KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 052
(Autonomous)

VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Providing value based quality education for the development of students as competent and responsible citizens.
- Contributing to the nation and beyond through research and development
- Continuously improving our services

DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION

To be a Centre of excellence for development and dissemination of knowledge in Automobile Engineering for the Nation and beyond.

MISSION

Department of Automobile Engineering is committed to:

MS1: Establish an admirable academic Centre through professional instructive techniques to build up quality Automobile Engineers to meet the world-class requirements

MS2: Develop research interest among the graduates through state of the art technologies

MS3: Promote innovation and industrial consultancy to meet the social needs

2014 REGULATIONS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Automobile Engineering will

PEO1: Pursue successful career in the domain of design, analysis, testing and diagnostics that meet the needs of global industries

PEO2: Lay solid foundation to pursue higher education / certifications and research interests.

PEO3: Inculcate entrepreneurial skills and contribute to the society as a responsible citizen

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	2
MS2	2	3	3
MS3	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **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.

PO4 **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.

PO5 **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.

PO6 **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.

PO7 **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.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **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.

PO11 **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.

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 Analyze the functioning of automotive engine, power train, chassis and other mechanical systems..

PSO2 Examine various electrical and electronic systems related to engine, transmission, braking, traction, cruise, safety, stability, comfort and convenience.

MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	3	3	3	3	1	2	3	1	2	3	3
PEO2	3	3	3	3	3	3	3	1	2	3	1	2	3	3
PEO3	2	2	2	2	1	1	1	3	3	3	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2014

Curriculum Breakdown Structure(CBS)	**Curriculum Content (% of total number of credits of the program)**	**Total number of contact hours**	**Total number of credits**
Basic Sciences(BS)	16.4	510	30
Engineering Sciences(ES)	14.2	450	26
Humanities and Social Sciences(HS)	9.3	285	17
Program Core(PC)	38.8	1455	71
Program Electives(PE)	9.8	270	18
Open Electives(OE)	4.9	135	9
Project(s)/Internships(PR)	6.6	360	12
Total			183

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14EGT11	Communicative English I	3	0	0	3	40	60	100	HS
14MAT11	Mathematics I	3	1	0	4	40	60	100	BS
14PHT11	Applied Physics	3	0	0	3	40	60	100	BS
14CYT11	Applied Chemistry	3	0	0	3	40	60	100	BS
14MET11	Basics of Civil and Mechanical Engineering	3	0	0	3	40	60	100	ES
14MEC11	Engineering Drawing	2	0	3	3	40	60	100	ES
14VEC11	Value Education	0	2	1	1	100	0	100	HS
	PRACTICAL								
14PHL11	Physical Sciences Laboratory I	0	0	3	1	100	0	100	BS
14MEL11	Basics of Civil and Mechanical Engineering Laboratory	0	0	3	1	100	0	100	ES
				Total	**22**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14EGT21	Communicative English II	3	0	0	3	40	60	100	HS
14MAT21	Mathematics II	3	1	0	4	40	60	100	BS
14PHT21	Materials Science	3	0	0	3	40	60	100	BS
14CYT21	Environmental Science	3	0	0	3	40	60	100	BS
14CSC11	Problem Solving and Programming	3	0	3	4	40	60	100	ES
14EET11	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
	PRACTICAL								
14PHL21	Physical Sciences Laboratory II	0	0	3	1	100	0	100	BS
14EEL11	Basics of Electrical and Electronics Engineering Laboratory	0	0	3	1	100	0	100	ES
				Total	**22**				

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CBS – Curriculum Breakdown Structure

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CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MAT31	Mathematics - III	3	1	0	4	40	60	100	BS
14MET31	Engineering Mechanics	3	1	0	4	40	60	100	ES
14MET32	Engineering Thermodynamics	3	1	0	4	40	60	100	PC
14MET33	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60	100	PC
14MTT33	Manufacturing Processes	3	0	0	3	40	60	100	PC
14AUT31	Automotive Engine Technology	3	0	0	3	40	60	100	PC
	PRACTICAL								
14MEL31	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	3	1	100	0	100	PC
14MTL33	Manufacturing Processes Laboratory	0	0	3	1	100	0	100	PC
14AUL31	Automotive Engine Components Laboratory	0	0	3	1	100	0	100	PC
				Total	**24**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MAT42	Statistics and Numerical Methods	3	1	0	4	40	60	100	BS
14MET41	Strength of Materials	3	1	0	4	40	60	100	ES
14MET45	Engineering Materials and Metallurgy	3	0	0	3	40	60	100	PC
14AUT41	Thermal Science	3	1	0	4	40	60	100	PC
14AUT42	Automotive Chassis	3	0	0	3	40	60	100	PC
14AUT43	Automotive Electrical and Electronics Systems	3	0	0	3	40	60	100	PC
	PRACTICAL								
14MEL43	Advanced Materials Testing Laboratory	0	0	3	1	100	0	100	PC
14AUL41	Automotive Chassis Component Laboratory	0	0	3	1	100	0	100	PC
14AUL42	Automotive Electrical and Electronics Laboratory	0	0	3	1	100	0	100	PC
				Total	**24**				

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CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MET52	Design of Machine Elements	3	0	0	3	40	60	100	ES
14AUT51	Vehicle Dynamics	3	1	0	4	40	60	100	PC
14AUT52	Mechanics of Machines	3	1	0	4	40	60	100	PC
14AUT53	Automotive Transmission Systems	3	0	0	3	40	60	100	PC
14AUT54	Automotive Fuels and Lubricants	3	0	0	3	40	60	100	PC
	Elective-I (Professional)	3	0	0	3	40	60	100	PE
	PRACTICAL								
14AUL51	Engine Performance and Emission Testing Laboratory	0	0	3	1	100	0	100	PC
14MEL51	CAD Laboratory	0	0	3	1	100	0	100	PC
14EGL41	Communication Skills Laboratory	0	0	3	1	100	0	100	HS
				Total	**23**				

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CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET61	Economics and Management for Engineers	3	0	0	3	40	60	100	HS
14AUT61	Automotive Chassis Component Design	2	2	0	4	40	60	100	PC
14AUT62	Automotive Engine Component Design	2	2	0	4	40	60	100	PC
14AUT63	Two and Three Wheeler Technology	3	0	0	3	40	60	100	PC
	Elective-II (Professional)	3	0	0	3	40	60	100	PE
	Elective-III (Open)	3	0	0	3	40	60	100	OE
	PRACTICAL								
14AUL61	Design and Modeling of Engine and Chassis Components Laboratory	0	0	3	1	100	0	100	PC
14AUL62	Two and Three Wheeler Laboratory	0	0	3	1	100	0	100	PC
14AUL63	Automotive Fuels and Lubricants Laboratory	0	0	3	1	100	0	100	PC
				Total	**23**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdown Structure

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CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET71	Total Quality Management	3	0	0	3	40	60	100	HS
14MET71	Finite Element Analysis	3	1	0	4	40	60	100	PC
14AUT71	Vehicle Maintenance	3	0	0	3	40	60	100	PC
	Elective-IV (Professional)	3	0	0	3	40	60	100	PE
	Elective-V (Open)	3	0	0	3	40	60	100	OE
	Elective-VI (Open)	3	0	0	3	40	60	100	OE
	PRACTICAL								
14MEL71	Computer Aided Simulation and Analysis Laboratory	0	0	3	1	100	0	100	PC
14AUL71	Vehicle Maintenance and Reconditioning Laboratory	0	0	3	1	100	0	100	PC
14AUP71	Design and Fabrication Project	0	0	6	3	100	0	100	PR
				Total	**24**				

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CBS – Curriculum Breakdown Structure

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B.E. DEGREE IN AUTOMOBILE ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET81	Professional Ethics and Human Values	3	0	0	3	40	60	100	HS
	Elective-VII (Professional)	3	0	0	3	40	60	100	PE
	Elective-VIII (Professional)	3	0	0	3	40	60	100	PE
	Elective-IX (Professional)	3	0	0	3	40	60	100	PE
	PRACTICAL								
14AUP81	Project Work	0	0	18	9	100	100	200	PR
				Total	**21**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdown Structure

Total Credits: 183

LIST OF PROFESSIONAL ELECTIVES						
Course Code	**Course Title**	**Hours/Week**			**Credit**	**CBS**
		L	**T**	**P**		
SEMESTER V						
14MET54	Operations Research	3	0	0	3	PE
14MEE01	CAD/CAM/CIM	3	0	0	3	PE
14AUE01	Automotive HVAC	3	0	0	3	PE
14AUE02	Hydraulics and Pneumatics	3	0	0	3	PE
SEMESTER VI						
14AUE03	Automotive Noise, Vibration and Harshness	3	0	0	3	PE
14AUE04	Vehicle Body Engineering	3	0	0	3	PE
14AUE05	Automotive Control Systems	3	0	0	3	PE
14AUE06	Styling and Modeling of Vehicles	3	0	0	3	PE
SEMESTER VII						
14MEE08	Gas Dynamics and Jet Propulsion	3	0	0	3	PE
14AUE07	Vehicle Aerodynamics	3	0	0	3	PE
14AUE08	Electric and Hybrid Vehicles	3	0	0	3	PE
14AUE09	Special Types of Vehicles	3	0	0	3	PE
SEMESTER VIII						
14GEE81	Entrepreneurship Development	3	0	0	3	PE
14MEE12	Robotics	3	0	0	3	PE
14MEE13	Non Destructive Evaluation Techniques	3	0	0	3	PE
14MEE14	Computational Fluid Dynamics	3	0	0	3	PE
14MEE15	Composite Materials	3	0	0	3	PE
14MEE17	Cryogenic Engineering	3	0	0	3	PE
14AUE10	Manufacturing of Automotive Components	3	0	0	3	PE
14AUE11	Vehicle Instrumentation and Data Management	3	0	0	3	PE
14AUE12	Advanced Theory of IC Engines	3	0	0	3	PE
14AUE13	Vehicle Testing and Validation	3	0	0	3	PE
14AUE14	Fuel Cell and Applications	3	0	0	3	PE
14AUE15	In-Vehicle Networking	3	0	0	3	PE

LIST OF OPEN ELECTIVES						
Course Code	**Course Title**	**Hours/Week**			**Credit**	**CBS**
		L	**T**	**P**		
SEMESTER VI						
14AUO01	Transport Management	3	0	0	3	OE
14AUO02	Automotive Pollution Control	3	0	0	3	OE
SEMESTER VII						
14AUO03	Automotive Sensors and Embedded Systems	3	0	0	3	OE
14AUO04	Alternate Energy Sources for Automobiles	3	0	0	3	OE
14AUO05	Automotive Safety and Control	3	0	0	3	OE
14AUO06	Bio Energy Conservation Technologies	3	0	0	3	OE

14EGT11 COMMUNICATIVE ENGLISH I

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Functional Grammar: Basics of Vocabulary - Parts of speech or Word Classes including Determiners - Prefixes and Suffixes - Homonyms and Homophones - Connectives - Compound Nouns. **Listening:** Introduction to Listening / Types of Listening – Extensive / Intensive Listening - Listening Activities. **Speaking:** Verbal and non verbal communication – An introduction to speech sounds, syllables & word stress – Speaking Activities. **Reading:** Introduction to Skimming and scanning as reading techniques - understanding discourse coherence – sequencing of sentences – Reading activities. **Writing:** Introduction to aspects of technical writing – writing definitions and descriptions- Letter Writing – Informal letters-Punctuation in Letter Writing

UNIT – II **9**

Functional Grammar: Concord - Tenses - Voice - Use of Articles and prepositions. **Listening:** Listening Comprehension – Cloze Test - Extensive listening – listening for general information. **Speaking:** Role Play – Situational Conversations. **Reading:** Reading newspaper articles – global understanding skills and ability to infer, extract gist and understand main ideas. **Writing:** Letter Writing - Formal letters, Writing a Profile about an organization—Punctuation (General).

UNIT – III **9**

Functional Grammar: Phrasal verbs - Clauses - Simple, Compound and Complex Sentences - Synonyms and Antonyms. **Listening:** Listening Comprehension – Cloze Text - Intensive listening – listening for specific information. **Speaking:** Describing Places, People, Technical Processes. **Reading:** Reading different types of texts – Understanding general and specific information. **Writing:** Paragraph Writing – Writing reviews on short films and videos - Offering suggestions and recommendations

UNIT – IV **9**

Functional Grammar: Conditional clauses (If clause) - Adjectives, Compound Adjectives and Degrees of Comparison. **Listening:** Listening to different accents, listening to speeches / presentations. **Speaking:** Describing Technical Processes and Machines and Gadgets - Telephone Skills. **Reading:** Reading Texts with focus on use of verbs and verb phrases. **Writing:** Writing e-mails –Transcoding - Using Charts, pictures and tables for interpretations.

UNIT – V **9**

Functional Grammar: Modals – Types of Sentences – Idioms and Phrases and proverbs - identifying odd words. **Listening:** Retrieval of factual information – listening to identify topic, context, function, speaker's opinion, attitude, etc. **Speaking:** Interviews - Personal and Telephonic - Giving impromptu talks, making presentations on given topics. **Reading:** Reading for structure and detail – finding key information in a given text and finding topic sentences. **Writing:** Designing and Making Posters – Writing Advertisements-Free writing on any given topic (Technical and topics on current affairs)

TOTAL : 45

TEXT BOOKS :

1. "Learn English – A Fun Book of Functional Language, Grammar and Vocabulary", McGraw Hill Education [India] Pvt. Ltd., Santanu Sinha Chaudhuri, 2013.

REFERENCE BOOKS :

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Regional Institute of English, "English for Engineers", Cambridge University Press, New Delhi, 2006.
3. Rizvi, Ashraf M., "Effective Technical Communication", Tata McGrawHill, New Delhi. 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: speak clearly, confidently, comprehensibly, and communicate with others using appropriate communicative strategies

CO2: write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic

CO3: read different genres of texts adopting various reading strategies

CO4: listen/view and comprehend different spoken discourses / excerpts in different accents

CO5: use language effectively and accurately acquiring vocabulary from real-life context

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			2	3		2		
CO2						1			1	3		1		
CO3						1			1	3		2		
CO4						1			2	3		2		
CO5						2			2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT11 MATHEMATICS I

(Common to all Engineering and Technology branches)

3 1 0 4

Pre-requisites: Basics concepts of matrices, Basic idea of differentiation, Knowledge of differential equations

UNIT – I **9**

Matrices: Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors (without proof) – Cayley-Hamilton Theorem (Statement and Applications) - Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of quadratic forms – Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT – II **9**

Functions of Several Variables: Functions of two variables – Partial derivatives – Total differential – Taylor's Series expansion –Maxima and Minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians – Properties.

UNIT – III **9**

Ordinary Differential Equations of First Order: Solutions of equations in separable form – Exact differential equations – Integrating factors – Linear first order differential equations – Bernoulli's equation – Clairaut's equation.

UNIT – IV **9**

Ordinary Differential Equations of Higher Order: Linear differential equations of second and higher order with constant coefficients – Particular Integrals for the types: e^{ax} – cos(ax) / sin(ax) – x^n – $e^{ax}x^n$, $e^{ax}\sin(bx)$ and $e^{ax}\cos(bx)$ – $x^n\sin(ax)$ and $x^n\cos(ax)$ – Linear differential equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.

UNIT – V **9**

Applications of Ordinary Differential Equations: Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Simple harmonic motion – Deflection of beams – Electric circuits (Differential equations and associated conditions need to be given).

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics for First Year B.E/B.Tech", Reprint Edition 2014, S. Chand and Co., New Delhi.
2. Veerarajan T., "Engineering Mathematics, (for first year)", Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, Reprint 2014.
3. Bali N.P. and Manish Goyal, "Text Book of Engineering Mathematics", 8th Edition, Laxmi Publications, New Delhi, 2011.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2011.
5. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: solve engineering problems which needs matrix computations
CO2: solve extremal problems which arise in function of several variables
CO3: identify the appropriate method for solving first order ordinary differential equations
CO4: classify and find the solution of ordinary differential equations of higher order
CO5: apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1		
CO2	3											1		
CO3	3	3	1	1								1		
CO4	3	3	1	1								1		
CO5	3	3	2	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHT11 APPLIED PHYSICS

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Properties of Matter: Elasticity – Hooke's law – Modulus of elasticity (qualitative) – Stress-strain diagram – Poisson's ratio – Bending moment – Depression of a cantilever (theory) – Derivation of Young's modulus of the material of the beam – Uniform and non-uniform bending – I-shaped girders. **Thermal Physics:** Modes of heat transfer – Thermal conductivity – Derivation of rectilinear flow of heat along a bar – Radial and cylindrical heat flow – Conduction through compound media (series and parallel).

UNIT – II **9**

Acoustics: Classification of sound – Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption coefficient and its determination –Factors affecting acoustics of buildings and their remedies. **Ultrasonics:**Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitation – Industrial applications – Drilling, welding, soldering and cleaning –Nondestructive testing – Ultrasonic pulse echo system.

UNIT – III **9**

Laser and Applications: Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Types of lasers – Nd: YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction – Laser Applications – Industrial applications: laser welding, laser cutting, laser drilling – Holography – Construction and reconstruction of images.

UNIT – IV **9**

Fiber Optics and Applications: Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Crucible-crucible technique for fiber fabrication – Sources (LED and LASER) and detectors (p-i-n photodiode and avalanche photodiode) for fiber optics - Fiber optical communication links – Losses in optical fibers – Fiber optic sensors – Temperature and displacement sensors.

UNIT – V **9**

Quantum Physics and Applications: Black body radiation – Planck's theory (derivation) – Compton effect (theory) – Matter waves – Uncertainty principle (qualitative) – Schroedinger's wave equations – Time independent and time dependent wave equations – Physical significance of wave function – Particle in a box (One dimensional) – Electron microscopes – Scanning electron microscope – Transmission electron microscope.

TOTAL : 45

TEXT BOOKS:

1. Tamilarasan K and Prabu K, "Engineering Physics-I", Tata McGraw Hill Education Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2009.
2. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2011.
3. Laud B.B., "Lasers and non- linear optics", New Age International (p) Limited Publishers, New Delhi, 1996.
4. Ajoy Ghatak and Thyagarajan K., "Introduction to Fiber Optics", Cambridge University Press, New York, USA, 2000
5. Mehta and Neeraj, "Applied Physics for Engineers", Prentice-Hall of India Private Limited, New Delhi, 2011.
6. Douglas Brandt and Douglas C. Giancoli, "Physics for Scientists and Engineers", Prentice-Hall of India Private Limited, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: infer the extensive properties of matter and heat conduction in metal

CO2: demonstrate acoustically good buildings and non-destructive testing using ultrasonic waves

CO3: employ the laser in engineering and technology

CO4: sketch the principle of fiber optics and fiber optic communication link

CO5: interpret the concepts of quantum physics to optical phenomena and electrons in a metal

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2	2		2		1					
CO2	3			2	2		2		1					
CO3	3			2	2		2		1					
CO4	3			2	2		2		1					
CO5	3			2	2		2		1					

1 – Slight, 2 – Moderate, 3 – Substantial

14CYT11 APPLIED CHEMISTRY

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Water: Introduction - Sources of water - Impurities in water - Types of water - Water quality standards - Water quality parameters (Brief discussion only) - Hardness of water- Expression of hardness - Units of hardness –Estimation of Hardness of water by EDTA method – Determination of alkalinity - Disadvantages of using hard water - Boiler troubles due to hard water - scale and sludge formation – boiler corrosion – caustic embrittlement- priming and foaming- Softening of water- External treatment methods - zeolite and demineralization process (principle, process, advantages and disadvantages only) - Internal treatment process - colloidal, carbonate, calgon and phosphate conditioning (brief discussion only) - desalination by reverse osmosis method

UNIT – II **9**

Electrochemistry: Introduction – Electrolytic and Electrochemical Cells – Representation of a galvanic cell - Reversible and Irreversible cells - EMF and its determinations – Electrode potential - Nernst Equation – Reference electrodes (hydrogen and calomel electrodes) – Electrochemical series and its applications – Conductometric titrations (strong acid vs strong base only) - Batteries (Lead Acid battery, NICAD, Lithium battery, Lithium Sulphur battery) – Proton exchange membrane cells.

UNIT – III **9**

Corrosion and Its Control: Introduction – Mechanism of chemical and electrochemical corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic protection methods – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Non-metallic coating - surface conversion coating (phosphate coating and anodized coating) - Organic coating - paints – constituents and their function – Special paints (Fire retardant, temperature indicating, water repellant and luminescent paints)

UNIT – IV **9**

Fuels: Coal and its varieties – proximate and ultimate analysis – their significance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum – Manufacture of synthetic petrol – Cracking - Polymerization - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas and LPG).

Combustion: Introduction – Calorific Values – Gross and Net Calorific Values – Dulong's formula (simple problems)- Flue gas analysis by Orsat's method - Explosive range and Spontaneous Ignition Temperature

UNIT – V **9**

Polymers: Introduction – Nomenclature of polymers – functionality – polymerization - types – addition, condensation and co-polymerization with examples – Effect of polymer structure on properties (strength, plastic deformation, glass transition temperature and melting point of polymers (Tg and Tm), crystallinity and chemical resistance) - plastics – types (thermo and thermosetting plastics) - individual polymers - Polyethylene, Polypropylene, PVC, Teflon and Bakelite (preparation, properties and uses only) - Compounding of plastics- Fabrication of plastics (compression, injection and extrusion moulding methods) – conducting polymers

TOTAL : 45

TEXT BOOKS:

1. Palanisamy P.N, Geetha A, Manjula Rani K, "Applied Chemistry", 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2013.
2. Jain P C and Monica Jain, "Engineering Chemistry", 15th Edition, Dhanpat Rai Publication Co., New Delhi, 2008.

REFERENCE BOOKS:

1. Sharma B.K., "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut, 2001.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill, New Delhi, 2008.
3. Krishnamurthy N., "Engineering Chemistry", 2nd Edition, PHI Learning Private Limited, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: get the basic knowledge of water quality parameters and treatment methods
CO2: obtain the principles of electrochemical cells, EMF series and energy storing devices
CO3: acquire the knowledge of the types and prevention methods of corrosion
CO4: know the concepts and developments in combustion and various types of fuels
CO5: understand the knowledge about the types of polymers, plastics and moulding methods

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2	2		2	3	3	1	1			
CO2	3	2		2	2		2	3	3	1	1			
CO3	3	2		2	2		2	3	3	1	1			
CO4	3	2		2	2		2	3	3	1	1			
CO5	3	2		2	2		2	3	3	1	1			

1 – Slight, 2 – Moderate, 3 – Substantial

14MET11 BASICS OF CIVIL AND MECHANICAL ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

PART-A: CIVIL ENGINEERING

UNIT – I **5**

Introduction: History of civil engineering - Role and Functions of civil engineer - Fields of civil engineering

UNIT– II **5**

Building Materials: Introduction – Properties and applications of Construction Materials – bricks – stones – sand – cement – mortar- concrete – steel – glass-wood –plastics- ceramics -rubber- FRP – Non ferrous materials - Geosynthetics – Smart materials.

UNIT – III **4**

Sub Structure: Soil – classification- bearing capacity- foundation -function- requirements- types-failures -remedial measures- machine foundation

UNIT – IV **4**

Super Structures: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering- damp proofing- weathering course

UNIT – V **4**

Interior design and Landscaping: History of Interior Design-Importance of Interior design- Basic elements of Interior design. Landscape Architecture-Elements of Landscaping- Green Engineering

PART-B: MECHANICAL ENGINEERING

UNIT – I **5**

Thermal Science: Laws of thermodynamics and their applications – Principle of operation of Steam, Diesel, Hydro-electric and Nuclear power plants - Classification of internal combustion engines and their working principles – Components of basic Vapour Compression Refrigeration system.

UNIT – II **4**

Fluid Science: Properties of fluids – Classification of hydraulic turbines, working principle of Pelton turbine – Applications of steam and gas turbines. Classification of pumps, working principle of centrifugal and reciprocating pump

UNIT – III **4**

Mechanics and Materials: Classification of engineering materials - Mechanical properties of engineering materials- Definition and importance of stress and strain - Definition and importance of centre of gravity and moment of inertia.

UNIT – IV **5**

Mechanical Components And Their Applications: Basic principles and applications of power transmission systems such as belt, rope, chain and gear drives – Function and principles of coupling, clutch, brake, flywheel and governor

UNIT – V **5**

Manufacturing Technology: Principle and applications of Metal forming process – Foundry, Forging. Principle and applications of Metal Joining process – Welding, Soldering and Brazing, Basics of CAD/CAM/CIM.

TOTAL : 45

TEXT BOOKS:

1. Palanichamy M.S., "Basic Civil Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Pravin Kumar, "Basic Mechanical Engineering", Pearson Publishers, New Delhi, 2013.

REFERENCE BOOKS:

1. Rangawala S.C., "Engineering Materials" Charotor Publishing House(P) Ltd., Anand, 2013.
2. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, "Building Construction," Laxmi Publications (P) Ltd., NewDelhi, 2005.
3. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw-Hill, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., "Basic Mechanical Engineering", 6th Edition, Anuradha Publishers, Kumbakonam, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: select the suitable materials and components required for building construction
CO2: demonstrate an understanding of basic concepts in thermal engineering
CO3: demonstrate an understanding of basic concepts in fluid mechanics and fluid machines
CO4: demonstrate an understanding of basic concepts in engineering mechanics and materials
CO5: demonstrate an understanding of principles and applications of different mechanical components
CO6: demonstrate an understanding of principles and applications of various manufacturing process

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2	1	2			2		2		
CO2	3	2	2		2	1	2			2		2	1	
CO3	3	2	2		2	1	2			2		2	1	
CO4	3	2	2		2	1	2			2		2	1	
CO5	3	2	2		2	1	2			2		2	1	
CO6	3	2	2		2	1	2			2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEC11 ENGINEERING DRAWING

(Common to all Engineering and Technology branches)

2 0 3 3

Pre-requisites: Basic knowledge in practical geometry construction and mathematics

UNIT – I **9**

General Principles of Orthographic Projection: Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projections of Points, Lines and Planes. General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT – II **9**

Projections of Solid: Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT – III **9**

Sectioning of Solids: Sectioning of solids- prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

UNIT – IV **9**

Development of Surfaces: Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cone with cutout, perpendicular and inclined to the horizontal axis.

UNIT – V **9**

Isometric and Perspective Projection: Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL : 45

TEXT BOOKS:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw-Hill, New Delhi, 2008.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, New Delhi, 2008.

REFERENCE BOOKS:

1. Bhatt N.D., "Engineering Drawing", 46th Edition, Charotar Publishing House, Anand, 2003.
2. Gopalakrishnana K.R., "Engineering Drawing", Volume. I & II, Subhas Publications, Bangaluru, 2006.
3. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD", Tata McGraw Hill, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: gain knowledge on international standards of drawings and to draw the different types of projections for points, lines and planes
CO2: draw the different positions of 3D primitive objects like cube, cone, cylinder, etc.
CO3: draw sections of solids including prisms, pyramids, cylinders and cones
CO4: understand the concepts of development of surfaces of simple and truncated solids
CO5: draw the isometric and perspective projections for the given object

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		2	1				2		2		
CO2	3	2	3		2	1				2		2		
CO3	3	2	3		2	1				2		2		
CO4	3	2	3		2	1				2		2		
CO5	3	2	3		2	1				2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14VEC11 VALUE EDUCATION

(Common to all Engineering and Technology branches)

0 2 1 1

UNIT – I **6**

Philosophy of Life Science: Life – Purpose of life (four stages of life) – Philosophy of life (who am 'I') – Law of nature (cause of the life and body) – Content of the Life (five sheaths) – Goal of life. Five duties in life.

Methodology: Life and messages of spiritual and national leaders– The forgotten hero, etc.

Project report: Complementing with happiness - Every soul is potentially divine

UNIT – II **6**

Human Values-Moral foundation: Truth, forgiveness, compassion, endurance, humility, non violence, moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith– Good habits – Attitude forming for Individual peace.

Practical Methods: Personal experience with above characters, Puranic Stories - Self resolve diary maintenance

UNIT – III **6**

Social Values: Family – Family System - Greatness of women – World brotherhood (vasudeiva kudumbagam) – Glorious Bharath - Bharathian systems - Past –Present – Future - Team spirit - Goal setting – Economics – Education – Politics – Responsibilities of people – Preserving natural resources.

Methodology: Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games. Team Spirit - Yogic Games.

UNIT – IV **6**

Development of Mental Prosperity: Prosperity of mind – Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga – Types – Uses – Precaution – Contradiction – Kriyas - Asanas – Pranayamas – Meditative techniques.

Methodology: Asana - Pranayama – Cyclic meditation – Nada anu sandhana – Meditation – Yogic games for memory. Album on asanas , pranayama and mantra.

UNIT – V **6**

Maintenance of Physical Health: Human body – Structure - Ten Systems of the body as per modern science. Five elements - Harmonious relationship – Life force – Conserving vitality& health throughnatural life – Pranic food and its importance – Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease – Acute and chronic - Disease - Life and death.

Methodology: Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.

TOTAL : 30

TEXT BOOK:

1. "Value Education", compiled by Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, Pollachi, for Kongu Engineering College.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the purpose and value of life
CO2: exhibit positive human values
CO3: understand social values
CO4: take steps to develop mental and physical health

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3				3		
CO2						3		3				3		
CO3						3		3				3		
CO4						3		3				3		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHL11 PHYSICAL SCIENCES LABORATORY I

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: APPLIED PHYSICS LABORATORY
(Any five experiments)

LIST OF EXPERIMENTS:

1. Determination of Young's modulus of a given material using uniform bending.
2. Determination of thermal conductivity of bad conductor using Lee's disc arrangement.
3. Determination of velocity of ultrasonic waves in liquid and compressibility of liquid using ultrasonic interferometer.
4. (a) Particle size determination using diode laser.

(b) Determination of wavelength of laser

5. Determination of specific resistance of a given coil of wire using Carey Foster bridge.
6. Determination of wavelength of Hg spectrum using spectrometer and grating.

Demonstration

1. Measurement of efficiency of a solar cell
2. Non destructive testing
3. Tyndall effect

PART-B: APPLIED CHEMISTRY LABORATORY
(Any five experiments)

LIST OF EXPERIMENTS:

1. Estimation of Total, Temporary and Permanent hardness of water by EDTA method.
2. Estimation of Ca^{2+} and Mg^{2+} hardness separately by EDTA method.
3. Estimation of Alkalinity of the given water sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using pH meter.
6. Estimation of Ferrous ion by potentiometric titration.

Demonstration

1. Distillation system
2. RO water treatment system
3. UV Spectrophotometer

REFERENCES / MANUALS / SOFTWARE:

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N.Palanisamy, P.Manikandan, A.Geetha and K.Manjularani

TOTAL : 45

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: describe the basics of modulus of elasticity, thermal conductivity, ultrasonic and compressibility of water, laser parameters, specific resistance of electrical conductors, and interference and diffraction of light waves

CO2: operate the basic measuring devices, travelling microscope, Lee's disc arrangement, ultrasonic interferometer, Carrey Foster bridge and spectrometer, and to measure the related physical parameters

CO3: analyze the hardness, amount of Ca^{2+} and Mg^{2+} ions, and presence of alkalinity in water

CO4: employ the instruments like pH meter, conductivity meter and potentiometer for the estimation of unknown concentration of acids and ferrous ion

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	1		2		2					
CO2	3	3		2	1		2		2					
CO3	3	3		2	1		2		2					
CO4	3	3		2	1		2		2					

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL11BASICS OF CIVIL AND MECHANICAL ENGINEERING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. To prepare a square or rectangular shaped two identical MS plates by cutting and filing operations
2. To prepare a square/rectangular/circular/trapezoidal/Vshaped projection and its counterpart formating from the given square or rectangular MS plates.
3. To carryout drilling, tapping and assembly on the given MS plates.
4. To carryout thread forming on a GI and PVC pipes and cut to the required length.
5. To use various pipe fitting accessories and prepare water leak proof water line from overhead tank.
6. To prepare a T/L/Lap joint from the given wooden work pieces.
7. To prepare a plywood box/tray to the given dimensions.
8. To prepare a leak proof sheet metal tray/box/funnel to the given dimensions.
9. Cutting of MS plates by gas cutting method and arc weld joining by Lap/Butt/T joint method
10. Preparing a simple PVC window/door frame assembly.
11. Preparing a simple memento or similar articles using wood/sheet metal
12. Preparing innovative articles involving waste metals.

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Introduction to basic manufacturing processes and workshop technology by Rajender Singh, New Age International (P) Limited, 2006.
2. Elements of Workshop Technology by S.K.Hajra Choudhury, Media Promoters, 2009.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: demonstrate knowledge on safety and adhere to safety features
CO2: mark the given dimensions accurately and execute cutting and joining operations
CO3: select methods and tools and execute the given experiments
CO4: finish the job to the requirements and quantify the accuracy
CO5: plan and complete simple and innovative articles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		2	2	1		2	2		2		
CO2	3	1	2		2	2	1		2	2		2		
CO3	3	1	2		2	2	1		2	2		2		
CO4	3	1	2		2	2	1		2	2		2		
CO5	3	1	2		2	2	1		2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial 1

14EGT21 COMMUNICATIVE ENGLISH II

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Functional Grammar: Sentences – Affirmative / Negative – Asking questions in the simple present – Using reference words - Cause and Effect expressions. **Listening:** Listening practice - listening to different types of conversation and answering questions - listening to Audio texts and completing cloze exercises. **Speaking:** Opening a conversation and getting acquainted with people. **Reading:** Reading excerpts from a novel, itinerary, magazine and news paper articles. **Writing:** Formal Letter writing – Job Application Letter – CV and Resume – Writing Instructions

UNIT – II **9**

Functional Grammar: Sentences – Interrogative & WH questions - SI units – Numerical Adjectives

Listening: Listening to situation based dialogues – listening to short and long conversations in different domains of activity. **Speaking**: Conversation practice in real life situations, describing places, narration, introducing ideas. **Reading:** Reading historic writing – biographical writing – Non fictional book extracts and news feeds. **Writing:** Filling Forms – Academic Writing - Basics of Business Writing – Calling for Quotation, Placing Orders, Letter of Complaint

UNIT – III **9**

Functional Grammar: Sentences – Imperative – Gerunds & Infinitives - Commonly confused words. **Listening:** Understanding the structure of conversations - Listening to academic lectures and live speech – advertisements and announcements. **Speaking:** Giving and Justifying opinions – apologizing – extempore. **Reading:** Reading Blogs - Website articles – e-mails. **Writing:** e-mails – Tweets – Texting and SMS language

UNIT – IV **9**

Functional Grammar: Transformation of Sentences – Simple, Compound and Complex - Vocabulary (single word substitute) – conjunctions - reporting verbs – Direct and Indirect speech. **Listening:** Listening to a telephone conversation, viewing of model interviews (face–to–face, telephonic and video conferencing). **Speaking:** Giving instructions – Role play – Interviews. **Reading:** Reading job advertisements and profile of the company concerned **Writing:** Writing Reports - Preparing a Check list

UNIT – V **9**

Grammar: Analyzing sentence structures in a given short passage - Identifying parts of speech in a given short passage. **Listening:** Viewing a model group discussion and reviewing the performance of each participant – identifying the characteristics of a good listener – casual conversation. **Speaking:** Group discussion skills – initiating, turn taking and concluding the discussion. **Reading:** Making notes from long passages or any form of written materials – providing a suitable title – identifying main points, supporting points. **Writing:** Email writing – Effective use of email.

TOTAL: 45

TEXT BOOKS :

1. Dr. Elango et al. "Resonance: English for Engineers and Technologists", Foundation, Chennai, 2013.

REFERENCE BOOKS:

1. Anderson, Paul V., "TechnicalCommunication: A Reader–Centered Approach", Cengage.
2. Muralikrishna and Sunita Mishra, "Communication Skills for Engineers", Pearson, New Delhi, 2011.
3. Sharma, Sangeetha and Binod Mishra, "Communication Skills for Engineers and Scientists", PHI Learning, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: speak effectively, express their opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies

CO2: write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing

CO3: read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation

CO4: listen and comprehend different spoken excerpts critically and infer unspoken and implied meanings

CO5: use functional grammar for improving employment oriented skills

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3		2		
CO2						1			1	3		1		
CO3						2			1	3		2		
CO4						1			2	3		2		
CO5						1			1	3		1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT21 MATHEMATICS II

(Common to all Engineering and Technology branches)

3 1 0 4

Pre-requisites: Basic ideas of integration, Basic ideas of vectors and complex numbers

UNIT – I **9**

Multiple Integrals: Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Triple integration in Cartesian coordinates –Volume as Triple integrals (Simple problems only).

UNIT – II **9**

Vector Calculus: Gradient of a scalar point function – Directional derivative – Divergence of a vector point function – Curl of a vector – Irrotational and Solenoidal vectors – Line Integral, Surface integral and Volume integral (Concept only) – Green's, Stoke's and Gauss divergence theorems (Statement only) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

UNIT – III **9**

Analytic Functions: Functions of a complex variable – Analytic functions – Necessary conditions and Sufficient conditions (excluding proofs) – Cauchy– Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic functions – Construction of Analytic functions – Conformal mapping: $w = z + a$, az, $1/z$ – Bilinear transformation.

UNIT – IV **9**

Complex Integration: Cauchy's theorem and Cauchy's integral formula (Statement and applications) – Taylor's and Laurent series – Singularities – Classification – Cauchy's Residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

UNIT – V **9**

Laplace Transform: Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions - Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Solution of linear ODE of second order with constant coefficients.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics for First Year B.E/B.Tech", Reprint Edition 2014, S. Chand and Co., New Delhi.
2. Veerarajan T., "Engineering Mathematics", (for first year), Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, Reprint 2014.
3. Bali N.P. and Manish Goyal, "Text Book of Engineering Mathematics", 8th Edition, Laxmi Publications, New Delhi, 2011.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2011.
5. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: solve problems involving double and triple integrals
CO2: apply the concept of vectors in engineering problems
CO3: have a clear idea about functions of complex variables and analytic function which are widely used in study of fluid and heat flow problems
CO4: evaluate complex integrals which is extensively applied in engineering
CO5: handle Laplace transforms to solve practical problems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1		
CO2	3	3	1	1								1		
CO3	3	3										1		
CO4	3	3	1	1								1		
CO5	3	3	1	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHT21 MATERIALS SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Crystal Physics: Crystalline and amorphous solids – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – Derivation of '*d*' spacing in cubic lattice – Atomic radius – Coordination number– Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections: Point and line imperfections.

UNIT – II **9**

Conducting Materials: Conductors – Classical free electron theory of metals – Electrical and thermal conductivities – Wiedemann–Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.

UNIT – III **9**

Semiconducting Materials: Intrinsic semiconductor – Carrier concentration derivation – Electrical conductivity and band gap (theory) – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications –Solar cell – LDR.

UNIT – IV **9**

Magnetic and Superconducting Materials: Magnetic materials - Types of magnetic materials (qualitative) – Domain theory – Hysteresis – Soft and hard magnetic materials – Applications - Transformer core – Magneto optical recording – Superconductors – Properties – Types of superconductors – BCS theory of superconductivity (qualitative) – Josephson effect - Applications of superconductors – SQUID – Cryotron – Magnetic levitation. **Dielectric Materials:** Dielectric constant – Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor) – Ferro electric materials (qualitative).

UNIT – V **9**

Smart Materials: Metallic glasses: Preparation (Melt spinning method only), properties and applications – Shape memory alloys (SMA): Characteristics and applications. **Nano Materials:** Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method – Carbon nanotubes: Structures – Properties – Fabrication by laser ablation – Applications.

TOTAL : 45

TEXT BOOKS:

1. Tamilarasan K. and Prabu K., "Engineering Physics-II", Tata McGraw Hill Education Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. Mehta and Neeraj, "Applied Physics for Engineers", Prentice-Hall of India Private Limited, New Delhi, 2011.
2. Raghavan V., "Materials Science and Engineering: A first course", 5th Edition, Prentice-Hall of India, New Delhi, 2009.
3. Poole Charles P. and Ownen Frank J., "Introduction to Nanotechnology", Wiley India, 2007.
4. William Fortune Smith and Javad Hashemi, "Foundations of Materials Science and Engineering", McGraw-Hill Education, 2006, New Delhi.
5. Pillai S.O., "Solid State Physics", 5th Edition, New Age International, New Delhi, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: explain the various crystal systems and crystal defects
CO2: comprehend the theory of conducting materials
CO3: classify the types of semiconducting materials and to illustrate the device applications
CO4: summarize the theory and applications of magnetic, superconducting and dielectric materials
CO5: outline the properties and applications of smart materials and nano materials

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2	2		2		1					
CO2	3			2	2		2		1					
CO3	3			2	2		2		1					
CO4	3			2	2		2		1					
CO5	3			2	2		2		1					

1 – Slight, 2 – Moderate, 3 – Substantial

14CYT21 ENVIRONMENTAL SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Introduction to Environmental Studies and Natural Resources: Introduction to Environmental Science – Forest resources: Use and over-exploitation, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams - benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture - effects of modern agriculture, fertilizer and pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource – Conservation Practices - Role of an individual in conservation of natural resources.

UNIT – II **9**

Ecosystems: Concept of an ecosystem – Components of an ecosystem - Structural and functional features – Functional attributes (Food chain and Food web only) –Ecological Succession- Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:**Introduction – Classification: genetic, species and ecosystem diversity – Bio geographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value – Biodiversity at global, national and local level- Hotspots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

UNIT – III **9**

Environmental Pollution: Definition – Causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Solid Waste Management - Disaster management: floods, earthquake, cyclones and landslides - Role of an individual in prevention of pollution - Case studies. **Water Treatment methods:** Treatment of Water for Domestic Supply (Screening, Aeration, Sedimentation with Coagulation, Filtration and Disinfection methods) - Break point chlorination- Estimation of dissolved oxygen, BOD and COD - Sewage treatment (Primary, Secondary & Tertiary methods) – Introduction to industrial wastewater treatment using Reverse Osmosis Technology- Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

UNIT – IV **9**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation– Environmental ethics - Wasteland reclamation – Environment Production Act – Air (Prevention and control of pollution) Act – Water (Prevention and control of pollution) Act – Wildlife protection Act – Forest conservation Act – Issues involved in enforcement of environmental legislation – Public awareness. **Human Population and the Environment:** Introduction - Population growth - Variation of population based on age structure - Variation among nations – Population explosion – Family welfare programme – Value Education – HIV / AIDS – Women and Child welfare – Role of Information Technology in Environment and human health – Case studies.

UNIT – V **9**

Green Chemistry for Sustainable Future: Water the greenest solvent – Role of catalyst – Biopolymers – Biofertilizers – Principle and applications of green chemistry. **Food and Human Health:** Introduction – Classification and applications of carbohydrates, amino acids, proteins, lipids and vitamins – Food additives – Balanced food – Minerals rich, carbohydrates rich and proteins rich – Chemistry of soft drinks – Oils and fats – Simple tests for identification of adulterants in food stuffs – Impacts of fluoride and arsenic on human health – Fluoride and arsenic removal methods – Significance of iodine, iron and calcium content in human health.

TOTAL : 45

TEXT BOOKS:

1. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., "Environmental Science", Pearson Education, New Delhi, Revised Edition 2014.
2. Anubha Kaushik, and Kaushik C.P., "Environmental Science and Engineering", 4th multicolour Edition, New Age International (P) Ltd., New Delhi, 2014.

REFERENCE BOOKS:

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 2005, University Grands Commission, Universities Press India Private Limited, Hyderguda, Hyderabad.
2. Uppal M.M. revised by Bhatia S.C., "Environmental Chemistry", 6th Edition, Khanna Publishers, New Delhi, 2002.
3. Bahl B.S. and Arun Bahl, "Advanced Organic Chemistry", 3rd Edition, S. Chand & Co., New Delhi, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: know the types of natural resources and the individual role in conserving the resources
- CO2: understand the ecological balance and the preservation of biodiversity
- CO3: gain the knowledge of the various types of pollution and the waste water treatment methods
- CO4: attain the knowledge of various social issues and impact of population explosion on environment
- CO5: know about the green chemistry for sustainable future, food and human health

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			3	2	3	2	1	1				
CO2	3	2			3	2	3	2	1	1				
CO3	3	2			3	2	3	2	1	1				
CO4	3	2			3	2	3	2	1	1				
CO5	3	2			3	2	3	2	1	1				

1 – Slight, 2 – Moderate, 3 – Substantial

14CSC11 PROBLEM SOLVING AND PROGRAMMING

(Common to all Engineering and Technology branches)

3 0 3 4

UNIT – I **9**

Introduction to Computer and Problem Solving: Overview of computers – Applications of computers-Characteristics of computer - Basic computer Organization – Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudo codes – Structuring the logic - Top-Down design.

UNIT – II **9**

Case Study on Problem Solving: Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables – Finding the biggest number - Counting – Summation of numbers – Factorial computation – Generation of Fibonacci Sequence - Summation of series – Base Conversion - Reversing the digits of an Integer.

UNIT – III **9**

Introduction to C and Control Statements: Overview of C – Basic structure of a C Program – Executing a C Program – C Character set – Tokens – Keywords and Identifiers – Constants – Variables – Data types - Storage classes - Managing Input and Output operations – Operators and Expressions - Decision making and Branching - Looping – break and continue statements.

UNIT – IV **9**

Arrays, Strings and Functions: Arrays – One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables – String handling functions - Library functions – User defined functions: Elements of User defined Functions – nesting of functions – passing arrays to function – passing strings to functions - recursion.

UNIT – V **9**

Structures, Unions and Pointers: Structure definition – Structure declaration – Accessing a structure member- Structure initialization – Array of Structures - Arrays within structures –Structures within Structures – Structures and Functions, Unions. Understanding pointers – Accessing address of a variable – Declaring pointer variables – Initialization of pointer variables – accessing a variable through its pointer – Pass by value vs. Pass by pointers.

Lecture: 45, Practical: 45, TOTAL: 90

REFERENCE BOOKS:

1. Dromey R.G., "How to Solve it by Computer", Pearson Education, 2009.
2. Balagurusamy E., "Fundamentals of Computing and Programming", Tata McGraw-Hill Education Pvt. Ltd, 2010.
3. Stephen G. Kochan, "Programming in C", 3rd Edition, Pearson Education, 2005.
4. Yashavant P. Kanetkar, " Let Us C", BPB Publications, 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply fundamental principles of problem solving techniques
CO2: develop algorithm, flowchart and pseudo code to provide solutions to problems
CO3: develop programs using basic programming principles of C language
CO4: implement modular programming concepts using functions
CO5: design simple applications using arrays, structures and pointers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2							2		
CO2	3	3	1		2							2		
CO3	3	3	2	1	2							2		
CO4	3	3	3	2								2		
CO5	3	3	3	2	2							2		

1 – Slight, 2 – Moderate, 3 – Substantial

14EET11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT- I **9**

Introduction to Power Systems: Introduction: Electric Potential, Current, Power and Energy. Generation of Electrical Energy: Sources of Energy - Renewable and Non Renewable - Power Generation: Thermal, Hydro and Nuclear Power plants - Solar and Wind (schematic arrangement and operation) Power plants - Structure of Electric Power System - Transmission and Distribution Voltages. Electrical Safety Aspects - Phase-Neutral - Earthing: Need for Earthing and Types - Domestic Wiring (Simple and staircase) - Energy Conservation and Sustainability.

UNIT - II **9**

DC Circuits and AC Circuits: Resistance: Resistors in Series and Parallel - Network Reduction - Voltage and Current Division Rule - Ohm's Law- Kirchhoff's Laws - Mesh Analysis of Simple Resistive Networks.

Single phase systems: Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor - AC Series Circuits (RL, RC & RLC). Three phase Systems (Qualitative only): Star and Delta Connected Systems - Line and Phase Voltage/Current - Three Phase Power Measurement by Two Wattmeter Method.

UNIT - III **9**

Electrical Machines: DC Machines: Construction, Principle of Operation of DC Motor-Torque Equation, Types and Applications. AC Machines: Construction and Working Principle of AC Generator , Single Phase Transformer, Three Phase Induction Motor and Single Phase Induction Motor (Split Phase and Capacitor Start Induction Motor) - Applications.

UNIT - IV **9**

Basic Electronics: PN Junction Diode - Operation of Rectifiers (Half wave, Full wave - Bridge Rectifiers with waveforms) and Filters - Zener Diodes - Zener Diode as Voltage Regulator - IC Voltage Regulators (78XX & 79XX) - Transistors: Types - Operation of NPN Transistor - Transistor as an Amplifier - Operation and Characteristics of SCR - UPS and SMPS (Block Diagram approach).

UNIT - V **9**

Digital Electronics: Introduction – Binary Number Systems and Conversions - Binary Addition and Subtraction - Logic Gates and Truth tables - Boolean Algebra - Basic Laws and Demorgan's theorem - Simplification of Boolean Functions - Full Adder and Full Subtractor - Flip Flops - Counters: Asynchronous Binary Ripple Counter .

TOTAL: 45

TEXT BOOKS:

1. Prasad P.V., Sivanagaraju S. and Prasad R., "Basics of Electrical and Electronics Engineering", 1st Edition, Cengage Learning, 2013.
2. Muthusubramanian R. and Salivahanan S., "Basics of Electrical and Electronics Engineering", 1st Edition ,Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Jegathesan V., Vinoth Kumar K. and Saravanakumar R., "Basic Electrical and Electronics Engineering", 1st Edition, Wiley India, 2011.
2. Sukhija M.S. and Nagsarkar T.K., "Basics of Electrical and Electronics Engineering", 1st Edition ,Oxford University Press, 2012.
3. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, PHI Learning, 2007.
4. Edward Hughes, Ian McKenzie Smith, Dr. John Hiley and Keith Brown, "Electrical and Electronics Technology", 8th Edition, Pearson Education, 2012.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: develop a basic understanding of the concept of electrical systems
CO2: analyze the DC and AC circuits
CO3: interpret the construction and working of different types of electric machines
CO4: discuss the basic electronic components
CO5: distinguish analog and digital electronics

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3									1		
CO2	3	3	3									1		
CO3	3	3	3									1		
CO4	3	3	3									1		
CO5	3	3	3									1		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHL21 PHYSICAL SCIENCES LABORATORY II

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS:

1. Determination of band gap of a semiconductor material using post office box.
2. Determination of dispersive power of a prism using spectrometer.
3. Determination of viscosity of liquid - Poiseuille's method.
4. Determination of thickness of a thin wire – air wedge method.
5. Determination of AC frequency using Melde's string experiment.
6. Determination of hysteresis loss in a ferromagnetic material.

Demonstration

1. Thin film deposition using RF magnetron sputtering technique
2. Synthesis of nano-particles
3. Phase change memory materials - RW CD / DVD

PART - B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS:

1. Estimation of Chloride in the given water sample.
2. Determination of Dissolved Oxygen in the given wastewater sample.
3. Estimation of Ferrous ion in the given solution.
4. Estimation of Copper in the given solution by Iodometric method.
5. Estimation of Chromium (Cr^{6+}) in the wastewater.
6. Estimation of copper content of the given solution by EDTA method.

Demonstration

1. Turbidity measurement using Nephelometer
2. COD analyzer
3. Dissolved Oxygen measurement using DO analyzer

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N. Palanisamy, P. Manikandan, A. Geetha and K.Manjularani

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: describe **t**he basics of band gap of semiconductors, dispersive power of a prism, viscosity of liquids, interference of light, AC frequency and hysteresis of ferromagnetic materials.

CO2: operate the instruments likepost office box, air wedge arrangement, Melde's string apparatus and hysteresis arrangement, and to measure the related parameters

CO3: estimate the amount of DO and chloride in a given water sample

CO4: determine the amount of chromium, ferrous ion and copper in waste water

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	1		2		2					
CO2	3	3		2	1		2		2					
CO3	3	3		2	1		2		2					
CO4	3	3		2	1		2		2					

1 – Slight, 2 – Moderate, 3 – Substantial

14EEL11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Control of incandescent and fluorescent lamp by simple and stair-case wiring
2. Resistor color coding and verification of Ohm's Law and Kirchhoff's Laws
3. Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits.
4. Measurement of Earth's resistance
5. Load test on DC shunt motor
6. Performance characteristics of single phase Transformer
7. Load test on single phase induction motor.
8. Verification of basic logic gates and their truth tables.
9. Implementation of Half wave and Full wave Rectifier with simple Capacitor Filter
10. Study of Mixie, Ceiling Fan and Vacuum Cleaner

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

- Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: create a basic electrical connections for domestic applications
CO2: test basic electrical machines like transformer and DC motors
CO3: construct and analyze basic electronic circuits
CO4: measure the various electrical parameters of the circuit
CO5: explain the working of various domestic appliances

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3									2		
CO2	3	3	3									2		
CO3	3	3	3						2			2		
CO4	3	3	3									2		
CO5	3	3	3					1				2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT31 MATHEMATICS III

(Common to all Engineering and Technology Branches)

3 1 0 4

UNIT – I **9**

Fourier Series: Dirichlet's conditions – General Fourier series – Change of interval - Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.

UNIT – II **9**

Partial Differential Equations: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Homogeneous linear partial differential equations of higher order with constant coefficients.

UNIT – III **9**

Applications of Partial Differential Equations: Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).

UNIT – IV **9**

Fourier Transform: Fourier Integral theorem (without proof) –Fourier transform pair – Properties – Transforms of simple functions – Fourier Sine and Cosine transforms – Convolution theorem and Parseval's identity (Statement and applications only).

UNIT – V **9**

Z - Transform: Definition – Elementary properties – Z-transform of some basic functions – Inverse Z-transform – Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms – Solution of difference equations.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics, Volume - III", Reprint Edition, S.Chand & Co., New Delhi, 2014.
2. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Reprint Edition, Narosa Publishing House, New Delhi, 2014.
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi Publications, New Delhi, 2014.
4. Ramana B.V., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw Hill Publishing Company, New Delhi, 2010.
5. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Edition, Wiley & Co, 2011.

Course Outcomes:

On completion of the course the students will be able to

CO1: expand a function in terms of Fourier series and apply it for solving engineering problems
CO2: model and solve higher order partial differential equations
CO3: apply the methods of solving PDE in practical problems
CO4: gain knowledge on Fourier transforms
CO5: handle problems in Z transforms and apply it to solve difference equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1		
CO2	3	3	1	1								1		
CO3	3	3	1	1								1		
CO4	3	3	1	1								1		
CO5	3	3	1	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MET31 ENGINEERING MECHANICS

(Common to Mechanical, Mechatronics and Automobile branches)

3 1 0 4

Pre-requisites: Mathematics I & II, Applied Physics.

UNIT – I **9**

Statics of Particles: Introduction –Laws of Mechanics – Parallelogram and triangular Law of forces – Principle of transmissibility – Coplanar Forces – Resolution and Composition of force -Free body diagram–Equilibrium of a particle in plane – Forces in space - Vectorial representation of forces–Equilibrium of a particle in space.

UNIT – II **9**

Statics of Rigid Bodies: Moments: Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar component of moments – Varignon's theorem– Equivalent systems of forces – Single equivalent force. Types of supports and their reactions – requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions – Trusses: Method of joints- Method of sections, Equilibrium of Rigid bodies in three dimensions.

UNIT – III **9**

Properties of Surfaces and Solids: Determination of Areas and Volumes – First moment of area and Centroid of sections – T section, I section, Angle section, Hollow section from primary simpler sections – Second moment of plane areas – Parallel axis theorem and Perpendicular axis theorem—T section, I section, Angle section, Hollow sections – Polar moment of inertia – Product of inertia- Principal Moment of inertia of plane area- Mass moment of inertia – Relation to area moments of inertia.

UNIT – IV **9**

Friction and Kinematics of Particles: Surface Friction – Laws of dry friction – Sliding friction – Static and Kinetic friction– Ladder friction – Wedge friction – Belt friction. Rectilinear motion of particles- Displacement, velocity and acceleration, their relationship – Relative motion- Curvilinear motion – Projectile motion.

UNIT – V **9**

Dynamics of Particles and Rigid Body: Newton's law, Work - Energy and Impulse - Momentum equations of particles – Impact of elastic bodies. Kinematics of Rigid body -Translation, Rotation about a fixed axis–General plane motion- Kinetics of rigid body.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Rajasekaran S. and Sankarasubramanian G., "Fundamentals of Engineering Mechanics", 3rd Edition, Vikas Publishing House, Noida, 2009.
2. Beer F.P., Johnston E.R., Cornwell P. and Maurek D., "Vector Mechanics for Engineers: Statics and Dynamics", 10th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.

REFERENCE BOOKS:

1. Shames Irving H., "Engineering Mechanics: Statics and Dynamics", 4th Edition, Pearson Education Asia, New Delhi, 2014.
2. Hibbeller R.C., "Engineering Mechanics Statics and Dynamics", 11th Edition, Pearson Education Asia, Noida, 2015.
3. Timoshenko S.P., Young D.H., Sukumar Pati, Rao J.V., "Engineering Mechanics", 5thEdition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

Course Outcomes:

On completion of the course the students will be able to

CO1: represent the forces in vector components (both 2D and 3D) and apply equilibrium conditions
CO2: calculate the moment produced by various force systems and develop static equilibrium equations for rigid body system
CO3: evaluate the centroid, centre of gravity and moment of inertia of geometrical shapes and solids respectively
CO4: comprehend the effect of dry friction and its applications
CO5: apply the different principles to study the motion of a body and analyse their constitutive equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2							2	1	
CO2	3	3	3	2	2							2	1	
CO3	3	3	3	2	2							2	1	
CO4	3	3	3	2	2							2	1	
CO5	3	3	3	2	2							2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MET32 ENGINEERING THERMODYNAMICS

(Common to Mechanical and Automobile branches)

(Use of standard Steam table with Mollier diagram and Psychometric chart are permitted)

3 1 0 4

Pre-requisites: Mathematics I & II, Applied Physics.

UNIT – I **9**

Basic Concepts and First Law of Thermodynamics: Basic concepts –concept of continuum, micro, macroscopic approach, thermodynamic systems – closed, open and isolated. Property, state, path, process and quasi-static process. Specific heat capacities, internal energy, enthalpy, work - modes of work. Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems. Steady flow energy equation (SFEE) with reference to various thermal equipments.

UNIT – II **9**

Second Law, Entropy and Availability: Second law of thermodynamics – Kelvin–Planck and Clausius statements of second law. Carnot cycle, Heat engine, reversed Carnot cycle – efficiency, Refrigerator, Heat pump – COP. Reversibility and irreversibility. Thermodynamic temperature scale, Inequality of Clausius. Concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot's theorem, absolute entropy, Basic concepts of availability.

UNIT – III **9**

Properties of Pure Substance: Properties of pure substances –Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, p-v, p-T, T-s, h-s diagrams, pvT surface. Thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes.

UNIT – IV **9**

Ideal and Real Gases and Thermodynamic Relations: Concept of ideal and real gases, Properties of ideal and real gases, equation of state, Avogadro's law, Van der Waals equation of state, Compressibility and compressibility chart. Dalton's law of partial pressure - Gas mixtures. Exact differentials, TdS equations, Maxwell's equations, Clausius- Clapeyron equation, Joule-Kelvin coefficient.

UNIT – V **9**

Psychrometry: Psychrometry-Properties of atmospheric air, calculations of properties of air-vapour mixtures. Psychrometric charts. Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling-Problems.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Nag P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
2. Rajput R.K., "Engineering Thermodynamics", 4th Edition, Lakshmi Publications, New Delhi, 2012.

REFERENCE BOOKS:

1. Arora C.P., "Thermodynamics", Tata McGraw Hill Publishing Company, New Delhi, 2003.
2. Cengel Y., "Thermodynamics: An Engineering Approach", 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.
3. Holman J.P., "Thermodynamics", McGraw-Hill, New York, 2000.
4. Ballaney P.L., "Thermal Engineering", 24th Edition, Khanna Publishers, New Delhi, 2000.

Course Outcomes:

On completion of the course the students will be able to

CO1: gain the capability of problem solving in thermodynamic processes
CO2: acquire the knowledge on second law of thermodynamics and entropy concept
CO3: solve the problems related to thermodynamic properties of pure substances
CO4: recognize the concept of real and ideal gases and applications of thermodynamic relations in physical problems
CO5: gather the psychrometric concepts in various processes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1			1	2	2	2	2	
CO2	3	3	3	3	2	1			1	2	2	2	2	
CO3	3	3	3	3	2	1			1	2	2	2	2	
CO4	3	3	3	3	2	1			1	2	2	2	2	
CO5	3	3	3	3	2	1	3		1	2	2	2	2	

1 – Slight, 2 – Moderate, 3 – Substantial

14MET33 FLUID MECHANICS AND HYDRAULIC MACHINES

(Common to Mechanical, Mechatronics and Automobile branches)

3 0 0 3

Pre-requisites: Physics, Mathematics I & II, Basics of Mechanical Engineering.

UNIT – I **9**

Fluid Properties and Fluid Statics: Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal's law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement.

UNIT – II **9**

Fluid Kinematics and Fluid Dynamics: Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

UNIT – III **9**

Viscous Flow, Flow through Pipes and Dimensional analysis: Viscous flow: Shear stress, pressure gradient relationship – Flow of viscous fluid through circular pipe – Flow through pipes: Loss of head due to friction – Minor head losses – Hydraulic gradient and Total energy lines – Flow through pipes in series and in parallel – Power transmission through pipes. Dimensional analysis: Buckingham's π theorem.

UNIT – IV **9**

Hydraulic Turbines: Impact force – work done – Efficiency of stationary, moving flat and curved vanes due to moving water jet – Construction of velocity vector diagrams – Degree of reaction – Pelton wheel – Francis turbine – Kaplan turbine – working principles – velocity triangles – work done.

UNIT – V **9**

Hydraulic Pumps: Centrifugal pump: classifications, working principle, velocity triangles, Work done. Reciprocating pump: classification, working principle- Basic principles of indicator diagram, cavitations in pumps.

TOTAL: 45

TEXT BOOKS:

1. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", 9th Edition, Laxmi Publications, New Delhi, 2015.
2. Rajput R.K., "A Text Book of Fluid Mechanics" 5th Edition, S.Chand & Company Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Som S.K., Biswas G., "Introduction to Fluid Mechanics and Fluid Machines", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Kumar K.L., "Engineering Fluid Mechanics", 7th Edition, Eurasia Publishing House, New Delhi, 2005.
3. Frank M. White., "Fluid Mechanics", 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the fluid flow properties
CO2: solve the problems related to kinematics and dynamics of fluid flow
CO3: calculate the energy losses in flow through pipes
CO4: design the velocity triangle by various hydraulic machines
CO5: estimate the work done by the various pumps

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								2	1	
CO2	3	3	3	2								2	1	
CO3	3	2	3	2								2	1	
CO4	3	3	3	2								2	1	
CO5	3	3	3	2								2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MTT33 MANUFACTURING PROCESSES

(Common to Mechatronics and Automobile branches)

3 0 0 3

Pre-requisites: Basics of Civil and Mechanical Engineering

UNIT – I **9**

Foundry Technology: Introduction to Molding and Casting. Molding sand: types, properties, preparation of green sand molding. Pattern making: Pattern materials, types and allowances. Core making: types of core, core materials, making of cores. Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting. Defects in casting.

UNIT – II **9**

Metal Forming Processes: Rolling: Introduction, rolling mills, Rolling operations. Extrusion: Forward and Backward extrusion, Production of seamless tubing and pipes, Cold and Hydrostatic Extrusion. Drawing: Introduction, Hot and Cold drawing, Deep drawing, Tube and wire drawing. Sheet metal and forging operations.

UNIT – III **9**

Metal Removal Processes: Lathe: types, main parts and operations, single point cutting tool nomenclature. Drilling Machine: Types, operations, types of drills, twist drill nomenclature, reaming and tapping. Milling Machine: Types, operations, types of milling cutters. Shaper and Planer: types, main parts, operations. (Numerical problems in Lathe, Drilling and Milling operations).

UNIT – IV **9**

Metal Joining Processes: Classification of Welding Process. Fusion Welding: Arc Welding, Gas Tungsten Arc welding, Gas Metal Arc Welding, Electron Beam Welding, Laser Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Gas welding: Oxy - Acetylene welding process. Welding defects.

UNIT – V **9**

Metal Finishing Processes: Grinding Machine: Methods of grinding, Types of grinding machines, Grinding wheel and its selection, Lapping, Honing, and super finishing operations. Broaching Machine: pull type and push type broachers, broaching methods, operations and types of broaching machines.

TOTAL: 45

TEXT BOOKS:

1. Kaushish J.P., "Manufacturing Processes", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
2. Rao P.N., "Manufacturing Technology, Volume I & II", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCE BOOKS:

1. Kalpakjian, S, Schmid, "Manufacturing Process for Engineering Materials", 5th Edition, Pearson Education India, New Delhi, 2014.
2. Groover M.P., "Principles of Modern Manufacturing", Wiley India Pvt. Ltd., New Delhi, 2014.
3. Paul Degarma E., Black J.T. and Ronald A. Kosher, "Materials and Processes in Manufacturing", 8th Edition, Prentice Hall of India, New Delhi, 2006.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the various foundry techniques like pattern making, molding, casting, melting furnaces and inspection

CO2: categorize various forming processes involving bulk forming and sheet metal operations

CO3: choose the metal removal processes according to the material and geometrical design

CO4: select the metal joining processes based on the properties of base metal

CO5: recommend the various metal finishing processes for surface finishing operations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1		1	2					2	1	
CO2	3	2	2	1		1	2					2	1	
CO3	3	2	2	1		1	2					2	1	
CO4	3	2	2	1		1	2					2	1	
CO5	3	2	2	1		1	2					2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT31 AUTOMOTIVE ENGINE TECHNOLOGY

3 0 0 3

Pre-requisites: Basics of Mechanical Engineering

UNIT – I **9**

Introduction: Evolution of automobiles, Engine classifications, Constructional and working details of Spark Ignition (SI) - Compression Ignition (CI) engines, Comparison of four stroke SI - CI engines, Firing order.

UNIT – II **9**

Fuel Systems: Air – fuel (A/F) ratio requirements of SI engines. Simple carburetor working, SI fuel injection system. CI fuel injection systems-jerk pumps, distributor pumps, pintle, multihole nozzles and unit injector. Injection pump calibration. Principle of Governor used in engines.

UNIT – III **9**

Combustion and Combustion Chambers: Introduction to combustion in SI and CI engines, stages of combustion. Dependence of ignition timing on load and speed. Knocking in SI and CI engines. Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of swirl, squish and turbulence.

UNIT – IV **9**

Supercharging, Turbocharging and Engine Testing: Supercharging, Turbocharging - Different methods of turbocharging, intercooling. Turbocharger controls including - waste gate, variable geometry, variable nozzle types. Dynamometers, indicated thermal, brake thermal, mechanical and volumetric efficiencies. Measurement of friction in single and multi-cylinder engines, cylinder pressure measurement. Engine performance maps, engine testing standards.

UNIT – V **9**

Cooling and Lubrication Systems: Need for cooling-types of cooling systems- air and liquid cooling systems. Thermo siphon, forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

TOTAL: 45

TEXT BOOKS:

1. Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill, 2012.
2. Ramalingam K.K., "Internal Combustion Engines", 2nd Edition, Sci-Tech Publications, 2009.

REFERENCE BOOKS:

1. Heisler, "Advanced Engine Technology", Butterworth-Heinemann Ltd., 1995.
2. Gupta H.N., "Fundamentals of Internal Combustion Engines", 2nd Edition, PHI Learning Pvt. Ltd, 2013.
3. Willard W. Pulkrabek, "Engineering Fundamentals of the Internal Combustion Engine", 2nd Edition, Pearson Education Ltd., 2013.

Course Outcomes:

On completion of the course the students will be able to

CO1: describe the construction and working of IC engine
CO2: outline the various fuel systems involved in IC engine
CO3: differentiate the combustion process and combustion chamber of IC engine
CO4: express the working of supercharging, turbocharging and calculate the performance of IC engine
CO5: understand the concept of cooling and lubrication systems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1										3	
CO2	3	1	1										3	
CO3	3	2	2			1	1						3	
CO4	3	3	3	2									3	
CO5	3	1	1										3	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL31 FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS / EXERCISES:

1. Determination of co-efficient of discharge for venturimeter
2. Determination of co-efficient of discharge for orifice meter
3. Determine the impact of jet on flat plate (normal / inclined)
4. Determination of friction losses in pipes
5. Determination of minor losses in pipes
6. Performance test on of Pelton turbine (constant head method)
7. Performance test on Francis turbine (constant head and constant speed method)
8. Performance test on Centrifugal pump
9. Performance test on reciprocating pump.
10. Performance test on submersible pump.
11. Performance test on Jet pump.
12. Performance test on Gear pump.

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Bansal R.K., "Fluid Mechanics and Hydraulics Machines", 9th Edition, Laxmi Publications, New Delhi, 2012.
2. Som S.K., Biswas G., "Introduction to Fluid Mechanics and Fluid Machines", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.

Course Outcomes:

On completion of the course the students will be able to

CO1: perform empirical investigation and quantitative assessment of important mechanics of fluid
CO2: demonstrate the performance characteristics of hydraulic machinery
CO3: find the co-efficient of discharge and frictional losses in open and closed flows

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2		1		3	2		2	1	
CO2	3	3	3	1	2		1		3	2		2	1	
CO3	3	3	3	1	2		1		3	2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MTL33 MANUFACTURING PROCESSES LABORATORY

(Common to Mechatronics and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS / EXERCISES:

1. Exercises using Lathe – Step turning
2. Exercises using Lathe – Taper turning and Knurling
3. Exercises using Lathe – Thread Cutting
4. Exercises using Lathe – Eccentric turning
5. Exercises using Milling machine – Spur gear milling
6. Exercises using Milling machine – Contour / Key way milling
7. Exercises using Shaper / planner Machine – Key way / Dove tail shape Cutting
8. Exercises using Drilling machine- Drilling, Reaming and Tapping
9. Exercises using grinding machine – Cylindrical grinding
10. Exercises using grinding machine – Surface grinding
11. Exercises on Preparation of green sand mould with solid and split patterns
12. Exercises on TIG / MIG Welding (Lap and Butt joint)

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Lab Manual
2. Kaushish J.P., "Manufacturing Processes", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
3. Hajra Choudhury S.K. and Hajra Choudhury A.K., "Elements of Workshop Technology", 14th Edition, Volume I and II, Media Promoters and Publishers, Mumbai, 2009.

Course Outcomes:

On completion of the course the students will be able to

CO1: design and develop the parts of machine elements using various machine tools

CO2: develop green sand moulds using standard patterns

CO3: create the joints using TIG / MIG welding setup

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1		2	2		2	2		2	1	
CO2	2	2	2	1		2	2		2	2		2	1	
CO3	2	2	2	1		2	2		2	2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL31 AUTOMOTIVE ENGINE COMPONENTS LABORATORY

0 0 3 1

Pre-requisites: Basic Mechanical Engineering

LIST OF EXPERIMENTS :

1.Study of Automobile Components and its Functions

2.Study of Multi-cylinder Inline Petrol Engine and Diesel Engine

3.Study of Multi cylinder V type diesel Engine

4.Study of Fuel system in Petrol Engine and Diesel Engine

5.Dismantling and assembly of Two stroke Petrol engine

6.Dismantling and assembly of Four stroke Petrol engine

7.Dismantling and assembly of Multi-cylinder Petrol Engine

8.Dismantling and assembly of Multi-cylinder Diesel Engine

9.Dismantling and assembly of Carburetors

10.Dismantling andassembly of Petrol and Diesel Fuel injection system (MPFi & CRDi)

11. Dismantling and assembly of Cooling system

12. Dismantling andassembly of Lubricating system

13. Dismantling and assembly of Turbocharger and Supercharger

14. Measurement of engine cylinder dimensions using Internal micrometer and Bore gauge

15. Measurement of piston and connecting rod dimensions using Vernier/ Micrometer

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manual
2. Dr. G. Devaradjane and Dr. M. Kumaresan, "Automobile Engineering", AMK Publishers, 2013.
3. Gupta H.N., "Fundamentals of Internal Combustion Engines", Reprint, PHI Learning Pvt. Ltd., 2006.

Course Outcomes:

On completion of the course the students will be able to

CO1: dismantle and assemble the automobile engine components
CO2: identify and differentiate the components of SI and CI engines
CO3: measure the dimensions of engine components

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1							2	1			3	
CO2	3	1							2	1			3	
CO3	3	1							2	1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT42 STATISTICS AND NUMERICAL METHODS

(Common to Mechanical, Mechatronics and Automobile Engineering)

3 1 0 4

UNIT – I **9**

Testing of Hypothesis: Large sample tests – Z-test for single mean and difference of means – Small sample tests – Student's t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes.

UNIT – II **9**

Design of Experiments: Analysis of variance – One way classification – Completely Randomized Design – Two way classifications – Randomized Block Design – Three way classifications – Latin Square Design.

UNIT – III **9**

Solution to Algebraic and Transcendental Equations: Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.

UNIT – IV **9**

Interpolation: Interpolation with equal intervals: Newton's forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. **Numerical Differentiation and Integration**: Differentiation using Newton's forward, backward and divided difference interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons $1/3^{rd}$ rule.

UNIT – V **9**

Numerical Solution of First order Ordinary Differential Equations: Single step methods**:** Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Manish Goyal, "Statistics and Numerical Methods", 1^{st} Edition, Laxmi Publications, New Delhi, 2010.
2. Veerarajan T., "Probability, Statistics and Random Processes", Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Kandasamy P., Thilakavathy K. and Gunavathy K., "Numerical Methods", Reprint Edition, S.Chand & Co, New Delhi, 2014.

REFERENCE BOOKS:

1. Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9^{th} Edition, Pearson Education, Asia, 2012.
2. Johnson R. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", 11^{th} Edition, Pearson Education, Asia, 2011.
3. Sankara Rao K., "Numerical Methods for Scientists and Engineers", 3^{rd} Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 6^{th} Reprint, New Age International Pvt. Ltd., New Delhi, 2014.

Course Outcomes:

On completion of the course the students will be able to

CO1: identify large and small samples and apply suitable tests for getting required results
CO2: handle design of experiments problems
CO3: solve algebraic and transcendental equations numerically where analytical methods fail to give solution
CO4: gain knowledge in the concept of interpolation
CO5: understand the concept of numerical differentiation and integration and apply numerical techniques for solving first order ordinary differential equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		1	1							1		
CO2	3	3		1	1							1		
CO3	3	3		1	1							1		
CO4	3	3		1	1							1		
CO5	3	3		1	1							1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MET41 STRENGTH OF MATERIALS

(Common to Mechanical, Mechatronics and Automobile branches)

3 1 0 4

Pre-requisites: Engineering Mechanics, Mathematics I & II.

UNIT – I **9**

Stress, Strain, and Deformation of Solids: Rigid and deformable bodies – Stability, Strength and Stiffness, Tensile, compressive and shear stresses, strain, Poisson's ratio – lateral stress. Deformation of simple and compound bars – Relation between elastic constants – Thermal stresses – Strain Energy in uniaxial loads – gradually applied load, suddenly applied load and impact load.

UNIT – II **9**

Analysis of State of Stress: Biaxial state of stress – thin cylinders and shells – Deformation in Thin cylinders and spherical shells. Thick Cylinder – Lame's Equation. Biaxial stresses at point – stresses on inclined planes – Principal planes and stresses – Mohr's circle for biaxial stress- Maximum shear stress.

UNIT – III **9**

Transverse Loading on Beams and Stresses in Beams: Beams – types and transverse loading on beams-shear force and bending moment in beams – cantilevers, simply supported and overhanging Beams-Point of contra flexures. Theory of simple bending – analysis of stress- load carrying capacity.

UNIT – IV **9**

Deflection of Beams and Columns: Elastic curve of neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay's method, Area moment theorems for computation of slopes and deflection in beams. Columns: End condition –Equivalent length of column – Euler's equation – Slenderness ratio – Rankine's formula for columns.

UNIT – V **9**

Torsion on Circular Shafts and Coiled Helical Springs: Torsion of circular shaft – Shear stress distribution – hollow and solid circular section. Torsional rigidity – stepped shaft – Twist and torsional stiffness - Torsion on springs – Wahl's factor of springs stresses in helical springs under torsion loads-stiffness and deflection of springs under axial load.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Rajput R.K., "Strength of Materials", 4th Edition, S.Chand & Co, New Delhi, 2012.
2. Bansal R.K., "Strength of Materials", 4th Edition, Lakshmi Publications, New Delhi, 2014.

REFERENCE BOOKS:

1. Timoshenko S.P., "Elements of Strength of Materials", 10th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. Sadhu Singh, "Strength of Materials", 11th Edition, Khanna Publishers, New Delhi, 2014.
3. Popov E.P., "Engineering Mechanics of Solids", 2nd Edition, Prentice-Hall of India, New Delhi, 1998.

Course Outcomes:

On completion of the course the students will be able to

CO1: solve the stress and strain relations for simple and compound bars
CO2: analyze the biaxial state of stresses in thin, thick cylinders and spherical shells
CO3: plot the shear force and bending moment diagrams and analyze the bending stresses
CO4: estimate the slope and the deflection of beams and the strengths of columns
CO5: design and analyze the torsional behavior of shafts and springs

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14MET45 ENGINEERING MATERIALS AND METALLURGY

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Applied Physics, Materials Science

UNIT – I **9**

Constitution of Alloys: Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, lever rule, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steels and cast irons, microstructure, properties and applications. Ferrite and austenite stabilizers.

UNIT – II **9**

Phase Diagrams and Non Ferrous Alloys: Effect of alloying additions on steel Manganese (Mn), Silicon (Si), Chromium (Cr), Molybdenum (Mo),Vanadium (V), Titanium (Ti) and Tungsten (W) - stainless and tool steels – HSLA maraging steels – Gray, White, malleable, spheroidal – Graphite - alloy cast irons. Copper and Copper alloys –Brass, Bronze and Cupronickel –Aluminum and Aluminum -Copper –precipitation strengthening treatment.

UNIT – III **9**

Non -Metallic Materials: Polymers – types of polymer, commodity and engineering polymers –Glass transition and melting temperature of polymers – Structures, Properties and applications of Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyvinylchloride (PVC), Poly methyl metha acrylate (PMMA), Polyethylene terephthalate (PET), Polycarbonate (PC), Polyamide (PA), Polyimide (PI), Polyamide-imide (PAI), Poly phenylene oxide (PPO), Polyphenylene sulfide (PPS), Polyether ether ketone (PEEK), Poly tetra fluro ethylene (PTFE) - Urea and Phenol Formaldehydes – Engineering Ceramics –Properties and applications of Alumina (Al_2O_3), Silicon carbide (SiC), Silicon nitride ($Si_3.N_4$), Partially stabilized zirconia (PSZ) and Sialon – Glass annealing – Fibre and particulate reinforced composites.

UNIT – IV **9**

Heat Treatment: Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, quenching, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on Time Temperature Transformation (TTT) diagram, Critical Cooling Rate (CCR) – Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

UNIT – V **9**

Testing of Mechanical Properties: Mechanism of plastic deformation, dislocation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads –Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and Charpy, fatigue and creep test.

TOTAL: 45

TEXT BOOKS:

1. Rajan T.V., Sharma, "Heat Treatment Principles and Techniques", 2nd Edition Prentice Hall of India Pvt., Ltd., New Delhi, 2012.
2. Avner Sydney H., "Introduction to Physical Metallurgy", 2nd Edition, McGraw-Hill, New York, 2009.

REFERENCE BOOKS:

1. Budinski Kenneth G., Budinski Michael K., "Engineering Materials: Properties and Selection", 9th Edition, 4th Indian Reprint, Prentice-Hall of India, New Delhi, 2009.
2. Callister William D., "Material Science and Engineering", 4th Edition, John Wiley and Sons, New York, 2012.
3. Dieter George E., "Mechanical Metallurgy", 3rd Edition, McGraw-Hill, New York, 2013.
4. Raghavan V., "Materials Science and Engineering", 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
5. Premamoy Ghosh, "Polymer Science and Technology-Plastics, Rubber, blends and Composites", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the structure, composition and properties of alloys and non-metals
CO2: identify the phase diagram of various materials
CO3: present the applications of heat-treatment
CO4: demonstrate the mechanical testing of materials
CO5: identify and select suitable materials for various engineering applications

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1				2	2			2		3	1	
CO2	3	2	1	1	1	2	2				1	3	1	
CO3	2	2	1		1	1	1					2	1	
CO4	2	2	1		2	1	1			1		3	1	
CO5	2	2	2	2		2	1		1	1	1	3	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT41 THERMAL SCIENCE

(Use of Refrigeration and Air conditioning, Heat and Mass Transfer Data books are permitted)

3 1 0 4

Pre-requisites: Applied Physics,Engineering Thermodynamics and Fluid Mechanics.

UNIT – I **9**

Gas Power Cycles: Air standard cycle – Otto, Diesel, Dual, Brayton cycles – Calculation of mean effective pressure and air standard efficiency- Actual and theoretical p-v diagrams, port and valve timing diagram of engines. Engine performance calculations

UNIT – II **9**

Air Compressors and Air-Conditioning System: Single acting and double acting reciprocating air compressors, centrifugal air compressor, work required effect of clearance volume,volumetric efficiency, isothermal efficiency, and free air delivery(FAD).Vapour compression and vapour absorption refrigeration systems (VCRS and VARS), Automotive HVAC system.

UNIT– III **9**

Heat Transfer Conduction: Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – GeneralDifferential equation of Heat Conduction – Fourier Law of Conduction – Cartesian – One DimensionalSteady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems –Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – UnsteadyHeat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT – IV **9**

Convection: Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types ofConvection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Flow over Bank of tubes -Free Convection – Dimensional Analysis – Flow over Vertical Plate.

UNIT – V **9**

Radiation : Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation –Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction toGas Radiation.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1. Rajput R.K., "Thermal Engineering", 9th Edition, Lakshmi Publications, New Delhi, 2014**.**
2. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", 4th Edition, New Age International, New Delhi, 2010.

REFERENCE BOOKS:

1. Ballaney P.L., "Thermal Engineering", 24th Edition, Khanna Publishers, New Delhi, 2014**.**
2. Nag P.K., "Heat and Mass Transfer", 3rd Edition, Tata McGraw Hill, New Delhi, 2011.
3. Arora C.P., "Refrigeration and Air Conditioning", 3rdEdition, Tata McGraw Hill, New Delhi, 2010.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the working of gas power cycles and their applications
CO2: recognize the types of air compressor, air conditioning system and their performance
CO3: describe the analytical and numerical methods of steady and unsteady states of heat conduction
CO4: solve problems by understanding the physical phenomenon associated with convection heat transfer
CO5: express the physical mechanisms involved in radiation heat transfer

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2				1						3	
CO2	2	3	2				1						3	
CO3	2	3	2				1						3	
CO4	2	3	2				1						3	
CO5	2	3	2				1						3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT42 AUTOMOTIVE CHASSIS

3 0 0 3

Pre-requisites: Basic Mechanical Engineering

UNIT – I **9**

Layout, Frame, Front Axle and Steering System: Basic construction of chassis, types of chassis layout - power plant location and drive, types of frames, loads acting on vehicle frame, types of front and stub axles, front wheel geometry. Condition for true rolling motion. Ackerman's and Davi's steering mechanisms, steering linkages, types of steering gear boxes, slip angle, oversteer and understeer, reversible and irreversible steering, power steering. Problems in steering system.

UNIT – II **9**

Drive Line, Final Drive and Differential: Driving thrust and its effects, torque reactions and side thrust, hotchkiss drive, torque tube drive, radius rods and stabilizers, propeller shaft, universal joints, constant velocity universal joints, final drive, types of final drive, worm and worm wheel, straight bevel gear, spiral bevel gear and hypoid gear final drive. Differential principle. Constructional details of differential unit, differential housings, non–slip differential, differential locks.

UNIT– III **9**

Rear Axles, Wheels, Rims and Tyres: Construction of rear axles, types of loads acting on rear axles, Full –floating, three quarter floating and semi floating axles, twist beam rear axle. Multi axles vehicles. Wheels and rims, types of tyres and their constructional details.Measurement of wheel and axle load.

UNIT – IV **9**

Suspension System: Requirement of suspension System, types of suspension springs, constructional details and characteristics of single leaf, multi–leaf spring, coil and torsion bar springs, rubber, pneumatic and hydro elastic suspension spring systems, independent suspension system, shock absorbers. Active suspension system.

UNIT – V **9**

Braking Systems: Need for brake systems, stopping distance, time and braking efficiency, effect of weight transfersduring braking, classification of brakes, braking torque, drum brake and disc brake theory, types and construction of hydraulic, mechanical, pneumatic, power assisted braking system, servo brakes, retarders. Electronic braking system. Problems in braking system.

TOTAL: 45

TEXT BOOKS:

1. Dr Kirpal Singh, "Automobile Engineering", Volume 1 & 2, 13th Edition, Standard Publishers Distributors, 2013.
2. Devaradjane G. and Kumaresan M., "Automobile Engineering", AMK Publishers, 2013.

REFERENCE BOOKS:

1. Heldt P.M., "Automotive Chassis", 3rd Edition, Chilton Co., New York, 1952.
2. Newton Steeds and Garret, "Motor Vehicles", 13th Edition, Butterworth, London, 2005.
3. Heinz Heisler, "Advanced Vehicle Technology", 2nd Edition, Butterworth, London, 2002.

Course Outcomes:

On completion of the course the students will be able to

CO1: explain the different types of chassis frames
CO2: summarize the different steering geometry and types of front axle
CO3: understand the various suspension systems
CO4: develop knowledge on modern drive line
CO5: identify the different braking systems like power brake, assisted brakes,disc brakes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1										3	
CO2	3		1										3	
CO3	3	1	1										3	
CO4	3		1										3	
CO5	3	2	1										3	1

1 – Slight, 2 – Moderate,3 – Substantial

14AUT43 AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS

3 0 0 3

Pre-requisites: Basics of Electrical and Electronics Engineering

UNIT – I **9**

Batteries and Starting System: Introduction about electrical and electronics in automobiles. Types of Batteries – principle, rating, testing and charging, new developments in electrical storage batteries. Starter motors characteristics, principle and construction of starter motor, drive mechanisms, capacity requirements, servicing and trouble shooting, starter switches and solenoids.

UNIT – II **9**

Charging System, Lighting System and Accessories: DC Generators and Alternators their characteristics. Control unit – electronic regulators. Vehicle interior and exterior lighting systems. Wiring requirements, lighting design. Dashboard instruments - (fog lamps, auxiliary lighting, temperature gauge, oil pressure gauge, fuel gauge, speedometer, odometer, horn, windscreen wiper signaling devices and trafficator).

UNIT– III **9**

Electronic Ignition and Injection System: Conventional ignition system and its components, Electronic, Programmed, Distributor less and direct injection systems, spark advance and retard mechanisms. Types of spark plugs. Types of fuel injection in Petrol and Diesel engines.

UNIT – IV **9**

Sensors, Controller and Actuators: Types of sensors – Vehicle speed sensor, Oxygen sensor (Lambda sensor), pressure sensor, Hot wire anemometer sensor, Knock sensor, Throttle position sensor, Crank position sensor. Electronic Controle Module (ECM). Types of actuators- Exhaust gas recirculation, idle speed, ignition controller, (SI Engines), Injection control and ABS actuator. Applications - Keyless entry system, Electronic suspension system, Electronic steering system.

UNIT – V **9**

Safety Systems: Antilock braking system, Air bag restraint system, Voice warning system, Seat belt system, Road navigation system, Obstacle avoidance radar system, Alarms and immobilizer system.

TOTAL: 45

TEXT BOOKS:

1. TOM Denton, "Automobile Electrical and Electronic Systems", 3rd Edition, Elsevier Butterworth – Heinemann Publications, 2004.
2. William B. Ribbens, " Understanding Automotive Electronics", 5th Edition, Butterworth – Heinemann Publications, 1998.

REFERENCE BOOKS:

1. Judge A.W., "Modern Electrical Equipment of Automobiles: Motor Manuals Volume Six", 2nd Edition, Springer Science & Business Media, 2012.
2. Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, 2014.
3. Aditya P.Mathur, "Introduction to Microprocessors", 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1989.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the battery types and components involved in starting system

CO2: interpret the wiring diagrams and working of charging, lighting and miscellaneous systems involved in automobiles

CO3: describe the types of ignition and injection systems of IC engine

CO4: determine the function and operation of sensors and actuators and have a good knowledge of how they are used in the management of the vehicle control

CO5: know the various safety systems of automobiles and their working

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1			1	1						1	3
CO2	3		1			1							1	3
CO3	3												1	3
CO4	3	2	1										1	3
CO5	3		1			3							1	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL43 ADVANCED MATERIALS TESTING LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

Pre-requisites: Material Science

LIST OF EXPERIMENTS / EXERCISES:

METALLURGY LABORATORY

1. Preparation and determination of compressive strength shear strength of green sand and dry sand.
2. Sieve analysis – Determination of AFS fineness number.
3. Microstructure of low carbon, eutectoid steel.
4. Microstructure of Grey cast-iron and spheroidal cast iron.
5. Microstructure of copper and aluminum alloys.
6. Rockwell and Brinell hardness measurement for different materials.

STRENGTH OF MATERIALS LABORATORY

1. Tension test on a mild steel rod.
2. Double shear test on Mild steel and Aluminium rods.
3. Torsion test on mild steel rod.
4. Impact test on metal specimen (Izod and Charpy Test).
5. Deflection test on cantilever beam and simply supported beam (Aluminium, Steel and Wood).
6. Test on Helical springs (open and closed coil)

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Rajput R.K., "Strength of Materials", S.Chand & Co., New Delhi, 2007.
2 Rajan T.V., Sharma, "Heat Treatment Principles and Techniques", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: examine microstructure and analyse various metals and alloys
CO2: demonstrate the preparation and testing of molding sands
CO3: demonstrate the mechanical testing of materials and components
CO4: identify and analyse the mechanical behavior of structural components like beam

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	2	1	1	3	2	1	2	2	
CO2	2	1	1	1	1	1		1	3	2		2	1	
CO3	2	1	1	1	2	1		1	3	2	1	2	2	
CO4	3	2	2	2	1	2	1	1	3	2	1	2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL41 AUTOMOTIVE CHASSIS COMPONENT LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Study and Measurement of Light and Heavy Commercial Vehicle Frame
2. Study the layout of steering systems with different Steering gearboxes
3. Dismantling and Assembly of Transfer case
4. Dismantling and Assembly of Constant Velocity Joint(Front Axles)
5. Dismantling and Assembly of Clutch.
6. Dismantling and Assembly of Sliding mesh gear box
7. Dismantling and Assembly of Constant mesh gear box
8. Dismantling and Assembly of Syncromesh gear box
9. Dismantling and Assembly of Differential.
10. Dismantling and Assemblyof Rear Axle.
11. Dismantling and Assemblyof of Braking system.
12. Dismantling and Assembly of suspension system.
13. Study of Automatic transmission system.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manual
2. Rajput R.K., "A Text Book of Automobile Engineering",1st Edition, Laxmi Publications Pvt. Ltd., 2007.
3. Heldt P.M., "Automotive Chassis", 3rd Edition, Chilton Co., New York, 1952.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the various types of frames and develop skills in dismantling and assembling of chassis components
CO2: dismantle and assemble the braking, steering, clutch, transmission and suspension systems
CO3: undertake the chassis components minor repairs

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1							2	1			3	
CO2	3	1							2	1			3	
CO3	3	1							2	1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL42 AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY

0 0 3 1

Pre-requisites: Basics of Electrical and Electronics Engineering

LIST OF EXPERIMENTS:(Electrical Laboratory)

1. Performance test on battery.
2. Fault finding in starting system.
3. Testing and checking of charging systems.
4. Fault finding in ignition systems.
5. Design and development of electrical wiring systems.
6. Testing and checking of body controller systems.
7. Experiment on light focusing and adjustment of head light beam.

LIST OF EXPERIMENTS:(Electronics Laboratory)

1. Experiment on Accelerometer sensor using Arduino coding
2. Experiment to acquire output from hall sensor and display output by glowing of LED.
3. Experiment to verify performance of instrumentation amplifier using 2 Op-Amps.
4. Experiment to study the characteristics of LDR(Light Dependent Resistor)
5. Experiment to study the characteristics of Photodiode
6. Stepper Motor and DC Motor interface using microcontroller.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manual
2. TOM Denton, "Automobile Electrical and Electronic Systems", 3rd Edition, Elsevier Butterworth – Heinemann Publications, 2004.
3. Aditya P. Mathur, "Introduction to Microprocessors", 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1989.

Course Outcomes:

On completion of the course the students will be able to

CO1: check the batteries, lighting system, ignition system and charging system in automobiles
CO2: handle the electrical equipments like starter motor and alternator
CO3: interface the electronic equipments and microcontrollers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1							2	1				3
CO2	3	1							2	1				3
CO3	3	1							2	1				3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET52 DESIGN OF MACHINE ELEMENTS

(Common to Mechanical and Automobile branches)

Use of PSG Data book is permitted

3 0 0 3

Pre-requisites: Engineering Mechanics, Strength of Materials.

UNIT – I **9**

Steady Stresses and Variable Stresses in Machine Members: Introduction to the design process – factor influencing machine design, selection of materials based on mechanical properties – Direct Bending and torsion stress equations – calculation of principal stresses for various load combinations, eccentric loading – factor of safety- Theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT – II **9**

Design of Shafts and Couplings: Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints.

UNIT– III **9**

Design of Fasteners and Welded Joints: Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints – Axially loaded unsymmetrical welded joints - Eccentric load in the plane of welds - Welded joint subjected to bending moment and twisting moment.

UNIT – IV **9**

Design of Springs and Levers: Design of helical and leaf Springs Theory of disc and torsional springs under constant loads and varying loads – Concentric springs – Belleville springs (Theory only) – Design of levers.

UNIT – V **9**

Design of Bearings and Flywheels: Design of bearings-Preloading, design of rolling contact bearings -cubic mean load-Design of journal bearings-McKee's equation-calculation of bearing dimensions, Design of flywheels. Solid disc-flywheel-rimmed flywheel-stresses in rimmed flywheel.

TOTAL: 45

TEXT BOOKS:

1 Bhandari V.B., "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

2 Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", 10th Edition, McGraw Hill International Education, New York, 2015.

REFERENCE BOOKS:

1 Norton R.L., "Design of Machinery", 5th Edition, Tata McGraw Hill, New Delhi, 2013.

2 Spotts M.F., Shoup T.E. and Lee E. Horn Berger, "Design and Machine Elements", 8th Edition, Pearson Education, 2003.

3 Juvinall R.C. and Marshek K.M., "Fundamentals of Machine Component Design", 5th Edition, John Wiley & Sons, New Delhi, 2011.

Course Outcomes:

On completion of the course the students will be able to

CO1: design and specify the shape of the machine components subjected to eccentric loading

CO2: design and specify the shafts , couplings, keys and knuckle joint for different applications

CO3: design and specify the screw fasteners and welded joints for different applications

CO4: design and specify the helical, leaf springs and levers for different applications

CO5: design and select the bearing, prediction of their life and design of flywheels for different applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1						2	1	
CO2	3	3	3	2	2	1		2				2	1	
CO3	3	3	3	3	2	1		2				2	1	
CO4	3	3	3	2	2	1						2	1	
CO5	3	3	3	2	2	1						2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT51 VEHICLE DYNAMICS

3 1 0 4

Pre-requisites: Engineering Mechanics, Strength of Materials.

UNIT – I **9**

Concepts of Vehicle Dynamics: Introduction to Vehicle Dynamics, Fundamental approach to modeling- lumped mass, Vehicle fixed coordinate system, Motion variables, Earth fixed coordinate system, Euler angles, Forces. Dynamic Axle loads - Static loads on level ground, Low speed acceleration, Loads on grades, Effects of weight distribution.

UNIT – II **9**

Acceleration Performance: Power limited acceleration- engines, power train and automatic transmissions with sample calculations. Traction limited acceleration- Transverse weight shift due to drive torque and traction limits.

UNIT– III **9**

Braking Performance: Basic Equations – Constant Deceleration, Deceleration with wind resistance and energy/power. Braking forces – Rolling resistance, aerodynamic drag, driveline drag, and grade. Brake factor, Federal requirements for braking performance, ABS systems, Braking efficiency, Rear wheel lock up, Pedal force gain.

UNIT – IV **9**

Steady State Cornering: Turning and cornering- Tire cornering forces, cornering equations, understeer gradient, characteristic speed, critical speed, lateral acceleration gain, yaw velocity gain, side slip angle. Suspension effects on cornering - Roll moment distribution, camber change, roll steer, lateral force compliance steer, aligning torque, effect of tractive forces on cornering.

UNIT – V **9**

Aerodynamics and Rolling Resistance: Mechanism of air flow, pressure distribution, forces, drag components, aids, drag, side and lift forces, RPY moments, crosswind sensitivity. Rolling Resistance- Factors affecting, tire temperature and pressure, velocity, tire slip. Total road loads.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1 Thomas D. and Gillespie, “Fundamentals of Vehicle Dynamics”, SAE International Publication, 2005.

REFERENCE BOOKS:

1 Popp Karl and Schiehlenand Werner, “Ground Vehicle Dynamics”, Springer Publication, 2014.
2 Rao V. Dukkipati, “Road Vehicle Dynamics: Problems and Solutions”, SAE International Publication, 2010.

Course Outcomes:

On completion of the course the students will be able to

CO1: acquire the knowledge about the coordinate systems and loads on grades
CO2: understand acceleration performance on different grades
CO3: analyze braking performance on different grades
CO4: solve the problems of steady state cornering
CO5: evaluate factors affecting road loads and methods of overcoming them

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2										3	
CO2	3	1	2										3	
CO3	3	1	2										3	
CO4	3	1	2										3	
CO5	3	1	2										3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT52 MECHANICS OF MACHINES

3 1 0 4

Pre-requisites: Engineering Mechanics

UNIT – I **9**

Basics of Mechanisms: Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions –Applications – Kinematic analysis of simple mechanisms – Velocity and Acceleration of simple four bar and slider crank mechanism using relative velocity method.

UNIT – II **9**

Design of Cam Profile: Types of cams, Types of followers, Radial cam, Terminology of radial cam, Types of follower motions: uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, Cam profile for knife edge, Roller and flat faced follower – Graphical method

UNIT– III **9**

Kinematics of Gear Trains: Gear profile and geometry – Nomenclature of spur and helical gears, Classification of gear trains, Calculation of Gear ratio, Number of teeth for the gears in the gear trains, Velocities of the gears in gear trains such as Simple, Compound, Reverted and Epicyclic (using tabulation method) gear trains, Differential gear train.

UNIT – IV **9**

Balancing: Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – Direct and reverse crank method

UNIT – V **9**

Vibration: Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1 Khurmi R.S and Gupta J.K. "Theory of Machines", 14th Revised Edition, S. Chand and Company Ltd., New Delhi, 2005.

2 Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2014.

REFERENCE BOOKS:

1 Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

2 Ballaney P.L., "Theory of Machines", 3rd Edition, Khanna Publishers, New Delhi, 2004.

3 Shigley J.E., Pennock G.R., Uicker J.J., "Theory of Machines and Mechanisms", 5th Edition, Oxford University Press, 2017.

Course Outcomes:

On completion of the course the students will be able to

CO1: calculate the velocity and acceleration of various links of simple mechanisms
CO2: develop cam profile for different follower motions
CO3: solve and evaluate the kinematics aspects of gears and gear trains
CO4: solve and plot the static and dynamic balancing of various mechanical systems
CO5: evaluate, analyze and demonstrate the free and forced vibrations for different applications

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT53 AUTOMOTIVE TRANSMISSION SYSTEMS

3 0 0 3

UNIT – I **9**

Clutch: Role of Clutch-Positive and gradually engaged types - Types of clutches- Single plate clutch- Coil spring type and diaphragm spring type -Multiple PlateClutch-Centrifugal clutch. Clutch operating mechanisms- Hydraulic - Vacuum - Electromagnetic clutch and cone clutch.

UNIT – II **9**

Gearbox: Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes - Determination of gear ratios for vehicles - Performance characteristics in different speeds. Transfer case and overdrives. Problems on performance of automobile such as resistance to motion, tractive effort, engine speed and power and acceleration.

UNIT– III **9**

Hydrodynamic Transmission: Fluid Coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque Converter-Principle-constructional details, Performance characteristics. Multistage torque converters and Polyphase torque converters.

UNIT – IV **9**

Planetary Gear Boxes: Principle of Planetary gear trains - Wilson Gear box, Cotal electromagnetic transmission, Need for Automatic Transmission - Hydraulic control system for Automatic Transmission. Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT – V **9**

Hydrostatic and Electric Drive: Hydrostatic drive -Various types of hydrostatic systems – Principles of Hydrostatic DriveSystem-Advantages and Limitations-Construction and working of typical Janny hydrostatic drive - Introduction to Tandem operation of hybrid vehicles. Electric drive-types- Principle of modified Ward Leonard Control system-Advantages and limitations.

TOTAL: 45

TEXT BOOKS:

1 Heinz Heisler, "Advanced Vehicle Technology", 2nd Edition, Butterworth Heinemann Publishers, 2002.

REFERENCE BOOKS:

1 Giri N.K., "Automobile Mechanics", 8th Edition, Khanna Publications, 2008.
2 Garrett T.K., Newton K. and Steeds W., "The Motor Vehicle", 13th Edition, Butterworth Heinemann, 2001.
3 Judge A.W., "Modern Transmission Systems", Chapman and Hall Ltd., 2000.

Course Outcomes:

On completion of the course the students will be able to

CO1: illustrate the construction and working principle of various types of friction clutches
CO2: classify the types of gearboxes used in manual gear boxes
CO3: demonstrate the construction and working principle of Hydrodynamic transmission system
CO4: know the types of planetary gear boxes and the working of CVT4
CO5 :understand the various types of Hydrostatic and Electric of drives

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					1							3	
CO2	3	2	2			1							3	
CO3	3	2	2			1							3	
CO4	3					1							3	
CO5	3						1						3	2

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT54 AUTOMOTIVE FUELS AND LUBRICANTS

3 0 0 3

UNIT – I **9**

Fuels for I.C. Engines: Types of Fuels, Liquid and gaseous fuels, Heating value of fuels, Higher and lower heating values, Chemical structure of hydro-carbon fuels, Volatility characteristics, Desirable characteristics of fuels, Knock rating and additives, Cetane rating, Alternative fuels for SI and CI engines, Biodiesels.

UNIT – II **9**

Combustion of Fuels: Stoichiometry - Calculation of theoretically correct air required for combustion of liquid and gaseous fuels, Volumetric and gravimetric analysis of the dry products of combustion, Mass of dry gas per kg of fuel burnt, Mass of carbon in the exhaust gas, Mass of carbon burnt to carbon-monoxide per kg of fuel and heat loss due to incomplete combustion.

UNIT– III **9**

Fuels and Testing: Automotive fuel – Classifications – Diesel, petrol, biodiesel, LPG and CNG – Chemical composition – ASTM testing– Octane number – Self ignition temperature – Cetane number – Distillation temperature measurement – Viscosity measurement – Flash point and fire point measurement – Calorific value measurement – Aniline point measurement – Relative density, vapour pressure, pour point, flammability, ignitability, diesel index, API gravity, carbon residue and copper strip corrosion - Effects of fuel properties on engine performance.

UNIT – IV **9**

Lubricants and Testing: Lubricants – Classification – Components of lubricants – Functions – Selection of lubricating oils – Properties – Nomenclature and specifications – SAE Rating – Synthetic lubricants – Grease – Properties – NLGI Numbers– ASTM testing– Viscosity measurement – Flash point and fire point measurement – Pour point and cloud point measurement – Effects of lubricant properties on engine performance.

UNIT – V **9**

Additives: Fuel additives – Gasoline additives – Anti-static additives – Metal deactivators, dyes – De-emulsifiers– Corrosion inhibitors– Oxidant additive – Antioxidants – Anti-valve seat recession additives – Deposit control additives. Diesel additives – Wax crystal modifiers/middle distillate flow improvers – Wax Anti-Settling Additives, Antifoams– Diesel fuel stabilizers – Color stabilizers – Detergents – Cetane improvers – Lubricity improvers. Lubricant additive – Need of additives – Functions – Anti-wear and EP Agent – Corrosion and Rust Inhibitor – Detergents – Dispersant – Friction modifier – Pour point depressant – Seal swell agent – Viscosity modifier – Anti-foamant – Antioxidant.

TOTAL: 45

TEXT BOOKS:

1 Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill, New Delhi, 2013.

2 Mathur P.L., and Sharma, "Internal Combustion Engines", Dhanpat Rai and Sons, 2010.

REFERENCE BOOKS:

1 George E. Totten, "Fuels and Lubricants Handbook: Technology, Properties, Performance and Testing", ASTM International, 2003.

2 Lansdown A.R., "Lubrication, A Practical Guide to Lubricant Selection", Pergamon Press, 2013.

3 Francis W., "Fuels and Fuel Technology: A Summarized Manual in Two Volumes", Elsevier Publications, 2016.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the testing procedures of fuels as per ASTM standard
CO2: understand the various types of fuels and their characteristics when used in engines
CO3: illustrate the combustion characteristics of fuels in I.C. Engines
CO4: understand the properties, testing and purpose of lubricants
CO5: know the effect of additives for fuels and lubricants

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1		2	2					1	3	
CO2	3	3	2	1		2	2					1	3	
CO3	3												3	
CO4	3												3	
CO5	3			1		2	2					1	3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL51 ENGINE PERFORMANCE AND EMISSION TESTING LABORATORY

0 0 3 1

Pre-requisites: Thermal science

LIST OF EXPERIMENTS:

1. Valve timing and Port timing diagram
2. Performance test on single cylinder diesel engineby mechanical, hydraulic, eddy current and electrical loading
3. Study of twin cylinder diesel engine by electrical loading
4. Heat balance test on diesel engines by mechanical, hydraulic, eddy current and electrical loading
5. Performance and Morse test on multi cylinder SI engine using hydraulic loading
6. Retardation test on I.C engine
7. Emission test on diesel and petrol engines using exhaust gas analyzer
8. Performance and emission test on variable compression ratio engine
9. Performance test and combustion analysis on single cylinder four stroke dual fuel engine by mechanical loading
10. Performance test on multistage reciprocating air compressor

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Rajput R.K., "Thermal Engineering", 9th Edition, Lakshmi Publications, New Delhi, 2013.
2. Laboratory Manual.

Course Outcomes:

On completion of the course the students will be able to

CO1: test the performance of various engines using dynamometers
CO2: define the engine parameters and their effects over the performance
CO3: analyze the emission standards of SI and CI engines

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		1		1	1		2	1			3	
CO2	3	2		1		1	1		2	1			3	
CO3	3	2		1		2	2		2	1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL51 CAD LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Practice for Sketching with different sketching tools (Line, Polyline, Circle and Generalized constraint methods)
2. Practice for Datum Plane, Axis, Point and Coordinate systems.
3. Practice for reading two dimensional (2D) drawings with conventional tolerances, conversion of two dimensional drawings to three dimensional (3D) models.
4. 3D Part modeling options – protrusion and cut (extrude, revolve)
   Exercises: Flange Coupling, Screw Jack.
5. 3D Part modeling options – protrusion and cut (sweep, blend, helical sweep)
   Exercises: Machine Vice, Knuckle Joint.
6. Features creation with editing operations – Move, Pattern, Mirror, Round, Chamfer, Rib
   Exercises: Simple Eccentric.
7. Model Tree with family table and parametric concepts
   Exercises: Types of Bolts and Nuts with different sizes.
8. Assembly – creating assembly from individual parts – Imposing assembly constraints.
9. Assembly mass properties and checking of interferences of components.
10. Conversion of 3D solid model to 2D drawing –different views, sections, isometric view and dimensioning creations.
11. Surface Modeling with advanced options (Trim, Merge, Projections, Toroidal and Spinal bend)

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Pro-E Wildfire 4.0, Solid works 2014 and CATIA V5R12

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the CAD and its applications in various fields
CO2: identify the principles associated with CAD and the common drafting techniques
CO3: apply the advanced competences of CAD to create 3D part models and assemblies

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		3	3	2			1	2		2	3	
CO2	2	3		3	3	2			1	2		2	3	
CO3	2	3		3	3	2			1	2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

14EGL41 COMMUNICATION SKILLS LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Listening Skills: Listening activity using software package in the communication laboratory – Listening to native speakers – Developing oral communication by imitating the model dialogues. Listening for specific information – Listening to improve pronunciation – Listening and typing – Filling the blanks–TV programmes and News.

Audio Visual Lab: Activity based learning

2. Activity based Reading Skills: Reading for getting information and understanding; scanning, skimming and identifying topic sentences – Reading for gaining knowledge-Group activity.
3. Activity based Writing Skills: Preparing a draft – Word editing features, editing and proof reading; Writing a short essay using the draft prepared – Group activity.
4. Speaking Skills: Verbal and Non-Verbal Communication; Introducing oneself –Describing a place, Expressing views and opinions; Giving a presentation on a Topic – eye contact, speaking audibly, clearly and with confidence; Group discussion.Conversations – Face-to-Face conversation – Simulated Telephonic Conversation.

Career Lab

5. Interview Skills: Introducing oneself – Answering other FAQ's. Presentation Skills: Elements and structure of effective presentation – Presentation Tools – Voice modulation – Body language –Video samples. Group Discussion: Structure of Group Discussion – Strategies in group discussion – Team work – Video Samples. Soft Skills: Fundamentals of Soft Skills – Work Place Culture and Inter-Personal Relationships.

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Orell Digital Language Lab Software

Course Outcomes:

On completion of the course the students will be able to

CO1: communicate efficiently in real life and career related situations
CO2: demonstrate good Presentation skills and team skills
CO3: familiarize in using modern communication software packages to enhance their soft skills

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									3	3		2		
CO2									2	3		1		
CO3									1	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14GET61 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.

UNIT – II **9**

National Income and its measurement techniques. Inflation – Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling – Managerial Skills – Levels of Management – Roles of manager.

UNIT – III **9**

Marketing – Core Concepts of Marketing – Four P's of Marketing – New product development – Product Life Cycle – Pricing Strategies and Decisions.

UNIT – IV **9**

Operations Management – Resources – Types of Production system – Site selection, Plant Layout, Steps in Production Planning and Control – Inventory - EOQ Determination.

UNIT – V **9**

Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Meaning – Types of decisions – Methods (Theory).

TOTAL : 45

TEXT BOOK:

1. "Economics and Management for Engineers", Complied by Department of Management Studies, Kongu Engineering College, McGraw-Hill Education, India, 2013.

REFERENCE BOOKS:

1. Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, "Fundamentals of Business", Cengage Learning Inc., India, 2007.
3. Stanley L. Brue and Campbell R. Mcconnell, "Essentials of Economics", Tata McGraw-Hill, New Delhi, 2007.
4. Jain S.P., Narang K.L. and Simi Agrawal, "Accounting for Management", 1st Edition, Tata McGraw Hill, New Delhi, 2009.

Course Outcomes:

On completion of the course the students will be able to

CO1: estimate market equilibrium and interpret national income calculation and inflation issues
CO2: categorize the forms of business and analyse the functions of management
CO3: appraise marketing management decisions
CO4: apply appropriate operation management concept in business situations
CO5: interpret financial and accounting statements

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2		
CO2		1	2			2	2	2	2	2	3	2		
CO3	1	2	1			2		2	2	2	3	2		
CO4	1	2	1			2		2	2	2	3	2		
CO5	2	2				2		2	2	2	3	2		

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT61 AUTOMOTIVE CHASSIS COMPONENT DESIGN

(Use of PSG Design Data Book is permitted for End Semester Examination)

2 2 0 4

UNIT – I **6**

Vehicle Frame and Suspension: Study of Loads – Moments and Stresses on Frame Members – Design of Frame for Passenger and Commercial Vehicles – Design of Leaf Springs – Coil Springs and Torsion Bar Springs.

UNIT – II **6**

Front Axle and Steering Systems: Analysis of loads – Moments and stresses at different sections of front axle – Determination of bearing loads at Kingpin bearings – Wheel spindle bearings – Choice of Bearings - Determination of optimum dimensions and proportions for steering linkages, Ensuring minimum error in steering – Design of front axle beam.

UNIT– III **6**

Drive Line and Real Axle: Design of propeller shaft – Design details of final drive gearing – Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.

UNIT – IV **6**

Gear Box and Flywheel: Gear train calculations – Calculation of bearing loads and selection of bearings – Design of four, five and six speed gearboxes – Design of flywheel.

UNIT – V **6**

Design of Clutch and Braking System: Design of single plate clutch, multiplate clutch and cone clutch –Torque capacity of clutch – Design of clutch components – Design details of roller and sprag type of clutches - Design and analysis of brake shoes and friction pads – Design of drum brakes – Design of shoe brakes – Role of hand brake and its types.

Lecture:30, Tutorial:30, TOTAL: 60

TEXT BOOKS:

1 Khurmi R.S. and Gupta J.K., "A Text Book of Machine Design", 14th Edition, Eurasia Publishing House Pvt. Ltd., 2005.

2 Dean Averns, "Automobile Chassis Design Book", 2nd Edition, Kotelian Sky Press, 2016.

REFERENCE BOOKS:

1 Julian Happian-Smith, "Introduction to Modern Vehicle Design", SAE International, 2004.

2 Giri N.K., "Automobile Mechanics", Khanna Publications, 2014.

3 Heldt P.M., "Automotive Chassis", Chilton Book Co., 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand thedesginconcepts of vehicle frames and suspension
CO2: design the automotive components like frame and suspension systems
CO3: apply the design procedures of front and rear axles and the drive lines in real time applications
CO4: design the automotive gear boxes
CO5: understand the various types of brakes, clutches and its design

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3			1							3	
CO2	3	2	3			1							3	
CO3	3	2	3			1							3	
CO4	3	2	3			1							3	
CO5	3	2	3			1							3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT62 AUTOMOTIVE ENGINE COMPONENT DESIGN

(Use of PSG Data Book is permitted for End Semester Examination)

2 2 0 4

Pre-requisites: Automotive Engine Technology

UNIT – I **6**

Introduciton: Engineering materials – Introduction endurance limit, notch sensitivity – Tolerances – Types of tolerances and fits – Design considerations for interference fits, surface finish, surface roughness – Rankine's formula – Tetmajer's formula – Johnson formula – design of pushrods.

UNIT – II **6**

Design of Cylinder, Piston and Connecting Rod: Choice of material for cylinder and piston – Design of cylinder, piston, piston pin, piston rings, piston failures – Lubrication of piston assembly. Material for connecting rod – Determining minimum length of connecting rod – Small end design, shank design, design of big end cap bolts.

UNIT– III **6**

Design of Crankshaft: Balancing of I.C. engines – Significance of firing order – Material for crankshaft – Design of crankshaft under bending and twisting –Balancing weight calculations - Development of short and long crankarms – Front and rear-end details.

UNIT – IV **6**

Design of Flywheels: Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel – Stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram.

UNIT – V **6**

Design of Valves and Valve Train: Design aspects of intake and exhaust manifolds, inlet and exhaust valves, valve springs, tappets and valve train – Design of cam and camshaft – Design of rocker arm – Cam profile generation.

Lecture:30, Tutorial: 30, TOTAL: 60

TEXT BOOKS:

1 Khurmi R.S. and Gupta J.K., "A Text Book of Machine Design", 14th Edition, Eurasia Publishing House Pvt. Ltd., 2005.

REFERENCE BOOKS:

1 Giri N.K., "Automobile Mechanics", Khanna Publishers, New Delhi, 2014.
2 Jain R.K., "Machine Design", Khanna Publishers, New Delhi, 2005.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the design concepts and design the pushrods
CO2: design the cylinder, piston and connecting rod
CO3: analyze and design the crankshaft of IC engines
CO4: calculate the various parameters of designing the flywheel of IC engines
CO5: evaluate the dimensions of valve and valve train components

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3			1							3	
CO2	3	2	3			1							3	
CO3	3	2	3			1							3	
CO4	3	2	3			1							3	
CO5	3	2	3			1							3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT63 TWO AND THREE WHEELER TECHNOLOGY

3 0 0 3

Pre-requisites: Automotive Engine Technology, Automotive Chassis

UNIT – I **9**

The Power Unit: Two stroke SI engine - merits and demerits - symmetrical and unsymmetrical port timing diagrams - types of scavenging processes - merits and demerits - scavenging efficiency - scavenging pumps. Rotary valve engine - fuel system - lubrication system - magneto coil and battery coil spark ignition system - electronic ignition system - variable timing ignition system (VTI) - starting system - kick starter system.

UNIT – II **9**

Chassis and Sub-Systems: Main frame for two and three wheelers - its types - Chassis and different drive systems for two wheelers - Single, multiple plates and centrifugal clutches - Gear box and its and various gear controls in two wheelers - Front and rear suspension systems - Shock absorbers - Panel meters and controls on handle bar - Freewheeling devices

UNIT– III **9**

Brakes and Wheels: Drum brakes and Disc brakes Construction and Working and its Types - Front and Rear brake links layouts - Brake actuation mechanism - Spoked wheel, Cast wheel, Disc wheel and its merits and demerits - Tyres and tubes Construction and its Types - Steering geometry.

UNIT – IV **9**

Two Wheelers: Case study of major Indian models of motorcycles, sports bikes, scooters and mopeds - TVS mopeds and motorcycles - Hero Honda motorcycles - Bajaj scooters and motorcycles - Yamaha, Enfield motorcycles - Servicing and maintenance.

UNIT – V **9**

Three Wheelers: Case study of Indian models - Auto rickshaws, pickup van, delivery van and trailer. Maintenance and Fault tracing.

TOTAL: 45

TEXT BOOKS:

1 Irving P.E. and Clymer F., "Motor Cycle Engineering", Veloce Press, 2017.
2 Ramalingam K.K., "Two Wheelers and Three Wheelers", Scitech Publications, Chennai, 2009.

REFERENCE BOOKS:

1 Chris Rees, "Three Wheelers A-Z", Quiller Print, 2014.
2 Roland Brown, "On 2 Wheels: An Encyclopedia of Motorcycles and Motorcycling", Anness Publications, 2009.
3 Dhruv U. Panchal, "Two and Three Wheeler Technology", 1st Edition, PHI Learning Pvt. Ltd., 2015.

Course Outcomes:

On completion of the course the students will be able to

CO1: know and understand the constructional details, operating characteristics of two and three wheelers
CO2: understand the various subsystem of two and three wheelers and also know how it is different from light motors and heavy motor vehicles
CO3: familiar with the construction and maintenance of braking mechanism and the construction of wheels and tyres
CO4: summarise the new technologies and mechanisms adopted in two wheelers
CO5: compare the construction and maintenance of different three wheeler vehicle models

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												3	1
CO2	3												3	1
CO3	3												3	
CO4	1											2	3	
CO5	1											2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL61 DESIGN AND MODELING OF ENGINE AND CHASSIS COMPONENTS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Design and drawing of piston, piston pin and piston rings and drawing of these components.
2. Design of crankshaft and its balancing weight calculations
3. Design of cylinder liners
4. Design of leaf and helical spring
5. Design and drawing of torsion bar
6. Design of chassis and its frames
7. Design and drawing of flywheel, clutch and its components.
8. Design and drawing of the inlet and exhaust valves.
9. Design of cam and camshaft, cam profile generation, drawing of cam and camshaft.
10. Design of connecting rod small end and big end, shank design, design of big end cap, bolts and drawing of the connecting rod assembly.
11. Design of propeller shaft
12. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Pro-E Wildfire 4.0, Solid works 2014 and CATIA V5R12
2. Gupta R. B, "Auto Design", 2nd Edition, Satya Prakashan Publisher, 2015.
3. Gopalakrishna K.R., "Machine Drawing", 20th Edition, Subhas Publishing House, 2007.
4. Laboratory Manual

Course Outcomes:

On completion of the course the students will be able to

CO1: familiar with the modeling software for automobile components design
CO2: design the chassis components using modeling tools
CO3: design the engine components using modeling tools

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		3				2	1			3	
CO2	3		2		3				2	1			3	
CO3	3		2		3				2	1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL62 TWO AND THREE WHEELER LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Performance test of a two wheeler using chassis dynamometer
2. Performance test on shock absorber
3. Performance test on coil spring
4. Two wheeler chain test
5. Brake and Clutch adjustment as per specification
6. Dismantling and assembling of two wheeler gear box and finding gear ratios
7. Dismantling and assembling of three wheeler gear box and finding gear ratios
8. Three wheeler brake and clutch play adjustment
9. Dismantling and assembling of three wheeler steering system
10. Study of three wheeler chassis frame and power transmission system

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manual

Course Outcomes:

On completion of the course the students will be able to

CO1: measure the various testing procedure of two wheelers using chassis dynamometer
CO2: know the procedure of using suitable tools for dismantling and assemble of gearboxes of 2 and 3 wheelers
CO3: define the performance study on shock absorber and coil spring

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	1			3	
CO2	3								2	1			3	
CO3	3	2	2						2	1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL63 AUTOMOTIVE FUELS AND LUBRICANTS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Study of International and National standards for fuels and lubricants
2. Study of Octane and Cetane Number of fuels
3. ASTM distillation test of liquid fuels
4. Aniline Point test of diesel
5. Calorific value of liquid fuel
6. Calorific value of gaseous fuel
7. Reid vapour pressure test
8. Flash and Fire points of petrol and diesel
9. Copper strip Corrosion Test
10. Cloud and Pour point Test
11. Temperature dependence of viscosity of lubricants and Fuels by Redwood Viscometer
12. Viscosity Index of lubricants and Fuels by Saybolt Viscometer
13. Ash content and Carbon Residue Test
14. Drop point of grease and mechanical penetration in grease

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manual.

Course Outcomes:

On completion of the course the students will be able to

CO1: characterize the fuels and lubricants for the automobiles
CO2: measure the properties of fuels and lubricants
CO3: perform an in-depth analysis related with any fuel / lubricant

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2					2	1		1	3	
CO2	3			2					2	1		1	3	
CO3	3	2		2					2	1		1	3	

1 – Slight, 2 – Moderate, 3 – Substantial

14GET71 TOTAL QUALITY MANAGEMENT

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Quality (Basic concepts and principles): Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT – II **9**

TQM Principles and strategies: Customer satisfaction – Customer Perception of Quality, Customer Complaints, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development

UNIT – III **9**

TQM Tools (Process Control): The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT – IV **9**

TQM Tools: Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, Poka Yoke.

UNIT – V **9**

Quality Systems -Need for ISO 9000 and Other Quality Systems, ISO 9000:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, Introduction to TS 16949, QS 9000, ISO 14000, ISO 18000, ISO 20000, ISO 22000.

TOTAL : 45

TEXT BOOKS:

1. Besterfield, Dale H. et al., "Total Quality Management", 3rd Edition (Revised), Pearson Education, 2011.
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS:

1. Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill, New Delhi, 2004.
2. Suganthi L. and Samuel A. Anand, "Total Quality Management", PHI Learning, New Delhi, 2011.
3. Evans James R. and Lindsay William M., "The Management and Control of Quality", 7th Edition, South-Western (Thomson Learning), 2011.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the meaning of quality and its importance
CO2: know the principles of total quality management and peculiarities of their implementation
CO3: develop in-depth knowledge on various tools and techniques of quality management
CO4: learn the applications of quality tools and techniques in both manufacturing and service industry
CO5: develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	2	2	2	3		
CO2						3	2	3	3	3	2	3		
CO3	3	2	2	2	2	2		1	2	2	3	2		
CO4	2	2	2	2	2	2		1	2	2	3	2		
CO5						3	3	2	3	2	2	2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MET71 FINITE ELEMENT ANALYSIS

(Common to Mechanical and Automobile branches)

3 1 0 4

Pre-requisites: Fundamentals of matrix approach, Knowledge on governing differential equations, Strength of materials.

UNIT – I **9**

Fundamental of Finite Element Analysis: Historical background– Matrix approach – Coordinates, Numerical simulation–Gauss Elimination based Solvers. FEA General procedure – Basic element shapes -Discretization process, Node Numbering Scheme –Interpolation **–**Weighted residual method – Ritz techniques. Application of FEA

UNIT – II **9**

One Dimensional Problem: One Dimensional finite element modeling – Element Types–Linear Elements – Linear Element Shape Function –Finite Element Equation – Galerkin's method – Solid Mechanics – Heat transfer – fin pin and composite wall– Beam Element.

UNIT– III **9**

Two Dimensional Problems: Introduction to 2-D Finite element modeling – Constant Strain Triangular – Finite element formulation – Shape Functions – strain displacement and stress strain relationship matrix – Plane Stress and Plane Strain - Temperature Effects.

UNIT – IV **9**

Axisymmetric Continuum and Plane truss: Axisymmetric formulation – Element stiffness matrix and force vector – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Applications of plane truss.

UNIT – V **9**

Isoparametric Elements for Two Dimensional Continuum: Natural Co-ordinate Systems –Isoparametric elements – The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Jacobin matrix – Stress calculations – Numerical integration- Gauss Quadrature.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1. Logan L. Daryl, "A first course in the Finite Element Method", 5th Edition, Cengage learning India Pvt. Ltd., Delhi, 2012.
2. Rao S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth–Heinemann(An imprint of Elsevier), Elsevier India Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, and Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley, John & Sons, 2003.
2. Segerlind L.J., "Applied Finite Element Analysis", 2nd Edition, John Wiley, 1984.
3. Reddy J.N., "An Introduction to the Finite Element Method", International Edition, McGraw Hill, 2005.

Course Outcomes:

On completion of the course the students will be able to

CO1: formulate finite element equations and solve the engineering problems
CO2: solve and analyze the 1D structural and heat transfer problems for different applications
CO3: Evaluate and analyze the 2D structural problems for different applications
CO4: impart knowledge on axisymmetric problems and plane truss
CO5: formulate and analyze isoparametric formulation and numerical integration

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	3		1		1	2		1	2	
CO2	2	3	1	3	3		2		1	2		1	2	
CO3	2	3	1	3	3		2		1	2		1	2	
CO4	2	3	1	3	3		1		1	2		1	2	
CO5	2	3	1	3	3		1		1	2		1	2	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUT71 VEHICLE MAINTENANCE

3 0 0 3

Pre-requisites: Automotive Engine Technology and Automotive chassis

UNIT – I **9**

Maintenance, Workshop Practices, Safety and Tools: Maintenance - Need, importance, policies - Classification of maintenance work - Vehicle insurance. Automotive service procedures – Workshop operations. 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 – II **9**

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– III **9**

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 servicing differential assemblies - Fault diagnosis.

UNIT – IV **9**

Brake, Suspension, Wheel and Steering Maintenance: Inspection, Maintenance and Service of different types of brakes - Bleeding of brakes. Inspection, Maintenance and Service of Macpherson strut, coil spring, leaf spring, shock absorbers. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service - Worm type steering - Power steering system.

UNIT – V **9**

Auto Electrical and HVAC 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, and evaporator - Replacement of hoses- Leak detection- AC Charging - Fault diagnosis.

TOTAL: 45

TEXT BOOKS:

1 Ed May, "Automotive Mechanics", Volume 1and 2, McGraw Hill Publications, 2014.

2 Jigar A Doshi, Dhruv U Panchal and Jayesh P Maniar, "Vehicle Maintenance and Garage Practice", PHI Learning Pvt. Ltd., 2014.

REFERENCE BOOKS:

1 Vehicle Service Manuals of Two and Three Wheelers of Reputed Manufacturers

2 Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, 2014.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the importance of maintenance, workshop practices, tools and safety requirements for automotive

CO2: discuss the maintenance procedure of engine and engine subsystems

CO3: solve the problems related with transmission and driveline

CO4: service the steering, brake, suspension and wheel

CO5: diagnose the problems in auto electrical and air-conditioning systems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					1							3	
CO2	1		2			1							3	
CO3	1		2			1							3	
CO4	1		2			1							3	
CO5	1		3			1							1	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL71 COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Stresses and Deflections of different types of beams with various types of loads.
2. Deflections of different types of truss with point loads.
3. Application of plane stress and plane strain conditions.
4. Deflection of Tensile and Compressive Springs
5. Axisymmetric Application.
6. Heat conduction and convection applications.
7. Thermo-structural Analysis.
8. Contact Analysis of Two Bodies.
9. Modal Analysis of a Beam.
10. Harmonic Response of a Beam for stepped and ramped loads.
11. Bimetallic Layered Cantilever Plate with structural Loading.
12. Incompressible fluid flow analysis with and without obstacles.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Robert D. Cook, Malkus, Witt, and Plesha, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley India Pvt. Ltd., 2007.
2. Rao S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth-Heinemann Ltd,. 2010.
3. ANSYS 16.2 Software.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the Boundary conditions with respect to FEA for the real physical problem
CO2: perform structural, thermal and fluid problems in FEA and FVM, software packages
CO3: validate the various FEA and FVM results based on theoretical or experimental results

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	2				2		2	1	
CO2	2	3	2	3	3	2				2		2	1	
CO3	2	3	2	3	3	2				2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUL71 VEHICLE MAINTENANCE AND RECONDITIONING LABORATORY

0 0 3 1

Pre-requisites: Automotive Engine Technology, Automotive chassis and Thermal Science

LIST OF EXPERIMENTS:

1. Study of tools and instruments required for maintenance
2. Study of safety aspects with respect to man, machine and tools
3. Study of Wheel Alignment Parameters and general procedures for servicing and maintenance schedule
4. Minor and major tune up of gasoline and diesel engines
5. Calibration of Fuel pump
6. Engine fault diagnosis using scan tool
7. Fault diagnosis and service of transmission and driveline system
8. Fault diagnosis and service of braking system
9. Fault diagnosis and service of suspension and steering system
10. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system etc
11. Fault diagnosis and service of vehicle air conditioning system
12. Practice the following:
    i. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play
    ii. Air bleeding from hydraulic brakes, air bleeding of diesel fuel system
    iii. Wheel bearings tightening and adjustment
    iv. Adjustment of head lights beam
    v. Removal and fitting of tyre and tube

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Ed May, "Automotive Mechanics" Volume 1 and 2, McGraw Hill Publications, 2003.
2. Vehicle Service Manuals of Reputed Manufacturers.
3. Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, 2014.

Course Outcomes:

On completion of the course the students will be able to

CO1: tune up of gasoline and diesel engines

CO2: diagnose the problems in transmission, drive line, braking, suspension, steering and electrical systems

CO3: adjust the different parameters in clutch, brake, fuel, light, wheel and tyres

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2			1			2	1			3	
CO2	1		2			1			2	1			3	1
CO3	1		2			1			2	1			3	1

1 – Slight, 2 – Moderate, 3 – Substantial

14AUP71 DESIGN AND FABRICATION PROJECT

0 0 6 3

Prerequisites:

- Knowledge of Basic sciences, Material science and metallurgy, Engineering Design, Cost and Economic Analysis and comprehensive knowledge in IC engines, chassis design, automotive electronics, electric and hybrid vehicle
- Skill to identify and interpret project ideas
- Knowledge of planning, implementation and control

Project Description:

Upon identification of the real time engineering issues that needs to the modified or solved for better effectiveness and efficiency, the team of project students is expected to undergo the following.

i. Explore the problem further through literature survey.
ii. Formulate the problem to be solved based on literature survey or field survey.
iii. Fix appropriate Project title, objectives, methodology and expected outcomes.
iv. Design the overall system and sub assemblies.
v. Fabricate and test the system.
vi. Check for expected results.
vii. Present project reports.

Course Outcomes:

On completion of the course the students will be able to

- identify, conceptualize and define engineering problems that needs to be solved
- identify and refer literature
- design/develop/assemble/experiment components/systems applying engineering research tools/methods
- plan, carryout and control project activities like Design, Development, fabrication, Experimentation, etc.
- present the project work in the form of oral presentation, Report/Thesis and Technical papers publications

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14GET81 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Understanding: Morals – Values-Ethics–Honesty – Integrity – Work Ethic – Service Learning – Civic Virtue – caring – Sharing – Courage – Valuing Time – Co-operation – Commitment – Empathy –Self-Confidence – Character – Spirituality- Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry.

UNIT – II **9**

Moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self-interest – customs and religion- uses of ethical theories. Meaning of Engineering experimentation - engineers asresponsible experimenters.

UNIT – III **9**

Codes of ethics for engineers - a balanced outlook on law - the challenger case study. Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk, Bhobal Gas Tragedy and Chernobyl case studies.

UNIT – IV **9**

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – discrimination – Intellectual Property Rights (IPR) – Multinational corporations.

UNIT – V **9**

Environmental ethics - Computerethics – weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers(IETE).

TOTAL : 45

TEXT BOOKS:

1. Martin Mike and Schinzinger Roland, "Ethics in Engineering", 4th Edtion, Tata McGraw-Hill, New Delhi, 2014.
2. Govindarajan M., Natarajan S., and Senthil Kumar V.S., "Engineering Ethics", Prentice Hall of India, New Delhi, Reprint 2013.

REFERENCE BOOKS:

1. Fleddermann Charles D., "Engineering Ethics", 4th Edition, Pearson Education/Prentice Hall, New Jersey, 2014.
2. Harris Charles E., Protchard Michael S. and Rabins Michael J., "Engineering Ethics: Concepts and Cases", 4th Edition Wadsworth Thompson Learning, United States, 2008.
3. Seebauer Edmund G. and Barry Robert L., "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2008.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the components of ethics and values
CO2: understand the knowledge interpersonal and organizational issues in ethics
CO3: acquired knowledge on ethical theories and their application
CO4: ability to highlight ethical issues in risky situation
CO5: understand the role of professional bodies

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		2		
CO2						3		3	2	3		2		
CO3						3	2	3	2	1		2		
CO4						3	3	3	2	3		2		
CO5						2	2	3	2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14AUP81 PROJECT WORK

0 0 18 9

Prerequisites:

- Knowledge of Basic sciences, Material science and metallurgy, Engineering Design, Cost and Economic Analysis and comprehensive knowledge in IC engines, chassis design, automotive electronics, electric and hybrid vehicle
- Skill to identify and interpret project ideas
- Knowledge of planning, implementation and control

Project Description:

Upon identification of the real time engineering issues that needs to the modified or solved for better effectiveness and efficiency, the team of project students is expected to undergo the following.

i. Explore the problem further through literature survey and/or field survey.
ii. Formulate the problem to be solved based on literature survey and/or field survey.
iii. Carryout gap analysis.
iv. Fix appropriate Project title and objectives.
v. Identify solution methodology and the research tools used.
vi. Fix the expected result and outcome.
vii. Carryout appropriate design/analysis/experimentation.
viii. Analyze the result and compare it with expected results or do necessary comparison if necessary.
ix. Check for expected outcomes and present the conclusion.
x. Prepare project reports.

Course Outcomes:

On completion of the course the students will be able to

- identify, conceptualize and define engineering problems that needs to be solved
- identify and refer literature
- design/develop/assemble/experiment components/systems applying engineering research tools/methods
- plan, carryout and control project activities like Design, Development, Fabrication, Experimentation, Analytical and Simulation work, etc.
- present the project work in the form of oral presentation, Report/Thesis and Technical papers publications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET54 OPERATIONS RESEARCH

(Common to Mechanical, Mechatronics and Automobile branches)

3 0 0 3

Pre-requisites: Mathematics I, Mathematics II, Statistics and Numerical Methods

UNIT – I **9**

Linear Models: Introduction-Phases of OR study – Formation of LPP - Canonical form of LPP- Solutions to LPP: Graphical Solution, Simplex Algorithm, Artificial Variables Technique – Big M method, Two Phase method.

UNIT – II **9**

Transportation, Assignment problems and Sequencing problems: Transportation-Mathematical Formulation-Basic Feasible solutions-NWC, LCM, VAM. Optimality test – MODI technique. Assignment problems- Mathematical formulation – Hungarian Algorithm. Sequencing Problems- n jobs 2 machine, n jobs 3 machine, n jobs m machine and 2 jobs n machine problems.

UNIT– III **9**

Network models: Shortest route – minimal spanning tree - maximum flow models-Project Management: Construction of networks- activity and event based diagrams, PERT- CPM-problems – Cost analysis and crashing of networks.

UNIT – IV **9**

Inventory Models: Types of Inventory- EOQ – Deterministic inventory models – Price break problems – stochastic inventory models- multi item deterministic models- selective inventory control techniques.

UNIT – V **9**

Queuing and Replacement Models: Queuing models – queuing systems and structures – notations–parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population. Replacement Models**:** Replacement of Items due to deterioration with and without time value of Money -Individual and group replacement policy.

TOTAL: 45

TEXT BOOKS:

1. Vohra N.D., "Quantitative Techniques in Management", 4th Edition, McGraw Hill Education, 2009.
2. Gupta P.K. and Hira D.S., "Operations Research", 7th Edition, S.Chand and Company Ltd., New Delhi, 2014.

REFERENCE BOOKS:

1. Taha, Hamdy A., "Operation Research: An Introduction", 9th Edition, Pearson Education, 2014.
2. Hiller Frederick S. and Lieberman Gerald J., "An Introduction to Operations Research", 9th Edition, McGraw-Hill Science, 2011.
3. Panneerselvam R., "Operations Research", 2nd Edition, PHI Learning, 2009.

Course Outcomes:

On completion of the course the students will be able to

CO1: formulate and solve linear programming problems
CO2: propose solutions to transportation and assignment problems
CO3: evaluate optimal job sequence that minimizes the make span
CO4: construct networks and analyze optimality for various applications
CO5: identify inventory models and solve for optimality
CO6: assess queuing characteristics and solve problems
CO7: determine the optimum replacement period for capital equipment's and items that fail suddenly

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2						2	2		
CO2	3	3	3	2	2						2	2		
CO3	3	3	3	2	2						2	2		
CO4	3	3	3	2	2						2	2		
CO5	3	3	3	2	2						2	2		
CO6	3	3	3	2	2						2	2		
CO7	3	3	3	2	2						2	2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE01 CAD/CAM/CIM

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Basic knowledge of Mathematics, Production Technology and Engineering Drawing.

UNIT – I **9**

CAD: The Design process and role of CAD – Introduction to computer graphics –Output primitives – Bresenhams line and circle drawing algorithms– Parametric equations for line and circle – 2D & 3D transformations – Translation – Scaling – Rotation – Homogeneous coordinate.

UNIT – II **9**

Visual Realism: Hidden line – Surface algorithms – Shading and Coloring, RGB, HSV, HLS – UCS, WCS –Solid modeling – CSG and B-rep Techniques –Parametric modeling.

UNIT– III **9**

CAM:CNC Technology, Classification–contouring – interpolators-open loop and closed loop system–CNC controller-Structural members of CNC machines–Function of ball screws-ATC, feedback devices–Fundamentals of part programming – Manual programming–Canned cycle and subroutines – APT language programs.

UNIT – IV **9**

Code generation and CIM: ISO standards for coding – G codes and M-codes, CL data and tool path simulation–Code generation from 3D solid models using software. CIM Definition–CIM Wheel–role of G.T in CAD/CAM integration –part families –classification and coding –DCLASS and MICLASS and OPITZ coding systems–cellular manufacturing.

UNIT – V **9**

Process Planning and FMS: Process planning –variant and generative approaches –CAPP and CMPP process planning systems. Shop floor control-factory data collection system -automatic identification methods–Bar code technology-automated data collection system. FMS-components of FMS –types -FMS workstation -material handling and storage systems–FMS layout -application and benefits. Communication fundamentals–local area networks -topology -LAN implementations –network management and installations.

TOTAL: 45

TEXT BOOKS:

1. Radhakrishnan P. and Subramanian S., "CAD/CAM/CIM", 3rd Edition, New Age International Publishers, New Delhi, 2008.
2. Zeid, Ibrahim, Sivasubramanian, "CAD/CAM Theory and Practice", 2nd Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCE BOOKS:

1. Groover M.P., "Automation, Production System and Computer Integrated Manufacturing", 3rd Edition, Prentice-Hall of India, New Delhi, 2008.
2. Bedworth David, "Computer Integrated Design and Manufacturing", 1st Edition, McGraw-Hill, 1991.
3. Hearn Donald and Baker M. Pauline, "Computer Graphics", 2nd Edition, Pearson Education, 2004.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate and analyze various modeling algorithms and 2D & 3D transformations
CO2: clarify the concepts behind visual realism and parametric modeling
CO3: generate the CNC part programs using G and M codes
CO4: identify the part families and demonstrate different classification and coding systems
CO5: streamline the concepts of FMS, CAPP and LAN implementations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	1		3	2		1	1	
CO2	3	2	3	2	3	2	1		3	2		1	1	
CO3	3	2	3	2	3	2	1		3	2		1	1	
CO4	3	2	3	3	3	2	1		3	2		1	1	
CO5	3	2	2	3	3	2	1		3	2		1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE01 AUTOMOTIVE HVAC

(Use of Approved Refrigeration and Air-Conditioning Data Book is permitted)

3 0 0 3

Pre-requisites: Engineering Thermodynamics and Thermal Science

UNIT – I **9**

Automotive Air-Conditioning Fundamentals: Purposes of Heating - Ventilation and Air Conditioning - Environmental Concerns - Ozone layer depletion - Location of air conditioning components in a car - Schematic layout of a vehicle refrigeration system. Psychrometry - Basic terminology and Psychrometric mixtures - Psychrometric Chart- Related problems.

UNIT – II **9**

Automotive Cooling and Heating System: Vehicle Refrigeration System and related problems - Fixed thermostatic and Orifice tube system - Variable displacement thermostatic and Orifice tube system - Vehicle air conditioning operation. Types of compressor - Compressor Clutches - Compressor Clutch electrical circuit - Compressor lubrication - Condensers - Evaporators- Expansion devices- Evaporator temperature and pressure controls - receiver-drier- Accumulators - refrigerant hoses, Connections and other assemblies - Heating system.

UNIT– III **9**

HVAC Controls, Delivery System and Refrigerants: Types of Control devices - Preventing Compressor damage - Preventing damage to other systems - Maintaining drivability - Preventing Overheating. Ram air ventilation - Air Delivery Components- Control devices- Vacuum Controls. Containers - Handling refrigerants - Discharging, Charging and Leak detection - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures.

UNIT – IV **9**

Automatic Temperature Control: Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for fixed and variable displacement type air conditioning system.

UNIT – V **9**

System Servicing and Testing: Special tools for servicing vehicle air conditioning - Diagnosing components and air conditioning systems - Diagnosing cooling system - Air delivery system - Automatic temperature Control system diagnosis and service.

TOTAL: 45

TEXT BOOKS:

1 Warren Farnell and James D. Halderman, "Automotive Heating, Ventilation and Air Conditioning Systems", Classroom Manual, Pearson Prentice Hall, 2004.

2 Steven Daly, "Automotive Air Conditioning and Climate Control Systems", 1st Edition, Butterworth-Heinemann Publication, 2006.

REFERENCE BOOKS:

1 Chris Johanson, "Auto Heating & Air Conditioning Technology", Goodheart-Willcox Publisher, 2001.

2 Mark Schnubel, "Today's Technician: Automotive Heating & Air Conditioning Classroom Manual", 5th Edition, Cengage Learning, 2013.

Course Outcomes:

On completion of the course the students will be able to

CO1:understand basic concepts used in automotive air-conditioning and its related parameters
CO2:demonstrate the technology used in vehicle refrigeration and various types of compressors
CO3:control various mechanisms used in system safety precautions and refrigerant charging and problem identification
CO4:control temperature through sensors and actuators in various types of air conditioning system
CO5:understand different servicing and testing procedures

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			2	3						3	
CO2	3												3	1
CO3	3					2							3	
CO4	3												3	2
CO5	3												3	1

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE02 HYDRAULICS AND PNEUMATICS

3 0 0 3

Pre-requisites: Fluid Mechanics and Hydraulic Machines

UNIT – I **9**

Introduction to Fluid Power and Principle: Introduction to fluid power – Properties of fluid – Types of hydraulic fluids – Advantages and drawbacks of fluid power – Applications of fluid power – Components of fluid power system – Pascal's law: Multiplication of Force – Analysis of simple hydraulic jack – Applications of Pascal's law: Hand operated hydraulic jack - Air to Hydraulic pressure Booster – Laminar and Turbulent flow – Reynold's Experiment – Darcy's equation – Frictional losses in turbulent and Laminar Flow – Losses in valves and fittings.

UNIT – II **9**

Hydraulic Pumps, Actuator and Valves: Pumps Pumping theory - Pump classification – Working principle of Gear pump, Vane pump, Piston pump, Screw pump - Hydraulic Actuators: Hydraulic motors – Gear and vane motors, Hydraulic cylinders: single acting and double acting cylinders, Special type cylinders: rodless, tandem and telescopic – Hydraulic valves: Pressure relief valve, Compound relief valve, Direction control valve, Unloading valve, Sequence valve – Flow control valve Pressure compensated and Non pressure compensated types.

UNIT– III **9**

Pneumatic System: Properties of air – Compressors: Rotary compressor – Screw compressor, vane compressor – Piston Compressor: Single and Multi stage Compressor – Filter, Regulator and Lubricator Unit – Valves: Direction control valves, Two way, Three way, Four way valves – Pneumatic check valves – Flow control valve, Pneumatic shuttle valve – AND type valve – Quick exhaust valve.

UNIT – IV **9**

Design of Hydraulic and Pneumatic Circuits: Construction of Hydraulic circuits - Counter balance circuit - Fail safe circuit - Regenerative circuit - Pressure intensifier circuits - Accumulator circuits. Construction of Pneumatic circuits: Cascade method - Sequence circuit. Electro-pneumatic circuit-Basics of Fluidics.

UNIT – V **9**

Automotive Applications: Hydraulic tipping mechanism - Power steering, and fork lift hydraulic gear, Hydro-pneumatic suspension, Air brake and maintenance and trouble shooting of pneumatic circuits.

TOTAL: 45

TEXT BOOKS:

1 Anthony Esposito, "Fluid Power with Application", 7th Edition, Pearson Education Ltd, 2013.

2 Srinivasan R., "Hydraulic and Pneumatic Controls", McGraw-Hill Education Pvt. Ltd., 2007.

REFERENCE BOOKS:

1 Andrew Parr, "Hydraulics and Pneumatics", 7th Edition, Jaico Publishing House, 2005.

2 Majumdar S.R., "Pneumatic Systems – Principle and Maintenance", 2nd Edition, Tata McGraw Hill, 2015.

3 Majumdar S.R.,"Oil Hydraulic Systems – Principle and Maintenance", 2nd Edition, Tata McGraw Hill, 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: know the fundamental properties of fluids, Pascal's law, the applications, advantages of fluid power system and losses in fluid flow

CO2: understand the different types of pumps, actuators and its working principles, the valves involved in hydraulic circuit and its working

CO3: illustrate the construction and working principles of different types of compressors and FRL and the valves Involved in pneumatic circuit

CO4: design hydraulic and pneumatic circuits for various applications using cascade method

CO5: understand the significance of fluid power circuit for automotive applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											3	
CO2	1												3	
CO3	1												3	
CO4	1	2	3										3	
CO5	1	2											3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE03 AUTOMOTIVE NOISE, VIBRATION AND HARSHNESS

3 0 0 3

UNIT – I **9**

Fundamentals of Acoustics and Noise, Vibration: Theory of Sound - Predictions and Measurement - Sound Sources - Sound Propagation in the Atmosphere - Sound Radiation from Structures and their response to Sound - General introduction to vibration - Vibration of Simple Discrete and Continuous Systems - Random Vibration - Response of Systems to Shock - Passive Damping.

UNIT – II **9**

Effects of Noise, Blast, Vibration, and Shock on People: General Introduction to Noise and Vibration Effects on People and Hearing Conservation - Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance - Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People - Auditory Hazards of Impulse and Impact Noise - Effects of Intense Noise on People and Hearing Loss - Effects of Vibration on People - Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise..

UNIT– III **9**

Transportation Noise and Vibration-Sources, Prediction, and Control: Introduction to Transportation Noise and Vibration Sources - Internal Combustion Engine Noise Prediction and Control-Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise -Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles - Prediction and Control - Transmission and Gearbox Noise and Vibration Prediction and Control - Brake Noise Prediction and Control.

UNIT – IV **9**

Interior Transportation Noise and Vibration Sources-Prediction and Control: Introduction to Interior Transportation Noise and Vibration Sources-Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control-Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control.

UNIT – V **9**

Noise and Vibration Transducers, Analysis Equipment, Signal Processing, and Measuring Techniques: General Introduction to Noise and Vibration Transducers - Measuring Equipment, Signal Acquisition, and Processing - Acoustical Transducer Principles and Types - Vibration Transducer Principles and Types - Sound Level Meters - Noise Dosimeters - Analyzers and Signal Generators - Equipment for Data Acquisition, Noise and Vibration Measurements - Determination of Sound Power Level and Emission Sound Pressure Level - Sound Intensity Measurements - Noise and Vibration Data Analysis - Metrology and Traceability of Vibration Measurements.

TOTAL: 45

TEXT BOOKS:

1 Clarence W. De Silva, "Vibration Monitoring, Testing, and Instrumentation", CRC Press, 2007.
2 David A. Bies and Colin H. Hansen, "Engineering Noise Control: Theory and Practice", Spon Press, London, 2009.

REFERENCE BOOKS:

1 Allan G. Piersol and Thomas L. Paez Harris, "Shock and Vibration Handbook", McGraw-Hill, New Delhi, 2010.
2 Colin H Hansen, "Understanding Active Noise Cancellation", Spon Press, London, 2003.
3 Matthew Harrison, "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier Butterworth-Heinemann, Burlington, 2004.

Course Outcomes:

On completion of the course the students will be able to

CO1: acquire knowledge in basic of noise and vibration
CO2: understand the effect of noise, blast and shock on human comfort and environment
CO3: know the source, prediction, and control of transportation noise and vibration
CO4: summarize the prediction and control methods of interior transportation noise
CO5: measure signal condition and analyze the noise and vibration using transducers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					2	2						3	
CO2	1					3	2						3	
CO3	1					3	2						3	
CO4	1					3	2						3	
CO5	3												2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE04 VEHICLE BODY ENGINEERING

3 0 0 3

Pre-requisites: Engineering Mechanics, Vehicle Dynamics, Mechanics of Machines

UNIT – I **9**

Car Body Details: Types of Car body - Saloon, Hatchback, convertibles, Limousine, EstateVan, Racing and Sports car – Visibility regulations, Driver's visibility, Improvement in visibility and tests for visibility. Driver seat design –Car body construction-Various panels in car bodies - Safety aspect of car body.

UNIT – II **9**

Bus Body Details: Types of bus body: based on capacity, distance traveled and based on construction - Bus body lay out for various types, Types of metal sections used – Regulations – Constructional details: Conventional and integral - Driver seat design.

UNIT– III **9**

Commercial Vehicle Details: Types of commercial vehicle bodies - Light commercial vehicle body - Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design - Regulations.

UNIT – IV **9**

Vehicle Aerodynamics: Objectives, Vehicle drag and types -Various types of forces and moments - Effect of forces and moments - Side wind effects on forces and moments - Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types - Wind tunnel testing such as: Flow visualization techniques, Airflow management test – Measurement of various forces and moments by using wind tunnel.

UNIT – V **9**

Body Materials, Trim, Mechanisms and Body Repair: Types of materials used in body Construction-Steel sheet, timber, plastics, GRP, properties of materials. Body trim items-body mechanisms. Hand tools - power tools - panel repair - repairing sheet metal - repairing plastics - body fillers - passenger compartment service. Corrosion: Anticorrosion methods, Modern painting process procedure - Paint problems.

TOTAL: 45

TEXT BOOKS:

1 Powloski J., "Vehicle Body Engineering", Business Books Ltd., 1998.

2 James E. Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.

REFERENCE BOOKS:

1 David A Crolla, "Automotive Engineering: Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann Publications, 2009.

2 Dieler Anselm, "The Passenger Car Body", SAE International, 2001.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the different types and constructions of car body

CO2: know the different types, construction and aspects of bus body

CO3: know the different types, construction, and aspects of commercial vehicle body

CO4: summarize the role of various aerodynamic forces and moments, measuring instruments

CO5: identify the materials used in body building and body repairs

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2			2							3	
CO2	1		2										3	
CO3	1		2										3	
CO4	2	2											3	
CO5	1	2											3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE05 AUTOMOTIVE CONTROL SYSTEMS

3 0 0 3

UNIT – I **9**

Mathematical Modeling of Systems: Introduction - Open loop and closed loop systems - Automotive Examples - Transfer function of physical systems - Mechanical systems - Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Block diagram reduction techniques -Signal flow graphs - Mason's gain formula.

UNIT – II **9**

Time Response Analysis: First order, Second order control system response for step, ramp and impulse inputs. Time domain specifications - Steady-state error constants - Position, velocity and acceleration error constants. System poles and zeros - Root - locus plots - General rules for constructing root locus - Control systems design by the root - locus method. Stability analysis - Routh-Hurwitz criterion of stability - Lag, Lead and Lag - Lead Compensators design.

UNIT– III **9**

Frequency Response Analysis: Frequency domain specifications - Peak resonance, resonant frequency, bandwidth and cut-off rate - Correlation between time and frequency responses for second order systems. Stability in the frequency domain - Gain and Phase margins - Bode plot - Control systems design using frequency response.

UNIT – IV **9**

State Variable Analysis: Introduction - General state space representation - Converting transfer function to state space - Converting state space to transfer function - Application examples - Controllability - Controller design - Observability - Observer design.

UNIT – V **9**

Automotive Control Techniques: Proportional control - Integral control - Derivative control - PI and PID control actions - Tuning rules - Introduction to optimal control and rule based control techniques - Application examples - Fuel Control - Spark - Timing Control - Idle - Speed Control - Cruise Control - Automatic transmission control - ABS control.

TOTAL: 45

TEXT BOOKS:

1 Gopal M, "Control Systems - Principles and Design", Tata McGraw-Hill, New Delhi, 2012.
2 Norman S. Nise, "Control System Engineering", John Wiley & Sons, New Delhi, 2012.

REFERENCE BOOKS:

1 Nagrath I. J. and Gopal M., "Control System Engineering", New Age International, New Delhi, 2011.
2 Ogata K., "Modern Control Engineering", Prentice Hall of India, New Delhi, 2010.
3 Benjamin Kuo, "Automatic Control Systems", Prentice Hall of India, New Delhi, 2010.
4 GalipUlsoy A., Huei Peng and Melih Cakmakci, "Automotive Control Systems", Cambridge University Press, 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: construct the mathematical models for linear time-invariant systems of different sub systems in automobile engineering
CO2: design a state-feedback controller using pole placement to meet transient response specification
CO3: apply the frequency domain analysis techniques to determine the system response
CO4: identify the system elements and their representations in state space form
CO5: know about the basics of vehicle control system design

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2											3
CO2	1		2											3
CO3	1		2											3
CO4	1		2											3
CO5	1		2			1								3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE06 STYLING AND MODELING OF VEHICLES

3 0 0 3

UNIT – I **9**

Automotive Interior and Exterior Design: Introduction - Creative and innovation - Modern automobile systems - Interior and exterior design - Colour selection - Automobile aesthetics - Vehicle body types - Body styles, front grill shapes, headlight shapes, side vent, rear side shapes, overall profiles, visual features, vehicle color - color codes, Introduction to computer-aided concept design system

UNIT – II **9**

Materials and Manufacturing Processes for Automobile: Introduction to light weight vehicle design - Composite material - The manufacturing challenge for automotive designers - Advances in manufacturing processes, structure, properties and manufacturing technology of automotive materials Design to manufacture as a single process

UNIT– III **9**

Automotive Concept Design: Body Design: Automotive styling and sketching – Streamlining - Automotive concept design using clay modeling and sculpting technique - Freeform and surface modelling - Vehicle aerodynamics and thermal management

UNIT – IV **9**

Structures, Safety and Impact: Ergonomics in automotive design, driver comfort - Seating, visibility - Man-machine system - Passenger comfort - ingress and egress – Spaciousness – Ventilation - Temperature control, dust and fume prevention and vibration. Crashworthiness and its influence on vehicle design - Accident and injury analysis - Vehicle impacts: General dynamics

UNIT – V **9**

Automotive Design Management: Design methodology and research - Automotive digital design - Digital visualization - Scale models - Digital prototyping and design management.

TOTAL: 45

TEXT BOOKS:

1 Julian Happian Smith, "An Introduction to Modern Vehicle Design", Butterworth Heinemann, 2004.

REFERENCE BOOKS:

1 Vivek D. Bhise, "Ergonomics in the Automotive Design Process", CRC Press, 2016.
2 William D. Callister, Jr., "Materials Science and Engineering- An Introduction", 9th Edition, John Wiley & Sons, 2013.
3 John Fenton, "Vehicle Body Layout and Analysis", Mechanical Engg. Publication Ltd., London, 1982.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the concepts of automotive interior and exterior design
CO2: know the different materials and manufacturing processes used in designing bodies
CO3: know the concepts adopted in designing automotive bodies
CO4: identify the safety and different impact analysis in automobiles
CO5: summarize the methodology, prototyping, digital design and visualization of automotive design management

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3										3	
CO2	1	2	3										3	
CO3	1		3										3	
CO4	1		2			2							3	
CO5	1		3										3	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE08 GAS DYNAMICS AND JET PROPULSION

(Common to Mechanical and Automobile branches)

Use of approved Gas Tables is permitted for the End Semester Examination

3 0 0 3

Pre-requisites: Engineering Thermodynamics, Fluid Mechanics.

UNIT – I **9**

Fundamentals and Flow Through Variable Area Ducts: Energy and momentum equations for compressible fluid flows, stagnation state, critical states, Mach number, reference velocities, various regions of flow, Mach cone, Mach angle, effect of Mach number on compressibility. Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, Area ratio as a function of Mach number, mass flow rate through nozzles and diffusers

UNIT – II **9**

Flow Through Constant Area Ducts: Flow in constant area ducts with friction – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length –Flow in constant area ducts with heat transfer -Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer

UNIT– III **9**

Flow Across Shock: Generation of shock in shock tubes – Desirable and undesirable effects of shock –Governing equations of normal shock, variation of flow parameters across the normal shock, Prandtl –Meyer equation, Impossibility of shock in subsonic flows – Strength of shock wave –Introduction to oblique shock

UNIT – IV **9**

Aircraft Propulsion: Types of jet engines – Energy flow through jet engines, Study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, Performance of turbo jet engines – Thrust, thrust power, propulsive and overall efficiencies, Ram jet and Pulse jet engines

UNIT – V **9**

Rocket Propulsion: Types of Rocket engines – Solid Propellant rocket, Liquid Propellant rocket and Hybrid rocket – Thrust equation – Effective jet velocity, Specific impulse – Rocket engine performance, Solid and liquid propellants – Comparison of different propulsion systems

TOTAL: 45

TEXT BOOKS:

1. Yahya S.M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", 4th Edition, New Age International Pvt. Ltd., New Delhi, 2012.
2. Rathakrishnan E., "Gas Dynamics", 5th Edition, Prentice Hall of India, New Delhi, 2013.

REFERENCE BOOKS:

1. Oosthuizen Patrich H. and Carscallen William E., "Introduction to Compressible Fluid Flow", 2nd Edition, CSR Press, 2013.
2. Cohen H., Rogers R.E.C. and Saravanamuttoo, "Gas Turbine Theory", 6th Edition, Pearson Education, 2008.
3. Ganesan V., "Gas Turbines", 3rd Edition, Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate an understanding of basic concepts of compressible flow and flow behavior in nozzles and diffusers

CO2: solve the problems in flow associated with friction and heat transfer

CO3: solve the problems in flow associated with shock waves

CO4: assess the performance of jet engines

CO5: demonstrate an understanding of working of different types of rocket engines

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE07 VEHICLE AERODYNAMICS

3 0 0 3

UNIT – I **9**

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-Engine cooling requirement- Air flow to passenger compartment -Duct for air conditioning-Cooling of transverse engine and rear engine.

UNIT – II **9**

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 **9**

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.

UNIT – IV **9**

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.

UNIT – V **9**

Wind Tunnels for Automotive Aerodynamics: Introduction-Principle of wind tunnel technology- Limitation of simulation-Stress with scale models-Full scale wind tunnels - Measurement techniques -Equipment and transducers - Road testing methods - Numerical methods.

TOTAL: 45

TEXT BOOKS:

1 Hucho W.H., “Aerodynamic of Road Vehicles”, Butterworth-Heinemann, 2013.

2 Anthoine J.and Lofdahl L., “Road Vehicle Aerodynamics”, Von Karman Institute for Fluid Dynamics, 2005.

REFERENCE BOOKS:

1 Pope A., “Wind Tunnel Testing”, 3rd Edition, John Wiley & Sons, New York, 1999.

2 Yomi Obidi T., “Theory and Applications of Aerodynamics for Ground Vehicles”, SAE International, 2014.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand various flow phenomenon of air
CO2: analyze aero drag forces
CO3: design the frontal shape according to drag
CO4: solve the problems of drag affecting stability
CO5: conduct experiment in wind tunnel analysis

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1									3	
CO2	2	3	3	1									3	
CO3	2	3	3	1									3	
CO4	2	3	3	2									3	
CO5	2	2	2	2									3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE08 ELECTRIC AND HYBRID VEHICLES

3 0 0 3

UNIT – I **9**

Introduction to Electric Vehicles: Layout of an electric vehicle-Performance of electric vehicles- Traction motor characteristics-Tractive effort-Transmission requirements-Vehicle performance- Energy consumption-Advantage and limitations-Specifications-System components-Electronic control system.

UNIT – II **9**

Hybrid Vehicles: Concepts of hybrid electric drive train, types - Architecture of series and parallel hybrid electric drivetrain-Merits and demerits -Series and parallel hybrid electric drive train design- Impact of modern drive-trains on energy supplies - Fuel efficiency analysis.

UNIT– III **9**

Electric Propulsion Systems, Generators, Motor Controllers and Control Systems: DC motors- AC Motors-Permanent MagnetMotors-Brushless DC and reluctance Motors-Characteristics- Regenerative braking-DC generators - AC generators and voltage and frequency regulations. Control system principles - Speed and torque control - DC motors and AC motors - Configuration and control of DC Motor drives - Configuration and control of Induction Motor drives - configuration and control of Permanent Magnet Motor drives - Configuration and control of Switch Reluctance Motor drives -Drive system efficiency.

UNIT – IV **9**

Energy Storages: Electromechanical batteries - Types of batteries - Lead acid batteries, nickel based batteries, lithium based batteries - Electrochemical Reactions-Thermodynamic Voltage-Specific energy, specific power, energy efficiency, ultra-capacitors. 42 V System for Traction Applications - Lightly Hybridized vehicles, Low-Voltage Storage System, Low -Voltage main system with High voltage bus for propulsion-Heavy Vehicles Hybrid Electric Heavy Duty Vehicles-Fuel cell Heavy-duty vehicles.

UNIT – V **9**

Fuel Cell Technology: Structures, Operations and properties of Fuel cells - (Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Photovoltaic Cell Molten Carbonate Fuel Cell)-Characteristics. Electrochemical energy conversion - Theoretical efficiency - Factors affecting electrochemical energy conversion - Helmholtz double layer model.

TOTAL: 45

TEXT BOOKS:

1 Ronald K Jurgen, "Electric and Hybrid - Electric Vehicles", SAE Publication, 2011.

2 Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth-Heinemann Publishers, 2002.

REFERENCE BOOKS:

1 Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth-Heinemann Publishers, 2001.

2 James Larminie and John Loury, "Electric Vehicle Technology-Explained", 2nd Edition, John Wiley & Sons Ltd., 2012.

3 Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the basics of electric vehicles
CO2: develop the skills on hybrid vehicles
CO3: analyze the techniques used in electric motors and propulsion system
CO4: analyze about the various energy storage devices
CO5: compare various types of fuel cell technology

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	3
CO2	1												1	3
CO3	2	1											1	3
CO4	1	1					1							3
CO5	1													3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE09 SPECIAL TYPES OF VEHICLES

3 0 0 3

UNIT – I **9**

Earth Moving Equipments: Earthmovers like dumpers, loaders - Single bucket, Multi bucket and rotary types - bulldozers, excavators, backhoe loaders, drag and self-powered types, Bush cutters, stumpers, tree dozer, rippers etc. - Power and capacity of earth moving machines.

UNIT – II **9**

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– III **9**

Farm Equipment: Classification of tractors - Main components of tractor - Working attachment of tractors - Auxiliary equipment - Trailers and body tipping mechanism - Ploughing - Paddy plantation machine harvesting machines, sugarcane harvesting and Power trailers.

UNIT – IV **9**

Military and Combat Vehicles: Ride and stability characteristics - Power take off - Special Implementations - Special Features and constructional details of tankers - Gun carriers and transport vehicles - Bridge builders - Communication Vehicles.

UNIT – V **9**

Vehicle Systems and Features: Brake system and actuation - OCDB and dry disc caliper 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.

TOTAL: 45

TEXT BOOKS:

1 Nakra C.P., "Farm Machines and Equipments", Dhanpatrai Publishing Company Pvt. Ltd., 2016.

2 Wong J. Y., "Theory of Ground Vehicles", 4th Edition, John Wiley & Sons Inc.,2008.

REFERENCE BOOKS:

1 George W Green, "Special Use Vehicles: An Illustrated History of Unconventional Cars and Trucks Worldwide", McFarland & Company Inc. Publishers, 2003.

2 Ageikin Ia S., "Off the Road Wheeled and Combined Traction Devices", Ashgate Publishing Co. Ltd., 1988.

Course Outcomes:

On completion of the course the students will be able to

CO1: know the construction and layout of earth moving equipments
CO2: understand special type of vehicles based on their need and purpose
CO3: illustrate the construction of farm equipments and the working of harvesting machines
CO4: understand the construction and outline of military and combat vehicles
CO5: summarize the special features in off road vehicles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2										3	
CO2	1												3	
CO3	1	2											3	
CO4	1	2											3	
CO5	1		2										3	

1 – Slight, 2 – Moderate, 3 – Substantial

14GEE81 ENTREPRENEURSHIPDEVELOPMENT

(Common to all Engineering and Technology branches except Civil and Chemical Engg.)

3 0 0 3

UNIT – I **9**

Entrepreneurship Concepts: Meaning and concept of entrepreneurship, Role of Entrepreneurship in Economic Development. Factors affecting Entrepreneurship – Creativity, Innovation and Entrepreneurship, Intrapreneurship

UNIT – II **9**

Entrepreneur: Definition, Entrepreneurial Motivation, Characteristics of Entrepreneurs, Distinction between an Entrepreneur and a Manager.

UNIT – III **9**

Business Plan: Objectives of a Business Plan, Business Planning Process, Opportunity Identification and Selection, Contents of a Business Plan, Functional Plans.

UNIT – IV **9**

Entrepreneurial Eco System: Forms of Business Ownership, Sources of Finance, Institutional Support to Entrepreneurs.

UNIT – V **9**

Small Business Management: Definition of Small Scale Industries, Strengths and Weaknesses of Small Business, Growth Strategies in Small Scale Enterprises, Sickness in Small Enterprises – Symptoms, Causes and Consequences.

TOTAL : 45

TEXT BOOK:

1. S.S.Khanka, "Entrepreneurial Development", 4th Edition, S.Chand & Company Ltd., 2012.
2. Madhurima Lall and Shikha Sahai, "Entrepreneurship", 2nd Edition, Excel Books, New Delhi, 2008.

REFERENCE BOOKS:

1. Raj Shankar, "Entrepreneurship, Theory and Practice", Vijay Nicole Imprints Pvt. Ltd., Chennai 2012.
2. Barringer and Ireland, "Entrepreneurship", 3rd Edition, Pearson Education, 2012.
3. Zimmer and Scarborough, "Essentials of Entrepreneurship and Small Business Management", 5th Edition, PHI Learning Pvt. Ltd., 2009.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the concepts of entrepreneurship and its importance
CO2: understand the traits of an entrepreneur and the sources of his motivation
CO3: understand the components of a business plan
CO4: demonstrate knowledge of various sources of finance and institutions supporting entrepreneurship
CO5: understand the nature of small business and causes of industrial sickness

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1						1	3	2	3		3	2		
CO2						1	3	2	3		3	2		
CO3				2		1	3	2	3		3	2		
CO4				1		1	3	2	3		3	2		
CO5		2		2		1	3	2	3		3	2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE12 ROBOTICS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Engineering Mechanics

UNIT – I **9**

Fundamentals of Robot: Robot Definition – Basic Components of Robot –Anatomy – Laws of Robotics – Classification – Robot Degree of Freedom – Work Envelope – Joint Notations – Dynamic Performance – Functions and Specification of Robot Systems – Robot Applications.

UNIT – II **9**

Robot Drive Systems and End Effectors: Robot Drive Systems – Mechanical, Electrical, Hydraulic and Pneumatic Actuators – Features, Applications and Comparison of all the above Actuators –Robot End Effectors and Classifications – Gripper Mechanisms and Force analysis – Other Types of Grippers – Gripper Selection and design.

UNIT– III **9**

Robot Sensors: Transducers – Requirements of a sensor – Types of sensors – Principles and Applications – Non Optical and Optical Position sensors: Piezo Electric Sensor, Linear Variable Differential Transducer (LVDT), Resolvers, Optical Encoders – Range Sensing Techniques (Triangulation Principle, Structured Lighting Approach, Laser Range Meters) – Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors) –Touch Sensors (Binary Sensors, Analog Sensors) – Slip Sensors.

UNIT – IV **9**

Machine Vision and Robot Kinematics: Introduction to Machine Vision – Sensing and Digitizing the data, Image Processing and Analysis – Training and Vision Systems – Robotic Applications –Introduction to Manipulator Kinematics – Forward and Inverse Kinematics – Forward and Inverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) –Problems.

UNIT – V **9**

Robot Programming and Artificial Intelligence: Programming Methods – Teach Pendant Programming, Lead through programming Methods, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End Effector commands, and Simple programs –Introduction to Artificial Intelligence – Goals – Artificial Intelligence (AI) Techniques – An Approach for Implementing Robotics in Industries – Various Steps; Safety Considerations for Robot Operations – Future Applications.

TOTAL: 45

TEXT BOOKS:

1. Groover M.P., "Industrial Robotics – Technology, Programming and Applications", 2nd Edition, McGraw-Hill Education (India) Pvt. Ltd., 2012.
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – An Integrated Approach", 1st Edition, Prentice-Hall India, 2010.

REFERENCE BOOKS:

1. Fu K.S., Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", 1st Edition, McGraw-Hill Book Co., 2008.
2. Saha S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Education (India), 2014.
3. James G. Kermas, "Robot Technology Fundamentals", Cengage Learning Pvt. Ltd., New Delhi, 2009.
4. nptel.ac.in/downloads/112101098/
5. nptel.ac.in/courses/112101099/
6. www.nptelvideos.in/2012/12/robotics.html

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate an expansive view of concepts, parts and dynamic properties of robots
CO2: explore on the drive systems of robots and end effectors
CO3: apply the concept of sensory devices
CO4: apply the basic concepts of a machine vision and manipulator kinematics
CO5: perform programming and develop a robot for a accomplishing a particular task

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1		2	1	1	3		3
CO2	2	2	2	2	2			1	1	1		1		3
CO3	3	3	2	2	3		1				1	3		3
CO4	3	3	3	2	2	1	1	1				2		3
CO5	2	3	3	3	3	1	1					3		3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE13 NON DESTRUCTIVE EVALUATION TECHNIQUES

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Materials and Metallurgy, Metrology and Measurement.

UNIT – I **9**

Introduction and Liquid Penetrant Testing: Non-destructive testing(NDT) and its importance – NDT vs. Destructive Testing – Visual Examination – Basic Principles, optical aids used and applications. Liquid Penetrant – Principles, Procedure for Penetrant testing, Penetrant testing methods, Post emulsification, properties of liquid penetrant, sensitivity, applications and Limitations – Standards.

UNIT – II **9**

Magnetic Particle Testing: Magnetic Particle Testing –Principles, Magnetizing techniques, Procedures, Equipments, Sensitivity, applications and Limitations – Standards. Case studies.

UNIT– III **9**

Ultrasonic Testing: Properties of sound beam, Transducers, inspection methods, Techniques for normal and angle beam inspection, Flaw characterization – equipments, methods of display – A–Scan–B–Scan -C–Scan – Immersion testing – application, advantages and limitations–standards.

UNIT – IV **9**

Radiography: Electromagnetic radiation sources–X-ray production & gamma ray sources, properties, radiation–attenuation and effects in film, Exposure charts – radiographic imaging – inspection techniques–applications and limitations – safety in industrial radiography–neuron radiography–standards. Case studies.

UNIT – V **9**

Eddy Current: Principles, Instrumentation, Techniques, Probe, Sensitivity, Advanced Test Methods, applications & Limitations – Standards. **Other Techniques:** Acoustic Emission Testing–Principle, Techniques, Instrumentations, Applications and Standards, Homography Thermography –Principles, Equipments, Techniques, Applications and Standards, Leak testing-methods , detection and standards.

Selection of NDT Methods: Defects in material – Selection of NDT and Instrumentation – Some case studies.

TOTAL: 45

TEXT BOOKS:

1. Baldev Raj, Jayakumar T. and Thavasimuthu M., "Practical Non Destructive Testing", 3rd Edition, Narosa Publishing House, New Delhi, 2009.
2. Shull Peter J., "Non Destructive Evaluation: Theory - Techniques and Applications", Marcel Dekkar Inc., New York, USA, 2002.

REFERENCE BOOKS:

1. Baldev Raj and Venkatraman B., "Practical Radiology",Narosa Publishing House, New Delhi, 2004.
2. Hull Barry and John Vernon, "Non Destructive Testing", 1st Edition, Macmillan, London, 1988.
3. Brichan D., "Non Destructive Testing", Oxford Press, 1975.
4. ASM Handbook, "Non Destructive Evaluation and Quality Control", Vol. 17, 9th Edition, 1989.

Course Outcomes:

On completion of the course the students will be able to

CO1: depict the importance of Nondestructive testing methods
CO2: gain the knowledge on liquid penetrant method and Magnetic Particle Testing
CO3: understand the principle of Ultrasonic testing
CO4: demonstrate Radiographic principles and testing of defects
CO5: gain knowledge on other techniques and selection of different methods

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					2	1			1		2	1	
CO2	2	1			2	2	1			1		2	1	
CO3	2				1	1	1			1		2	1	
CO4	2	1			3	2	1			1		3	1	
CO5	2	2	2	2	3	2	1			1		3	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE14 COMPUTATIONAL FLUID DYNAMICS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Fluid Mechanics, Heat Transfer, Partial Differential Equations.

UNIT – I **9**

Governing Equations and Boundary Conditions: Basics of computational fluid dynamics – Governing equations – Continuity, Momentum and Energy equations – General transport equation – Physical boundary conditions – Discretization – Mathematical behavior of PDEs on CFD –Elliptic, Parabolic and Hyperbolic equations

UNIT – II **9**

Finite Difference Method: Finite Difference Method – Taylor‘s series – Forward, Central and Backward differences – Explicit Method – Implicit Method – Tridiagonal matrix – ADI Method –Solution methodology for parabolic and elliptic equations – Errors

UNIT– III **9**

Finite Volume Method: Finite volume formulation for steady state One and Two -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicholson and fully implicit schemes. Steady state one-dimensional convection and diffusion – Central, Upwind differencing schemes-, Hybrid, Power-law, QUICK Schemes – properties of discretization schemes – Conservativeness, Boundedness, Transportiveness.

UNIT – IV **9**

Grid and Flow Filed Variables: Types of grids –Grid generation – Grid transformation – Calculation of flow field variable –Staggered grid –Pressure and Velocity correction – SIMPLE algorithm – Flow and heat transfer analysis on simple components like nozzle, diffuser, pipe flow etc.

UNIT – V **9**

Turbulence Models: Turbulence – Effect of turbulence on Time averaged Navier Stokes equation – Characteristics of simple turbulent flow – Flat plate boundary layer – Pipe flow – Turbulence models – Mixing length model –K-ε Models – Reynolds stress equation model – Algebraic stress model.

TOTAL: 45

TEXT BOOKS:

1. Anderson John D., “Computational Fluid Dynamics: Basic with Applications”, 1st Edition, Tata McGraw Hill, New Delhi, 2012.
2. Versteeg H. and Malalasekera W., “An Introduction to Computational Fluid dynamics: A Finite Volume Approach”, 2nd Edition, Addison Wesley Longman Ltd., 2007.

REFERENCE BOOKS:

1. Ghoshdastidar P.S., “Computer Simulation of Fluid Flow and Heat Transfer”, 1st Edition, Tata McGraw-Hill, New Delhi, 1998.
2. Patankar S.V., “Numerical Heat Transfer and Fluid Flow”, 1st Edition, Hemisphere Publishing Corporation, Washington, 1980.
3. Date Anil W., “Introduction to Computational Fluid Dynamics”, 1st Edition, Cambridge University Press, Cambridge, 2005.

Course Outcomes:

On completion of the course the students will be able to

CO1: derive the governing equations and identify the type of partial differential equation
CO2: apply the finite difference method for convection and diffusion problems
CO3: apply the finite volume method for convection and diffusion problems
CO4: perform grid transformation and calculate the flow field variables
CO5: demonstrate an understanding of turbulence models

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3					2		2	1	
CO2	3	3	3	2	3					2		2	1	
CO3	3	3	3	2	3	1	1			2		2	1	
CO4	3	3	3	2	3	1	1			2		2	1	
CO5	3	3	3	2	3	1	1			2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE15 COMPOSITE MATERIALS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Engineering mechanics, Strength of Materials, Engineering materials and Metallurgy.

UNIT – I **9**

Basics of Fibers, Matrices and Composites: Basics of fibers, matrices and composites: Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Fiber surface treatments, Fillers and Additives.

UNIT – II **9**

Manufacturing: Bag molding – Compression molding – Pultrusion – Filament winding – Resin film infusion - Elastic reservoir molding - Tube rolling – Quality inspection methods. Processing of metal matrix composites (MMC) – Diffusion bonding – Stir casting – Squeeze casting.

UNIT– III **9**

Performance: Static mechanical properties – Fatigue and impact properties – Environmental effects – Long term properties, Fracture behavior and Damage tolerance.

UNIT – IV **9**

Mechanics: Fiber content, density and void content. Rule of mixture -Volume and mass fractions – Density - Void content, Evaluation of four elastic moduli based on strength of materials approach and semi-empirical model-Longitudinal Young's modulus-Transverse Young's modulus–Major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina–Laminates–Lamination theory.

UNIT – V **9**

Design: Failure Predictions, Laminate Design Consideration-Design criteria-Design allowable -Design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – Design of a compression member – Design of a beam-Design of a torsional member, Application of Finite element method (FEM) for design and analysis of laminated composites.

TOTAL: 45

TEXT BOOKS:

1. Mallick P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition, Taylor and Francis, 2008.
2. Autar K. Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2006.

REFERENCE BOOKS:

1. Bhagwan D. Agarwal, Lawrence J. Broutman, Chandrashekhar K., "Analysis and Performance of Fiber Composites", 3rd Edition, John Wiley & Sons, New York, ISBN: 978-0-471-26891-8, June 2006.
2. Gibson R.F., "Principles of Composite Material Mechanics", 3rd Edition, CRC Press, 2011.
3. Chawla K.K., "Composite Materials", 3rd Edition, Springer – ISBN: 978-0-387-74364-6 Verlag, Boston, 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the knowledge on the fundamentals of fibers, matrices and composites
CO2: portray the various manufacturing processes involved in the fabrication of composite material
CO3: demonstrate knowledge on the performance of composite materials
CO4: understand and solve problems concerning the mechanics of composite materials
CO5: perform design calculations for the development of fiber reinforced matrics

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	2	3	1	1	1	1	2	1	
CO2	2	1	2		2	1	2		1	1		2	1	
CO3	2	2	2	1		1	1			1		2	1	
CO4	2	3	3	3	1							3	1	
CO5	2	3	3	3	1					1		3	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE17 CRYOGENIC ENGINEERING

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Applied Physics, Engineering Thermodynamics and Material science.

UNIT – I **9**

Cryo Physics: Review of Basic Thermodynamics− First and Second Law approaches to the study of thermodynamic cycles, Isothermal, Adiabatic and Isenthalpic processes. Insight on Cryogenics− Properties of Cryogenic fluids − Material properties at Cryogenic Temperatures − mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials −super fluidity of He_3&He_4. Applications of Cryogenics in Space Programs, Medical applications.

UNIT – II **9**

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

UNIT– III **9**

Separation of Cryogenic Gases: Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification−Simple condensation and evaporation− Rectification Column Analysis - McCabe Thiele Method. Adsorption Systems for purification.

UNIT – IV **9**

Cryogenic Refrigerators: Isothermal and reversible isobaric source refrigeration cycles − Joule Thomson system, cascade or precooled joule Thomson refrigeration systems− expansion engine and cold gas refrigeration systems, Philips refrigerators − Importance of regenerator effectiveness for the Philips refrigerators − Gifford single volume refrigerator − Gifford double volume refrigerators analysis, COP,− regenerators − pulse tube refrigerators − various types of pulse tube refrigerator

UNIT – V **9**

Thermometry for Low Temperature: Gas thermometers, Vapor pressure thermometers, resistance thermometers, Thermocouples, 3He Melting Curve Thermometers, Noise thermometers, Superconducting Fixed point Thermometers, Nuclear Orientation thermometers, Mossbauer – Effect thermometers, Coulomb Blockade Thermometers, Osmotic Pressure Thermometers, Infrared thermometers, Fibre – Optic Thermometers, Secondary thermometers.

TOTAL: 45

TEXT BOOKS:

1. Randall F. Barron, "Cryogenic Systems", 2nd Edition, McGraw-Hill, 1985.
2. Mukhopadhyay Mamata, "Fundamentals of Cryogenic Engineering", 4th Edition, Eastern Economy Edition, New Delhi, 2010.

REFERENCE BOOKS:

1. Klaus D. Timmerhaus and Thomas M. Flynn, "Cryogenic Process Engineering", 1st Edition, Plenum Press, New York, 1989.
2. Jha A.R., "Cryogenic Technology and Applications", 1st Edition, Butterworth-Heinemann, 2006.
3. Francis S. Tse, Ivan E. Morse, "Measurement and Instrumentation in Engineering", 1st Edition, CRC Press, 1989.
4. Stephen A. Dyer, "Wiley Survey of instrumentation and Measurement", 1st Edition, John-Wiley & Sons,New York, 2004.

Course Outcomes:

On completion of the course the students will be able to

CO1: identify the appropriate materials for cryogenic application
CO2: demonstrate the working principle of different cryogenic liquification cycle
CO3: demonstrate various methods gas separation and purification system
CO4: design low-temperature systems and machinery to meet the requirements for their maximum performance and durability
CO5: select appropriate thermometry for low temperature measurements

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1		2	2			2		2	1	
CO2	3	2	2	1	2	2	2			2		2	1	
CO3	3	3	2	2	2	2	2			2		2	1	
CO4	3	3	3	2	2	2	2			2		2	1	
CO5	3	2	2	1	2	2	2			2		2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE10 MANUFACTURING OF AUTOMOTIVE COMPONENTS

3 0 0 3

Pre-requisites: Manufacturing processes

UNIT – I **9**

Engine Components I: Material selection and Manufacturing methods for Piston - Piston rings -Cylinder block - Wet and dry liners - Engine head - Thermal barrier coating of Engine head and valves.

UNIT – II **9**

Engine Components II: Material selection and Manufacturing methods for Crank shaft - Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

UNIT– III **9**

Transmission System: Material selection and Manufacturing methods for Clutch - Clutch lining - Gear Box - Gear - Propeller Shaft - Differential - Axle Shaft - Bearing - fasteners - Wheel drum - Methods of Gear manufacture - Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving.

UNIT – IV **9**

Vehicle Chassis: Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers - Wheel housing - Steering system, Brake shoes, wheel rim, Tyres.

UNIT – V **9**

Recent Developments: Surface treatment - Plastics - Plastics in Automobile vehicles - Interior Dashboard - Processing of plastics - Hydro forming of exhaust manifold and lamp housing - Stretch forming of Auto body panels - MMC liners - Selection of materials for Auto components - Use of Robots in Body weldment.

TOTAL: 45

TEXT BOOKS:

1 Garrett T. K., Newton K and Steeds W., "The Motor Vehicle", 13th Edition, Butterworth Heinemann, 2001.

REFERENCE BOOKS:

1 Dr. Kirpal Singh, "Automobile Engineering, Volume 1 & 2", 13th Edition, Standard Publishers Distributors, 2013.
2 Serope Kalpakjian and Steven Schmid, "Manufacturing Processes for Engineering Materials", 6th Edition, Pearson Education India, New Delhi, 2016.
3 Gupta K.M., "Automobile Engineering", Vol. I & II, Umesh Publishers, 2012.
4 Heldt P.M, "High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1996.

Course Outcomes:

On completion of the course the students will be able to

CO1: know basic principle and production methods of engine components
CO2: understand the material selection and the production of forged engine components
CO3: discuss the material selection and manufacturing of transmission system components
CO4: summarize the importance and manufacturing of vehicle chassis components of automobile
CO5: understand the recent developments in manufacturing process for automotive components

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE11 VEHICLE INSTRUMENTATION AND DATA MANAGEMENT

3 0 0 3

UNIT – I **9**

Instrument Characteristics and System Errors: Instrument classifications – Standards - Static and Dynamic characteristics of instruments – Calibration - Choice of instruments - Systematic Errors - Random errors - Total measurement system errors.

UNIT – II **9**

Instrument Calibration and Signal Processing: Process in instrument calibration - Validation of standard laboratory - Primary Reference standards – Traceability – Documentation - Signal amplification, attenuation, linearization, filtering, manipulation - Bias removal - Digital signal processing - Signal transmission - Wheat stone bridge - Error analysis.

UNIT– III **9**

Intelligent Instruments and Computer Networks: Elements of micro-computer – Operations – Interfacing - Serial communication lines - Parallel data bus - Communication protocol - Local area networks.

UNIT – IV **9**

Virtual Instrumentation: Definition and flexibility - Block diagram and Architecture of Virtual Instrumentation - VI programming techniques. A/D and D/A Converters - Data acquisition modules with serial communication - Design of digital voltmeter with transducer input Timers and Counters. Introduction to PC buses - Local buses, Interface buses, Instrumentation Buses and Networked Buses - Ethernet and TCP/IP Protocols.

UNIT – V **9**

Automotive Instrumentation: Modern automotive instrumentation - Computerized instrumentation system - Multiplexing - Sampling and advantages - Measurements - Fuel quality, coolant temperature, oil pressure vehicle speed - Display devices - LED,LCD,CRT,VFD types - Glass cockpit and information system.

TOTAL: 45

TEXT BOOKS:

1 Alan S Morris and Reza Langari, "Measurement and Instrumentation: Theory and Application", Academic Press Publication, 2016.

2 Jain R.K., "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2008.

REFERENCE BOOKS:

1 Nadovich C., "Synthetic Instruments Concepts and Applications", 1st Edition, Elsevier, 2004.

2 Ernest O. Doebelin, "Measurement Systems Application and Design", 4th Edition, International Student Edition, McGraw-Hill Book Company, 1990.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the operation of instruments and system errors

CO2: solve system errors and calibrate the instruments and process the signals

CO3: analyze and process the data using computer networks

CO4: design and develop networks virtually and learn the protocols of data transmission

CO5: analyze and study the automotive instrumentation

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2												3
CO2	1	2												3
CO3	1	2												3
CO4	2	1												3
CO5	2	1												3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE12 ADVANCED THEORY OF IC ENGINES

3 0 0 3

Pre-requisites: Automotive Engine Technology

UNIT – I **9**

Combustion of Fuels: Chemical composition and molecular structure of hydrocarbon fuels - Combustion Stoichiometry of hydrocarbon fuels - Chemical energy and heat of reaction calculations - Chemical equilibrium and adiabatic flame temperature calculation - Theory of SI and CI engine combustion - Flame velocity and area of flame front - Fuel spray characteristics - Droplet size, depth of penetration and atomization.

UNIT – II **9**

Engine Cycle Analysis: Ideal air, fuel air cycle and actual cycle analysis - Progressive combustion analysis in SI engines - Parametric studies on work output, efficiency and other engine performance.

Combustion Modeling: Basic concepts of engine simulation- Governing equations - Classification of engine models - Thermodynamic models for Intake and exhaust flow process - Quasi steady flow - Filling and emptying - Gas dynamic Models - Thermodynamic based in cylinder models for SI engine and CI engines.

UNIT – IV **9**

Non-conventional IC Engines: Concept of L.H.R. engine and its recent developments - Variable compression ratio engine and its use in engine research - Wankel rotary combustion engine - Dual fuel engine concept for multi fuel usage in CI engines - Performance studies on dual fuel engine - Free piston engine - Stratified charge and lean burn engines - Locomotive and marine engines.

UNIT – V **9**

Combustion Analysis in IC Engines: Photographic studies of combustion processes - Analysis of Pressure crank angle diagrams in SI and CI engines - Knock study for Pressure crank angle histories - Apparent heat release rate and Wiebe's law analysis for combustion - Calculation of Ignition delay and combustion duration - Hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines.

TOTAL: 45

TEXT BOOKS:

1 Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill Publishing Co., 2013.

2 Ramalingam K. K., "Internal Combustion Engine", 2nd Edition, Scitech Publications, 2009.

REFERENCE BOOKS:

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

2 Ganesan V., "Computer Simulation of Compression Ignition Engine Process", Universities Press (India) Ltd., Hyderabad, 1996.

3 John B., Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., Indian Edition, 2011.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the process of fuel combustion and its characteristics in SI and CI engines

CO2: analyze the engine cycles and carry out the parametric studies in engines

CO3: model and simulate the various combustion processes of IC engines

CO4: discuss about the various technologies available for non-conventional IC engines

CO5: discover the various combustion analyses of IC engines

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2		1									3	
CO2	2	1	3	1									3	
CO3	1	1		2									3	
CO4	1		3	2									3	
CO5	1	3	2	2									3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE13 VEHICLE TESTING AND VALIDATION

3 0 0 3

Pre-requisites: Automotive Electrical and Electronics

UNIT – I **9**

Measurement Systems: Introduction to Measurement systems - Static and dynamic measurement -Closed and open loop system - Requirements and characteristics - Analysis of experimental detail - Error analysis.

UNIT – II **9**

Transducers, Modifiers and Terminating Devices: Transducers for Automotive Applications – Amplifiers - Filters - Data Acquisition - Indicators, Printers and displays - Signal Analyzing.

UNIT– III **9**

Mechanical Measurement: Instrumentation for measuring Weight, Force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion.

UNIT – IV **9**

Engine Experimental Techniques: B.I.S Code for Engine testing - Instrumentation for performance testing of engine - Instrumentation for Research and development - Instrumentation for noise, vibration, in cylinder gas flow, flame temperature - Dynamic Cylinder pressure measurements.

UNIT – V **9**

Vehicle Experimental Techniques: Laboratory tests - Test tracks - Endurance Tests- Crash tests - Vehicle performance test - Brake test - Procedure and regulations.

TOTAL: 45

TEXT BOOKS:

1 William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth Heinemann Publications, 2017.

2 Thomas G.Beckwith, Roy D. Marangoni and John H.Lienhard V., "Mechanical Measurements", 6th Edition, Pearson Education Inc., 2007.

REFERENCE BOOKS:

1 Patranabis D., "Principle of Industrial Instrumentation", 2nd Edition, Tata McGraw Hill Publishing Co, New Delhi, 2008.

2 Rangan, Sharma and Mani, "Instrumentation Devices and Systems", 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., 2001.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the fundamentals and characteristics of measurement systems

CO2: know the concepts of transducers, modifiers and terminating devices

CO3: measure the mechanical parameters in vehicles

CO4: summarize the experimental techniques for engines testing

CO5: conduct various vehicle experiments in laboratory and test tracks

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												3	
CO2	1												2	3
CO3	1												3	
CO4	1		2										3	
CO5	1		2										3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE14 FUEL CELL AND APPLICATIONS

3 0 0 3

UNIT – I **9**

Introduction and Overview of Fuel Cells: Overview of fuel cells - Need of fuel cell – History - Principle and overview of fuel cell - Basic electrochemistry for all the fuel cells - Low and high temperature fuel cells. Fuel cell thermodynamics - heat, work potentials - Prediction of reversible voltage - Nernst equation - Effect of temperature, pressure, concentration on Nernst potential fuel cell efficiency - Concept of electrochemical potential.

UNIT – II **9**

Fuel Cell Types: Types of fuel cells - Alkaline Fuel Cell - Phosphoric Acid Fuel Cell - Solid Oxide fuel cell - Molten Carbonate fuel cell - Direct Methanol Fuel Cell - Proton Exchange Membrane Fuel Cell - Relative merits and demerits - Comparison on battery Vs fuel cell.

UNIT– III **9**

Fuel Cell Components and Performance: Fuel cell performance characteristics - Current/voltage - Voltage efficiency and power density - Ohmic resistance - Butler-Volmer equation - Tafel equation - Kinetic performance - Mass transfer effects - Membrane electrode assembly components - Fuel cell stack - Bi-polar plate, humidifiers and cooling plates.

UNIT – IV **9**

Fueling: Hydrogen storage technology - Pressure cylinders - Liquid hydrogen - Metal hydrides - Carbon fibers - Reformer technology - Steam reforming - Partial oxidation - Auto thermal reforming - CO removal - Fuel cell technology based on bio-mass.

UNIT – V **9**

Application of Fuel Cell and Economics: Fuel cell usage for domestic power systems - Large scale power generation - Automobile, Space, Economic and environmental analysis on usage of Hydrogen and Fuel cell - Future trends in fuel cells.

TOTAL: 45

TEXT BOOKS:

1 Larminie J. and Dicks A., "Fuel Cell Systems Explained", 2nd Edition, Wiley, 2003.
2 Xianguo Li, "Principles of Fuel Cells", Taylor and Francis, 2005.

REFERENCE BOOKS:

1 Srinivasan S., "Fuel Cells: From Fundamentals to Applications", Springer, 2006.
2 Hayre R. P., Cha S., Colella W., Prinz F.B., "Fuel Cell Fundamentals", Wiley, New York, 2006.
3 Basu S., "Fuel Cell Science and Technology", Springer, New York, 2007.

Course Outcomes:

On completion of the course the students will be able to

CO1: understand the thermodynamics and kinetics of fuel cell
CO2: illustrate the working of various types of fuel cell
CO3: comprehend the various performance characteristics and components of fuel cells
CO4: understand the various types of fueling methods
CO5: analyze the cost effectiveness and eco-friendliness of fuel cells

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2											3	
CO2	1	1											3	
CO3	1	2											3	
CO4	2												3	
CO5	1												3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUE15 IN-VEHICLE NETWORKING

3 0 0 3

UNIT – I **9**

Basics of In-vehicle Networking: Over view of Data communication and networking - Need for In-Vehicle networking - Layers of OSI reference model - Multiplexing and de-multiplexing concepts - Vehicle buses.

UNIT – II **9**

Networks and Protocols: Overview of CAN - Fundamentals - Selecting CAN controller - CAN development tools - CAN application areas. CAN protocol: Principles of data exchange - Real time data transmission - Message frame formats - Bit encoding - Bit-timing and synchronization - Data rate and bus length - Network topology - Bus access - Physical layer standards.

UNIT– III **9**

CAN Higher Layer Protocol and LIN Protocol: Introduction to CAN open - Device net - TTCAN -SAE J1939 - Overview of CAN open and application in transportation electronics - CAN open standards.LIN standard overview – Applications - LIN communication concept message frame -Development flow.

UNIT – IV **9**

MOST and FlexRay: MOST overview - Data rates - Data types – Topology - Application areas -FlexRay introduction - Network topology - ECUs and bus interfaces - Controller host interface and protocol operation controls - Media access control and frame and symbol processing - Coding/decoding unit - FlexRay scheduling - Message processing - Wakeup/ startup - Applications.

UNIT – V **9**

Wireless Systems: Introduction towireless systems - GPS - Setting receivers – Positioning - Activating the navigation function -Concept of latitude and longitude grid system -Mapping and locationtechnologies - Application. WiFi and Bluetooth Implementation.

TOTAL: 45

TEXT BOOKS:

1 Olaf Pfeiffer, Andrew Ayre and Christian Keydel, "Embedded Networking with CAN and CAN Open", 1st Edition, Rtc Books Publication, 2008.

2 Ronald K. Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill Inc. 1999.

REFERENCE BOOKS:

1 Dennis Foy, "Automotive Telematics", Red Hat, 2002.

2 Konrad Etschberger, "Controller Area Network", IXXAT Automation GmbH, 2001.

3 Hoffman–Wellenhof B., Lichtenegger H. and Collins J., "GPS Theory and Practice", 5th Revised Edition, Springer, Wein, New York, 2001.

4 Leick A., "GPS Satellite Surveying", 4th Revised Edition, John Wiley & Sons, New York, 2015.

5 Indra Widjaja, Alberto Leon-Garcia, "Communication Networks: Fundamental Concepts and Key Architectures", 2nd Edition, McGraw-Hill Publishers, 2003.

Course Outcomes:

On completion of the course the students will be able to

CO1: know about the basics of in-vehicle networks

CO2: understand the various layers of protocols and networks

CO3: illustrate the CAN and LIN protocol

CO4: understand the concepts of MOST and FlexRay

CO5: analyze the importance of navigation and intelligent transport system in automobiles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1												3
CO2	1	1												3
CO3	1	1												3
CO4	1	1												3
CO5	1	1												3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO01 TRANSPORT MANAGEMENT

3 0 0 3

UNIT – I **9**

Motor Vehicle Act: Short titles and definitions - Laws governing to use of motor vehicle and vehicle transport - Licensing of drivers and conductors - Registration of vehicle - State and interstate permits - Traffic rules, Signals and controls - Offences, penalties and procedures - Different types of forms - Government administration structure, Personnel, Authorities and duties - Rules regarding construction of motor vehicles

UNIT – II **9**

Insurance and Road Safety: Insurance types and significance – Comprehensive - Third party insurance - Furnishing of particulars of vehicles involved in accident - MACT (Motor Accident Claims Tribunal) - Solatium Fund, Hit and Run case - Duty of driver in case of accident - Surveyor and Surveyor's report

UNIT– III **9**

Passenger Transport Operation: Structure of passenger transport organizations - Typical depot layouts - Requirements - Problems on fleet management - Fleet maintenance - Planning - Scheduling operation and control, personal and training - Training for drivers and conductors, Public relations, Propaganda, publicity, passenger amenities, Advertisement work, Parcel traffic. Theory of fares - Basic principles of fare charging - Differential rates for different types of services - Depreciation and debt charges - operation cost – Revenues - Economics and records.

UNIT – IV **9**

Goods Transport Operation: Structure of goods transport organizations - Typical depot layouts - Requirements - Scheduling of goods transport - Materials Handling equipment in the goods transport operation - Storage and transportation of petroleum products

UNIT – V **9**

Taxation and Traffic Management: Objectives, Structure and methods of laving taxation - One-time tax, Tax Exemption and tax renewal - Global positioning system - Traffic navigation - Advanced traffic control devices.

TOTAL: 45

TEXT BOOKS:

1 "Motor Vehicle Act and Amendments", Govt. of India Publications, 2010.

2 Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Road Transport Undertakings, New Delhi, 2005.

REFERENCE BOOKS:

1 Kadiyali L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2011.

2 Shrivastava S.K., "Economics of Transport", S.Chand & Co., NewDelhi, 2005.

Course Outcomes:

On completion of the course the students will be able to

CO1: know the legislative laws governing the use of motor vehicle

CO2: familiar with types of vehicle insurance and understand the importance of road safety

CO3: acquire the knowledge about the operations of passenger transport system

CO4: summarize the operation of goods transport system

CO5: illustrate the taxation and the traffic management

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	2	1					1	
CO2						3	2	1					1	
CO3						3	1						1	
CO4						3	1						1	
CO5						3	1	1					1	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO02 AUTOMOTIVE POLLUTION CONTROL

3 0 0 3

Pre-requisites: Automotive Engine Technology

UNIT – I **9**

Introduction: Pollutants – Sources - Formation - Effects of pollution on environment – Human - transient operational effects on pollution - Regulated - Unregulated emissions - Emission Standards.

UNIT – II **9**

Emissions in SI Engine: Chemistry of SI engine combustion - HC and CO formation in SI engines - NO formation in SI engines - Smoke emissions from SI engines - Effect of operating variables on emission formation.

UNIT– III **9**

Emissions in CI Engine: Basics of diesel combustion - Smoke emission and its types in diesel engines - NOx emission and its types from diesel engines - Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines - Effect of operating variables on emission formation.

UNIT – IV **9**

Control Techniques for Reduction of Emission: Design modifications - Optimization of operating factors - Fuel modification - Evaporative emission control - Exhaust gas recirculation - SCR - Fumigation - Secondary Air injection - PCV system - Particulate Trap - CCS - Exhaust treatment in SI engines - Thermal reactors - Catalytic converters - Catalysts - Use of unleaded petrol.

UNIT – V **9**

Test Procedure, Instrumentation and Emission Measurement: Test procedures CVS1, CVS3- Test cycles - IDC - ECE Test cycle - FTP Test cycle - NDIR analyzer - Flame ionization detectors - Chemiluminescent analyzer - Dilution tunnel - Gas chromatograph - Smoke meters - SHED test.

TOTAL: 45

TEXT BOOKS:

1 Guy B Marin, "Automotive Emission Control", Academic Press, 2008.
2 Pundir B.P., "IC Engines Combustion and Emissions", Narosa Publishers, 2010.

REFERENCE BOOKS:

1 Ramalingam K.K., "Internal Combustion Engines", 2nd Edition, Scitech Publications, 2009.
2 Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill Co., 2013.
3 John B., Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., Indian Edition, 2011.
4 Femina Patel and Sanjay Patel, "Automotive Emissions and Its Control", Lap Lambert Academic Publishing GmbH KG, 2012.

Course Outcomes:

On completion of the course the students will be able to

CO1: know the sources, formation and effects of automobile pollution
CO2: understand the different emissions of SI engine and the effect of operating variables in emission formation
CO3: understand the different emissions of CI engine and the effect of operating variables in emission formation
CO4: analyze different control techniques for emission reduction
CO5: illustrate different test procedures and instruments used in emission measurement

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2						3						3	
CO2	2						2						3	
CO3	2					1	2						3	
CO4	1	2	2			1	2						3	
CO5	1	1					1						3	

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO03 AUTOMOTIVE SENSORS AND EMBEDDED SYSTEMS

3 0 0 3

UNIT – I **9**

Fundamentals of Sensor: Introduction of automotive sensor and instrumentation - Sensor electronics and techniques - Overview of sensor measurements - Sensor Linearization and techniques - Sensor classification - Signals and systems - Sensor product - Selection Guide.

UNIT – II **9**

Sensors for Engines and Chassis: Sensor and interfacing - Pressure, position, flow, temperature, Humidity, speed, acceleration, oxygen, torque, light, distance and level - Detonation - Fuel Metering Engine Control - Adaptive Cruise control - Braking control - Traction control - Steering and Stability.

UNIT– III **9**

Actuators: Pneumatic and Hydraulic Actuation Systems - Actuation systems - Pneumatic and hydraulic systems - Directional Control valves - Pressure control valves - Process control valves - Rotary actuators Mechanical Actuation Systems - Types of motion - Kinematic chains - Cams - Gears - Ratchet and pawl - Belt and chain drives - Bearings - Mechanical aspects of motor selection Electrical Actuation Systems - Electrical systems -Mechanical switches - Solid-state switches - Solenoids - D.C. Motors - A.C. motors - Stepper motors.

UNIT – IV **9**

Embedded Networking: Introduction-Register, memory devices, ports, timer, interrupt controller using circuit block diagram-Serial/Parallel Communication- Serial communication protocols - Synchronous Serial Protocols -Serial Peripheral Interface (SPI)-Inter Integrated Circuits (I2C) - PC Parallel port programming - USB bus communication - CAN Bus - Introduction - Frames - Bit stuffing -Types of errors-Nominal Bit Timing - PIC microcontroller CAN Interface-A simple application with CAN.

UNIT – V **9**

Real Time Operating System (RTOS): Introduction to basic concepts of RTOS-Basics of real time and embedded system operating systems - RTOS - Interrupt handling - Task scheduling - Embedded system design issues in system development process - Action plan, use of target system - Emulator, use of software tools.

TOTAL: 45

TEXT BOOKS:

1 Patranabis D., "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2003.
2 BoltonW, "Mechatronics", 5th Edition, Pearson Education Ltd., 2011.

REFERENCE BOOKS:

1 Yu-Cheng Liu and Glenn A. Gibson, "Microcomputer Systems, The 8086/8088 Family", 2nd Edition, Prentice Hall of India, 1985.
2 Rajkamal, "Embedded Systems - Architecture, Programming, Design", 2nd Edition, Tata McGraw Hill, 2009.
3 Daniel W. Lewis, "Fundamentals of Embedded Software", 2nd Edition, Prentice Hall of India, 2003.
4 William, Ribbens B., "Understanding Automotive Electronics", 7th Edition, ButterWorth Heinemann, 2012.
5 Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, 2014.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the working of sensors and its characteristics
CO2: understand the role of sensors used in engines and chassis of the vehicles
CO3: analyze the working of actuators with the input of sensors
CO4: implement embedded systems and data transfer modes
CO5: construct a real time operating system used in automobiles

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO04 ALTERNATE ENERGY SOURCES FOR AUTOMOBILES

3 0 0 3

UNIT – I **9**

Introduction: Energy scenario in India - Energy and Environment Overview - Importance of Alternate Energy sources - Availability of Alternate Energy Sources for SI and CI Engines - Emission standards and measuring techniques.

UNIT – II **9**

Biodiesel: Availability of vegetable oils - Non-edible oils as biodiesel - Blending, Emulsification, Preheating and transesterification - Effect of vegetable oils physical and chemical characteristics on biodiesel properties - Estimation of Physical and chemical properties - Performance, Emission and Combustion Characteristics in diesel engines.

UNIT– III **9**

Alcohols as Fuels: Production methods of alcohols - Production of alcohol from biomass - Properties of alcohols as fuels - Methods of using alcohols in CI and SI engines - Blending, dual fuel operation, fumigation, surface ignition and oxygenated additives - Performance, emission and combustion characteristics in CI and SI engines.

UNIT – IV **9**

Gaseous Fuels: Production methods of Biogas, NG, CNG and LPG - Biogas Digester – Reactions -Viability - Economics - Physical and chemical properties - Modification required in SI and CI Engines - Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines

UNIT – V **9**

Hybrid Electrical Vehicle: Introduction to HEV - Types of motors, battery pack, and accessories - HEV Classification - Layout of series, parallel and combined HEV - Degree of Hybridization (strong, medium, mild/micro, Plug-in) - Fuel cell Hybrid, Hydraulic Hybrid, Pneumatic Hybrid - Advantages and Disadvantages of HEV.

TOTAL: 45

TEXT BOOKS:

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

2 Richard Folkson, "Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance", Woodhead Publishing Ltd., 2014.

REFERENCE BOOKS:

1 Gerhard Knothe, Jon Van Gerpen and Jargon Krahl, "The Biodiesel Handbook", 2nd Edition, AOCS Press Champaign, Illinois, 2015.

2 Transactions of SAE on Biofuels. (Alcohols, Vegetable Oils, CNG, LPG, Hydrogen, Biogas etc.)

3 Science Direct Journals on Biofuels. (Biomass and Bio energy, Fuels, Energy, Energy Conversion Management, Hydrogen Energy, etc.)

Course Outcomes:

On completion of the course the students will be able to

CO1: create an awareness about alternative fuels and their need
CO2: differentiate the conventional fuels and alternative fuels
CO3: acquire the knowledge about application of alternative fuels
CO4: identify the emission parameters from engine emission, its causes and remedies
CO5: get knowledge of emission from different automotive vehicles and its control

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2				2	1						3	
CO2	1		3			2	1						3	
CO3	1		3			2	1						3	
CO4	1		3			2	1						3	
CO5	1													3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO05 AUTOMOTIVE SAFETY AND CONTROL

3 0 0 3

Pre-requisites: Automotive Electrical and Electronics

UNIT – I **9**

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 **9**

Safety Concepts: Active safety: Driving safety - Conditional safety - Perceptibility safety - Operating safety - Passive safety: exterior safety, interior safety - Deformation behavior of vehicle body - Speed and acceleration characteristics of passenger compartment on impact.

UNIT– III **9**

Safety Equipment: 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 **9**

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 **9**

Comfort and Convenience System: Steering and mirror adjustment - Central locking system - Garage door opening system – Tyre pressure monitoring system - Rain sensor system - Environment information system.

TOTAL: 45

TEXT BOOKS:

1 Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, 2014.

REFERENCE BOOKS:

1 Mark Gonter and Ulrich Seiffert, "Integrated Automotive Safety Handbook", SAE Publication, 2013.
2 Ronald K. Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill Inc., 1999.
3 Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", 2ndRevised Edition, SAE Publication, 2007.

Course Outcomes:

On completion of the course the students will be able to

CO1: analyze and solve the energy equation to make a better crumble zone in automobiles
CO2: illustrate the concepts of safety measures in automobiles
CO3: know about safety equipments used in the automobiles
CO4: know the ways to warn and avoid the collision between vehicles
CO5: deal with the comfort and convenience system used in automobiles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		3			3								3
CO2	1		1			3								3
CO3	1		1			3								3
CO4	1					2								3
CO5	1					2	1							3

1 – Slight, 2 – Moderate, 3 – Substantial

14AUO06 BIO ENERGY CONSERVATION TECHNOLOGIES

3 0 0 3

UNIT – I **9**

Introduction: Biomass: Types - Advantages and drawbacks - Indian scenario - Characteristics - Carbon neutrality - Conversion mechanisms - Fuel assessment studies - Densification technologies - Comparison with coal - Proximate and Ultimate Analysis - Thermo Gravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry.

UNIT – II **9**

Biomethanation: Microbial systems - Phases in biogas production - Parameters affecting gas production - Effect of additives on biogas yield - Possible feed stocks. Biogas plants - Types - Design - Constructional details and comparison - Biogas appliances - Burner, luminaries and power generation -Effect on engine performance

UNIT– III **9**

Combustion: Perfect, complete and incomplete combustion - Stoichiometric air requirement for biofuels - Equivalence ratio - Fixed Bed and fluid Bed combustion - Fuel and ash handling systems - Steam cost comparison with conventional fuels

UNIT – IV **9**

Gasification, Pyrolysis and Carbonization: Chemistry of gasification - Types – Comparison - Application - Performance evaluation - Economics - Dual fuelling in IC engines - 100 % Gas Engines - Engine characteristics on gas mode - Gas cooling and cleaning systems - Pyrolysis - Classification - Process governing parameters - Typical yield rates - Carbonization Techniques - Merits of carbonized fuels.

UNIT – V **9**

Liquefied Biofuels: History of usage of Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel health effects / emissions / performance. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications.

TOTAL: 45

TEXT BOOKS:

1 Anju Dahiya, "Bioenergy: Biomass to Biofuels", Academic Press, 2015.
2 Khandelwal K.C. and Mahdi S.S., "Biogas Technology - A Practical Handbook", Tata McGraw Hill, 1988.

REFERENCE BOOKS:

1 Yebo Li and Samir Kumar Khanal, " Bioenergy: Principles and Applications", John Wiley & Sons, 2017.
2 Mahaeswari R.C., "Bio Energy for Rural Energisation", Concepts Publication, 1997.

Course Outcomes:

On completion of the course the students will be able to

CO1: demonstrate the types, advantages, disadvantages, characteristics, conversion mechanism and various analysis of biomass
CO2: familiar with the biomethanation process of producing biogas and its various characteristics
CO3: analyze the different combustion process of bio sources
CO4: understand the producing fuels using gasification, pyrolysis and carbonization
CO5: summarize the transesterification process, production of alcoholic fuels and the modification required

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1						2						3	
CO2	1		2				2						3	
CO3	1	3					2						3	
CO4	1		2				2						3	
CO5	1		1			1	2						3	

1 – Slight, 2 – Moderate, 3 – Substantial