insurance – IRDA
2. Automobile Insurance – Actuarial Model: Lemaire Jean, Springer

Reference Books:

1. Motor Vehicle Act, 1988 together with Central Motor Vehicle Rules, 1989, Eastern Book Company, Lucknow, 2nd Edition 1989.
2. Lemaire Jean, Automobile Insurance – Actuarial Model, Springer
3. Georges Dionne HEC, Montreal, Automobile Insurance: Road Safety, New Drivers, Risks, Insurance Fraud and Regulation, Springer
4. P S Palande, R S Shah, M L Lunawat, Insurance in India: Changing Policies and Emerging Opportunities, SAGE Publications
5. IRDA website https://www.irdai.gov.in

Material Handling Systems

AE 805C	Material Handling Systems	PEC	3-0-0	3 Credits

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain principles, objectives of material handling systems
CO2	Understand the design requirement of material handling systems like storing, hoisting, and conveying equipment's
CO3	Implement CIMS (Computer Integrated Manufacturing Systems) in material handling systems
CO4	Implement safety regulations in material handling systems

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit-I:
Introduction
Principles of material handling, Objective and benefits of better material handling, material handling and plant layout, concepts of unit load containerization and palletization.

Unit-II:
Material handling Equipment's and Systems for Various Materials -

a. Storing equipment's like pallets, bins, racks, decking, order picking, positioning equipment's.
b. Hoisting equipment's like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators.
c. Conveying equipment's like belt, chain, roller, wheel, trolley, tray conveyors, gravity and vibratory type conveyors, screw conveyors.
d. Mobile equipment's like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks, order pickers.

Unit-III:

Material Handling in CIMS

Need, Comparison with conventional systems, Equipment like industrial robots and automatically guided vehicles etc.

Unit-IV:

Material Flow

Operation sequence, material flow pattern, stages of material flow at receiving, in process and at shipping, flow planning criteria & design of flow pattern.

Unit-V:

Selection of Material Handling Equipment

Factors affecting selection of material handling equipment, Material handling equation, Choices of Material Handling Equipment, General Procedure for Selection, Basic Analytical techniques, Selection of suitable types of material handling systems, Functions and Parameters, affecting service, packing and storage material, Selection of Material Handling Equipment in Green Sand Moulding Foundry, Sugar Manufacturing Industry.

Unit-VI:

Safety & Training

Need, Environmental and human factors in material handling, Safety Regulations

Textbooks:

1. Immer J. R., "Material Handling", Tata McGraw Hill Publication.
2. James Apple, "Material Handling System Design", John Wiley
3. Theodore H., Allegre Sr., "Material Handling Principles & Practice", CBS Publishers & Distributors

References:

1. James Apple, "Plant Layout and Material Handling", John Wiley
2. O. P. Khanna, "Work Study", Dhanpat Rai and Sons
3. Work Study – I. L. O.

Project Stage-II

AE 806	Project Stage-II	PCC	0-0-8	4 Credits

Pre-Requisites: None
Course Outcomes: At the end of the course, students will be able to

CO1	State the aim and objectives for this stage of the project
CO2	Construct and conduct the tests on the system/product
CO3	Analyze the results of the tests.
CO4	Discuss the findings, draw conclusions, and modify the system/product, if necessary.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	1										
CO2			2	2	2	1	1					
CO3		1			1	2		1		1		
CO4			2	1	2	1	2			3		1

Course Contents:

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II. The report shall be comprehensive and presented typed on A_4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.