RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF AUTOMOBILE ENGINEERING
CURRICULUM AND SYLLABUS REGULATIONS – 2017
B.E. AUTOMOBILE ENGINEERING

VISION:

To be a department of excellence in the domain of Automotive Engineering and develop competent engineers imbibed with entrepreneurial and innovative skills with a concern for the society.

MISSION:

- To provide accessible quality education well grounding the students in the fundamental principles of Automotive Engineering and humane values.
- To provide a conducive environment for the students to get transformed themselves into professionals who can design, develop and effectuate automotive systems for industry and societal needs.
- To explore, develop and create innovations in Automotive Engineering thereby furthering research activities resulting in products satisfying industrial and social needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S)

1. To provide students with sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze and solve engineering problems and to prepare them for higher studies and for successful careers in automobile industry.

2. To impart students with knowledge, innovation and skills towards research, design and development of Automotive Systems and allied integrated systems of global standards for betterment of society. To impart knowledge in usage of alternate fuels and emission control in IC engines.

3. To instill the values, skills, leadership, team spirit and professional ethics for comprehensive and wholesome personality and to promote entrepreneurial interest among students so that they can compete globally in the field and to create a fervor for use of Engineering in addressing societal concerns.

PROGRAM OUTCOMES (PO)

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

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1. Will be able to design and develop power plant and chassis systems in a view to meet the dynamic needs of the society by harnessing the potential of electronic systems and modern software tools.

PSO2. Will be able to explore possibilities of viable alternate fuels and to develop emission control technologies and safety systems

PSO3. Will be able to work in an industry as a team member as well as an individual with professional qualities and evolve oneself for lifelong learning.

CURRICULUM AND SYLLABUS

CURRICULUM

SEMESTER I								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS17151	Communicative English	HS	3	3	0	0	3
2	MA17151	Engineering Mathematics - I	BS	5	3	2	0	4
3	PH17151	Engineering Physics	BS	3	3	0	0	3
4	CY17151	Engineering Chemistry	BS	3	3	0	0	3
5	GE17151	Problem Solving and Python Programming	ES	3	3	0	0	3
6	GE17152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7	GE17161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8	GE17162	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**17**	**2**	**12**	**24**

SEMESTER II								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
	HS17251	Technical English						
1	HS17252	Professional English Communication	HS	3	3	0	0	3
2	MA17251	Engineering Mathematics - II	BS	5	3	2	0	4
3	AT17201	Applied Thermodynamics	PC	3	3	0	0	3
4	CY17251	Environmental Science and Engineering	HS	3	3	0	0	3
5	EE17252	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
6	GE17251	Engineering Mechanics	ES	4	2	2	0	3
PRACTICALS								
7	GE17261	Engineering Practices Laboratory	ES	4	0	0	4	2
8	GE17262	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**17**	**4**	**8**	**23**

		SEMESTER III						
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17351	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2	ME17401	Fluid Mechanics and Machinery	PC	4	2	2	0	3
3	AT17301	Automotive Engines	PC	3	3	0	0	3
4	AT17302	Automotive Chassis	PC	3	3	0	0	3
5	AT17303	Automotive Heat Transfer	PC	3	3	0	0	3
6	AT17304	Production Technology - I	PC	3	3	0	0	3
PRACTICALS								
7	AT17311	(a) Thermal Laboratory and (b) Fluid Mechanics and Machinery Laboratory	PC	4	0	0	4	2
8	AT17312	Engine Performance and Emission Testing Laboratory	PC	2	0	0	2	1
9	AT17313	Automotive Components Lab	PC	4	0	0	4	2
10	HS17361	Interpersonal Skills - Listening & Speaking	EEC	2	0	0	2	1
			TOTAL	**33**	**17**	**4**	**12**	**25**

0200

		SEMESTER IV						
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17452	Statistics and Numerical Methods	BS	5	3	2	0	4
2	AT17401	Theory of Machines	PC	5	3	2	0	4
3	AT17402	Automotive Transmission	PC	3	3	0	0	3
4	AT17403	Engineering Materials and Metallurgy	PC	3	3	0	0	3
5	AT17404	Production Technology - II	PC	3	3	0	0	3
6	AT17405	Strength of Materials for Automobile Engineers	PC	3	3	0	0	3
PRACTICALS								
7	AT17411	(a) Strength of Materials Laboratory and(b) Theory of Machines Laboratory	PC	4	0	0	4	2
8	AT17412	Production Technology Laboratory	PC	2	0	0	2	1
9	AT17413	Computer Aided Automotive Machine Drawing Lab	PC	4	0	0	4	2
			TOTAL	**32**	**18**	**4**	**10**	**25**

SEMESTER V								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17501	Vehicle Dynamics	PC	5	3	2	0	4
2	AT17502	Electrical Drives and Microcontrollers	PC	3	3	0	0	3
3	AT17503	Automotive Electrical and Electronics	PC	3	3	0	0	3
4	AT17504	Automotive Pollution and Control	PC	3	3	0	0	3
5	AT17505	Machine Design	PC	5	3	2	0	4
6		Open Elective - I	OE	3	3	0	0	3
PRACTICALS								
7	AT17511	Automotive Electrical and Electronics Laboratory	PC	4	0	0	4	2
8	AT17512	Geometric Modelling of Automotive Systems	PC	4	0	0	4	2
			TOTAL	**30**	**18**	**4**	**8**	**24**

SEMESTER VI								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17601	Automotive System Design	PC	5	3	2	0	4
2	AT17602	Electric and Hybrid Vehicles	PC	3	3	0	0	3
3	AT17603	Automotive Fuels and Lubricants	PC	3	3	0	0	3
4	AT17604	Finite Element Analysis for Automobile Engineers	PC	5	3	2	0	4
5		Open Elective- II	OE	3	3	0	0	3
PRACTICALS								
6	AT17611	Automotive Fuels and Lubricants Laboratory	PC	2	0	0	2	1
7	AT17612	Computer Aided Vehicle Design Data Characteristics Laboratory	PC	2	0	0	2	1
8	AT17613	Mini Project	EEC	4	0	0	4	2
9	HS17561	Communication and Soft Skills –Laboratory Based	EEC	4	0	0	4	2
			TOTAL	**31**	**15**	**4**	**12**	**23**

SEMESTER VII								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	GE17451	Total Quality Management	HS	3	3	0	0	3
2	AT17701	Engine and Vehicle Management System	PC	3	3	0	0	3
3	AT17702	Intelligent Vehicle System	PC	3	3	0	0	3
4		Professional Elective – I	PE	3	3	0	0	3
5		Professional Elective – II	PE	3	3	0	0	3
PRACTICALS								
6	AT17711	Vehicle Maintenance Laboratory	PC	2	0	0	2	1
7	AT17712	Computer Aided analysis of Automotive Components Laboratory	PC	4	0	0	4	2
8	AT17713	Two and Three Wheelers Laboratory	PC	2	0	0	2	1
9	AT17714	Technical Seminar/ Industrial Training/Comprehension	EEC	2	0	0	2	1
			TOTAL	**25**	**18**	**0**	**8**	**20**

SEMESTER VIII								
Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective – III	PE	3	3	0	0	3
2		Professional Elective – IV	PE	3	3	0	0	3
PRACTICALS								
3	AT17811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

SEM	I	II	III	IV	V	VI	VIIˋ	VIII
Credits	**24**	**23**	**25**	**25**	**24**	**23**	**20**	**16**
TOTAL NO. OF CREDITS:180								

PROFESSIONAL ELECTIVE - I

Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17E71	Two and Three Wheelers	PE	3	3	0	0	3
2	AT17E72	Off road vehicles	PE	3	3	0	0	3
3	AT17E73	Automotive Sensors	PE	3	3	0	0	3
4	AT17E74	Noise, Vibration and Harshness Control	PE	3	3	0	0	3
5	ME17E82	Operations Research	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - II

Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17E75	Vehicle Maintenance	PE	3	3	0	0	3
2	AT17E76	Transport Management	PE	3	3	0	0	3
3	GE17551	Principles of Management	PE	3	3	0	0	3
4	GE17E52	Entrepreneurship Development	PE	3	3	0	0	3
5	AE17505	Control Engineering	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - III

Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17E81	Production of Automotive Components	PE	3	3	0	0	3
2	AT17E82	Tractors and Farm Equipments	PE	3	3	0	0	3
3	AT17E83	Vehicle Body Engineering	PE	3	3	0	0	3
4	AT17E84	Instrumentation and Metrology	PE	3	3	0	0	3
5	ME17E86	Additive Manufacturing	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - IV

Sl. No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	AT17E85	Automotive Safety	PE	3	3	0	0	3
2	AT17E86	Automotive Testing	PE	3	3	0	0	3
3	AT17E87	Automotive Air-Conditioning	PE	3	3	0	0	3
4	AT17E88	Automotive Aerodynamics	PE	3	3	0	0	3
5	ME17E77	Computational Fluid Dynamics	PE	3	3	0	0	3

OPEN ELECTIVES
(List of Open Electives offered to Automobile Engineering Students)

Sl. No.	Course Code	Course Title	Category	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	0	0	3
5	OBM1701	Anatomy and Physiology for Engineers	OE	3	0	0	3
6	OBM1702	Biomaterials and Artificial Organs	OE	3	0	0	3
7	OBM1703	Fundamentals of Medical Instrumentation	OE	3	0	0	3
8	OBM1704	Engineering Mechanics for Medical Applications	OE	3	0	0	3
9	OBM1705	Basics of Biosensors and Biophotonics	OE	3	0	0	3
10	OBT1701	Basic Bioinformatics	OE	3	0	0	3
11	OBT1702	Biotechnology in Product Development	OE	3	0	0	3
12	OBT1703	Food and Nutrition	OE	3	0	0	3
13	OBT1704	Medical Sciences for Engineers	OE	3	0	0	3
14	OBT1705	Application of Biotechnology for Environmental protection	OE	3	0	0	3
15	OBT1706	Fermentation Technology	OE	3	0	0	3
16	OCH1701	Introduction to Fertilizer Technology	OE	3	0	0	3
17	OCH1702	Introduction to Petroleum Technology	OE	3	0	0	3
18	OCH1703	Unit operations in Environmental Engineering	OE	3	0	0	3
19	OCH1704	Process Technology	OE	3	0	0	3
20	OCH1705	Petrochemical Processing	OE	3	0	0	3
21	OCH1706	Recent trends in water treatment	OE	3	0	0	3
22	OCE1701	Disaster Management	OE	3	0	0	3
23	OCE1702	Coastal Zone Management	OE	3	0	0	3
24	OCE1703	Smart Structures and Smart Materials	OE	3	0	0	3
25	OCE1704	Non Destructive Testing of Materials	OE	3	0	0	3
26	OCE1705	Basics of Architecture	OE	3	0	0	3
27	OCE1706	Global Warming and Climate Change	OE	3	0	0	3
28	OCS1701	Web Design and Management	OE	3	0	0	3
29	OCS1702	Mobile Application Development	OE	3	0	0	3
30	OCS1703	Fundamentals of Database	OE	3	0	0	3

31	OCS1704	Web Programming with XML	OE	3	0	0	3
32	OCS1705	IOT and its Applications	OE	3	0	0	3
33	OCS1706	Programming in C	OE	3	0	0	3
34	OCS1707	Programming in C++	OE	3	0	0	3
35	OCS1708	Java Programming	OE	3	0	0	3
36	OCS1709	Computer Programming	OE	3	0	0	3
37	OEE 1701	Renewable Power Generation Systems	OE	3	0	0	3
38	OEE1702	Electrical Safety and Quality Assurance	OE	3	0	0	3
39	OEE1704	Electric Power Utilization	OE	3	0	0	3
40	OEC1701	MEMS and its Applications	OE	3	0	0	3
41	OEC1702	Consumer Electronics	OE	3	0	0	3
42	OEC1703	Digital Image Processing and its applications	OE	3	0	0	3
43	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	0	0	3
44	OEC1705	Electronics Engineering	OE	3	0	0	3
45	OIT1701	Data Science	OE	3	0	0	3
46	OIT1702	Advanced Python Programming	OE	3	0	0	3
47	OIT1703	Business Intelligence	OE	3	0	0	3
48	OIT1704	Computer Vision	OE	3	0	0	3
49	OIT1705	Cyber Security	OE	3	0	0	3
50	OIT1706	Machine Learning and R Programming	OE	3	0	0	3
51	OMT1701	Industrial Robotics	OE	3	0	0	3
52	OMT1702	Elements of Automation	OE	3	0	0	3
53	OMT1703	Bio-mechatronics	OE	3	0	0	3
54	OMT1704	CNC Systems- Design and Applications	OE	3	0	0	3
55	OMT1705	Mobile Robotics	OE	3	0	0	3
56	OME1701	Design of Experiments	OE	3	0	0	3
57	OME1702	Industrial Safety	OE	3	0	0	3
58	OME1703	Quality Concept	OE	3	0	0	3

59	OME1705	Supply chain and Logistics Management	OE	3	0	0	3
60	OMA1701	Computer based Numerical methods	OE	2	0	2	3
61	OMA1702	Number theory and applications	OE	3	0	0	3
62	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	0	0	3
63	OPH1702	Nanophysics	OE	3	0	0	3
64	OCY1701	Green Chemistry in Energy and Environment	OE	3	0	0	3
65	OCY1702	Interface Chemistry and Engineering	OE	3	0	0	3
66	OGE1701	Human Rights	OE	3	0	0	3
67	OGE1702	Foreign Language-Japanese	OE	3	0	0	3
68	OGE1703	Foreign Language-German	OE	3	0	0	3
69	OGE1704	Foreign Language-French	OE	3	0	0	3

SUMMARY

Sl. No.	Subject Area	Credits per semester								Credits Total	% of Credits
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	6	-	-	-	-	3	-	12	6.67
2	BS	12	4	4	4	-	-	-	-	24	13.33
3	ES	9	10	-	-	-	-	-	-	19	10.56
4	PC	-	3	20	21	21	16	10	-	91	50.56
5	PE	-	-	-	-	-	-	6	6	12	6.67
6	OE	-	-	-	-	3	3	-	-	06	3.33
7	EEC	-	-	1	-	-	4	1	10	16	8.89
	Total	24	23	25	25	24	23	20	16	180	100.00
8	Non-Credit / Mandatory	-	-	-	-	-	-	-	-	-	-

SYLLABUS

SEMESTER I

		L	**T**	**P**	**C**
HS17151	**COMMUNICATIVE ENGLISH**	**3**	**0**	**0**	**3**

OBJECTIVES:
1. To develop the basic reading and writing skills of first year engineering and technology students.

2. To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.

3. To help learners develop their speaking skills and speak fluently in real contexts.

4. To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I   SHARING INFORMATION RELATED TO ONESELF/FAMILY&   9
               FRIENDS**

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences- developing hints. Listening- short texts- short formal and informal conversations.   Speaking- introducing oneself - exchanging personal information- Language development- Questions- asking and answering yes or no questions. Subject-Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II   GENERAL READING AND FREE WRITING   9

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions. Vocabulary development - guessing meanings of words in context.

UNIT III   GRAMMAR AND LANGUAGE DEVELOPMENT   9

Reading- short texts and longer passages (close reading). Writing- understanding text structure - use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV   READING AND LANGUAGE DEVELOPMENT   9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development- synonyms-antonyms- phrasal verbs.

UNIT V   EXTENDED WRITING   9
Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing. Listening – listening to talks- conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs- present/ past perfect tense. Vocabulary development-functional uses of tenses.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

1.   Read articles of a general kind in magazines and newspapers.
2.   Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
3.   Comprehend conversations and short talks delivered in English
4.   Express ideas about oneself freely
5.   Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1   Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.

2   Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS:

1   Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.

2   Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning, USA: 2007

3   Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005

4   Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011

5   Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

MA17151	ENGINEERING MATHEMATICS – I	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

OBJECTIVES:

1. To learn the basics and concepts of traditional calculus.
2. To provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
3. To understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I   MATRICES   15

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II   DIFFERENTIAL CALCULUS   15

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT III   FUNCTIONS OF SEVERAL VARIABLES   15

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV   INTEGRAL CALCULUS   15

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts – Bernoulli's formula, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V   MULTIPLE INTEGRALS   15

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to:

1. Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems
2. Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
3. To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
4. Solve problems involving integration using different methods such as substitution, partial fractions, by parts.
5. Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCE BOOKS:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.

2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

3. Narayanan, S. and ManicavachagomPillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.

4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.

5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

6. Veerarajan T, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

	L	**T**	**P**	**C**
PH 17151 **ENGINEERING PHYSICS**	**3**	**0**	**0**	**3**

OBJECTIVES:
- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I   **PROPERTIES OF MATTER**   **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams –area moment of inertia - bending moment – cantilever - applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II   **WAVES AND OPTICS**   **9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index and mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III   **THERMAL PHYSICS**   **9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV   **QUANTUM PHYSICS**   **9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) – electron microscope – scanning tunnelling microscope.

UNIT V   **CRYSTAL PHYSICS**   **9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP –Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

                               TOTAL :   **45**   **PERIODS**

COURSE OUTCOMES:

On completion of the course students will be able to
1. Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.

2. Use the concepts of waves and optical devices and their applications in fiber optics.

3. Use the concepts of thermal properties of materials and their applications in heat exchangers.

4. Use the advanced physics concepts of quantum theory and its applications in electron microscope and material sciences.

5. Apply the basic knowledge of crystallography in materials preparation and device fabrication.

TEXT BOOKS:

1   Bhattacharya, D.K. &Poonam, T. "Engineering Physics". Oxford University Press, 2015.

2   Gaur, R.K. & Gupta, S.L. "Engineering Physics". DhanpatRai Publishers, 2012.

3   Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCE BOOKS:

1   Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.

2   Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers".   Cengage Learning, 2010.

3   Tipler, P.A. &Mosca, G. "Physics for Scientists and Engineers with Modern Physics",W.H.Freeman, 2007.

4   Arthur Besier and S. RaiChoudhury,"Concepts of Modern Physics (SIE)", 7th edition, McGraw-Hill Education, 1994.

5   Murugeshan R and KiruthigaSivaprasath, "Modern Physics", S.Chand, 2015.

CY17151   **ENGINEERING CHEMISTRY**   **L   T   P   C**

                                                                3   0   0   3

OBJECTIVES:

1. To acquire knowledge on characteristics of boiler feed water and water treatment techniques.

2. To develop an understanding on surface chemistry and its applications

3. To develop an understanding of the basic concepts of phase rule and its applications towards alloying

4. To acquire knowledge on different types of fuels and its characteristics.

5. To obtain knowledge on batteries and fuel cell.

UNIT I   WATER AND ITS TREATMENT   9

Hardness of water – types – expression of hardness – units– boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment – ion exchange process, zeolite process – potable water treatment – break point chlorination - desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II   SURFACE CHEMISTRY AND CATALYSIS   9

Adsorption - types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – Preparation and applications of activated carbon (up flow and down flow process) -applications of adsorption on pollution abatement.

Catalysis – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III   PHASE RULE, ALLOYS AND   COMPOSITES   9

Phase rule - introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

Alloys - definition- properties of alloys- significance of alloying- functions and effect of alloying elements- nichrome and stainless steel (18/8) – heat treatment of steel.

Composites- polymer matrix composites -metal matrix composites-ceramic matrix composites.

UNIT IV   FUELS AND COMBUSTION   9

Fuels - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gas (LPG) - power alcohol and biodiesel.

Combustion of fuels - introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range.

UNIT V   ENERGY SOURCES AND STORAGE DEVICES   9

Batteries - components – Characteristics – voltage, current, capacity, electrical storage density, energy density, discharge rate – types of batteries – primary battery (dry cell)- secondary battery (lead acid battery, Ni- Cdbattery,lithium-ion-battery).Fuel cells – H_2-O_2 fuel cell, methanol oxygen fuel cell, Proton exchange membrane fuel cell – SOFC and Biofuel cells

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to

1. Get familiarized on water treatment techniques.
2. Apply adsorption phenomena on various fields.
3. Analyse alloying composition based on phase rule concept.
4. Apply the role of fuels in day today applications.
5. Design batteries and fuel cells.

TEXT BOOKS:

1   Jain P C and Monika Jain, "Engineering Chemistry", 17th edition,DhanpatRai Publishing Company (P) LTD, New Delhi, 2015

2   Vairam S, KalyaniPand Suba Ramesh, "Engineering Chemistry", Wiley India Pvt. Ltd., New Delhi, 2013

REFERENCE BOOKS:

1   Friedrich Emich, "Engineering Chemistry", Scientific International Pvt. Ltd., New Delhi, 2014.

2   PrasantaRath, "Engineering Chemistry", Cengage Learning India Pvt. Ltd., Delhi, 2015.

3   ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

4   Dara S S and Umare S S, "A Textbook of Engineering Chemistry", 12th edition,S. Chand & Company LTD, New Delhi, 2015

	L	**T**	**P**	**C**
GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To know the basics of algorithmic problem solving
2. To develop Python programs with conditionals and loops.
3. To define Python functions and call them.
4. To use Python data structures –- lists, tuples, dictionaries.
5. To do input/output with files in Python.

UNIT I   ALGORITHMIC PROBLEM SOLVING   9

Introduction to computers, characteristics, basic organization of a computer- algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions)-notation (pseudo code, flow chart, programming language)-algorithmic problem solving-simple strategies for developing algorithms (iteration, recursion).

UNIT II   DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW   9

Python interpreter and interactive mode - values and types - data types – variables – keywords - expressions and statements - python I/O - operators - precedence of operators – comments. Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else) – nested conditional. Iteration: while – for - break – continue – pass. Illustrative programs: exchange thevalues of two variables - circulate the values of n variables - test for leap year.

UNIT III   FUNCTIONS   9

Function calls – type conversion – math function – composition - definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion. Strings: string slices – immutability - string functions and methods - string comparison. Illustrative programs: square root – GCD – exponentiation - sum the array of numbers - linear search - binary search.

UNIT IV   COMPOUND DATA: LISTS, TUPLES, DICTIONARIES   9

Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value. Dictionaries: operations and methods – dictionaries and tuples – dictionaries and lists. Advanced list processing - list comprehension. Illustrative programs: Sorting.

UNIT V   FILES, MODULES, PACKAGES   9

Files and exception: file operation - text files - reading and writing files - format operator- command line arguments -   errors and exceptions - handling exceptions – writing modules – packages. Illustrative programs: word count - copy file – case studies.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

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

1. Develop algorithmic solutions to simple computational problems

2. Structure simple Python programs for solving problems.

3. Decompose a Python program into functions.

4. Represent compound data using Python lists, tuples and dictionaries.

5. Read and write data from/to files in Python Programs.

TEXT BOOKS:

1   Allen B. Downey, "Think Python: How to Think Like a Computer Scientist",Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.   (http://greenteapress.com/wp/think-python/)

REFERENCE BOOKS:

1   Anita Goel,Ajay Mittal, "Computer Fundamentals and programming in C", Pearson India Publisher, First edition, 2013.

2   John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013.

3   Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

4   Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.

5   Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

6   Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

7   The Python Tutorial, https://docs.python.org/2.7/tutorial/

	L	**T**	**P**	**C**
GE 17152 **ENGINEERING GRAPHICS**	**2**	**0**	**4**	**4**

OBJECTIVES:
1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.
3. To study different type of projections and practice on free hand sketching.

CONCEPTS AND CONVENTIONS (Not for Examination)   **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I   PLANE CURVES AND FREEHAND SKETCHING   7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves- Construction of helical curve. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II   PROJECTION OF POINTS, LINES AND PLANE SURFACES   6+12

Orthographic projection- principles-Principalplanes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III   PROJECTION OF SOLIDS   5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method

UNIT IV   PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF   5+12
                SURFACES

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V   ISOMETRIC AND PERSPECTIVE PROJECTIONS   6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids andcylinders by visual ray method.

TOTAL :   90   PERIODS

COURSE OUTCOMES:

On Completion of the course, the student will be able to:

1. Draw basic geometrical constructions of plane curvesandfreehand sketching of multiple views of objects.
2. Drawtheorthographic projection of lines and plane surfaces.
3. Draw the projections solids.
4. Draw the true shape of the sectioned solid and development of surfaces.
5. Drawtheisometric and perspective sections of simple solids.

TEXT BOOKS:

1   Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2   Natrajan K.V., "A textbook of Engineering Graphics", DhanalakshmiPublishers,Chennai, 2009.

REFERENCE BOOKS:

1   BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2   Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3   Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphicsfor Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4   Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5   Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1   IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2   IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering
3   IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4   IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5   IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERINGGRAPHICS:

1   There will be five questions, each of either or type covering all units of the syllabus.
2   All questions will carry equal marks of 20 each making a total of 100
3   The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4   The examination will be conducted in appropriate sessions on the same day

GE17161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To be familiar with the use of office package exposed to presentation and visualization tools.
2. To implement Python programs with conditionals and loops.
3. To use functions for structuring Python programs.
4. To represent compound data using Python lists, tuples and dictionaries.
5. To read and write data from/to files in Python.

LIST OF PROGRAMS

1.   Search, generate, manipulate data using Open Office

2.   Presentation and Visualization – graphs, charts, 2D, 3D

3.   Problem Solving using Algorithms and Flowcharts

4.   Compute the GCD of two numbers.

5.   Find the square root of a number (Newton's method)

6.   Exponentiation (power of a number)

7.   Linear search and Binary search

8.   First n prime numbers

9.   Find the maximum of a list of numbers

10.   Sorting

11.   Removingall the duplicate elements in a list

12.   Multiply matrices

13.   Programs that take command line arguments (word count)

14.   Find the most frequent words in a text read from a file

15.   Mini Project

PLATFORM NEEDED:
        Hardware: PC with 2 GB RAM, i3 Processor
        Software: Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

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

1. Develop documentation, presentation and visualization charts.

2. Implement Python programs with conditionals and loops.

3. Develop Python programs stepwise by defining functions and calling them.

4. Use Python lists, tuples and dictionaries for representing compound data.

5. Read and write data from/to files in Python.

GE17162   **PHYSICS AND CHEMISTRY LABORATORY**   **L   T   P   C**
                     (Common to all branches of B.E. / B.Tech Programmes)   **0   0   4   2**

OBJECTIVES:

1. To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.
2. To impart practical skills in water quality parameter analysis, spectrophotometry, flame photometry and corrosion rate determination.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
    (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 Experiments)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.

2. Determination of total, temporary & permanent hardness of water by EDTA method.

3. Determination of DO content of water sample by Winkler's method.

4. Determination of chloride content of water sample by argentometric method.

5. Determination of strength of given hydrochloric acid using pH meter.

6. Estimation of iron content of the given solution using potentiometer.

7. Conductometric titration of strong acid vs strong base.

8. Determination of strength of acids in a mixture of acids using conductivity meter.

9. Estimation of copper content of the given solution by Iodometrxy.

10. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).

11. Estimation of sodium and potassium present in water using flame photometer.

12. Corrosion experiment-weight loss method.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to

1. Calculate elastic properties of materials, such as Young's modulus & Rigidity modulus (of solids) and Bulk modulus (through compressibility of liquids).
2. Measure various optical and thermal properties of materials (such as wavelengths of spectral lines & Laser source, acceptance angle &numerical aperture of fiber optical cable and thermal conductivity of media).
3. Analyse water quality parameters.
4. Be familiar in the use of instruments for chemical analysis.
5. Measure the corrosion rate in metals.

TEXT BOOKS:

1   Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014)

SEMESTER II

		L	**T**	**P**	**C**
HS17251	**TECHNICAL ENGLISH**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.

2. Foster their ability to write convincing job applications and effective reports.

3. Develop their speaking skills to make technical presentations, participate in group discussions.

4. Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization

UNIT I   INTRODUCTION TO TECHNICAL ENGLISH   9

Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from journals- newspapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations. Vocabulary Development- technical vocabulary.   Language Development –subject verb agreement - compound words.

UNIT II   READING AND STUDY SKILLS   9

Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabulary used in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III   TECHNICAL WRITING AND GRAMMAR   9

Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations.   Reading – longer texts both general and technical, practice in speed reading. Writing-Describing a process, use of sequence words. Vocabulary Development- sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV   REPORT WRITING   9

Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation(via email and hard copy)- analytical essays and issue based essays. Vocabulary Development- finding suitable synonyms-paraphrasing. Language Development- clauses- if conditionals.

UNIT V   GROUP DISCUSSION AND JOB APPLICATIONS   9

Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases   Language Development- reported speech, common errors in English.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Read technical texts and write area- specific texts effortlessly.
2. Listen and comprehend lectures and talks in their area of specialisation successfully.
3. Speak appropriately and effectively in varied formal and informal contexts.
4. Write reports and winning job applications.
5. Write error free language.

TEXT BOOKS:

1   Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016

2   Sudharshana,N.P and Saveetha, C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS:

1   Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.

2   Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015

3   Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.

4   Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

5   Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning, USA: 2007

       Students can be asked to read Tagore, ChetanBhagat for supplementary reading**.**

	L	**T**	**P**	**C**
HS17252 PROFESSIONAL ENGLISH COMMUNICATION	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To prepare students to be competent in a global business environment.
2. To think accurately, clearly and deeply in communicative contexts.
3. To improve career opportunities – get English language skills that are needed to be successful.

UNIT I   CRITICAL/ INFORMATIONAL LISTENING   9

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview(two or more speakers).

UNIT II   CONVERSATIONAL/ PRESENTATION SKILLS   9

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT III   INTENSIVE/ EXTENSIVE READING AND INTERPRETING   9

Short texts (signs, messages, emails, labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper- magazine or article- reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT IV   FORMAL COMMUNICATION   9

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT V   VERBAL ABILITY/ FUNCTIONAL GRAMMAR   9

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning - usage match.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

1. Listen to, understand and give opinions in meetings.
2. Apply for new jobs and develop their career.
3. Write short business messages and reports.
4. Use language in both official and unofficial contexts.
5. Speak effectively in business communication

TEXT BOOKS:

1   Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

REFERENCE BOOKS:

1   Hartley, Mary. "The Power of Listening," JaicoPublishing House; First Edition (2015).

2   Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

3   Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. "Business Communication," Eleventh Edition, Tata McGraw Hill Education Private Limited.

MA17251 **ENGINEERING MATHEMATICS – II** **L T P C**
3 2 0 4

OBJECTIVES:

1. To handle practical problems arising in the field of engineering and technology.
2. To solve problems using the concept of Differential Equation, Vectors calculus, complex analysis, Laplace transforms.

UNIT I   DIFFERENTIAL EQUATIONS   15

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT II   VECTOR CALCULUS   15

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals (cubes and parallelepipeds).

UNIT III   ANALYTIC FUNCTIONS   15

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, \; cz, \dfrac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV   COMPLEX INTEGRATION   15

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V   LAPLACE TRANSFORMS   15

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to **:**

1. Apply various techniques in solving differential equations.
2. Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
3. Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
4. Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
5. Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS:

1 Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

2 Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCE BOOKS:

1 Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.) New Delhi, 7th Edition, 2009.

2 Jain R.K. andIyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

3 O'Neil, P.V."Advanced Engineering Mathematics",Cengage Learning India Pvt., Ltd, New Delhi, 2007.

4 Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.

5 Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

6 Veerarajan T., "Engineering Mathematics I & II", McGraw Hill Education, 3rd Edition, 2012.

AT17201	**APPLIED THERMODYNAMICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart Refrigeration Tables and Psychrometric Chart permitted)

OBJECTIVES:

1. To illustrate the thermodynamic laws and their applications
2. To make the students to understand second law of thermodynamics and availability.
3. To make the student to understand basics of ideal and real gases and properties of steam and steam power cycles.
4. To explain the various principles involved in air compressors.
5. To make the students to understand the basics of refrigeration and Psychrometry

UNIT I   FIRST LAW OF THERMODYNAMICS   9

Macroscopic and microscopic aspects – thermodynamic system and surrounding – forms of energy– properties of a system – state - equilibrium– Quasi static process – Zeroth law of Thermodynamics – Heat – Work –First law of Thermodynamics - PMM I –Application of First law to non flow system– Thermodynamic analysis of control volume– Steady flow energy equation– Applications.

UNIT II   SECOND LAW OF THERMODYNAMICS   9

Limitations of first law – cyclic heat engine - heat pump – refrigerator - second law of thermodynamics – equivalence of Kelvin-Planck and Clausius statements - PMM II - Reversibility and irreversibility – causes of Irreversibility - Carnot cycle - reversed Carnot cycle - Carnot theorem – absolute thermodynamic temperature scale – Clausius theorem - Clausius inequality - concept of entropy – principle of increase of entropy - Applications of II Law. High and low grade energy - Available and unavailable energy - Exergy and Irreversibility (Descriptive Only) - I and II law Efficiency.

UNIT III   IDEAL & REAL GASES AND STEAM POWER CYCLE   9

Properties of ideal and real gases - equation of state for ideal and real gases - Vander Waal's equation of states, compressibility factor and compressibility chart.
Pure substance - thermodynamic properties of steam - Use of Steam Table and Mollier Chart - Determination of dryness fraction. Standard Rankine cycle, reheat and regenerative cycle.

UNIT IV   AIR COMPRESSOR   9

Classification and working principle - work of compression with and without clearance- volumetric efficiency, isothermal efficiency and isentropic efficiency of reciprocating air compressors - multistage air compressor and inter cooling – various types of rotary compressors (Descriptive treatment only).

UNIT V   REFRIGERATION AND PSYCHROMETRY   9

Fundamentals of refrigeration - vapour compression refrigeration cycle – effects of super heating, sub cooling and performance calculations. Working principle of vapour absorption system – comparison between vapour compression and absorption systems.

Psychrometry – Property calculations of air vapour mixtures by using chart and expressions – basic psychrometric processes.   - Air conditioning systems (Description only).

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to **:**

1. Explain the basic concepts in thermodynamics and solve problems in first law of thermodynamics

2. Apply the second law of thermodynamics and availability to calculate the efficiency of Heat engine and COP of Heat pump

3. Analyze the steam power plant with basic assumptions and find out the efficiency of the system. They can also calculate the properties of real gases using thermodynamics charts.

4. Explain the working principle of different types of air compressors and calculate the performance parameters of reciprocating air compressors.

5. Able to analyze various processes involved in refrigeration and psychrometrics

TEXT BOOKS:

1   Nag. P. K., 'Basic and Applied Thermodynamics', Tata McGraw-Hill Education Pvt. Ltd., 2010.

2   S. Domkundwar, C.P. Kothandaraman and A.V. Domkundwar., "A Course in Thermal Engineering", DhanpatRai and Co, 2004.

REFERENCE BOOKS:

1   Ramalingam K.K. 'Thermodynamics', Sci-Tech Publications, 2006.

2   P.Chattopadhyay, "Engineering Thermodynamics", Oxford University Press,2010.

3   RathakrishnanE, "Fundamentals of Engineering Thermodynamics", PHI Learning P.Ltd.New Delhi, 2009.

4   Holman.J.P., "Thermodynamics", 3rd Ed. Tata McGraw-Hill Education Pvt. Ltd., 2007.

5   Arora C.P, 'Thermodynamics', Tata McGraw-Hill Education Pvt. Ltd., 2004.

6   Merala C, Pother, Craig W, Somerton, 'Thermodynamics for Engineers', Schaum Outline Series, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2004.

7   Rajput R.K., "Thermal Engineering", Laxmi Publications (P) Limited, New Delhi, 2010

CY17251	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:
1. To find the scientific, technological, economic and political solutions to environmental problems.
2. To study the interrelationship between living organism and environment.
3. To study the importance of environment by assessing its impact on the human world.
4. To study the dynamic processes and understand the features of the earth's interior and surface.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I   ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY   12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest ecosystem - grassland ecosystem - desert ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Significance of medicinal plants - biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II   ENVIRONMENTAL POLLUTION   10

Definition - causes, effects and control measures of Air pollution (Atmospheric chemistry - Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry- Mitigation procedures - Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) - Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance - Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards– e-Waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution – pollution case studies.

UNIT III   NATURAL RESOURCES   10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization 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 and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources - energy production from waste materials. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT   7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – Principles of green chemistry - nuclear accidents and holocaust, case studies – wasteland reclamation – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Eco-mark). Enforcement machinery involved in environmental legislation- central and state pollution control boards - disaster management: floods, earthquake, cyclone and landslides. Public awareness and case studies.

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT   6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – Dengue fever- Swine flu – women and child welfare – Environmental impact analysis (EIA)- GIS-remote sensing - role of information technology in environment and human health – Case studies. Effect of Radiation from computing devices.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to

1. Solve problems that cannot be solved by mere laws.
2. Get familiarized with ecological balance.
3. Get public awareness of environment at infant stage.
4. Find ways to protect the environment and play proactive roles.
5. Develop and improve the standard of better living.

TEXT BOOKS:

1   Benny Joseph, 'Environmental Science and Engineering', 2nd edition, Tata McGraw-Hill, New Delhi,2008.
2   Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS:

1   Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt. Ltd., New Delhi, 2007.
2   ErachBharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press(I) Pvt. Ltd., Hydrabad, 2015.
3   Tyler G Miller and Scott E. Spoolman, "Environmental Science", 15th edition, Cengage Learning India Pvt. Ltd., Delhi, 2014.
4   Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', 3rd edition, Oxford University Press,2015.

EE17252   **BASIC ELECTRICAL,ELECTRONICSAND**   **L   T   P   C**
                    INSTRUMENTATION ENGINEERING   **3   0   0   3**

OBJECTIVES:

1. To impart knowledge on DC circuits.
2. To understand the concepts of AC circuits.
3. To acquire knowledge on principle of operations of various electrical machines.
4. To understand the working principle of different types of electronic devices.
5. To acquire knowledge on principle of operations of measuring instruments.

UNIT I   DC CIRCUITS   9

Basic circuit components - Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II   AC CIRCUITS   9

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three phase balanced circuits – Three phase loads - house wiring, industrial wiring, materials of wiring.

UNIT III   ELECTRICAL MACHINES   9

Principles of operation and characteristics of DC machines, Transformers (single and three phase), Synchronous machines, three phase and single phase induction motors.

UNIT IV   ELECTRONIC DEVICES & CIRCUITS   9

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics – Field Effect Transistors – Transistor Biasing – Introduction to operational Amplifier – Inverting Amplifier – Non Inverting Amplifier – DAC – ADC .

UNIT V   MEASUREMENTS & INSTRUMENTATION   9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes – three phase power measurements – instrument transformers (CT and PT).

                                           TOTAL :   45   PERIODS

COURSE OUTCOMES:

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

1. understand the DC circuits
2. analyze the AC circuits
3. understand the working principles of electrical machines
4. comprehend the concepts of various electronic devices
5. choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS:

1   Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013

2   D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint,2016

3   Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008.

REFERENCE BOOKS:

1   Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007

2   John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006

3   Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition, 2006

4   Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006

5   A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009

6   N K De, DipuSarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016

GE17251	ENGINEERING MECHANICS	L T P C
		2 2 0 3

OBJECTIVES:

1. To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces
2. To understand the concept of equilibrium and to solve problems of rigid bodies
3. To learn about thecenter of gravity and moment of inertia of surfaces and solids
4. To learn the basic concepts of friction
5. To learn the concepts in kinematics and kinetics of rigid bodies in plane motion.

UNIT I   STATICS OF PARTICLES   12

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

UNIT II   EQUILIBRIUM OF RIGID BODIES   12

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

UNIT III   PROPERTIES OF SURFACES AND SOLIDS   12

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

UNIT IV   DYNAMICS OF PARTICLES   12

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

UNIT V   FRICTION AND RIGID BODY DYNAMICS   12
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL :   60   PERIODS

COURSE OUTCOMES:

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

1. Understand the basics of Mechanics.
2. Solve problems in engineering systems using the concept of static equilibrium
3. Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas
4. Solve problems involving kinematics and kinetics of rigid bodies in plane motion
5. Solve problems involving frictional phenomena in machines

TEXT BOOKS:

1 Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

2 Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition,Vikas Publishing House Pvt. Ltd., 2005.

REFERENCE BOOKS:

1 Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 2005.

2 Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.

3 Irving H. Shames and Krishna MohanaRao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.

4 Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.

5 Vela Murali, "Engineering Mechanics", Oxford University Press, 2010.

GE17261	**ENGINEERING PRACTICES LABORATORY**	**L T P C**
		0 0 4 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I   CIVIL ENGINEERING PRACTICE

Buildings:
(a)   Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a)   Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings
(b)   Study of pipe connections requirements for pumps and turbines.
(c)   Preparation of plumbing line sketches for water supply and sewage works.
(d)   Hands-on-exercise:
      Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e)   Demonstration of plumbing requirements of high-rise buildings.

Carpentry Using Power Tools Only:
(a)   Study of the joints in roofs, doors, windows and furniture.
(b)   Hands-on-exercise : Wood work, joints by sawing, planning and cutting.

II   MECHANICAL ENGINEERING PRACTICE
Welding:
(a)   Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b)   Gas welding practice

Basic Machining:
(a)   Simple Turning and Taper turning
(b)   Drilling Practice

Sheet Metal Work:
(a)   Forming & Bending.
(b)   Model making – Trays and funnels.
(c)   Different type of joints.

Machine Assembly Practice:
(a)   Study of centrifugal pump
(b)   Study of air conditioner

Demonstration On:
(a)   Smithy operations, upsetting, swaging, setting down and bending. Example
      Exercise – Production of hexagonal headed bolt.
(b)   Foundry operations like mould preparation for gear and step cone pulley.
(c)   Fitting – Exercises – Preparation of square fitting and V – fitting models

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE
1 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2 Fluorescent lamp wiring.
3 Stair case wiring
4 Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit
5 Measurement of earth resistance.

IV ELECTRONICS ENGINEERING PRACTICE
1 Study of electronic components – Resistor measurement usingcolor coding -measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO.
2 Study of logic gates AND, OR, EXOR and NOT.
3 Generation of Clock Signal.
4 Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5 Measurement of ripple factor of HWR and FWR.

TOTAL :   60   PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. fabricate carpentry components.

2. fit pipe connections including plumbing works.

3. use welding equipment's to join the structures.
4. construct different types of wiring circuits.
5. fabricate electrical and electronic circuits.

REFERENCE BOOKS:

1 Jeyachandran K., Natarajan S. &Balasubramanian S., "A Primer on EngineeringPractices Laboratory", Anuradha Publications, 2007.

2 Jeyapoovan T., Saravanapandian M. &Pranitha S., "Engineering Practices Lab Manual",Vikas Publishing House Pvt.Ltd, 2006.

3 Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.

4 Rajendra Prasad A. &Sarma P.M.M.S., "Workshop Practice", SreeSai Publication, 2002.

EE17262	**BASIC ELECTRICAL,ELECTRONICSAND**	**L**	**T**	**P**	**C**
	INSTRUMENTAION ENGINEERING LABORATORY	**0**	**0**	**4**	**2**

OBJECTIVES:

1. To study and validate the principles of operation of DC motors.
2. To understand the principles of operation of AC motors.
3. To study the principles of operation of Transformer and its testing methods.
4. To study the applications of PN junction Diode.
5. To obtain the characteristics of various transducers.

LIST OF EXPERIMENTS:

1. Load test on DC Shunt Motor and DC Series Motor
2. Load test on Single phase Transformer
3. Load test on Induction motor(single, three phase)
4. Regulation of 3phase Alternator
5. Diode based application circuits
6. Transistor based application circuits
7. Study of Logic gates and Flip-Flops
8. Characteristics of LVDT
9. Characteristics of RTD
10. Characteristics of Thermistor

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

1. draw the speed characteristic of different types of DC motors.
2. draw the speed characteristic of different types of AC machines.
3. obtain the performance parameters of Transformer.
4. design an application involving diodes and transistors.
5. obtain the characteristics of transducers.

SEMESTER III

MA17351   **TRANSFORMS AND PARTIAL DIFFERENTIAL**   **L   T   P   C**
                                  EQUATIONS   **3   2   0   4**

OBJECTIVES:

1. To introduce Fourier series which is central to many applications in engineering apart from its use in solving boundary value problems.
2. To acquaint the student with Fourier transform techniques used in wide variety of situations.
3. To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I   PARTIAL DIFFERENTIAL EQUATIONS   15

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order   PDE: $f(p, q) = 0, f(z, p, q) = 0, z = px + qy + f(p, q), f(x, p) = f(y, q)$ - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT II   FOURIER SERIES   15

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT III   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   15

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV   FOURIER TRANSFORMS   15

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity - Application to boundary value problems.

UNIT V   Z - TRANSFORMS AND DIFFERENCE EQUATIONS   12

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Develop skills to solve different types of partial differential equations
2. Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
3. Classify different types of PDE and solve boundary value problems.
4. Develop skills to solve differential equations using Fourier transform techniques.
5. Solve difference equations using Z – transforms that arise in discrete time systems

TEXT BOOKS:

1   Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.

2   Grewal. B.S., "Higher EngineeringMathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.

REFERENCE BOOKS:

1   Bali N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, LaxmiPublicationsPvt. Ltd, 2007

2   RamanaB.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, NewDelhi, 2008.

3   Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

4   Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.

5   Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, Sixth Edition, New Delhi, 2012.

6   Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt. Ltd, Delhi, 2013.

ME17401   **FLUID MECHANICS AND MACHINERY**   **L   T   P   C**
                                                                   2   2   0   3

OBJECTIVES:

1. The applications of the conservation laws to flow through pipes and hydraulic machines are studied
2. To understand the flow and losses in pipe flow.
3. To understand the importance of dimensional analysis.
4. To understand the importance of various types of flow in pumps.
5. To understand the importance of various types of flow in turbine.

UNIT I   FLUID PROPERTIES AND FLOW CHARACTERISTICS   13

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristic – concept of control volume - application of continuity equation, energy equation and momentum equation – Venturi meter and orifice meter - applications.

UNIT II   FLOW THROUGH CIRCULAR CONDUITS   13

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – **Chezy's equation** – friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III   DIMENSIONAL ANALYSIS   10

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

UNIT IV   THEORY OF HYDRO TURBO MACHINES AND POSITIVE   12
                   DISPLACEMENT MACHINES

Theory of roto-dynamic machines - Classification– various heads & efficiencies– velocity components at entry and exit of the rotor - velocity triangles of turbines & pumps. Axial, radial and mixed flow turbines. Reciprocating pump- working principle – Rotary pumps –classification – **Application of pumps and Turbines**.

UNIT V   PUMPS AND TURBINES   12

Impact of jets - Euler's equation - Centrifugal pumps– working principle - work done by the impeller - performance curves - Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

TOTAL :   60   PERIODS

COURSE OUTCOMES:

On the successful completion of the course, students will be

1. Able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
2. Able to uunderstand the concept of losses during flow of liquid.
3. Able to apply the mathematical knowledge and the properties of fluid for Dimensional Analysis.
4. Able to critically analyse the performance of pumps and practical applications
5. Able to critically analyse the performance of turbines and practical applications.

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.

2. R.K. Bansal "Fluid Mechanics and Machinery", Laxmi Publications, 2017.

REFERENCE BOOKS:

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.

2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi,2016.

3. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Fluid Mechanics and Machinery", 2011.

4. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.

AT17301 **AUTOMOTIVE ENGINES** **L   T   P   C**
                                                     3   0   0   3

OBJECTIVES:

1. To understand the basic principles, construction and working of IC engines
2. To understand the concept & working of various fuels systems employed in IC engines
3. To understand the combustion and combustion chamber types in IC engine.
4. To understand the concept of turbocharging, supercharging, and engine testing
5. To understand the requirements and types of cooling and lubrication systems in IC engines

UNIT I   CONSTRUCTION AND OPERATION   9

Classification of IC engines, Constructional details of spark ignition (SI) and compression ignition (CI) engines. Working principles. Two stroke SI and CI engines – construction and working. Comparison of SI and CI engines and four stroke and two stroke engines. Firing order. Cam shaft and Valve train actuation mechanisms, Variable valve timing (VVT). Air Standard Otto, diesel and dual cycles.

UNIT II   FUEL SYSTEMS   9

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple carburetor, Throttle body injection, MPFI and GDI system. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multi-hole nozzles, Unit injector and common rail injection systems. Injection pumps calibration. Need for a governor for diesel engines. Description of a simple diesel engine governor.

UNIT III   COMBUSTION AND COMBUSTION CHAMBERS   9

Introduction to combustion in SI and diesel engines and stages of combustion. Dependence of ignition timing on load and speed. Knock 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. Factors controlling combustion chamber design.

UNIT IV   SUPERCHARGING, TURBOCHARGING AND ENGINE TESTING   9

Supercharging and Turbocharging, Different methods of turbocharging, Inter-cooling, Turbocharger controls including, waster gate, variable geometry, variable nozzle types. Measurement of Brake Power, Frictional Power and Cylinder pressure. Indicated thermal, brake thermal and volumetric efficiencies. Engine performance maps, Engine testing standards.

UNIT V   COOLING AND LUBRICATION SYSTEMS   9

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermo syphon and forced circulation and pressurized cooling systems. Radiator construction and Types. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. Students will be able to explain basic construction and Working of IC engines and operating cycles
2. Students will be able to identify and demonstrate various fuel systems employed in automobiles.
3. Students will be able to explain the stages of combustion, types of chambers and various parameters affecting combustion
4. Students will be able to explain turbocharging, and supercharging and to demonstrate about engine testing
5. Students will be able to explain the requirements of cooling and lubrication and different types of cooling and lubrication systems employed in IC engines

TEXT BOOKS:

1 Ganesan V., "Internal Combustion Engines", Tata McGraw Hill, 4th edition, 2012.

2 R.P. Sharma and M.L. Mathur "Internal Combustion Engines" Dhanpat Rai Publications, 2013

REFERENCE BOOKS:

1 B. P. Pundir, "IC Engines: Combustion and Emissions" Narosa Publication, 2017

2 Ramalingam K.K., "Internal Combustion Engines", Sci-Tech Publications, 3rd edition, 2016.

3 Devaradjane. Dr. G., Dr. M. Kumaresan, "Automobile Engineering", AMK Publishers, 2013

4 Heinz Heisler, "Advanced Engine Technology", Butterworth Heinemann Publications, 1995

5 John B. Heywood, "Fundamentals of Internal Combustion Engines", McGraw Hill, 1988

6 Gupta. H.N. "Fundamentals of Internal Combustion Engines", reprint, PHI Learning Pvt. Ltd. 2006

AT17302	AUTOMOTIVE CHASSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To learn about the types of chassis layout and constructional details of steering systems.
2. To learn about the principle, working and components of driveline system
3. To know about the loads acting on rear axles and the various types of tyres and wheels of an automobile.
4. To know about the necessity, types of suspension systems utilized for automobiles.
5. To understand the need and types of braking system in automobile

UNIT I   LAYOUT, FRAME, FRONT AXLE AND STEERING SYSTEM   9

Basic construction of vehicles, Types of Chassis layout, with reference to Power Plant location and drive, various, types of frames, Loads acting on vehicle frame, Types of Front Axles and Stub Axles, Front Wheel Geometry. Condition for True Rolling Motion. Ackerman's and Davis's Steering Mechanisms, Steering Linkages, Different Types of Steering Gear boxes, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power Steering

UNIT II   DRIVE LINE, FINAL DRIVE AND DIFFERENTIAL   9

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 and its types. Principle and Constructional details of differential unit, Non–Slip differential, Differential locks.

UNIT III   REAR AXLES, WHEELS, RIMS AND TYRES   9

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 axle vehicles and its types. Wheels and Rims, Types of Tyres and their constructional details.

UNIT IV   SUSPENSION SYSTEM   9

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.

UNIT V   BRAKE SYSTEMS   9

Need for Brake systems, Stopping Distance, Time and Braking Efficiency, Effect of Weight Transfer during Braking, Classification of brakes, Braking Torque, drum brake and disc Brake Theory, Types and Construction of Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders – antilock braking systems(ABS), Electromagnetic brake system, Electronic brake system(EBS).

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will understand the steering geometry and derive the condition for true rolling motion of an automobile.
2. The students will have the knowledge about the working of propeller shaft, universal joints and differential mechanism.
3. The students will able to select the appropriate type of rear axle for a given vehicle and know about the various types of wheels and tires.
4. The students will possess knowledge about the deployment of appropriate type of springs for vehicles.
5. The students will be able to realize the importance of braking systems in a vehicle and possess knowledge about ABS, EBS.

TEXT BOOKS:

1. T.K. Garrett, K. Newton and W. Steeds, "The Motor Vehicle", Butterworth-Heinemann Publication, 13th Edition, 2000
2. Kirpal Singh, "Automobile Engineering Vol.1", Standard Publisher Distributors, 14th Edition, 2017.

REFERENCE BOOKS:

1. Giri. N.K., "Automobile Mechanics" Khanna Publishers, New Delhi, 1998.

2. S.K.Gupta, "A Textbook of Automobile Engineering", S CHAND Publication, Copyright edition, 2013.

3. Heinz Heisler, "Advanced Vehicle Technology", Butterworth Heinemann Publications 2nd Edition, 2002.

4. S Srinivasan, "Automotive mechanics", McGraw-Hill Education, 2nd edition, 2003.

AT17303	**AUTOMOTIVE HEAT TRANSFER**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To understand the various modes of heat transfer &Heat Conduction through wall, pipes & cylinders etc.
2. To understand the free and forced convection mode of heat transfer over surfaces due to fluid flow
3. To understand the radiation and concept of black body , shape factor and radiation shield
4. To understand the principle of heat transfer features in various heat exchangers and their performances
5. To understand the various design aspects of radiator and its types

UNIT I   HEAT TRANSFER BY CONDUCTION   9

Fourier's law. General heat conduction equation in Cartesian coordinates and its transformation to cylindrical coordinates. Electrical analogy concept of overall heat transfer coefficient. One-dimensional steady-state heat conduction from plane wall, cylindrical wall and composite wall. Critical thickness of insulation for cylinder and sphere. Heat flow through plane wall with variable thermal conductivity. One dimensional steady state heat conduction with uniform heat generation through plane wall; hollow cylinder and solid cylinder. Heat transfer from extended surfaces. Efficiency and effectiveness in various configuration

UNIT II   HEAT TRANSFER BY CONVECTION   9

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

UNIT III   HEAT TRANSFER BY RADIATION   9

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

UNIT IV   HEAT EXCHANGERS   9

Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method

UNIT V   DESIGN ASPECTS OF RADIATORS   9

Heat generation in Engine, Cooling Requirements, coolant properties, Engine Cooling system construction, Radiator construction and Types, Design parameters for radiator design, Thermostat Valve, Radiators Cap, Radiator fan, Radiator Fan shroud, Surge Tank.

                                                              TOTAL: 45   PERIODS

COURSE OUTCOMES:

1. The student will able to evaluate heat transfer across surfaces due to conduction and various interface temperature
2. The student will able to evaluate heat transfer over various surfaces due to convection and the interacting fluid temperature.
3. The student will able to evaluate heat transfer over various surfaces due to radiation and shape factor responsible for radiation.
4. The student will able to evaluate of heat transferability of various heat exchangers and assess their performances
5. The student will able to assess the heat transferability of radiators in IC engines based on design and various types of cooling

TEXT BOOKS:

1. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" 4th Edition, New Age International (P) Ltd., New Delhi, 2012.

2. Holman J.P, Souvik Bhattacharyya "Heat Transfer" 10th Edition, McGraw-Hill Education Pvt. Ltd., 2011.

REFERENCE BOOKS:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" 5th Edition, New Age International publishers, 2010.

2. Rajput. R. K., "Heat and Mass Transfer", 6th Edition, S. Chand publishing (P) Ltd., New Delhi, 1999.

3. A. F. Mills and V. Ganesan, " Heat Transfer" 2nd, Edition, Pearson Education, 2009.

4. Nag P.K, "Heat and Mass Transfer", 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2011.

5. Frank P. Incropera, David P. Dewitt, Theodore L. Bergman, Adrienne S. Lavine, "Principles of Heat and Mass Transfer", 7th edition, John Wiley & Sons, 2013.

6. Ozisik M.N, "Heat Transfer: A Basic Approach", Tata McGraw-Hill Education Pvt. Ltd.,1985

7. G.S. Sawhney, "Heat and Mass Transfer" 2nd Edition, I.K. International Publishing House Pvt., Ltd., 2010.

AT17304   **PRODUCTION TECHNOLOGY – I**   **L   T   P   C**
                                                                3   0   0   3

OBJECTIVES:

1. To understand various metal casting process principle and procedure
2. To understand the process principle and application of powder metallurgy and polymer processing
3. To understand the process principle of various types of welding and its applications.
4. To understand the process principles of metal forming techniques.
5. To understand various sheet metal operations and processing techniques.

UNIT I   **METAL CASTING PROCESSES**   **9**

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; **Melting furnaces** : Blast and Cupola Furnaces; **Principle of special casting processes :** Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO2 process – Stir casting; **Defects in Sand casting. D**esign of patterns, moulds and cores; riser and gating design.

UNIT II   **POWDER METALLURGY and POLYMER PROCESSING**   **9**

Historical and modern developments in Powder Metallurgy. Advantages, limitations and applications of Powder Metallurgy. Basic Steps for Powder Metallurgy. Powder Compaction Methods, Powder Forming Methods and Sintering.
Types of plastics- Working principles and typical applications of - Injection Moulding- Compression molding- Extrusion- Thermoforming- Transfer molding

UNIT III   **JOINING PROCESSES**   **9**

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; **Operating principle and applications of:** Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding –Laser Beam welding, Friction welding and Friction Stir Welding; **Weld defects:** types, causes and cure. Principles of brazing, soldering and adhesive bonding.

UNIT IV   **METAL FORMING PROCESSES**   **9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Load estimation for bulk (forging, rolling, extrusion and drawing).

UNIT V   **SHEET METAL PROCESSES**   **9**

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.

                                             TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will be able to understand various metal casting process principle and procedure
2. The students will be able to understand the process principle and application of powder metallurgy and polymer processing.
3. The students will be to understand the process principle of various types of welding and its applications
4. The students will be able to understand the process principles of metal forming techniques.
5. The students will be able to understand various sheet metal operations and processing techniques

TEXT BOOKS:

1 P N Rao, "Manufacturing Technology: Vol. I",4th Edition, McGraw hill Education, 2013.

2 2013S K Hajra Choudhury and A K Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology Volume I: Manufacturing Processes", Media Publishers and Promoters Pvt. Ltd., 2008.

REFERENCE BOOKS:

1. Mikell P Groover, "Fundamentals of Modern Manufacturing Materials processes andsystems"Fourth Edition, Wiley Publication.

2. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006

3. J. T. Black, Ronald A. Kohser, "DeGarmo's Materials and Processes in Manufacturing" Twelfth Edition, John Wiley & Sons, 2017.

4. Steven R. Schmid and SeropeKalpakjian, "Manufacturing Engineering and Technology" Seventh Edition, Pearson Education, 2014.

		L	T	P	C
AT17311	**(A) THERMAL LABORATORY** **(b) FLUID MECHANICS AND MACHINERY** **LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

1. To study thermodynamic devices such as steam boiler, turbine, reciprocating compressor, air-conditioning system, and to test the same to find the performance characteristics.
2. To study various aspects of heat transfer and to calculate heat transfer, thermal conductivity, heat transfer coefficient, effectiveness, and emissivity for different cases.
3. To determine coefficient of discharge for Orifice & Venturi meter and friction factor for set of pipes.
4. To conduct performance test and to draw various performance curves for centrifugal pump, reciprocating pump, Pelton wheel turbine and Kaplan turbine.
5. To understand the significance of drag in automobiles and its estimation.

LIST OF EXPERIMENTS

(A) THERMAL LABORATORY

1. Study on Steam Boiler and Turbines
2. Performance test on a reciprocating air compressor
3. Performance test in Air Conditioning System
4. Determination of Thermal conductivity of composite wall.
5. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
6. Effectiveness of Parallel / counter flow heat exchanger.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of emissivity of a grey surface.

(B) FLUID MECHANICS AND MACHINERY LABORATORY

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Conducting experiments and drawing the characteristic curves of centrifugal pump.
4. Conducting experiments and drawing the characteristic curves of Reciprocating pump.
5. Determination of friction factor of given set of pipes.
6. Conducting experiments and drawing the characteristic curves of Pelton wheel.
7. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
8. Drag estimation of basic models in wind tunnel.

TOTAL :   60   PERIODS

COURSE OUTCOMES:

1. Upon Completion of this lab, the students will be able to explain in detail about steam boiler, turbine, reciprocating compressor, air-conditioning system, and they will be able to test the same to find the performance characteristics.
2. Upon Completion of this lab, the students will be able to explain in detail about various aspects of heat transfer and they will be able to calculate heat transfer, thermal conductivity, heat transfer coefficient, effectiveness, and emissivity for different cases.
3. The students will be able to determine coefficient of discharge for Orifice &Venturi meter and friction factor for set of pipes.
4. Upon completion of this course, the students will be able to conduct performance test and to draw various performance curves for centrifugal pump, reciprocating pump, Pelton wheel turbine and Kaplan turbine.
5. Upon completion of this course, the students will be able to understand the significance of drag in automobiles and its estimation

LIST OF EQUIPMENTS
(for the batch of 30 students)

(A) THERMAL LABORATORY

Sl. No.	Equipment Name	Nos.
1.	Steam Boiler with turbine setup	1
2.	Reciprocating air compressor test rig	1
3.	Air-conditioning test rig	1
4.	Composite wall apparatus	1
5.	Natural convection-vertical cylinder apparatus	1
6.	Parallel/counter flow heat exchanger apparatus	1
7.	Pin-fin apparatus	1
8.	Emissivity measurement apparatus	1

LIST OF EQUIPMENTS
(for the batch of 30 students)

(B) FLUID MECHANICS AND MACHINERY LABORATORY

Sl. No.	Equipment Name	Nos.
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Pipe Flow analysis setup	1
4	Centrifugal pump setup	1
5	Reciprocating pump setup	1
6	Pelton wheel setup	1
7	Kaplan turbine setup	1
8	Wind tunnel setup	1

AT17312   ENGINE PERFORMANCE AND EMISSION TESTING   L   T   P   C
LABORATORY   0   0   2   1

OBJECTIVES:

1. To study about the different dynamometers used to apply braking torque on engine shaft to measure brake power.
2. To draw the valve and port timing diagrams of engines.
3. To conduct Morse test on a Multi-cylinder SI engine and Retardation test on a single cylinder diesel engine
4. To conduct performance/emission/Heat balance test on different IC engines by varying different operands, and to draw performance and emission curves
5. To analyze engine performance by obtaining P-θ and P-V curves with Piezo-electric transducer fitted in the engine combustion chamber

LIST OF EXPERIMENTS

1. Study of hydraulic, electrical and eddy current dynamometers

2. Valve timing and port timing diagram

3. Performance and emission test on two wheeler SI engine

4. Performance and emission test on automotive multi-cylinder SI engine

5. Performance and emission test on automotive multi-cylinder CI engine

6. Retardation test on I.C. Engines.

7. Heat balance test on automotive multi-cylinder SI engine

8. Heat balance test on automotive multi-cylinder CI engine

9. Morse test on multi-cylinder SI engine

10. Determination of p-θ and p-V diagrams for IC engine with piezo-electric pick up, charge amplifier, angle encoder and PC

TOTAL :   30   PERIODS

COURSE OUTCOMES:

1. Student will be able to use a dynamometer to measure brake power in any shaft
2. Student will be able to demonstrate the significance of valve and port timing diagrams
3. Student will be able to conduct Morse test on a Multi- cylinder SI engine and Retardation test on single cylinder diesel engine to find out frictional loss in the engine
4. Student will be able to conduct performance / emission / Heat balance test on different IC engines by varying different operands, and draw performance and emission curves
5. Student will be to obtain P-θ and P-V curves with Piezo- electric transducer fitted in the engine combustion chamber and comment the obtained result.

LIST OF EQUIPMENT/SYSTEM FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	QUANTITY
1	Hydraulic dynamometer	1 No.
2	Eddy current dynamometer	1 No.
3	Electrical dynamometer	1 No.
4	Single cylinder two stroke cut section engine	1 No.
5	Single cylinder four stroke cut section engine	1 No.
6	Two-wheeler engine test rig.	1 No.
7	Automotive multi-cylinder SI engine test rig with heat balance arrangement	1 No.
8	Automotive multi-cylinder CI engine test rig with heat balance arrangement	1 No.
9	Emission Measuring Instruments for Petrol & Diesel Engines	1 No each
10	Piezo-electric pick up, Charge Amplifier, Angle Encoder and PC	1 set

AT17313	AUTOMOTIVE COMPONENTS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To impart students with fundamental and working of Petrol & Diesel Engine and is accessories (like staring system, charging system, etc.)
2. To impart students with fundamental and working of Diesel and Fuel Systems
3. To impart students with functions of sub system of light and heavy vehicle frame
4. To impart students with functions of front axle, rear axle and power steering
5. To impart students with fundamental and function of the vehicle transmission system

LIST OF EXPERIMENTS

1. Dismantling and study of Multi-cylinder Petrol Engine

2. Assembling of Multi-cylinder Petrol Engine

3. Dismantling and study of Multi-cylinder Diesel Engine

4. Assembling of Multi-cylinder Diesel Engine

5. Study of petrol engine fuel system

6. Study of diesel engine fuel system

7. Study and measurement of light and heavy commercial Vehicle Frame

8. Study, dismantling and assembling of front and rear Axles

9. Study, dismantling and assembling of differential

10. Study, dismantling and assembling of Clutch

11. Study, dismantling and assembling of Gear Box

12. Study of steering system

TOTAL :   60   PERIODS

COURSE OUTCOMES:

1. Graduates will have the basic knowledge in Petrol & Diesel engines and its accessories
2. Graduates will have the basic knowledge in Petrol and Diesel Engine Fuel systems
3. Graduates will have the basic knowledge in construction of light and heavy vehicle frames
4. Graduates will have the basic knowledge in front axle, rear axle and power steering functions
5. Graduates will have the basic knowledge in Clutch, gear box and differential functions

LIST OF EQUIPMENT/SYSTEM FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Multi Cylinder Petrol Engine	2 No.
2.	Multi Cylinder Diesel Engine.	2 No.
3.	Petrol and Diesel fuel systems	1 No. each
4.	Heavy duty vehicle chassis frame	1 No.
5.	Light duty vehicle chassis frame	1 No.
6.	Front axle.	2 No.
7.	Rear axle	2 No.
8.	Differential	2 No.
9.	Clutch and Gear box (light duty, heavy duty)	2 No. each
10.	Steering systems with different gearboxes	3 No.

HS17361   INTERPERSONAL SKILLS/LISTENING & SPEAKING   L   T   P   C

0   0   2   1

OBJECTIVES:

1. To upgrade the learner's listening and speaking skills for educational purposes.
2. To enhance the employability skills of the learners with a special focus on listening and speaking skills

UNIT I   INTRODUCTION   6

Importance of listening and Types of Listening – listening to TED Talks, lectures, etc. **Speaking**: group discussions on general topics like how to grow organic potted plants, to furnish an apartment inexpensively, etc. – **Phonetics**

UNIT II   APPRECIATIVE LISTENING AND IMPROMPTU   6

Listening - Listening to motivational speeches, music and poetry. **Speaking** – pick and talk, short talks on any event on topics- a trip to remember, a job I'd love to have, etc. – **Vocabulary**: Collocation.

UNIT III INFORMATIVE LISTENING AND PERSUASIVE SPEAKING   6

Listening – Listening- to gather information such as facts, directions, news or instructions. **Speaking** – Persuasive speaking- convincing the audience with the speaker's view on the topics- food additives and unhealthiness, financial education is important in today's world, etc. – **Vocabulary**: Idioms and Phrases.

UNIT IV CRITICAL LISTENING AND SPEAKING ON SPECIAL OCCASION   6

Listening – Critical Listening- listening to examine and evaluate the message for logic and truth - televised debate, election campaign. **Speaking** – speech to commemorate a person or an event- speech of Introduction, etc. – **Vocabulary**: Foreign Words and Phrases.

UNIT V EMPATHETIC LISTENING AND DEMONSTRATIVE SPEAKING   6

Listening– Empathetic Listening – paying attention to another person with empathy – listening to problems and issues (videos). **Speaking** – Demonstrative speaking – Demonstrate a process using visual aids (charts, graphs, maps, pictures, etc.) – **Grammar**: Different types of Questions.

TOTAL :   30   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Identify the different types of listening and speaking for effective interpersonal communication.
2. Discuss and respond to content of a listening passage.
3. Understand facts and directions and convince the listeners.
4. Understand different genres of communication and comprehend the materials to improve their vocabulary and get familiarized with new words, phrases, sentence structures and ideas.
5. Make inferences and predictions about spoken discourse

REFERENCE BOOKS:

1. "Technical Communication – Principles and Practice," Second Edition – Meenakshi Raman and Sangeetha Sharma, Oxford University Press, December, 2011.

2. "Interpersonal Skills: How to develop Interpersonal Skills for work and home," Henry Lee (Kindle Edition)

3. "Teaching the Core Skills of Listening and Speaking," Erik Palmer (Kindle Edition)

SEMESTER IV

			L	T	P	C
MA17452	**STATISTICS AND NUMERICAL METHODS**		**3**	**2**	**0**	**4**

OBJECTIVES:

1. To provide the necessary basic concepts of a few statistical methods in designing and solving problems.
2. To provide various numerical methods in solving problems that occur in the field of Engineering and Technology.

UNIT I   TESTING OF HYPOTHESIS   15

Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.

UNIT II   DESIGN OF EXPERIMENTS   15

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design

UNIT III   SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS   15

Newton Raphson method – secant method – Gauss Jordan method – Iterative method of Gauss Seidel – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

**UNIT IV   INTERPOLATION, NUMERICAL DIFFERENTIATION AND   15
                        NUMERICAL INTEGRATION**

Curve fitting (y=a+bx, y=a+bx+cx^2)-Lagrange's interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules.

**UNIT V   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL   15
                        EQUATIONS**

Taylor's series method – Modified Euler's method – Fourth order Runge–Kutta method for solving first order equations – Finite difference methods for solving second order equations- Finite difference solution of one dimensional heat equation by explicit and implicit methods - Two dimensional Laplace equation.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Obtain statistical data from experiments and able to analyze the same using statistical test.
2. Design experiments using suitable ANOVA techniques and draw conclusions.
3. Solve algebraic equations and eigen value problems that arise during the study of engineering problems.
4. Use interpolation methods to solve problems involving numerical differentiation and integration
5. Solve differential equations numerically that arise in course of solving engineering problems.

TEXT BOOKS:

1. Veerarajan T., 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks',McGraw Hill, 2016.

2. Kandasamy P., Thilagavathi and K. Gunavathi., "Statistics and Numerical Methods", S. Chand & Company Ltd. (2010).

REFERENCE BOOKS:

1. Johnson R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers",11th Edition, Pearson Education, Asia, 2011.

2. Walpole R.E., Myers R.H., Myers S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

3. Spiegel M.R., Schiller J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 2004.

4. Grewal B.S., and Grewal J.S., "Numerical Methods in Engineering and Science", 9thEdition,Khanna Publishers, New Delhi, 2007.

5. Gerald C.F., and Wheatley P.O. "Applied Numerical Analysis" Pearson Education, Asia, NewDelhi, 2006.

6. Chapra S.C., and Canale R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.

AT17401 **THEORY OF MACHINES** **L T P C**

3 2 0 4

OBJECTIVES:

1. To understand the principles in the formation of mechanisms and their kinematics.
2. To understand the fundamental concepts behind gear & power drives.
3. To understand the concepts in cam and gyroscopes.
4. To understand the concepts in balancing in machines.
5. To understand the importance of vibration in machines.

UNIT I **MECHANISMS** **15**

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 – Determination of velocity and acceleration by relative velocity Method. Velocity and acceleration of piston, angular velocity and angular acceleration of connecting rod of reciprocating engine.

UNIT II **GEARING AND POWER DRIVES** **15**

Gears: profile and geometry – Nomenclature of spur and helical gears –Velocity of sliding, Length of path of contact and arc of contact, Contact ratio, Interference, Calculation of minimum number of teeth.
Gear trains: Simple, compound gear trains and epicyclic gear trains – Determination of speed and torque.
Belt drive: Types of belts, Selection of belt drive, length of open and crossed belt drive Velocity ratio, slip and creep of belt drives, Power transmitted by a belt, Condition for transmission of maximum power.
Chain drive: Advantages over belt drive, Classification of chains.

UNIT III **CAMS AND GYROSCOPES** **15**

Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.
Gyroscopes: Gyroscopic forces and couple – Forces on bearing due to gyroscopic action – Gyroscopic effect in Ship, motor cycle, car and aircraft.

UNIT IV **BALANCING** **15**

Static and dynamic balancing – Several masses rotating in same and 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 (descriptive treatment only).

UNIT V **VIBRATION** **15**

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.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

1. The students will be able to calculate the velocity and acceleration for simple mechanisms
2. The students will be able to calculate the necessary dimensions for a spur gear and speeds of gears in a gear trains also they will be able to calculate the various parameters in a belt drive.
3. The students will be able to generate the cam profile for the given motion of the follower and will be able to apply gyroscopic effect to automobiles.
4. The students will be able to balance the reciprocating and rotating mechanisms.
5. The students will be able to calculate frequency of free, forced and damped vibration in a mechanical system.

TEXT BOOKS:

1. Thomas Bevan, "Theory of Machines", Dorling Kindersley India Pvt. Ltd. New Delhi, 2010.

2. Rattan S S, "Theory of Machines", MCGraw Hill, 2014.

REFERENCE BOOKS:

1. R.S.Khurmi, "Theory of Machines" by, S. Chand Pub. 2005

2. L. Balleney, "Theory of Machines and mechanisms", Khanna Pub. Delhi, 25th edition, 1965.

3. Ambekar A.G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007

4. AmitabhaGhosh, Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 3rd edition.

5. RaoJ.S. and Dukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.

6. Ramamurthi. V., "Mechanisms of Machine",Narosa Publishing House, 2002.

7. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2004.

8. John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 2016.

AT17402	AUTOMOTIVE TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the need and types of clutch and gearbox
2. To understand the basic construction and working of hydrodynamic transmission systems
3. To understand the need of epicyclic gear and its working principle
4. To understand the applications of automatic transmission
5. To understand the basic principles and working of hydrostatic and electric drives

UNIT I   CLUTCH AND GEAR BOX   12

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches, 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 at different speeds. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed, Power and acceleration. Design Consideration for Matching a transmission system to a vehicle.

UNIT II   HYDRODYNAMIC TRANSMISSION   9

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 III   EPICYCLIC GEARBOXES USED IN AUTOMATIC   8
**   TRANSMISSION**

Principle of Planetary gear trains - Wilson Gear box, Simpson planetary gear train, Ravigneaux planetary gear train, Lepelletier gear train, Cotal electromagnetic transmission- Hydraulic control system for Automatic Transmission.

UNIT IV   AUTOMATIC TRANSMISSION APPLICATIONS   8

Need for automatic transmission, Four speed longitudinally mounted automatic transmission - Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT. ShiftFX Electronic Shift Transmission

UNIT V   HYDROSTATIC AND ELECTRIC DRIVE   8

Principles of Hydrostatic drive; Various types of hydrostatic systems. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system -Advantages & limitations. Modern Electric drive, buses and performance characteristics.

TOTAL: 45   PERIODS

COURSE OUTCOMES:

1. The student will be able to understand the need and types of gearbox and clutch
2. The students will be able to understand the construction and working of hydrodynamic transmission system
3. The students will be able to understand the need and working of epicyclic gear train in transmission systems.
4. The students will be able to explain the working principle and applications of automatic transmission.
5. The students will be able to understand the principles of hydrostatic and electric drives

TEXT BOOKS:

1. Garrett T.K.,New ton.K.,Steeds.W., "The Motor Vehicle"Published:Butterworth Heinemann,13th Edition-2000.
2. Jack Erkavec, "Automotive Technology-A Systems approach", Cengage learning, Delmar,2010.

REFERENCE BOOKS:

1. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.

2. Judge.A.W., "Modern Transmission System", Chapman and Hall Ltd, 2000.

3. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, Elsevier, India Edition, 2011.

4. Heldt, P.M., "Torque converters", Chilton Book Co., 1992.

AT17403   **ENGINEERING MATERIALS AND METALLURGY**   **L**   **T**   **P**   **C**
                                                                     3   **0**   **0**   **3**

OBJECTIVES:

    1. To impart knowledge on the phase diagram, of alloys.
    2. To make the students understand the various heat treatment methods for steels
    3. To make the students understand various ferrous and non-ferrous materials
    4. To impart the knowledge about various non-metallic materials
  5. To make the students understand various destructive testing methods for metals

UNIT I   **ALLOYS AND PHASE DIAGRAMS**   **9**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast iron microstructure, properties and application.

UNIT II   **HEAT TREATMENT**   **10**

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, nito-carburising, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening, electron beam hardening, lazer beam hardening

UNIT III   **FERROUS AND NON-FERROUS METALS**   **9**

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV   **NON-METALLIC MATERIALS**   **9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON –Composites-Classifications- Metal Matrix and FRP - Applications of Composites.

UNIT V   **ADVANCED MATERIALS, MECHANICAL DEFORMATION AND**   **8**
                                  TESTING OF MATERIALS

Shape memory alloys – phases, shape memory effects, pseudoelastic effect -NiTi alloys applications. Nano materials-preparations, bottom up and top down approaches (outline only). Carbon nanotubes – types, properties-applications.
Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

                                         TOTAL :   **45**   **PERIODS**

COURSE OUTCOMES:

1. The students will be able to describe constitution of alloys and phase diagrams.
2. The students will be able to explain various heat treatment methods for steel.
3. The students will be able to distinguish ferrous and non-ferrous metals and explain about them in a comprehensive manner.
4. The students can brief about various polymers and ceramics and their applications.
5. The students can explain about smart materials and nano materials and illustrate various mechanical metal testing methods.

TEXT BOOKS:

1 Avner S.H., "Introduction to Physical Metallurgy", McGraw Hill Education; 2 edition 2017.

2 R. Balasubramaniam, Williams D Callister, "Material Science and Engineering", Wiley India Pvt Ltd, 2nd edition, 2014

REFERENCE BOOKS:

1. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 6th Revised edition 2015.

2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials: Properties and selection", Pearson; 9 edition 2009.

3. Upadhyay. G.S. and AnishUpadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd., New Delhi, 2006.

4. U.C.Jindal, "Material Science Metallurgy" Pearson Education India, First Edition, 2011.

AT17404   **PRODUCTION TECHNOLOGY – II**   **L   T   P   C**
                                                              3   0   0   3

OBJECTIVES:
1. To understand metal cutting principle and various factors affecting cutting tool life.
2. To understand the working principle and operation capabilities of a turning centre and estimating machining time.
3. To understand the working principle and various process capabilities of shaper and milling machine.
4. To understand working principle and applications of Abrasive machining and broaching machining.
5. To understand the process principle and capabilities of various unconventional machining processes and concept of using various jigs and fixtures.

UNIT I   THEORY OF METAL CUTTING   9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II   TURNING MACHINES   9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle: Introduction to CNC turning machine and codes.

UNIT III   SHAPER, MILLING AND GEAR CUTTING MACHINES   9

Shaper - Types of operations. Drilling, reaming, boring, And Tapping. Milling operations-types of milling cutter. Introduction to CNC milling machine and codes.
Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

UNIT IV   ABRASIVE PROCESS AND BROACHING   9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– Cylindrical grinding, surface grinding, Centre- less grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT V   NON TRADITIONAL MACHINING PROCESSES AND WORK   9
                  HOLDING DEVICES

Non-traditional machining Processes – Need – classification – Brief overview. Working Principle - Abrasive Jet Machining – Water Jet Machining- Electric Discharge Machining- Electro-Chemical machining. Basic principles, types of additive manufacturing.
Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling and Lathe, fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

                                        TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will be able to understand metal cutting principle and various factors affecting cutting tool life.
2. The students will be able to understand the working principle and various operations performed at turning centers with machining time estimation.
3. The students will be to understand the working principle and various process capabilities of shaper and milling machine
4. The students will be able to understand working principle and applications of Abrasive machining and broaching machining
5. The students will be able to understand the process principle and capabilities of various unconventional machining processes and concept of using various jigs and fixtures.

TEXT BOOKS:

1. Mikell P Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Sixth edition, John Wiley & sons, Inc, 2015.

2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Third edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE BOOKS:

1. Joshi, P.H. "Jigs and Fixtures", Third Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.

2. HMT, "Production Technology", First edition, Tata McGraw Hill, New Delhi, 1980.

3. Winston A. Knight, Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Third edition, CRC Press, 2005.

4. Roy. A. Lindberg, "Process and Materials of Manufacture", Fourth Edition, PHI/Pearson Education 2006.

AT17405 **STRENGTH OF MATERIALS FOR AUTOMOBILE** **L T P C**
ENGINEERS **3 0 0 3**

OBJECTIVES:

1. To understand the fundamental concepts of stress, strain and elastic constants of solids under external loading
2. To learn about the transverse loading and bending loads acting on structural components.
3. To learn about the deformation of shafts subjected to torsion
4. To know about the various methods for calculating deflection of beams
5. To learn about the various stresses acting in shell structures like thin cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method for computation of slopes and deflections in beams - Conjugate beam and strain energy.
Columns – end conditions – equivalent length of a column – Euler equation – slenderness ratio – Rankine formula for columns.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells – Lame's theorem.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will be able to understand the concepts of principal planes and stresses and draw Mohr's circle for the given stress conditions.
2. The students will be able to draw the shear force diagram and bending moment diagram for beams subjected to different loading conditions.
3. The students will be able to calculate the deformation of shafts subjected to torsional loads.
4. The students will be able to calculate the deflection of beams through Macaulay's method, Moment area method and strain energy methods.
5. The students will be able to understand the effect of stresses acting on thin cylinders and spheres and calculate the deformation.

TEXT BOOKS:

1. Bansal, R.K ,"Strength of Materials", Laxmi Publications (P) Ltd, Sixth Edition-2017

2. Jindal U.C., "Strength of Materials by Pearson", Publisher: Education Pearson; Second edition (2017).

REFERENCE BOOKS:

1. Egor. P.Popov "Engineering Mechanics of Solids" Publisher: Phi Learning, 2nd Edition-2009
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2016
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2018
4. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 2016.

AT17411	A. **STRENGTH OF MATERIALS LABORATORY**	**L**	**T**	**P**	**C**
	B. **THEORY OF MACHINES LABORATORY**	**0**	**0**	**4**	**2**

OBECTIVES:

1. To conduct experiments and know about the effects of tensile force and torsional force in a rod member
2. To conduct the hardness determining test on metals and find the hardness value under normal conditions and heat-treated conditions.
3. To conduct a deflection test and determine the deflection values of beams subjected to external loads.
4. To learn about the gear trains, governor Cams and gyroscope.
5. To learn about the principles of balancing of masses and vibration.

(A) STRENGTH OF MATERIALS LABORATORY

1. Tension test on a mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen (IZOD AND CHARPY)
4. Hardness test on metals – Brinell and Rockwell Hardness Number
5. Deflection test on beams
6. Compression test on helical springs
7. Hardness and impact strength of hardened, hardened and tempered steel.
8. Effect of Tempering and quenching – Comparison of Improvement Mechanical properties and Microscopic Examination of
   (i) Unhardened specimen
   (ii) Quenched Specimen and
   (iii) Quenched and tempered specimen.
9. Double Shear test on MS
10. Compression test on Wood & Brick

(B) THEORY OF MACHINES LABORATORY

1. Study of gear terminologies and determination of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. Motorized gyroscope – Study of gyroscopic effect and couple.
3. Determination of range sensitivity and effort of Hartnell Governor.
4. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
5. Determination of natural frequency and damping coefficient of spring mass system.
6. Balancing of rotating masses
7. Determination of natural frequency of torsional vibration in single rotor system.
8. Determination of free transverse vibration of a cantilever and simply supported beam

TOTAL :   60   PERIODS

COURSE OUTCOMES:

1. The students will be able to determine tensile forces and torsional forces in a simple structural member.
2. The students will be able to do heat treatment on metals and to determine the hardness values of normal and heat-treated specimens.
3. The students will be able to determine the deflection of beam member experimentally and compare with theoretical values.
4. The students will be able to understand the principles and applications of gear trains, governor Cams and gyroscope.
5. The students will be able to understand the principles of balancing of masses and vibration.

LIST OF EQUIPMENTS
(for the batch of 30 students)

(A) STRENGTH OF MATERIALS LABORATORY

Sl. No.	Equipment Name	Nos.
1	Universal Tensile Testing machine	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	2
8	Muffle Furnace (800 ^{o}C)	1

LIST OF EQUIPMENTS
(for the batch of 30 students)

(B) THEORY OF MACHINES LABORATORY

S.No.	NAME OF THE EQUIPMENT/SYSTEM	Qty.
1	Gear Models	1 set
2	Motorised gyroscope	1 No.
3	Hartnell governor apparatus	1 No.
4	Cam follower setup	1 No.
5	Spring mass vibration system	1 No.
6	Dynamic balancing machine	1 No.
7	Torsional vibration of single rotor system setup	1 No.
8	Transverse vibration setup of a) cantilever beam b) Simply supported beam	1 No. each

AT17412   **PRODUCTION TECHNOLOGY LABORATORY**   **L   T   P   C**
                                                           0   0   2   1

OBJECTIVES:

1. To make the student understand various process capabilities of lathe machine.
2. To make the student understand various process capabilities of drilling machine
3. To make the student understand various process capabilities of milling machine.
4. To make the student understand various process capabilities of shaper machine.
5. To make the student understand part programming in CNC machines and special machine operations.

LIST OF EXPERIMENTS

	Cylindrical Surface processes	
1	Lathe	Taper Turning
2	Lathe	External thread cutting
3	Drilling Machine	Drilling, Tapping & Reaming
	Milling Processes	
4	Milling Machine	Surface Milling
	Gear Manufacturing Processes	
5	Milling Machine	Spur gear
6	Gear hobber	Gear Hobbing
	Shaping Process	
7	Shaping Machine	Keyway cutting
	Surface Finishing Processes	
8	Grinding Machine	Surface Grinding
9	Grinding Machine	Cylindrical Grinding
	Tool Manufacturing Processes	
10	Tool and Cutter Grinder	Machining of single point cutting tool
	Demonstration	
11	Practice on CNC Machines - Part programming	
12	Demonstration of Mould preparation in sand casting process.	
13	Demonstration of TIG welding process.	

TOTAL :   30   PERIODS

COURSE OUTCOMES

1. Ability to use different machines depending on job profile requirement.
2. Ability to use different machine tools depending on job surface requirement.
3. Ability to manufacture single point cutting tool using cutter grinder
4. Ability to manufacture gear through generation process
5. Ability to develop CNC part programming and ability to use special machines.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Lathe	15 Nos.
2	Drilling Machine	1 No.
3	Milling Machine	2 Nos.
4	Gear hobber	1 No.
5	Shaping Machine	1 No.
6	Surface grinding machine	1 No.
7	Cylindrical grinding machine	1 No.
8	Tool and cutter Grinding machine	1 No.
9	Computer nodes	30 Nos.
10	Software for CNC programming	15 licenses

AT17413   **COMPUTER AIDED AUTOMOTIVE**   L   T   P   C
                  MACHINE DRAWING LABORATORY   0   0   4   2

OBJECTIVES:

1. To learn about the BIS specifications and symbols for welding joints, riveted joints, keys and fasteners.
2. To learn the concepts of fits and tolerances and to know about geometric dimensioning and tolerancing
3. To enable the students to interpret the production drawings and understand part drawings and assembly drawings.
4. To learn the commands and steps involved in creating two dimensional sketches of mechanical components.
5. To learn the commands and draw assembly drawing using part drawing of mechanical components.

LIST OF EXPERIMENTS

DRAWING STANDARDS

BIS specifications for Welded joints, riveted joints, fasteners – screws, bolts, studs, nuts, washers and keys. Standards used in surface roughness symbols.

2-D DRAWINGS

Limits, Fits – Tolerancing of individual dimensions- selection of Fits- Basic principles of GD&T (geometric dimensioning &tolerancing). Drawing of hexagonal and square headed bolts and their nuts - Manual Preparation of production drawings and reading of part and assembly drawings.

ASSEMBLY DRAWING(Preparation of assembled view in 2D only)

CAD PRACTICE (USING APPLICATION PACKAGES)

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing and Assembly.

ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages. Suggested Assemblies: Flange coupling, Cotter Joint, knuckle joint, universal joint, screw jack, piston, connecting rod, fuel injector, clutch, Lubricating oil Gear Pump

TOTAL :   60   PERIODS

COURSE OUTCOMES:

1. Students possess knowledge about BIS specifications and symbols for welding joints, riveted joints, keys and fasteners.
2. Students can understand the concepts of fits and tolerances and to know about geometric dimensioning and tolerancing.
3. Students will be able to understand the production drawings, part drawings and assembly drawings.
4. Students will be able to create two dimensional sketches of mechanical components.
5. Students will be able to generate assembly drawing of mechanical components using a CAD package.

LIST OF EQUIPMENTS
(for the batch of 30 students)

Sl. No.	Equipment Name	Nos.
1	**Computer System : i3, TFT** Color Monitor, 500 GB HDD, 4 GB RAM	30
2	Printer	1
3	**Software:** AutoCAD	30 licenses

REFERENCE BOOKS :

1. Ajeet Singh, "Machine Drawing", Tata Mcgraw Hill Education Pvt. Ltd., 2010.
2. K.R. Gopalakrishnan, "Machine Drawing" Subhas Publication, 1998
3. N.D. Junnarkar, "Machine Drawing", Pearson, 2009.

<u>SEMESTER V</u>

AT17501   **VEHICLE DYNAMICS**   **L   T   P   C**
                                                                                   3   2   0   4

OBJECTIVES:

1. To understand the concept of vibration and to measure the same.
2. To understand the various forces acting on tires and performance of tire.
3. To understand the various vertical forces acting on a vehicle
4. To understand the various longitudinal forces acting and control on a vehicle
5. To understand the various lateral forces acting on a vehicle.

UNIT I   CONCEPT OF VIBRATION   15

Definitions, Modeling and Simulation, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed.

UNIT II   TIRES   15

Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Tire models, Estimation of tire road friction. Test on Various road surfaces. Tire vibration.

UNIT III   VERTICAL DYNAMICS   15

Human response to vibration, Sources of Vibration. Design and analysis of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tire stiffness. Introduction to control law in active suspension. Air suspension system and their properties.

UNIT IV   LONGITUDINAL DYNAMICS AND CONTROL   15

Aerodynamic forces and moments. Equation of motion. Load distribution for three wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control, stability of vehicle on slope.

UNIT V   LATERAL DYNAMICS   15

Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Stability of vehicle on banked road and curved road. Effect of suspension on cornering.

                                                    TOTAL: 75   PERIODS

COURSE OUTCOMES:

1. The students will be able to explain the concepts involved in vibration.
2. The students will be able to explain the various forces acting on tyres and performance of tire.
3. The students will be able to explain the various vertical forces acting on a vehicle
4. The students will be able to describe the various longitudinal forces acting.
5. The students will be able to explain the various lateral forces acting on a vehicle.

TEXT BOOKS:

1. Rajesh Rajamani, "Vehicle Dynamics and Control", 2nd edition, Springer, 2012
2. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992

REFERENCE BOOKS/WEB LINK:

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

2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010

3. Dean Karnopp, "Vehicle Stability", 1st Edition, Marcel Dekker, 2004

4. Reza N. Jazar, "Vehicle Dynamics: Theory and Application", 3rd Edition, Springer, 2017

5. Mike Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", 2nd Edition, Butterworth-Heinemann, Elsevier, 2015

6. Hans B Pacejka, "Tire and Vehicle Dynamics", 3rd Edition, Butterworth-Heinemann, Elsevier, 2012

7. John C. Dixon, "Tires, Suspension, and Handling", 2nd edition, Society of Automotive Engineers Inc, 1996

8. Jan Zuijdijk, "Vehicle dynamics and damping", First revised edition, Author House, 2013.
9. https://nptel.ac.in/courses/107106080/

AT17502   **ELECTRICAL DRIVES AND MICRO**   **L   T   P   C**
                      CONTROLLERS   **3   0   0   3**

OBJECTIVES:

1. To learn the various control methods of DC motors.
2. To learn the various control methods of AC motors
3. To impart knowledge on basics of 8051 microcontroller.
4. To impart knowledge on programming of 8051 microcontroller.
5. To understand the various applications and interfacing techniques of 8051 microcontroller for automotive applications.

UNIT I   CONTROL OF DC MOTORS   9

DC shunt motors – Speed Torque characteristics – Ward Leonard method, DC series motor – series parallel control - Permanent Magnet Motors & BLDC Motors – solid state DC drives – Thyristor bridge rectifier circuits- chopper circuits-Starters for D.C.Motors.

UNIT II   CONTROL OF AC MOTORS   9

Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control- Starters for induction Motors-reluctance motor.

UNIT III   8051 MICRO CONTROLLER ARCHITECTURE   9

Architecture of 8051 -Pin configuration-Registers - Internal and External Memory-Counters and Timers-Serial Data I/O-Interrupts-Ports

UNIT IV   8051 MICRO CONTROLLER PROGRAMMING   9

Instruction Set of 8051 – Data transfer Instructions - Logical Operations - Arithmetic operations-Branching instructions-Boolean –Simple programs

UNIT V   INTERFACING AND APPLICATIONS OF MICROCONTROLLER   9

Interfacing Concepts and Data acquisition - A/D and D/A Conversion - Stepper motor control – DC motor speed control using PWM technique- Traffic Lights Control-   Automotive system applications. Introduction to PLC.

                                            TOTAL :   45   PERIODS

COURSE OUTCOMES:

After completion of this course, the student will be able to
1. analyse the various control methods of DC motors
2. acquire knowledge on various control methods of AC motors
3. comprehend the basics of 8051 microcontroller.
4. acquire knowledge about basic programming of 8051 microcontroller.
5. applyvarious speed control techniques for automotive application.

TEXT BOOKS:

1 VedamSubrahmanyam, "Electric Drives-Concepts and Applications" 2ndEdition,Tata McGraw-Hill Education Pvt. Ltd., 2011.

2 Kenneth.J.Ayala, "The 8051 Microcontroller" 3rd Edition, Cengage Learning, 2004.

REFERENCE BOOKS :

1 B.L. Theraja, A.K. Theraja, S. G. Tarnekar "A Text Book of Electrical Technology" S. Chand Company, 2011.
2 V.K.Mehta and Rohot Mehta, "Principles of Electrical Engineering", S. Chand Company, 2011.
3 V.K.Mehta and Rohot Mehta "Principles of Electronics", S. Chand and Company Ltd, 2010.
4 Jacob Millman and Christos C. Halkias, "Integrated Electronics", Tata McGraw-Hill Education Pvt. Ltd., 2009.
5 Donald Leach, Albert Malvino, GoutamSaha, "Digital Principles and Applications", Tata McGraw-Hill Education Pvt. Ltd., 2010.
6 Douglas V Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2006.

AT17503	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	L T P C
		3 0 0 3

OBJECTIVES:

1. To understand the basic principle and types of batteries
2. To understand the basics of starting and ignition systems
3. To understand the basic wiring, lighting and accessories used in vehicles
4. To understand the basic types and working principles of various sensors used in vehicles
5. To understand the various types of actuators along with its application.

UNIT I   INTRODUCTION AND TYPES OF BATTERIES   7

Electrical and electronic principles, insulator, conductor and semiconductor, voltage current and resistance, measurement of current, voltage and resistance, common circuit symbols for automobiles. Principle and construction of Lead Acid Battery - Characteristics, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery–Charging Techniques, Defects - Effect of overheating, Effect of overcharging, Dislocation of active material, sulphation, Internal short circuits, Corrosion / sulphation of terminals. Storage of lead acid battery (in dry & wet condition), Maintenance of batteries. Maintenance free battery-dry battery-Tubular battery.

UNIT II   STARTING, CHARGING AND IGNITION SYSTEMS   11

Starter motors characteristics, capacity requirements. Types of starter motor drives – mechanisms of Standard Bendix drive, Folo-thru' Bendix drive, Over running clutch drive, Dyer drive, Pre-engaged type. Starter switches- manual, solenoid switch cum shift, solenoid with relay. DC Generators and Alternators their characteristics. Control unit – cut out, electronic regulators. Spark plugs. Spark advance mechanisms. Different types of ignition systems, Electronic ignition systems.

UNIT III   AUTOMOTIVE WIRING, LIGHTING AND ACCESSORIES   9

Wiring cables, color codes, harness, multiplexing, electromagnetic compatibility, vehicle Interior wiring circuit, vehicle exterior wiring circuit, lamps-types-gas discharge, xenon, LED, headlight – bulbs, reflectors, lenses, leveling and beam setting- Adaptive Front Lights (AFL)-Digital turn signals-Auto dimming mirror- Dashboard instruments, Horn, windscreen wipers and its controls, power windows, electric pumps –fuel pump, wiper pump. Electric power steering, vehicle tracking system.

UNIT IV   AUTOMOTIVE SENSORS   11

Sensors construction with automotive applications Temperature measurement –Thermistor, Thermocouple - Potentiometer – LVDT and rotary – Air flow measurement, Throttle position, Hot wire anemometry – air flow measurement, Inductive – Magnetic and Hall effect – speed and position detection, Piezoelectric – Knock detection, Acceleration sensor – inertia and capacitive type, Yaw rate sensor Feedback sensor – EGO sensor-construction and working - Manifold Absolute Pressure (MAP) sensor, Differential exhaust gas pressure and Air bag sensor

UNIT V   AUTOMOTIVE ACTUATORS   7

Construction and working of actuators with automotive applications: Relays, Solenoid type – Injectors, Air valve, Linear motor – Door lock actuator, DC motors – Fuel pump, Gear shift actuators. Stepper motors – Idle speed control, Cruise control.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will be able to explain the basic principle and types of batteries
2. The students will be able to explain the basic principle starting and ignition systems
3. The students will be able to explain the basic wiring, lighting and accessories
4. The students will be able to explain the basic types of sensors and working principles
5. The students will be able to explain the various types of actuators use in vehicles.

TEXT BOOKS:

1 Kohli. P.L, "Automotive Electrical Equipment", Tata McGraw-Hill co ltd, New Delhi, 2006.
2 Bosch Automotive Electrics and Automotive Electronics, 5th Edition, Springer Vieweg, 2014.

REFERENCE BOOKS:

1 Ronald. K, Jurgen, "Automotive Electronics Handbook", McGraw Hill, New Delhi, 1999.
2 William B Ribbens, "Understanding Automotive Electronics – An engineering perspective", 8th Edition, Butterworth-Heinemann, 2017.
3 Hillier. V.A.W., Peter Coombes & David Rogers, "Hillier's Fundamentals of Motor Vehicle Technology", Nelson Thornes., United Kingdom, 2012.
4 Judge. A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992

AT17504	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the sources and causes of emission from automobile and their effect on human beings and environment.
2. To understand the sources of emission from SI engine and methods to control the same
3. To understand the sources of emission from CI engine and methods to control the same
4. To understand the sources of noise and methods to reducing the noise
5. To understand the various methods to measure emission

UNIT I   EMISSION FROM AUTOMOBILES   8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings - global warming – Acid Rain - National and International Emission standards - Automotive vehicle waste management - Old vehicle disposal, Recycling of Metals, Nonmetals, tyres and liquids.

UNIT II   EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL   10

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx and PM — Effects of design and operating variables on emission formation – controlling of pollutants - fuel modifications – cylinder deactivation - Positive Crank case ventilation system, Evaporative Emission Control, Exhaust Gas Recirculation, Secondary air injection, thermal reactor, Catalytic converters Types – substrate, Wash coat and Catalyst, Cold start emission control - Close coupled catalytic converter, Catalyst deactivation-Hydrocarbon Adsorber- Lean de-NOx Catalysts-NOx traps.

UNIT III   EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS   10
**   CONTROL**

Formation of White, Blue, and Black Smokes, Soot, Particulate Matter NOx, SOx, HC, CO and Intermediate Compounds – Significance Effect of design and Operating variables on Emission formation —Fuel modification/additives, CRDI - High Injection Pressure and Injection Rate Shaping and Multiple injection, EGR- EGR Cooling, EGR Control, Fumigation, Diesel Oxidation Catalysts, Diesel de-NOx Catalysts, NOx traps, SCR, Diesel Particulate Filters - DPF material, structure and regeneration.

UNIT IV   NOISE POLLUTION FROM AUTOMOBILES   8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction — Silencer Design - Active cabin noise suppression - Active Exhaust noise suppression

UNIT V   TEST PROCEDURES AND EMISSION MEASUREMENTS   9

Test cycles for light and medium duty vehicles – US-EPA cycle, ECE and EUDC cycle, Japanese cycle, Indian driving cycles – steady state and transient cycles - SHED Test - Chassis dynamometer – Constant Volume Sampling (CVS) Procedure for driving cycles - Emission analyzers — NDIR, FID, ChemiluminesecentAnalyzer (CLA), Smoke meters, Gas Chromatography, Particulate Emission Measurement - Dilution Tunnel, Sound level meters.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will be able to understand the sources and causes of emission and effects of emission on human beings and environment.
2. The students will be able to understand the sources of emission from SI engine and methods to control the same
3. The students will be able to understand the sources of emission from CI engine and methods to control the same
4. The students will be able to understand the sources of noise and methods to reducing the noise
5. The students will be able to understand the various methods to measure emission

TEXT BOOKS:

1 B.P. Pundir, "Engine Emissions - Pollutant Formation and Advances in Control Technology" Narosa Publishing house Pvt. Ltd, 2011
2 Paul Degobert, "Automobiles and Pollution", EditionsTechnics, 1995

REFERENCE BOOKS:

1 EranSher "Handbook of Air Pollution from Internal Combustion Engines- Pollutant Formation and Control", Academic Press, 2011.
2 Matthew Harrison, "Vehicle refinement: controlling noise and vibration in road vehicles", Elsevier, Indian Edition, 2011
3 Marco P Nuti, "Emissions from two stroke engines", SAE Publication – 1998.
4 AsifFaiz, Christopher S. Weaver, Michael P Walsh, "Air Pollution from Motor Vehicles – Standards and Technologies for Controlling Emissions" The world bank, Washington DC, 1996.

| **AT17505** | **MACHINE DESIGN** | **L** | **T** | **P** | **C** |
| | | **3** | **2** | **0** | **4** |

OBJECTIVES:

1. To enable the student to design a machine component when subjected to various types of loading and estimate corresponding stress induced in the machine component
2. To enable the student to design a shaft and coupling when subjected to combined bending and torsional moments.
3. To enable the student to design the various joints under the loading conditions.
4. To enable the student to design the energy absorbing members for the given constraints
5. To enable the student to design the bearings based on given set of constraints.

(Use of P S G Design Data Book is permitted)

**UNIT I   STEADY STRESSES AND VARIABLE STRESSES IN MACHINE   15
                 MEMBERS**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II   SHAFTS AND COUPLINGS   15

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III   TEMPORARY AND PERMANENT JOINTS   15

Indian Standard for fasteners - Threaded fasteners –- Bolted joints including eccentric loading, Specification of Bolts, Estimation of torque in bolt tightening- Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints – Seals, Orings, lip seals.

UNIT IV   ENERGY STORING ELEMENTS   15

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for single cylinder engines, multi cylinder engine and punching machines

UNIT V   BEARINGS   15

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs - Selection of Rolling Contact bearings.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

1. Upon the completion of this course the students will be able to explain the influence of steady and variable stresses in machine component design
2. Upon the completion of this course the students will be able to apply the concepts for designing of shafts and couplings
3. Upon the completion of this course the students will be able to apply the concepts for designing of temporary and permanent joints
4. Upon the completion of this course the students will be able to apply the concepts for designing of energy absorbing members
5. Upon the completion of this course the students will be able to apply the concepts for designing of bearings

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2016.

2. Richard G Budynas Richard Gordon Budynas, J.KeithNisbett., "Shigley's Mechanical Engineering Design", 10th edition, Tata McGraw-Hill, 2015

REFERENCE BOOKS:

1. R.S. Khurmi& J. K. Guptha, "A Textbook of Machine Design", 34th edition, S. Chand publication. 2014.
2. Sundararajamoorthy T. V. ShanmugamN, "Machine Design", Anuradha Publications, Chennai, 2003.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 6th Edition, Wiley, 2018
4. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
5. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
7. AnselUgural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
8. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements", 8th Edition, Printice Hall, 2003

AT17511	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To impart knowledge on battery testing and maintenance methods in automobiles.
2. To understand the characteristics of different types of motors used for automobile applications.
3. To learn about the basics of rectifiers, sensors and actuators.
4. To impart knowledge on the interfacing of ADC and DAC for various applications.
5. To learn the different methods of PWM control schemes for Stepper and DC Motors.

LIST OF EXPERIMENTS

(a) AUTOMOTIVE ELECTRICAL LABORATORY

1. Testing of batteries and battery maintenance
2. Testing of starting motors and generators
3. Study of Automobile electrical wiring, Sensors and Actuators
4. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
5. Load test on DC shunt and compound motor.
6. Load test on DC series motor
7. Load test on single-phase induction motor.
8. Load test on three-phase induction motor.

(b) AUTOMOTIVE ELECTRONICS LABORATORY

1. Study of rectifiers, filters, logic gates, adder and flip-flops
2. Study of SCR and IC timer
3. Interfacing Sensors like RTD, LVDT, Load Cell etc.
4. Interfacing ADC for Data Acquisition
5. Interfacing DAC for Control Application
6. Interfacing Actuators

8051 Microcontroller Programming and interfacing

7. Program to control traffic lights
8. Program to control the speed of a DC motor using PWM technique
9. Program to control a stepper motor
10. Program to control a stepper motor using Arduino controller.
11. Program to simulate a PLC operation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion of this course, the student will be able to

1. comprehend the various methods of battery testing and maintenance.
2. analyse the characteristics of different types of motors used for automobile applications.
3. acquire knowledge about the basics of rectifiers, sensors and actuators.
4. interface ADC and DAC for various applications.
5. apply different methods of PWM control schemes for Stepper and DC Motors.

AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY

LIST OF EQUIPMENTS
(for the batch of 30 students)

(a) AUTOMOTIVE ELECTRICAL LABORATORY

Sl. No.	Equipment Name	Nos.
1	Battery, hydrometer, voltage tester	1 No. each
2	Starter motor, regulator, cut-out	1 No. each
3	Distributor, ignition coil, spark plug	1 No. each
4	Auto electrical wiring system	1 No. each
5	Automotive Vehicle sensors and Actuators	1 Complete set

LIST OF EQUIPMENTS
(for the batch of 30 students)

(b) AUTOMOTIVE ELECTRONICS LABORATORY

Sl. No.	Equipment Name	Nos.
1	Rectifiers, filters	1 No. each
2	Amplifier	1 No.
3	IC timer	1 No.
4	Data logger	1 No.
5	Micro Controller 8051 trainer kit	10 Nos.
6	ADC interface board	2 Nos.
7	DAC interface board	2 Nos.
8	Sensors like RTD, Load cell, LVDT	2 Nos.
9	Actuators like stepper motor	2 Nos.
10	Arduino board	2 Nos.
11	DC Motor	2 Nos.

AT17512	GEOMETRIC MODELLING OF AUTOMOTIVE SYSTEMS	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To make the students understand and handle design problems in a systematic manner.
2. To make the students gain practical experience in handling 3D modelling software.
3. To enable the students to apply CAD in real life applications.
4. To understand the concepts G and M codes and manual part programming
5. To make the students expose students to modern control systems (Fanuc, Siemens etc)

LIST OF EXPERIMENTS

1. Introduction to 3D geometric modelling and application of GD&T.
2. 3D modelling of piston assembly.
3. 3D modelling of connecting rod with complete details.
4. 3D modelling of crankshaft assembly.
5. 3D modelling of engine flywheel.
6. 3D modelling of engine valves.
7. 3D modelling of inlet and exhaust manifolds.
8. 3D modelling of propeller shaft with universal joints.
9. 3D modelling of final drive with axle housing.
10. Introduction to Manual CNC part programming and tool path simulation.
11. Machining simple components by using CNC simulation software.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

1. The students will be able to understand the design features of the given component
2. The students will be able to create the 3D model of the connecting rod and crankshaft assembly
3. The students can create 3D models of engine flywheel and valve with fine details
4. The students will be able to create 3D models of engine valves, manifolds and propeller shaft and valve with fine details
5. The students will be able to write the CNC part programming for the given component

TEXT BOOKS:

1. K. L. Narayana - Machine drawing, New Age International,2009.

2. R. K. Dhawan - A Text book on Machine Drawing, S. Chand Publishing, 2015.

LIST OF EQUIPMENTS
(for the batch of 30 students)

Sl. No.	Equipment Name	Nos.
1	**Computer System : i3, TFT** Color Monitor, 500 GB HDD, 4 GB RAM	30
2	Printer	1
3	**Software'slike** CREO, FANUC	30 licenses

SEMESTER VI

AT17601	AUTOMOTIVE SYSTEMS DESIGN	L	T	P	C
		3	2	0	4

OBJECTIVES:

1. To understand the design considerations and procedure for cylinder, piston and connecting rod
2. To understand the design considerations and procedure for crankshaft
3. To understand the design of valve train
4. To understand the loads acting on axles and steering system
5. To understand the loads acting on vehicle frame and suspension system

UNIT I   DESIGN OF CYLINDER, PISTON AND CONNECTING ROD   15

Fundamentals of engineering design, 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 II   DESIGN OF CRANKSHAFT   15

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 crank arms. Front and rear-end details.

UNIT III   DESIGN OF VALVE MECHANISM   15

Rankine's formula – Johnson formula design of push- rods, Design of inlet & exhaust valves, valve springs, tappets, valve train, rocker arm.

UNIT IV   FRONTAXLE, STEERING SYSTEM AND REAR AXLES   15

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 propeller shaft, final drive gearing, full floating, semi-floating and three quarter floating rear shafts and rear axle housings and final drive.

UNIT V   VEHICLE FRAME AND SUSPENSION   15

Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle – Design of leaf Springs-Coil springs and torsion bar springs.

Note: Use of Approved Design Data Book is permitted in the University examination

TOTAL :   75   PERIODS

COURSE OUTCOMES:

1. The students will be able to understand the design considerations and procedure for cylinder, piston and connecting rod
2. The students will be able to understand the design considerations and procedure for crankshaft.
3. The students will be able to understand the selection of materials and design valve operating components.
4. The students will be able to understand the loads acting on axles and steering system
5. The students will be able to understand the loads acting on vehicle frame and suspension system

TEXT BOOKS:

1. U.C. Jindal, "Machine Design", Pearson Education, 2013.
2. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2016.

REFERENCE BOOKS:

1. R.S. Khurmi& J. K. Guptha, "A Textbook of Machine Design", 34th edition, S. Chand publication. 2014.
2. Giri, N.K., "Automobile Mechanics", Khanna publishers, New Delhi, 2007
3. Richard G Budynas Richard Gordon Budynas, J.KeithNisbett., "Shigley's Mechanical Engineering Design" 10th edition, Tata McGraw-Hill, 2015
4. Jain. R. K, "Machine Design", Khanna Publishers, New Delhi, 2005.
5. Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
6. Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

AT17602　　　　**ELECTRIC AND HYBRID VEHICLES**

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To give the students the idea of global energy scenario, pollution levels and green mobility technology solutions
2. To make the students understand the basics of traction batteries, their operating characteristics, charging and management system.
3. To make the students understand the basics of power electronics used in hybrid and electrical vehicles
4. To make the students understand the characteristics of traction motors, their performance and vehicle performance
5. To make the students familiarize with electromagnetic interference and EV testing standards.

UNIT I　　　　**INTRODUCTION**　　　　　　　　　　　**9**

Global energy scenario - Electric and hybrid vehicle – need, advantages, challenges — layout, components. Hybrid vehicle – advantages, disadvantages, architecture – series, parallel, plug-in, mild and assist hybrid. Hybrid vehicle operating modes – Fuel cells – basics, types, advantages and disadvantages.

UNIT II　　　　**TRACTION BATTERIES**　　　　　　　　　　**9**

Targets and properties of batteries, Li-Po battery, Li ion battery, Nickel MetalHydride Battery, Sodium Sulphur Battery and Aluminium Air Battery, Super capacitors. Battery charging - battery charging profile charging time – charging standards – charging methods – charging modes – vehicle to grid technology – Tesla power wall – Wireless power transfer – Regenerative Braking - Battery management System.

UNIT III　　　　**POWER ELECTRONICS FOR EV AND HEV**　　　　　**9**

Semiconductor power diodes, transistors, thyristors, triacs, GTOs. AC-DC converters, DC-DC converters and types – buck, boost, fly back. Isolated converters. Inverters based on MOSFET. Microcontrollers/DSP based controllers, Types of sensors for electric drive, Current sensors and signal conditioners.

UNIT IV　　　　**MOTORS FOR ELECTRIC VEHICLE**　　　　　　**9**

Introduction –Motor and engine ratings- motor torque and power characteristics – EV motor sizing - Construction and working principle of DC machines, BLDC Motor, three phase AC machines, PM and SR machines – Design criteria of DC motor drives, induction motor drives and PM/SRM motor drives for EVs. – Acceleration Performance and Vehicle Power - Final Drive - Speed Calculation with a Torque Profile.

UNIT V　　　　**ELECTROMAGNETIC INTERFERENCE & EV TESTING**　　　**9**

EMI – Noise propagation modes – cabling – components – PCB EMC – SAE Automotive EMC standards – SAE J551- SAE J 1113 – Test methodology - Need for testing EVs – Safety checklist (AIS 038). – significance of isolation resistance - measurement of isolation resistance – water tests(flood test/ wash test/ rain test) motor power test (AIS 041) – chassis dynamometer – motor dynamometer (motor testbed) – Energy consumption test (AIS 039) – battery testing (AIS 048) – steps for reducing the energy consumption – Range test (AIS 040) – FAME scheme of INDIA.

TOTAL :　45　PERIODS

COURSE OUTCOMES:

1. The students will be able to explain about the global pollution, emission standards and modern drive train technology options.
2. The students will be able to describe about various traction batteries, their performance and charging techniques.
3. The students can elucidate the various high power switching devices and their operating characteristics in electric and hybrid vehicles.
4. The students can suggest a suitable motor for an electric and hybrid vehicle.
5. The students can explain the various testing standards and electromagnetic interference and suppression techniques for electric vehicles.

TEXT BOOKS:

1. Tom Denton. " Electric and Hybrid Vehicles" Routledge Publications, 2016
2. IqbalHussain. "Electric and Hybrid Vehicles Design Fundamentals". CRC Press,2005
3. Automotive Research Association of India Testing standards

REFERENCE BOOKS:

1. Chau. K. T. "Electric Vehicle Machines and Drives – Design, Analysis and Application", John Wiley & Sons Singapore Pte. Ltd., 2015
2. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2017
3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 24-Oct-2014
4. Power Electronics and Motor Drives, Bogdan M. Wilamowski, J. David Irwin, CRC Press, 2016

		L	T	P	C
AT17603	**AUTOMOTIVE FUELS AND LUBRICANTS**	3	0	0	3

OBJECTIVES:

1. To understand the conventional fuels for IC engines, its production, additives and characteristics of fuels
2. To understand the alternate liquid fuels for engines with their compatibility, performance and emission characteristics
3. To understand the alternate gaseous fuels for engines with their compatibility, performance and emission characteristics
4. To understand the A/F ratio based on the engine operating conditions.
5. To understand the need of lubricants, factors influencing the lubricants and testing of fuels.

UNIT I   CONVENTIONAL FUELS FOR I.C. ENGINES   9

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – Production - vehicle population increase – national and international standards for conventional and alternative fuels. Crude Distillation, chemical structure, desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II   ALTERNATIVE LIQUID FUELS   9

Need for alternative liquid fuels - Availability, Properties, Composition, Merits, Demerits, Performance and Emission characteristics of Methanol, Ethanol, Straight Vegetable Oil, Bio diesel (Esterification) and their blends.

UNIT III   ALTERNATIVE GASEOUS FUELS   9

Need for alternative gaseous fuels – Availability, Properties, Composition, Merits, Demerits, Performance and Emission characteristics of Hydrogen, Compressed Natural Gas(CNG), Liquefied Petroleum Gas (LPG). Modifications required for LPG and CNG in the conventional engines.

UNIT IV   COMBUSTION OF FUELS   9

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, heat loss due to incomplete combustion.

UNIT V   LUBRICANTS AND TESTING OF FUELS   9

Lubricants: Need for lubricants, engine friction, effect of engine variables on friction requirements of automotive lubricants- Mineral & Synthetic, classification of lubricating oils, properties of lubricating oils, additives and tests on lubricants – Grease, classification, properties, testing of grease.
Testing of fuels: Relative density, calorific value, distillation, Reid vapour pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity and aniline point.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. The students will be able to explain the distillation process, additives for fuels and characteristics of fuels.
2. The students will be able to understand need and performance characteristics of alternative liquid fuels for both SI and CI engines.
3. The students will be able to understand need and performance characteristics of alternative gaseous fuels for both SI and CI engines.
4. The students will be able to calculate A/F ratio for the engine operating conditions and also can estimate quantitatively the exhaust gas constituents.
5. The students will be able to understand the need for lubricants, factors influencing the engine lubrication and testing of fuels.

TEXT BOOKS:

1. B.P. Pundir, "IC Engines – Combustion and Emissions", Narosa Publication, 2017
2. S.S. Thipse, "Alternative Fuels", JAICO Publishing House, 2010.

REFERENCE BOOKS:

1. M.L.Mathur and P.Sharma., "A course in internal combustion engines", Dhanpatrai Publications, 2004
2. V.Ganesan, "Internal Combustion Engines" 4th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2012.
3. Bechtold, Richard L., "Alternative Fuels Guide Book", Published By SAE International, 1997.
4. Owen, Keith, Coley, Trevor, "Automotive Fuels Reference Book", SAE International, 1995.
5. Sarkar, S., "Fuels And Combustion", Oriented Longmann Press, 1990.
6. Demirbas, Ayhan, "Biofuels: Securing The Planet's Future Energy Needs" Published By Springer, 2009.
7. Sterret, Frances S., "Alternative Fuels And The Environment", Lewis Publishers, 1994
8. Caines, Arthur J; Haycock, Roger F., "Automotive Lubricants Reference Book", Published By SAE International, 1996

AT17604   **FINITE ELEMENT ANALYSIS FOR**   **L   T   P   C**
AUTOMOBILE ENGINEERS   **3   2   0   4**

OBJECTIVES:

1. To introduce the concepts of mathematical modeling of engineering problems.
2. To solve one dimensional problem in solid mechanics, heat transfer and vibrations.
3. To solve two dimensional problems in solid mechanics, heat transfer and vibrations.
4. To solve problems using plane stress, plane strain and axisymmetric conditions.
5. To solve problems using isoparametric formulation

UNIT I   INTRODUCTION   15

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II   ONE-DIMENSIONAL PROBLEMS   15

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Fourth Order Beam Equation –Transverse deflections.

UNIT III   TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS   15

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Quadrilateral elements – Higher Order Elements

UNIT IV   TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS   15

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations.

UNIT V   ISOPARAMETRIC FORMULATION   15

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL :   75   PERIODS

COURSE OUTCOMES:

1. Ability to understand the concepts of Mathematical Modeling of Engineering Problems.
2. Ability to solve one dimensional problems in solid mechanics, heat transfer and vibrations.
3. Ability to solve two dimensional problems in solid mechanics, heat transfer and vibrations.
4. Ability to solve problems using plane stress, plane strain and axisymmetric conditions.
5. Ability to solve problems using isoparametric formulation.

TEXT BOOKS:

1 Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, McGraw-Hill Education, 2006.

2 Seshu, P, "Text Book of Finite Element Analysis", PHI Learning Pvt. Ltd., 2004.

REFERENCE BOOKS:

1 Singiresu S. Rao "The Finite Element Method in Engineering", Butterworth-Heinemann, 5th Edition, 2010.
2 Logan, D.L., "A first course in Finite Element Method", 5th Edition, CL-Engineering, 2011.
3 Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
4 Tirupathi R Chandrupatla& Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 2002
5 BhattiAsghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2013.
6 David Hutton, "Fundamentals of Finite Element Analysis" Tata McGraw Hill India, 2003.
7 Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.

AT17611	AUTOMOTIVE FUELS AND LUBRICANTS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

1. To understand the properties of Petrol, Diesel and Lubricant oil
2. To study the characteristics and standard testing of the Petrol and Diesel fuel
3. To study the characteristics and standard testing of Lubricant oil
4. To study the characteristics of grease
5. To understand the testing of carbon and ash content of fuels

LIST OF EXPERIMENTS

1. Study of International and National standards for fuels and lubricants.
2. Study of Octane and Cetane Number of fuels.
3. 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 fuel and oil.
9. Copper strip Corrosion Test
10. Cloud & Pour point Test
11. Temperature dependence of viscosity of lubricants by Redwood Viscometer
12. Viscosity Index of lubricants by Saybolt Viscometer
13. Viscosity measurement of lubricant and fuels by kinematic viscosity bath
14. Ash content and Carbon Residue Test
15. Drop point of grease and mechanical penetration in grease.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

1. Graduates will have the basic knowledge in properties of Diesel, Petrol and Lubricant oil and its effect of performance of automobile engines
2. Graduates will demonstrate the testing of various properties of fuels used in automobiles and its relevance with Indian standards
3. Graduates will demonstrate the testing of various properties of Lubricants used in automobiles and its relevance with Indian standards
4. Graduates will demonstrate the testing of drop point and consistency of grease.
5. Graduates will demonstrate the testing of ash an carbon residue in diesel fuel.

LIST OF EQUIPMENTS
(for the batch of 30 students)

Sl. No.	Equipment Name	Nos.
1	Distillation test Apparatus	1 No.
2	Aniline point Apparatus	1 No.
3	Bomb Calorimeter	1 No.
4	Junkers Calorimeter	1 No.
5	Reid vapor pressure test Apparatus	1 No.
6	Flash and Fire point apparatus – Open and Closed cup	1 No. each
7	Abels flash point apparatus for Petrol Fuel	1 No.
8	Copper Strip Corrosion Test Apparatus	1 No.
9	Cloud and Pour point Apparatus	1 No.
10	Redwood Viscometer	1 No.
11	Saybolt Viscometer	1 No.
12	Kinematic viscosity bath	1 No.
13	Ash Content Test Apparatus	1 No.
14	Carbon Residue Test Apparatus	1 No.
15	Drop point and penetration Apparatus for grease	1 No.

AT17612	**COMPUTER AIDED VEHICLE DESIGN DATA**	**L**	**T**	**P**	**C**
	CHARACTERISTICS LABORATORY	**0**	**0**	**2**	**1**

OBJECTIVES:

1. To know about the various resistance acting on a vehicle and their effects.
2. To calculate and draw the characteristic curves for the power, torque, tractive effort and acceleration with respect to vehicle speed.
3. To calculate and draw the characteristic curves for various efficiencies with respect of engine speed and simulate the cylinder pressure with respect to crank angle of an engine.
4. Tocalculateinstantaneous velocity and acceleration of the piston and connecting rod with respect of crank angle.
5. To find various forces and turning moment diagram with respect to crank angle.

LIST OF EXPERIMENTS

1. Calculation of Air, Rolling and Total Resistances of the selected vehicle & Plotting them against vehicle speed.

2. Calculation of Brake Power and Brake torque of the engine of the selected vehicle & Plotting them against engine speed.

3. Calculation of Vehicle speed of the selected vehicle at each gear & Plotting them against engine speed.

4. Calculation of Tractive force of the selected vehicle at each gear & Plotting them against vehicle speed.

5. Calculation of Acceleration of the selected vehicle at each gear & Plotting them against vehicle speed.

6. Calculation of Brake thermal efficiency, Mechanical Efficiency, Volumetric Efficiency and Brake specific fuel consumption of the engine of the selected vehicle & Plotting them against engine speed.

7. Calculation of Cylinder Pressure at every crank angle of the cycle of the selected engine & Plotting them against crank angle.

8. Calculation of Brake mean effective Pressure of the engine of the selected vehicle from P-V diagram plotted from pressure , volume data calculated against each crank angle.

9. Calculation of piston instantaneous velocity, acceleration & plotting them against each crank angle.

10. Calculation of connecting rod instantaneous velocity, acceleration & plotting them against each crank angle.

11. Calculation of gas force, inertia force and resultant force & plotting them against each crank angle.

12. Calculation of side thrust, turning moment and combined turning moment & plotting them against each crank angle.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The student able to draw the various resistances acting on a vehicle.
2. The students are able to draw the characteristic curves for the power, torque, tractive effort and acceleration with respect to vehicle speed for any given vehicle specification.
3. The students are able to plot the various efficiencies and p-V diagram for any given vehicle specification.
4. The students able to plot the velocity and acceleration diagram of piston using software.
5. The students able to plot the turning moment diagram of engine with respect to crank angle

LIST OF EQUIPMENTS
(for the batch of 30 students)

Sl. No.	Equipment Name	Nos.
1	**Computer System : i3, TFT** Color Monitor, 500 GB HDD, 4 GB RAM	30
2	Printer	1
3	**Software:** C / MATLAB	30 licenses

AT17613	MINI PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To develop knowledge to formulate a real world problem and set project objectives.
2. To identify and analyze the various methodologies to solve the problems.
3. To identify and learn new tools, algorithms and techniques to complete the work.
4. To understand the various procedures for validation of the product and analysis the cost effectiveness.
5. To develop the ability to prepare project report and present his/her work.

GUIDELINES FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device / system / component(s) to be designed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group with Title, Aim of the Project, Research Methodology, Component Design and Design calculations for the model to be fabricated, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination, the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

1. Student will be able to formulate a real-world problem, identify the requirement and develop the design solutions.
2. Student will be able to discuss the technical ideas and formulate strategies and methodologies.
3. Student will be able to utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Student will be able to test and validate the developed prototype with existing standards and analyze the cost effectiveness of the same.
5. Student will be able to prepare a detailed project report and demonstrate the work.

HS 17561	COMMUNICATION AND SOFT SKILLS – LABORATORY BASED	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To enable learners to develop their communicative competence
2. To facilitate them to sharpen their soft skills.

UNIT I   LISTENING AND SPEAKING SKILLS   12

Conversational skills (formal and informal) – group discussion and interview skills – making presentations. Critical/Analytical Listening – Watching videos (Talk Shows, news, Ted Talks etc).

UNIT II   READING AND WRITING SKILLS   12

Reading Types: Skimming, scanning, intensive and extensive reading – Writing: formal and informal letter, Job Application, resume, cover letter, emails, reports and article writing.

**UNIT III   ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS   12
                    AND PLACEMENTS**

An introduction to : International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT IV   SOFT SKILLS (1)   12

Communication – self motivation – leadership – responsibility – team work – problem solving – decisiveness – ability to work – time management – flexibility – negotiation.

UNIT V   SOFT SKILLS (2)   12

Creative and critical thinking – Learning styles and strategies - Intelligences: Verbal/Linguistic, Logical/Mathematical, Visual/Spatial, Bodily-Kinesthetic, Musical, Interpersonal, Intrapersonal, Naturalistic and Existential.

TOTAL: 60   PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Make presentations and participate in Group discussions
2. Comprehend the contextual meaning and able to infuse in writing.
3. Face international language testing modules
4. Develop leadership qualities and team work
5. Develop interpersonal skills and creative thinking.

REFERENCE BOOKS:

1   Barker, A. "Improve Your Communication Skills" New Delhi: Kogan PageIndiaPvt. Ltd., 2006

2   John Seely "The Oxford Guide to Writing and Speaking" New Delhi: Oxford University Press, 2004

3   Ramesh, Gopalswamy and Mahadevan Ramesh. "The ACE of Soft Skills" New Delhi: Pearson, 2010.

SEMESTER VII

GE17451	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To facilitate the understanding of basic quality management in engineering.
2. To facilitate the understanding of various principles of TQM.
3. To be acquainted with management tools, six sigma and benchmarking.
4. To be acquainted with quality functions, TPM concepts &continuous improvement tools.
5. To learn various quality systems and TQM implementation in manufacturing and service sectors.

UNIT I   INTRODUCTION   9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II   TQM PRINCIPLES   9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III   TQM TOOLS AND TECHNIQUES I   9

The seven traditional tools of quality - New management tools - Six sigma, Lean Six Sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV   TQM TOOLS AND TECHNIQUES II   9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. POKA-YOKE.

UNIT V   QUALITY SYSTEMS   9

Need for ISO 9000 - ISO 9001:2015 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits – ISO 9000:2005, ISO 9004:2009 - TQM Implementation in manufacturing and service sectors. Quality System for Automotive Supplier TS 16949, Quality System for Telecom Industries - TL 9000

TOTAL: 45   PERIODS

COURSE OUTCOMES:

On the successful completion of the course, students

1. Have Ability to explain the importance of quality in engineering.
2. Have Ability to explain various principles in TQM.
3. Can explore the knowledge of implementing various TQM tools.
4. Have Ability to create rapport among workers to form a quality team.
5. Have Ability to explain the benefits of implementing ISO-9000 & ISO-14000 in manufacturing and service sectors.

TEXT BOOKS:

1 Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2011.

REFERENCE BOOKS :

1 James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
3 Janakiraman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

AT17701	ENGINE AND VEHICLE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To learn about the principles of control systems
2. To know about the electronic engine management systems for petrol engines
3. To know about the electronic engine management systems for diesel engines
4. To learn about the various chassis management systems employed in automobiles
5. To understand the need for fault diagnosis systems

UNIT I   CONTROL SYSTEMS   9

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control, overview of automotive control systems.

UNIT II   SI ENGINE MANAGEMENT SYSTEMS   9

MPFI systems – Layout and working, Phases of SI engine control - Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cut-off, Cylinder deactivation. Fuel control maps, Gasoline Direct Injection, Catalytic emission control.

UNIT III   CI ENGINE MANAGEMENT SYSTEMS   9

Cylinder charge management – Turbocharger and supercharger, Fuel injection parameters, Diesel fuel injection designs, Discrete fuel injection pumps, Unit injector system, Unit pump system, Common rail system – working principle, operation and high-pressure components, Homogenous combustion process, Exhaust gas treatment.

UNIT IV   CHASSIS MANAGEMNT SYSTEMS   9

Antilock braking system, Traction and stability control system, Active suspension system, Automatic transmission control system, Electric power steering, Brake assist systems, Cruise control system. Vehicle dynamics control, XBW System.

UNIT V   FAULT DIAGNOSIS SYSTEMS   9

Need for diagnosis systems, Diagnostic process, Basic equipment – Oscilloscopes, Fault code readers, Diagnostics of sensors and actuators, On Board Diagnostics(OBD) – Requirements, Petrol/Diesel engines OBD, OBD2

TOTAL: 45   PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to:

1. The student will be able to explain and compare various control systems
2. The student will be able to explain fuel system layouts, injection techniques, phases of operation and parameter control in SI engine management.
3. The student will be able to identify the theoretical reasons for combustion quality, emission and noise. They will be able to explain injection techniques, Unit injection system and CRDI systems and EGR control.
4. The student will be able to explain the control system operation behind the function of various chassis management systems
5. The student will possess knowledge on various On-Board Diagnosis systems

TEXT BOOKS:

1 William B Ribbens, Understanding Automotive Electronics – An engineering perspective, 8th Edition, Butterworth-Heinemann, 2017.
2 Robert Bosch "Diesel Engine Management" SAE Publications, 2006
3 Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006

REFERENCE BOOKS:

1 Tom Denton, Advanced automotive fault diagnostics, 4th Edition, Routledge, Oxon, 2016.
2 A. GalipUlsoy, HueiPeng, MelihCakmakci, Automotive Control Systems, Cambridge University Press, New Delhi, 2012.
3 Bernd Heibing, Meting Ersoy, Chassis Handbook ATZ, Fundamentals, Driving Dynamics, Components, Mechatronics, Perspectives, ViewegTeubnerVerlag, Mercedes Druck, Berlin, 2011.

		L	**T**	**P**	**C**
AT17702	**INTELLIGENT VEHICLE SYSTEM**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To understand the intelligent vehicle systems, design and improve the driving comfort.

2. To understand the convenience systems in vehicles.

3. To understand the latest technologies and foster implementation in connected vehicle systems.

4. To understand the safety, comfort system for autonomous driving and pollution mitigation system.

5. To understand the vehicle architecture and system interactions.

UNIT I   INTRODUCTION TO INTELLIGENT VEHICLE SYSTEM   9

Need for IVS, Benefits, Modern trends in automotive industry, Goals and Visions for the Future. Overview of smart mobility- ADAS (Advanced Driver Assistance Systems) - Driver Alertness Monitoring, Navigation system.

UNIT II   CONVENIENCE SYSTEMS   9

Night Vision, Head-up Display, Adaptive Cruise Control (ACC), Curve speed warning system, Lane Departure Warning, Hill hold control, Adjustable Steering, Traffic assist system, Parking assistance, Automatic Braking.

UNIT III   CONNECTED VEHICLE SYSTEM   9

Introduction to V2V Communication, Telematics Control System,Vehicle -Vehicle interaction using TCS, Mirror link, Web link, App link, Apple Icar, Android car, V2I(Vehicle to infrastructure interaction),Wireless Technologies: DSRC, Bluetooth, Wi-Fi, Mobile Networks, Short Range radio, vehicle OBU(OBD).

UNIT IV   AUTONOMOUS VEHICLE SYSTEM   9

Introduction,theBosch Spectrum safety and comfort system for autonomous driving, Electronic Stability Protocol, Blind Spot Monitoring System, Pollution Mitigation System, Adaptive headlight.

UNIT V   VEHICLE ARCHITECTURE AND SYSTEM INTERACTIONS   9

System Interactions-Mechanical&Electrical System, Communication media systems CAN, LIN, XFCD- BMW, Diamler-chrysler city, FCD-Data flow.

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. Students will able to describe the intelligent vehicle systems, design and improve the driving comfort.

2. Students will able to explain the convenience systems in vehicles.

3. Students will able to explain the latest technologies and foster implementation in connected vehicle systems.

4. Students will able to illustrate the safety, comfort system for autonomous driving and Pollution mitigation system.

5. Students will able to describe thevehicle architecture and system interactions.

TEXT BOOKS:

1 A. Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.

2 Richard Bishop, Intelligent Vehicle Technology and Trends,ARTECH House, 2005

REFERENCE BOOKS:

1 H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin:Springer, 2011.

2 Michael E. McGrath, "Autonomous Vehicles: Opportunities, Strategies, and Disruptions", Amazon, 2018

3 Andreas Herrmann, Walter Brenner, Rupert Stadler, "Autonomous Driving: How the Driverless Revolution will Change the World" Emerald Publishing, 2018

4 R. K. Jurgen, Navigation and Intelligent Transportation Systems - Progress in Technology, Automotive Electronics Series, Warrendale, PA: SAE International, 2014.

5 A. Eskandarian (Ed.), Handbook of Intelligent Vehicles, Springer-Verlag London Ltd, 2012.

6 Website: http://www.mogi.bme.hu/TAMOP/jarmurendszerek_iranyitasa_angol/math-ch09.html

AT17711	**VEHICLE MAINTENANCE LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:

1. To understand the tune up of gasoline and diesel engines and also the calibration of fuel injection pump.
2. To understand the fault diagnosis of engine and transmission system
3. To understand the fault diagnosis for driveline and braking system
4. To understand the fault diagnosis for suspension and steering system
5. To understand the fault diagnosis of car electrical and air conditioning system

STUDY EXPERIMENTS:

1. Tools and instruments required for maintenance

2. Safety aspects with respect to man, machine and tools

3. General procedures for servicing and maintenance schedule

4. Wheel Alignment procedure

LIST OF EXPERIMENTS:

1. Minor and major tune up of gasoline and diesel engines

2. Calibration of Fuel pump

3. Engine fault diagnosis using scan tool

4. Fault diagnosis and service of transmission system

5. Fault diagnosis and service of driveline system

6. Fault diagnosis and service of braking system

7. Fault diagnosis and service of suspension system

8. Fault diagnosis and service of steering system

9. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system etc.

10. Fault diagnosis and service of vehicle air conditioning system

11. 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 tire and tube.

TOTAL :   30   PERIODS

COURSE OUTCOMES:

1. The students will be able to perform a major and minor tune up of gasoline and diesel engines and will be able to calibrate the fuel pump
2. The students will be able to diagnose and service the engine and transmission system using scan tool
3. The students will be able to diagnose and service the driveline and braking system
4. The students will be able to diagnose and service the suspension and steering system
5. The students will be able to diagnose and service the electrical and air conditioning system

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Engine Analyzer	1 No.
2.	Cylinder compression pressure gauge	1 No.
3.	Vacuum gauge	1 No.
4.	Spark plug cleaner and tester	1 No.
5.	Cam angle and rpm tester	1 No.
6.	Tachometer	1 No.
7.	Wheel alignment apparatus	1 No.
8.	Gas welding equipment	1 No.
9.	Tyre remover	1 No.
10.	Bearing puller	1 No.
11.	Head light alignment gauge	1 No.
12.	Service manuals of petrol, diesel engines	1 No.: each
13.	Cylinder reboring machine	1 No.
14.	Valve grinding machine 1 No.	1 No.
15.	Valve lapping machine 1 No.	1 No.
16.	Fuel injection calibration test bench with nozzle tester	1 No.
17.	HRD tester, Clamp on meter, Hydrometer	1 No.: each

AT17712	COMPUTER AIDED ANALYSIS OF AUTOMOTIVE COMPONENTS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To make the students understand the deflection of various beams under different loading conditions.
2. To make the students realize the distribution of stress on piston and piston pin.
3. To make the students visualize the stress distribution on connecting rod and mode frequency analysis of different beams
4. To make the students perform the mode frequency analysis on quarter car model and propeller shaft
5. To make the students understand the behaviour of exhaust valve and piston under thermal stress

LIST OF EXPERIMENTS
ANALYSIS (SIMPLE TREATMENT ONLY)

1 Stress analysis of beams (Cantilever, Simply supported, Fixed ends).
2 Stress analysis of a chassis frame.
3 Stress analysis of Piston.
4 Stress analysis of piston pin.
5 Stress analysis of connecting rod.
6 Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends).
7 Mode frequency analysis of a Quarter Car Model.
8 Mode frequency analysis of propeller shaft.
9 Thermal stress analysis of Exhaust Valve.
10 Thermal stress analysis of Piston.

TOTAL :60 PERIODS

COURSE OUTCOMES:

1. The students will be able to estimate the deflection of various beams under different loading conditions.
2. The students will be able to perform stress distribution analysis on piston and piston pin.
3. The students will be able to perform stress distribution analysis on connecting rod and mode frequency analysis of different beams
4. The students can perform mode frequency analysis on quarter car model and propeller shaft
5. The students will be able to analyze the behaviour of exhaust valve and piston under thermal stress

LIST OF EQUIPMENTS
(for the batch of 30 students)

Sl. No.	Equipment Name	Nos.
1	**Computer System : Computer System : i3, TFT** Colour Monitor, 500 GB HDD, 4 GB RAM	30
2	Printer	1
3	**Software:** Suitable analysis software (example ANSYS)	30 licenses
4	C / MATLAB	5 licenses

TEXT BOOKS:

1 ErdoganMadenci, Ibrahim Guven, "The finite element method and applications in engineering using ANSYS" Springer Publication, First Indian Edition 2011.

2 PaletiSrinivas, Sambana Krishna ChaitanyaDatti Rajesh Kumar, "Finite Element Analysis Using Ansys 11.0", Phi Learning Private Limited, 2010

AT17713	TWO AND THREE WHEELERS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

1. To impart students with fundamentals of two wheeler testing methods
2. To impart students with fundamentals principles of two and three wheeler clutch and braking system
3. To impart students with fundamentals principles of gear boxes used in two and three wheeled vehicles.
4. To impart students with fundamentals of chassis measurement of two and three wheelers.
5. To impart students with fundamentals of steering systems used in three wheelers and two wheelers.

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 and chain adjustment.

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 : 30 PERIODS

COURSE OUTCOMES:

1. Graduates will have basic knowledge in testing of two wheeler vehicles.
2. They will be able to dismantle and assemble of clutch and brake system used in two and three wheeler vehicles.
3. They will be able to dismantle and assemble of two and three wheeler gear boxes and find the gear ratios used.
4. They will be able to measuring the dimensions of three wheeler chassis.
5. They will be able to dismantle and assemble of front fork assembly used in two and three wheeler steering system.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Two wheeler chassis dynamometer	1 No.
2.	Coil spring test rig	1 No.
3.	Chain tension test rig	1 No.
4.	Shock absorber test rig	1 No.
5.	Two-wheeler gearbox	2 Nos.
6.	Two-wheeler clutch	2 Nos.
7.	Three-wheeler brake assembly	2 Nos.
8.	Three-wheeler steering assembly	2 Nos.
9.	Three-wheeler gear box	2 Nos.

AT17714	**TECHNICAL SEMINAR / INDUSTRIAL TRAINING /**	**L**	**T**	**P**	**C**
	COMPREHENSION	**0**	**0**	**2**	**1**

TECHNICAL SEMINAR
(for students opted for Technical Seminar)

Objectives:
To develop the ability to understand and present any technical topic.

Method of Evaluation:
To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

Course Outcomes:
On completion of the course students will be able to prepare and present any technical topic related to automotive domain.

INDUSTRIAL TRAINING
(for students completed three weeks of industrial training)

Objective:
To motivate the students to have a practical industrial training in the reputed automotive companies to understand the process and best practices followed in the company.

Method of Evaluation:
1. The students have to undergo practical industrial training for three weeks in recognized industrial establishments during their vacation periods.
2. At the end of the training they have to submit a report with following information:
   - a. Profile of the industry
   - b. Product range
   - c. Organization structure
   - d. Plant layout
   - e. Processes/Machines/Equipments/Devices
   - f. Personnel welfare schemes
   - g. Details of the training undergone
   - h. Projects undertaken during the training, if any
   - i. Learning points

   The assessments will be based equally on the report in the prescribed format and viva-voce examination by a committee nominated by the Head of the Department

Course Outcomes:
On completion of the course students will take on the challenges in the industry, prepare a presentation in a professional manner, and document all aspects.

COMPREHENSION
(for students opted for Comprehension)

Objectives :
To encourage the students to comprehend the knowledge from the previous semester course through periodic exercise.

Method of Evaluation:
The students will be assessed 100 % internally through weekly test with objective type questions on all the subject related topics.

Course Outcomes:
Ability to understand and comprehend any given problem related to automobile engineering domain.

SEMESTER VIII

AT17811	PROJECT WORK	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 180 PERIODS

COURSE OUTCOMES:

On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

	L	**T**	**P**	**C**
AT17E71 **TWO AND THREE WHEELERS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To know about the power plant of two and three wheelers
2. To learn about the construction of frames and various types of transmission systems used in two wheelers
3. To know about the end components of two wheeler drive train
4. To know about the layout and working of electrical systems in a two wheeler
5. To learn about the emissions from two wheelers

UNIT I   POWER UNIT   9

SI Engines and CI engines for two wheelers, Symmetrical and unsymmetrical port timing diagrams, Types of scavenging processes: merits and demerits, scavenging pumps, Rotary valve engine, CI engines for three wheelers Fuel supply systems for SI and CI engines, Lubrication and Cooling systems of two and three wheeler engines, Kick starting system. Electric drives for two and wheelers.

UNIT II   DRIVELINE AND SUSPENSION SYSTEM   9

Main-frame and its types for two and three wheelers, Chassis and shaft drive, Single, multi plate clutches, diaphragm clutch, centrifugal and Semi centrifugal clutches. Primary drive, Gear box and gear controls. Power transmission layout for two and three wheelers, Chain and sprockets, CVT, Front and rear suspension systems of two wheelers, Front and rear suspension systems for three wheelers. Shock absorbers, Panel meters and controls on handle bar, Attachments for sportive two wheelers- radiators, power boosters.

UNIT III   BRAKES, WHEELS AND TYRES   9

Brake system layout for two and three wheelers, Drum brakes, disc brakes, front and rear brake actuating mechanisms, ABS and regenerative brake system, Spoked wheel, cast wheel, disc wheel, disc types. Tyres and tubes, tyre aspect ratio, tyre pressure.

UNIT IV   ELECTRICAL AND ELECTRONIC SYSTEMS   9

Batteries for two and three wheelers, Magneto coil and battery coil spark ignition systems, electronic ignition system, Multiple Spark Plug Systems, Electric starting system-layout, constructional details and working principle for two and three wheelers, Electrical wiring layout of two and three wheelers, Lighting system, horn, fault diagnosis, Servicing and maintenance of two and three wheelers.

**UNIT V   EMISSION CONTROL OF TWO- AND THREE- WHEEL   9
                VEHICLES**

Introduction – World Wide Emission Standards for Two- and Three- Wheel Vehicles – Emission Control Technologies for Motorcycles – Engine Combustion Controls – Evaporative Emission Controls – Catalyst Technology – Catalytic Converters for Motorcycle Engines. Case study of major Indian models of motor cycles and three wheelers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The student can understand the various systems of engines of two and three wheelers
2. The student can understand the working of power transmission in a two wheeler
3. The student can understand the working of brakes, wheels and tyres in two/three wheelers
4. The student can understand the construction of batteries and possess knowledge about the spark plugs and other electrical accessories
5. The student can understand the emission control technologies in two wheelers

TEXT BOOKS:

1. K.K. Ramalingam, "Two Wheelers", published by scitech, 2009.
2. Irving., "P.E. Motor Cycle Engineering", Temple Press Book, London – 1992

REFERENCE BOOKS:

1. Encyclopedia of Motorcycling - 20 volume Marshall, Cavensih, UK - 1989
2. Emission Control of Two- and Three- Wheel Vehicles, Published by Manufacturers of Emission Controls Association, August 2008
3. The Cycle Motor Manual - Temple Press Limited, London - 1990
4. BrayantR.V,Vespa - Maintenance and Repair Series – S.Chand& Co., New Delhi - 1986.
5. Raymond Broad Lambretta,"A Practical Guide to maintenance and repair", S.Chand& Co., New Delhi - 1987.

AT17E72	**OFF ROAD VEHICLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To understand the basics of off road vehicles
2. To understand the constructional features and working of earth movers
3. To understand the constructional features and working of Shovels, ditchers, scrappers, graders
4. To understand the constructional features and working of farm equipments, military and combat vehicles
5. To understand the vehicle systems and features

UNIT I   CLASSIFICATION OF OFF ROAD VEHICLES   6

Introduction to off road vehicles – Classification :Construction layout, capacity and applications, Power Plants, Chassis and Transmission and Multi-axle vehicles.

UNIT II   EARTH MOVING AND MATERIAL HANDLINGMACHINES   9

Earthmovers like dumpers, loaders, dozers, excavators, backhoe loaders, bush cutters, stumpers, rippers – Power, Capacity and Mechanisms of earth moving machines. Material handling vehicles used in the industries – Hydraulic and Electric drives.

UNIT III   SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS   9

Scrappers, elevating graders, motor graders, self-powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – Power, Capacity and Mechanisms of mining machines.

UNIT IV   FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES   9

Constructional details of Tractors - power take off, special implements. **Case study of any one tractor.** Special features and constructional details of tanks, gun carriers and military transport vehicles.

UNIT V   VEHICLE SYSTEMS,FEATURES   9

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 PERIODS

COURSE OUTCOMES:

1. The students will be able to understand the basics of off-road vehicles
2. The students will be able to understand the constructional features and working of earth movers
3. The students will be able to understand the constructional features and working of Shovels, ditchers, scrappers, graders
4. The students will be able to understand the constructional features and working of farm equipments, military and combat vehicles
5. The students will be able to understand the vehicle systems and features

TEXT BOOKS:

1 Robert Peurifoy, Clifford J. Schexnayder, AviadShapira, Robert Schmitt, "Construction Planning, Equipment, and Methods", Tata McGraw-Hill Education Pvt. Ltd.,2011
2 Nakra C.P., "Farm machines and equipments", Dhanparai Publishing company Pvt. Ltd. 2003

REFERENCE BOOKS:

1 Wong.J.T., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.
2 Off the road wheeled and combined traction devices – Ashgate Publishing Co. Ltd. 1988.
3 Schulz Erich.J, Diesel equipment I & II, Mcgraw Hill company, London.
4 Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd London.
5 Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.

	L	**T**	**P**	**C**
AT17E73 **AUTOMOTIVE SENSORS**	**3**	**0**	**0**	**3**

OBJECTIVES:
1. To make the students to understand the various types of sensors and its characteristics used in automobiles.
2. To make the students to understand the various types of sensors used for position and speed and their applications in automobiles.
3. To make the students to understand the various types of sensors used for acceleration, pressure, force and torque and their applications in automobiles.
4. To make the students to understand the various types of sensors used for temperature, flow and climate control and their applications in automobiles.
5. To make the students to understand the various types of optoelectronic sensors and Actuators used in automobiles

UNIT I   INTRODUCTION   9

General concept- Automotive sensors, electronic control unit, actuator, Terms, definitions, Automotive applications, Features of vehicle sensors, sensor classification: assignment and application, Characteristic curve types, Types of output signal, Error types and tolerance requirements, Reliability, Main requirements and trends, Over view of the physical effects for sensors, Overview and selection of sensor technologies.

UNIT II   POSITION AND SPEED SENSORS   9

Position sensors: Characteristics, measured variables,Measuring principle, types- Potentiometer sensors, Magnetically inductive type sensors, Wave-propagation sensors, GPS position and distance traveled measurement. **Speed sensors:** measured variables, measuring principles, relative rpm and speed measurement- inductive types sensor, Absolute rotating speed measurement-oscillation gyroscope

Applications : Accelerator-pedal sensors: Application, design and operating concept**,** potentiometric accelerator pedal sensor, hall angular position sensors. **Engine speed sensors:**Application, design and operating concept, Inductive speed sensors, Active speed sensors, Hall phase sensors, Speed sensors for transmission control, Wheel speed sensors, Micromechanical yaw rate sensors, Piezoelectric "Tuning fork" yaw rate sensor. **Position sensors for transmission control**: Application,design and operating concept, requirements, Linear position determination on the basis of Hall switches, Rotational position determination on the basis of eddy currents. **Steering angle sensors:** Application and operating principle of steering angle sensor with AMR element and GMR element. **Axle sensors:** Application and operating principle

UNIT III   ACCELERATION, PRESSURE, FORCE AND TORQUE SENSORS   9

Acceleration sensors: measured variables, Measuring principles: displacement or travel measuring system, systems for measuring mechanical stress, Thermal acceleration sensors, packaging. **Pressure sensors:** measured variables, Measuring principles: Direct pressure measurement, Diaphragm type sensors, Transfer to a force sensor. **Force and torque sensors:** measured variables, Measuring principles: Strain measuring force sensors, Travel measuring force sensors. **Torque sensor:** strain measuring sensor, angle measuring sensors, eddy current sensors.

Applications: Acceleration sensors: Surface micromechanical (SMM) acceleration sensors, Micromechanical bulk silicon acceleration sensors, piezoelectric acceleration sensors. **Micro mechanical pressure sensors**: application, Version with the reference vacuum on the component side, version with reference vacuum in a special chamber, High pressure sensors. **Force sensor, Torque sensor, Piezoelectric**

knock sensors: application and operating principle, mounting.

UNIT IV   TEMPERATURE , FLOW AND CLIMATE CONTROL SENSORS   9

Temperature sensors: Measured variables, Measuring principles for direct contact sensors: Resistive sensors, sintered ceramic NTC resistors, PTC thin-film / thick-film metallic resistors, thick film resistors (PTC/NTC), mono crystalline silicon semiconductor resistors (PTC), Thermocouples, semiconductor depletion layers. Measuring principles for non-contacting temperature measurement: bolometer, thermopile sensor, single point sensors, imaging sensors. **Flow meters:** measured variables, Measuring principles. **Gas sensors and concentration sensors:** measured variables, Measuring principles
Applications: Temperature sensors: Application: engine temperature sensor, air temperature sensor, engine oil temperature sensor, fuel temperature sensor, exhaust gas temperature sensor, operating principles. **Hot film air mass meters:** application, HFM5 type, HFM6 type. **Climate control sensor.**

UNIT V   OTHER SENSORS AND ACTUATORS   9

Optoelectronic sensors: Internal photoelectric effect, Light sensitive sensor elements: photo resistors, semiconductor PN junctions, Imaging sensors: intergrading photodiodes, CCD imaging sensors, CMOS imaging sensors. Applications of optoelectronics sensors.
Other Sensors: Working principle of Ultrasonic sensor, Rain/light sensor, Dirt sensor, Two sep lambda oxygen sensors, Planar wide band lambda oxygen sensors, crash sensor.
Actuators: Working of Solenoids, Relays and Electric motors: stepper motors, permanent Magnet field motors and its applications.

TOTAL :45 PERIODS

COURSE OUTCOMES:

1. The students will be able to explain the working of various sensors and its characteristics used in automobiles.
2. The students will be able to explain the working and selection of various sensors used to determine position and speed in automobiles.
3. The students will be able to explain the working and selection of various sensors used to determine acceleration, pressure, force and torque in automobiles.
4. The students will be able to explain the working and selection of various sensors used to determine temperature, flow and climate control in automobiles.
5. The students will be able to explain the working and selection of optoelectronic sensors and actuators used in automobiles.

TEXT BOOKS :

1 "Automotive Sensors" by Robert Bosch GmbH, 2007.
2 Joseph Bell "Diesel Engineering – Electricity and Electronics" Cengage learning, Indian Edition, 2007.

REFERENCE BOOKS/WEBLINKS :

1 Steve V. Hatch "Electronic Engine controls" Cengage learning, Indian Edition, 2009.
2 Sean Bennett "Diesel Engineering – Electronic diesel engine diagnosis" Cengage learning, Indian Edition, 2007.
3 Ian Sinclair, "Sensors and Transducers", Newnes, Elsevier, Indian Edition, 2011
4 https://nptel.ac.in/courses/112103174/3

AT17E74	NOISE, VIBRATION AND HARSHNESS CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To make the students to understand the basic characteristics of noise and its sources from automobiles
2. To make the students to understand the different techniques to control noise from automobiles
3. To make the students to understand the basic characteristics of vibration and its sources from automobiles
4. To make the students to understand the different techniques to vibration from automobiles
5. To make the students to understand the Harshness and ride comfort in automobiles

UNIT I   BASICS OF NOISE AND SOURCES   9

Introduction, noise dose level, legislation, measurement and analysis of noise in engines, Noise characteristics, overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise **and Electromagnetic noise.**

UNIT II   NOISE CONTROL   9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

UNIT III   BASICS AND MEASUREMENT OF VIBRATION   9

Introduction to basic principles of vibration - determination of natural frequencies - Lumped modelling of automotive structure - Vibration measuring techniques -standard test procedure for vibration measurement.

UNIT IV   VIBRATION CONTROL TECHNIQUES   9

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers

UNIT V   ADVANCED CONCEPTS   9

Harshness definition and achieving Ride comfort - Latest computational tools and techniques to control noise and vibration in automobiles - Vehicle refinement - Recent material used for controlling interior and exterior noise produced in the vehicle- case studies.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

1. Gain knowledge on noise and its measurements in automobiles
2. Expose themselves to various control measures of noise in automobiles.
3. Gain knowledge on vibration and its measurements in automobiles
4. Expose themselves to various control measures of vibration in automobiles
5. Appreciate the need to study the harshness and advanced techniques to reduce harshness from automobiles

TEXT BOOKS:

1. Matthew Harrison, "Vehcile Refinement – Controlling Noise and Vibration in Road Vehicle", Butterworth-Heinemann, Indian Edition,2011.
2. SingiresuS.Rao - "Mechanical Vibrations" - Pearson Education, 2004.

REFERENCE BOOKS/WEBLINK:

1. Bernard Challen and RodicaBaranescu - "Diesel Engine Reference Book" -Second edition - SAE International, 1999.
2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth- Heinemann, 2004
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis" - Professional Engineering Publishing, 1998.
4. KewalPujara "Vibrations and Noise for Engineers", DhanpatRai& Sons, 1992.
5. M. Moser, "Engineering Acoustics – An Introduction to Noise Control", Springer, Indian Edition, 2009
6. https://nptel.ac.in/courses/107106080/31

		L	**T**	**P**	**C**
ME17E82	**OPERATIONS RESEARCH**	**3**	**0**	**0**	**3**

OBJECTIVES:

The course is intended to build up necessary background and

1. To create awareness about optimization techniques in utilization of resources and to formulate the linear programming model for industrial applications
2. To provide knowledge and training in various applications of LPP like assignment model, transportation model, Network model and sequencing models
3. To understand the deterministic and stochastic inventory models
4. To understand the Single and Multi-server queuing models
5. To provide knowledge about the various decision models

UNIT I   LINEAR MODELS   15

Introduction to Operations Research - Scope, objectives, phases, models and limitations. Linear programming – formulation of LPP - Graphical method – Simplex algorithm – Artificial variables – Big M method – Two phase method – Duality formulation.

UNIT II   TRANSPORTATION MODELS AND NETWORK MODELS   8

Transportation models - Finding basic feasible solution – LCM, NWC and VAM methods – Optimality test using MODI method .
Assignment Models – Hungarian method for optimal solution - Unbalanced problem - Traveling Salesman problem
Networks models – Shortest route – Minimal spanning tree – Project network – CPM and PERT networks – Critical path scheduling
Sequencing models - Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT III   INVENTORY MODELS   6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV   QUEUEING MODELS   6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V   DECISION MODELS   10

Decision models – Game theory – Two person zero sum games - Pure and mixed strategy – Graphical solution - Algebraic solution – Method of Dominance
Replacement models – Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value. Replacement of items that fail suddenly: individual replacement policy, group replacement policy technique – Dynamic Programming – Simple Problem.

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students can able

1. To formulate a real-world problem as a mathematical linear programming model and solve it using techniques of LPP
2. To build and solve specialized linear programming problems like Transportation Models Assignment Models and Network
3. To know about the maintenance of inventory level and its calculations
4. To model a dynamic system as a queuing model and compute important performance Measures
5. To solve the playing of game using pure and mixed strategy and to understand the Replacement policy

TEXT BOOKS:

1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS/WEBLINK:

1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986
5. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.
7. https://nptel.ac.in/courses/112106134/
8. https://nptel.ac.in/courses/110106062/

AT17E75	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the classification of maintenance work, vehicle insurance, workshop practices, safety and tools.
2. To understand the general engine services, engine subsystem maintenance and engine maintenance.
3. To understand thetransmission and driveline maintenance**.**
4. To understandthe steering, brake, suspension and wheel maintenance.
5. To understand theauto electrical and air conditioning maintenance.

**UNIT I   MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND   9
    TOOLS**

Maintenance – Need, classification of maintenance work – policies- vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual and records, Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments –Motor vehicle Act, traffic rules, driving rules and regulations.

UNIT II   ENGINE AND ENGINE SUBSYSTEM MAINTENANCE   8

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 engine management - emission controls service and fault diagnosis.

UNIT III   TRANSMISSION AND DRIVELINE MAINTENANCE   9

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- 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   STEERING,   BRAKE,   SUSPENSION,   WHEEL 9
    MAINTENANCE**

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering system and types.

**UNIT V   AUTO   ELECTRICAL   AND   AIR   CONDITIOING 10
    MAINTENANCE**

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

TOTAL :   45   PERIODS

COURSE OUTCOMES:

1. Students will be able to explain the classification of maintenance work, vehicle insurance, workshop practices, safety and tools.
2. Students will be able to explain the general engine services, engine subsystem maintenance and engine maintenance.
3. Students will be able to describe the transmission and driveline maintenance**.**
4. Students will be able to elucidate about the steering, brake, suspension and wheel maintenance.
5. Students will be able to illustrate about the auto electrical and air conditioning maintenance.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Bosch Automotive Handbook, Sixth Edition, 2004

		L	**T**	**P**	**C**
AT17E76	**TRANSPORT MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To introduce the various functions and their significance of personnel management. To introduce the basic job selection process.
2. To understand the importance of motor transport among other transport means, functions of various divisions and structure of various forms of ownerships.
3. To comprehend various components of operating costs, fare structure, fare collection methods and to prepare fare table. To study the basic factors and problems involved in bus scheduling
4. To familiarize with various aspects of motor vehicle acts related to road users, vehicle owners, drivers, and vehicle designers.
5. To realize the importance of vehicle maintenance in running profitable transport fleet and to know the basic bus depot layout.

UNIT I   INTRODUCTION   9

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

UNIT II   TRANSPORT SYSTEMS   9

Introduction to **various transport systems including shared mobility**. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility forms of ownership by state, municipality, public body and private undertakings.**Case study of transport system.**

UNIT III   SCHEDULING AND FARE STRUCTURE   9

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

UNIT IV   MOTOR VEHICLE ACT   9

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

UNIT V   MAINTENANCE   9

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

TOTAL :45 PERIODS

COURSE OUTCOMES:

1. Students will know the objectives and functions of personnel management team, job selection and training processes.
2. Students will be able to explain the importance of motor transport, functions of transport departments and various forms of ownerships
3. Students will be able to calculate operating cost, prepare fare charts, and he can explain fare structure, fare collection methods and factors involved in bus scheduling
4. Students will be able to classify traffic signs, explain the requirements for vehicle fitness, registration, permit insurance and describe various types of vehicles.
5. Students will be able to explain the various vehicle maintenance procedures and can prepare a depot layout to run a successful transport fleet.

TEXT BOOKS:

1 John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2 Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCE BOOKS/WEBLINK:

1 Government Motor Vehicle Act, Publication on latest act to be used as on date
2 https://nptel.ac.in/courses/105101008/29

	L	T	P	C
GE17551 **PRINCIPLES OF MANAGEMENT**	3	0	0	3

OBJECTIVES:

1. To provide an introduction to management and types of business organisations.
2. To provide the knowledge of planning, strategic management and decision making, theirrelevance, methodologies and benefits.
3. To provide the knowledge of organizing and human resources management.
4. To enrich about the directing and controlling functions in organisations.
5. To provide knowledge on marketing management and international management.

UNIT I   **INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**   **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers -managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment.

UNIT II   **PLANNING**   **9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III   **ORGANISING**   **9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning.

UNIT IV   **DIRECTING AND CONTROLLING**   **9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication. System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

UNIT V   **MARKETING AND MULTINATIONAL MANAGEMENT**   **9**

Marketing management – marketing mix and strategies – pricing – product – channels of distribution – promotion – market research.
International management – stages of internationalism - the multinational company – reasons - modes of foreign investment – problems faced by international managers-management functions in international operations.

TOTAL :45 PERIODS

COURSE OUTCOMES:

On the successful completion of the course, students will be

1. Able to know the basic aspects of management thought, its evolution and various approaches.
2. Able to provide policies and objectives for the organisation, and recommend appropriate tools and techniques.
3. Able to carry out structuring and restructuring of organisations and to effectively manage the human resources of the organization.
4. Able to carry out directing and controlling activities in organisations.
5. Able to plan, organize, direct and control marketing management and international management activities in organisations.

TEXT BOOKS:

1 Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2 Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

REFERENCE BOOKS:

1 Stephen A. Robbins & David A. Decenzo& Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
2 Robert Kreitner&MamataMohapatra, "Management", Biztantra, 2008.
3 Joseph C.Messie, "Essentials ofManagement", Prentice Hall of India, New Delhi, 2003.
4 https://nptel.ac.in/courses/122108038/

		L	**T**	**P**	**C**
GE17E52	**ENTREPRENEURSHIP DEVELOPMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To understand the meaning of Entrepreneur
2. To know different motivation techniques
3. To be familiarized with business opportunities
4. To have knowledge about source of finance and analysis
5. To know various supports for business

UNIT I   ENTREPRENEURSHIP   9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II   MOTIVATION   9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III   IDENTIFICATION OF BUSINESS   9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV   FINANCING AND ACCOUNTING   9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V   SUPPORT TO ENTREPRENEURS   5

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able:

1. Explain the meaning of Entrepreneur
2. Comprehend different motivation techniques
3. Describe various business opportunities
4. Identify sources of finance and to analyse
5. Know various supports for business development

TEXT BOOKS:

1 Khanka. S.S., "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.
2 Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition,Cengage Learning, 2014.

REFERENCE BOOKS/WEBLINK:

1 Hisrich R D, Peters M P, "Entrepreneurship", 8th Edition, Tata McGraw-Hill, 2013.
2 Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition, Dream tech, 2005.
3 Rajeev Roy, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011.
4 Jain P C, "A Hand Book for New Entrepreneurs", Oxford University Press, 2010.
5 https://nptel.ac.in/courses/122106032/26

AE17505	**CONTROL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To introduce the mathematical modelling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
2. To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
3. To introduce sampled data control system.

UNIT I   INTRODUCTION   9

Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II   OPEN AND CLOSED LOOP SYSTEMS   9

Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT III   CHARACTERISTIC EQUATION AND FUNCTIONS   9

Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV   CONCEPT OF STABILITY   10

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V   SAMPLED DATA SYSTEMS   8

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

TOTAL :45 PERIODS

COURSE OUTCOMES:

1. Ability to understand the importance of mathematical modeling of a system
2. Ability to Demonstrate the concept and needs of feedback control systems and its application
3. Ability to Determine the response of different order systems for various step inputs
4. Ability to Determine the (absolute) stability of a closed-loop control system
5. Ability to understand the concept of data system sampling and digital controller

TEXT BOOKS:

1 OGATA, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2 Azzo, J.J.D. and C.H. Houpis, Feedback control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.

REFERENCE BOOKS/WEBLINK:

1 Kuo, B.C. "Automatic control systems", Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.

2 Houpis, C.H. and Lamont, G.B. "Digital control Systems", McGraw Hill Book co., U.S.A. 1995.

3 Naresh K Sinha, "Control Systems", New Age International Publishers, New Delhi, 1998.

4 https://nptel.ac.in/courses/108106098/1

5 https://nptel.ac.in/courses/108101037

AT17E81	PRODUCTION OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand various process involved in powder metallurgy and various process available for processing plastics
2. To understand the process capabilities and application of metal forming techniques such as forging and extrusion in automobile component production.
3. To understand and to identify suitable casting technology available for automobile component
4. To understand the application of abrasive machining in automobile component production and to learn various gear generating and manufacturing techniques available
5. To understand the part programming concept in a Computer numeric controlled machine considering various machining and production constraints.

UNIT I   POWDER METALLURGY AND PROCESSING OF PLASTICS   9

Powder Metallurgy – Advantages and Limitations –metal powders manufacturing and Characteristics – Mixing and Blending – Compacting (Briquetting)- sintering – secondary operations-properties of Powder Metallurgy – General Applications and Manufacture of friction lining materials for clutches and brakes,

Processing of Plastics – Polymers-polymerization – plastics – Processing of Thermoplastic Plastics: Injection moulding, Extrusion process and Sheet forming process- Processing of Thermosetting plastics: Compression moulding – Casting, machining, welding and other processing like Calendering, Rotational moulding, Blow moulding – applications in automotive parts.

UNIT II   FORGING AND EXTRUSION PROCESSES   9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning.

Forging; materials, process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column.

Extrusions; Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets.

Hydro forming – Process, hydro forming of manifold and comparison with conventional methods-Hydro forming of tail lamp housing – forming of wheel disc and rims.

Stretch forming – Process, stretch forming of auto body panels –Super plastic alloys for auto body panels

UNIT III   CASTING AND MACHINING   9

Sand casting of cylinder block and liners – Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburetor other small auto parts.

Machining of connecting rods – crank shafts – cam shafts – pistons – piston pins – piston rings – valves – front and rear axle housings – fly wheel – Honing of cylinder bores – Copy turning and profile grinding machines.

UNIT IV   ABRASIVE PROCESSES AND GEAR CUTTING   9
Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining – Gear cutting, forming, generation, shaping, hobbing.

UNIT V   CNC MACHINE TOOLS AND PART PROGRAMMING   9
Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – slide ways –linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming.

TOTAL :45 PERIODS

COURSE OUTCOMES:

1. The student will be able to understand various process involved in powder metallurgy and various process available for processing plastics
2. The student will be able to understand the process capabilities and application of metal forming techniques such as forging and extrusion in automobile component production.
3. The student will be able to understand and identify suitable casting technology available for automobile component
4. The student will be able to understand the application of abrasive machining in automobile component production and to learn various gear generating and manufacturing techniques available
5. The student will be able to understand the part programming concept in a Computer numeric controlled machine considering various machining and production constraints

TEXT BOOKS:

1 P.C. Sharma, "A Textbook of Production Technology", S. Chand & Company Ltd., New Delhi, 2011.
2 HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.

REFERENCE BOOKS/WEBLINK:

1 M. Groover and E Zimmers, "CAD/CAM – Computer Aided Design and Manufacturing" Pearson Education Inc, 2011.
2 Rusinoff, "Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai, 1995.
3 "H.M.T. Production Technology – Handbook", Tata McGraw-Hill Education Pvt. Ltd., 2000.
4 Sabroff.A.M. & Others, "Forging Materials &Processes ", Reinhold Book Corporation, New York, 1988.
5 Upton, "Pressure Die Casting", Pergamon Press, 1985.
6 High Velocity "Forming of Metals", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990.
7 ASME Metals Handbook
8 https://nptel.ac.in/courses/125106001/

AT17E82	**TRACTORS AND FARM EQUIPMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To make the students understand the basics of tractors and their engines
2. To make the students understand the control and engine operation of a tractor.
3. To make the students understand the steering, transmission and brake systems of a tractor
4. To make the students understand the traction of a tractor
5. To make the students understand the farm equipments

UNIT I   BASICS OF TRACTORS   9

Classification of tractors - Different types and purpose - Main components of tractor - Safety rules. Tractor Engines – basics, air induction system, exhaust system, cooling system and lubrication systems

UNIT II   CLUTCH, DRIVE TRAINAND REAR TRANSMISSION   9

Clutch – necessity of clutch, types, Gear box – Types, Common Construction, Unique features and differences of differential gear boxes. Differential unit and final drive. Rear Transmission – Components and function. Power take-off.

UNIT III   STEERING, WHEELS AND BRAKES   9

Steering – components, types, power steering mechanism, hydrostatic steering. Wheels – size, Inflation, Ballasting, Wheel Slippage. Brakes – principle of operation, classification of brakes.

UNIT IV   TRACTION   9

Traction Mechanics – Performance equations – Tire size, Load, and Air pressure relationship-Tread design – Traction Improvement – Traction devices for paddy fields

UNIT V   FARM EQUIPMENTS   9

Working attachment of tractors - Farm equipment - Classification –Sowing and Planting equipment, Spraying equipment, Auxiliary equipments - Trailers and body tipping mechanism.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will be able to explain about the various components of tractor and its power unit
2. The students will be able to sketch the layout and the drive train components and will explain their working principle.
3. The students will be able to explain the working of steering system, wheels and brake systems of a tractor
4. The students will be able to explain the traction character tics of a tractor and methods to improve the traction
5. The students will be able to explain about the various attachments to the tractor and their working principle

TEXT BOOKS:

1. K. Srinivasan, "Tractor and Agricultural Machinery", 2nd edition, New India Publishing Agency, 2015.
2. Segun R. Bello, "Farm Tractor Systems: Maintenance and Operations",Createspace Independent Pub, 2012.

REFERENCE BOOKS:

1. Rodichev and Rodicheva. G, *Tractor and Automobiles*, MIR Publishers, 1987
2. Kolchin. A and Demidov. V, *Design of Automotive engines for tractor*, MIR Publishers, 1972
3. John B Lijedahl., *Tractors and their power units,* 4th edition, Van Nostrand Reinhold
4. https://nptel.ac.in/courses/126105009

AT17E83	VEHICLE BODY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1.To understand the different types of car body details.

2.To understand the different types of bus body details.

3.To understand the importance of commercial vehicle details.

4.To understand the importance of vehicle aerodynamics

5.To understand the different types of body materials, trims and mechanisms.

UNIT I	CAR BODY DETAILS	9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, 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	BUS BODY DETAILS	9

Types of bus body: based on capacity, distance travelled and based on construction.–Conventional and Modernbus body layouts - Types of metal sections used – Regulations – Constructional details: Conventional and integral. driver seat design- Safety aspect of bus body.

UNIT III	COMMERCIAL VEHICLE DETAILS	9

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	VEHICLE AERODYNAMICS	9

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind 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	BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR	9

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 PERIODS

COURSE OUTCOMES:
1. Students will be able to describe the different types of car body details.
2. Students will be able to explain the different types of bus body details.
3. Students will be able to describe the importance of commercial vehicle details.
4. Students will be able to illustrate the importance of vehicle aerodynamics
5. Students will be able to describe the different types of body materials, trims and mechanisms.

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	Giles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 1991.
2	John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.
3	Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 1997

	L	**T**	**P**	**C**
AT17E84 **INSTRUMENTATION AND METROLOGY**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To understand various characteristics of measuring instruments.
2. To understand various instruments used for measuring pressure, temperature and flow and their applications.
3. To understand various instruments used for measuring strain, force and torque and their applications.
4. To understand various instruments used for linear and angular measurements and their applications.
5. To understand various instruments used for form measurements and their applications.

UNIT I	**GENERAL CONCEPTS OF MECHANICAL INSTRUMENTATION, GENERALISED MEASUREMENT SYSTEM**	**9**

General concept – generalized measurement system – Units and standards- measuring instruments – sensitivity, readability, range of accuracy, precision – static and dynamic response – repeatability – systematic and random errors – correction, calibration, interchangeability.
Measurement of displacement, time, speed, frequency, acceleration, - Vibrometer, accelerometer.

UNIT II   **MEASUREMENT OF PRESSURE, TEMPERATURE & FLOW**   **9**

PRESSURE MEASUREMENT: Gravitational, Bourdon, elastic transducers, strain gauge, pressure cells, Measurement of high and low pressure, Dynamic characteristic of pressure measuring devices.

TEMPERATURE MEASUREMENT: Bi-metallic, pressure and resistance thermometer, Thermocouples, Pyrometer and Thermistors, Calibration.

FLOW MEASUREMENT: Orifice, flow nozzle, venturi, pitot tube, rotometer, Turbine type anemometer, Hot-wire anemometer, Magnetic flow meter, Ultrasonic flow meter, Calibration.

UNIT III   **MEASUREMENT OF STRAIN, FORCE & TORQUE**   **9**
STRAIN: Strain gauges, types, surface preparation and bonding technique, Wheatstone circuit, Temperature compensation, Gauge rosettes, calibration.

FORCE MEASUREMENT: Scales and balance, Elastic force meter, Strain gauge, Load cells, Hydraulic and pneumatic load cells.

TORQUE MEASUREMENT: Mechanical torsion meter, Optical torsion meter, Electrical torsion meter, Strain gauge torsion meter.

UNIT IV   **LINEAR AND ANGULAR MEASUREMENTS**   **9**
Definition of metrology - Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly. Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT V   **FORM MEASUREMENTS**   **9**
Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.
Coordinate measuring machine (CMM): constructional features – types and applications - Basic concepts of Machine Vision System.

TOTAL :45 PERIODS

COURSE OUTCOMES :

1. Students will be able to understand the various characteristics of measuring instruments and able to select the instruments based on applications.
2. Students will be able to understand various instruments used for measuring pressure, temperature and flow and apply the required instruments based on the applications.
3. Students will be able to understand various instruments used for measuring strain, force and torque and apply the required instruments based on the applications.
4. Students will be able to understand various instruments used for measuring linear and angular measurements and apply the required instruments based on the applications.
5. Students will be able to understand various instruments used for form measurements.

TEXT BOOKS:

1 Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
2 Jain R.K. "Engineering Metrology", Khanna Publishers, 2005

REFERENCE BOOKS/WEB LINK:

1 Alan S Morris, The Essence of Measurement, PHI, 1997
2 Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
3 Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
4 https://nptel.ac.in/courses/112106138/
5 https://nptel.ac.in/courses/112106179/

ME17E86	**ADDITIVE MANUFACTURING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To know role of Additive manufacturing in product development
2. To know the importance of CAD, reverse engineering and digitization techniques in additive manufacturing
3. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the various Additive Manufacturing technologies
4. To be familiar with the characteristics and different types of the powder based Additive Manufacturing.
5. To know the applications of additive manufacturing in medical and bio medical field

UNIT I   INTRODUCTION   10

Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II   CAD & REVERSE ENGINEERING   10

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III   LIQUID   BASED   AND   SOLID   BASED   ADDITIVE   10
MANUFACTURING SYSTEMS

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV   POWDER BASED ADDITIVE MANUFACTURING SYSTEMS   10

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V   MEDICAL AND BIO-ADDITIVE MANUFACTURING   5

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students can able

1. To understand the need of prototypes and its role in product development
2. To understand the importance of CAD model, reverse engineering and digitization techniques
3. To compare different method and discuss the effects of the liquid and solid based Additive Manufacturing technologies and analyze their characteristics
4. To understand the different methods, process and applications of the powder based Additive Manufacturing technologies and analyze its characteristics
5. To know the various applications of additive manufacturing in Medical and Bio additive manufacturing

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCE BOOKS/WEBLINK:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications:A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
4. https://nptel.ac.in/courses/112104204/47
5. http://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf

		L	**T**	**P**	**C**
AT17E85	**AUTOMOTIVE SAFETY**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To learn about the significance of energy equation in vehicle safety
2. To learn about the various types of automotive safety
3. To learn about the various safety equipments used in automobiles.
4. To learn about the working principle of collision warning system in a vehicle
5. To learn about the various comfort and convenience systems in automobiles

UNIT I   INTRODUCTION   9

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, Safety Standards.

UNIT II   SAFETY CONCEPTS   9

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

UNIT III   SAFETY EQUIPMENTS   9

Seat belt regulations, automatic seat belt tightener system, seat belt pre-tensioner, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety, Seat Position Control.

UNIT IV   ACTIVE SAFETY AND COLLISION AVOIDANCE SYSTEM   9

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions. Electronic Stability Control, Active vibration Control, Accident recorder, Event data recorder, Automatic Braking.

UNIT V   COMFORT AND CONVENIENCE SYSTEM   9

Steering and mirror adjustment, Remote keyless entry, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, Cabin environment controls, Head-up Display, Digital turn signals, Intelligent Speed Adaptation, Traffic assist, Hill hold control, Lane Correction, Lane Departure Warning, Night Vision. Blind spot recognition system, safety standard, case study.

TOTAL :45 PERIODS

COURSE OUTCOMES:

1. The student can derive the crash equation based on energy principles
2. The student can understand the various classification of active and passive safety.
3. The student can understand the working of seat belts, air bags and other safety systems.
4. The student can understand the working of collision warning system and integration with braking system
5. The student can understand the various comfort systems in a vehicle.

TEXT BOOKS:

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

REFERENCE BOOKS/WEBLINK:

1 Ronald K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.
2 http://nptel.ac.in/courses/105108073/module3/lecture8.pdf

	L	**T**	**P**	**C**
AT17E86 AUTOMOTIVE TESTING	**3**	**0**	**0**	**3**

OBJECTIVES:
1. To understand the vehicle classifications, regulations and need for certification
2. To learn the various test to be done on brakes, steering system and vehicle related tests
3. To impart knowledge about the various tests performed on the passenger safety and Engine emissions.
4. To learn the various tests to be performed on the Individual Vehicle Components.
5. To learn the various tests to be done on the vehicle lighting system

UNIT I   INTRODUCTION   10
Specification & Classification of Vehicles (including M, N and O layout), Regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, 2 Wheeler certification

**UNIT II   4 WHEELER PASSENGER VEHICLE – M1 CATEGORY 9
               (VEHICLE RELATED TESTS)**

Vehicle Testing - Photographs, CMVR physical verification, Vehicle weightment, Coast down test, Brake test, ABS, Turning circle diameter test, Steering effort test, Speedometer calibration, Pass by noise test, External projection test, Gradeability test, Acceleration control system, Horn installation, Rear view mirror installation, Installation requirement for lighting &signalling devices, Wind screen wiping system. Electric vehicles – Safety Norms, Range, Energy consumption, Power test.

**UNIT III   4 WHEELER PASSENGER VEHICLE – M1 CATEGORY 10
               (PASSENGER SAFETY AND EMISSION TESTS)**

Steering Impact test (GVW<1500 kg), Body block test, Head form test, Fixtures charges, Crash test with dummies, Different crash tests, Crash worthiness/ratings, Bumper testing, OBD I, Engine power test (petrol & diesel), Indian driving cycle, Vehicle mass emission, Evaporative emission (petrol vehicles), Broad band / Narrow band EMI test.

**UNIT IV   4 WHEELER PASSENGER VEHICLE – M1 CATEGORY 7
               (COMPONENT RELATED TESTS)**

Size and Ply rating of tyres, Safety Glasses: Windscreen laminated safety glass, Side window / door glass, Back light / Rear toughened glass, Wind screen wiping system, Wiper Blade, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention, EV Battery Safety, EV Motor power test, EMI-EMC (CI, BCI, RE,RI and CTE)

UNIT V   AUTOMOTIVE LIGHTING TESTS   9
Performance requirement for lighting & signalling devices - Vertical orientation of dipped beam-head lamp, driver's field of vision, Head lamp assembly (glass lens & plastic lens), Head lamp + Front position lamp / Front indicator lamp / front fog lamp, Rear combinational lamp (each additional function), Independent front position lamp / Front direction indicator lamp / Front fog lamp, Rear combination lamp (single function), Warning triangles, Fuel tank: Metallic & Plastic (excluding fire resistance test).

TOTAL :45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students will be able to

1. Classify the vehicle and identify the regulations governing for each vehicle type
2. Perform and analyze the braking, steering systems of any vehicle
3. Perform various test related to vehicle engine emissions
4. Test and analyze the performance of Individual Vehicle Components.
5. Perform the tests to be done on the vehicle lighting system

TEXT BOOKS :

1. "Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators

2. Michael Plint& Anthony Martyr,"Engine Testing & Practice", Butterworth Heinmenn, 3rd edition, 2007

REFERENCE BOOKS /WEBLINK:

1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUNE
2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007
3. Tim Gilles, "Automotive Service" Delmar publishers, 1998.
4. Motor Vehicle Manual
5. ECE standards
6. EEC standards
7. FMVSS standards

8. CMVR standards
9. https://nptel.ac.in/courses/112104033/16

		L	**T**	**P**	**C**
AT17E87	**AUTOMOTIVE AIR-CONDITIONING**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To understand fundamentals of air conditioning and working of air conditioning components.
2. To understand fundamentals of heating system employed in automobiles and working of components.
3. To understand handling of refrigerant and various steps involved in diagnostic procedures of air conditioning system used in automobiles.
4. To understand air routing and temperature controls employed in automobile air conditioning and heating systems.
5. To understand procedure to service the automobile air conditioning and heating systems.

UNIT I   AIRCONDITIONING FUNDAMENTALS   9

Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator.

UNIT II   HEATING,   VENTILATION   AND   AIR   CONDITIONING   9
              SYSTEM (HVAC)

Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, climate control systems, air conditioning protection, engine protection.

UNIT III   REFRIGERANT   9

Types of Refrigerant, Containers handling refrigerants, tapping into the refrigerant container, refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures.

UNIT IV   AIR ROUTING AND TEMPERATURE CONTROL   9

Evaporator airflow through the re-circulating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems.

UNIT V   AIR CONDITIONING SERVICE   9

Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service.
Case study – Air-conditioning in passenger vehicle & commercial vehicle.

                                                          TOTAL :45 PERIODS

COURSE OUTCOMES:

1. Students will be able to understand the working of air conditioning system and its components.
2. Students will be able to understand the heating system used in automobiles.
3. Students will be able to understand procedure to handle refrigerants and diagnostic procedure for refrigerants.
4. Students will be able to understand various steps involved in designing of air routing and temperature controls.
5. Students will be able to understand various steps in services of automotive air conditioning and heating systems.

TEXT BOOKS:

1 RusellCarrign, John Eichelberger, "Automotive Technology – Heating and air conditioning", Cengage learning, Indian Edition, 2011
2 Steven Daly, "Automotive Air conditioning and Climate Control systems", Butterworth-Heinemann, Indian Edition, 2011.

REFERENCE BOOKS/WEBLINK:

1 Mark Schnubel, "Automotive Engineering – Heating and Air conditioning" classroom and shop manual, Cengage learning, Indian Edition, 2011
2 Arora C.P., "Refrigeration and Air conditioning HVAC", Tata McGraw-Hill Education Pvt. Ltd., 2008.
3 Arthur Bell, "HVAC Equations, Data, and Rules of Thumb", Tata McGraw-Hill Education Pvt. Ltd., 2008.
4 https://nptel.ac.in/courses/112107208/

		L	**T**	**P**	**C**
AT17E88	**AUTOMOTIVE AERODYNAMICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To make the students understand the design concept of automobile
2. To understand the effect of drag force on car
3. To optimize Automobile shapes for better aerodynamic performance
4. To study the characteristics of forces and moments when vehicle running on the road.
5. To study the wind tunnel experiment procedure and measurement techniques

UNIT I   INTRODUCTION   9

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT II   AERODYNAMIC DRAG OF CABS   9

Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III   SHAPE OPTIMIZATION OF CABS   9

Front and Rear modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT IV   VEHICLE HANDLING   9

The origin of force and moments on a vehicle – side wind 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   WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS   9

Introduction – Principles 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 PERIODS

COURSE OUTCOMES:

1. The student will be able to design vehicle with good aerodynamic characteristics.
2. The student will be able to calculate drag on car
3. The student will be to design front and rear shape for better aerodynamic performance
4. The student will be able to calculate forces and moment induced on car
5. The student will be able to use wind tunnel for calculating aerodynamic performance of car model.

TEXT BOOKS:

1 Hucho, Wolf-Heinrich., "Aerodynamics Of Road Vehicles: From Fluid Mechanics To Vehicle Engineering" Published by SAE International, 1998.
2 Anderson, John D., "Fundamentals Of Aerodynamics, by Tata Mcgraw-Hill, 2007.

REFERENCE BOOKS/WEBLINK:

1 Houghton, E. L; Carpenter, P. W., "Aerodynamics For Engineering Students" Cbs Publisher & Distributors, 2003
2 Pope,A., Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1974.
3 https://nptel.ac.in/courses/101106042/2

		L	**T**	**P**	**C**
ME17E77	**COMPUTATIONAL FLUID DYNAMICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To analyze mathematical and computational methods for fluid flow and heat transfer simulations.
2. To use the Finite difference and volume method for solving diffusion problems
3. To use finite volume method for convection diffusion.
4. To assess the flow parameters in internal and external flows.
5. To expose the students to various models in flow analysis.

UNIT I   GOVERNING EQUATIONS AND BOUNDARY CONDITIONS   8

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

**UNIT II   FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR   9
                   DIFFUSION**

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

UNIT III   FINITE VOLUME METHOD FOR CONVECTION DIFFUSION   10
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV   FLOW FIELD ANALYSIS   9
Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V   TURBULENCE MODELS AND MESH GENERATION   9

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

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students can able to

1. Use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.
2. Solve One, Two and Three -dimensional diffusion problems.
3. Apply Finite volume method and solve the convection diffusion problems.
4. Use finite volume method to solve fluid flow analysis.
5. To know the various features used to solve turbulence problem in Software.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCE BOOKS/ WEBLINK:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

7. https://nptel.ac.in/courses/112105045/4