SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Recognized by UGC & Affiliated to Anna University
Accredited by NBA-AICTE, NAAC-UGC with 'A+' Grade

Saravanampatti , Coimbatore -641035

CURRICULA AND SYLLABI

REGULATION 2016

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF AUTOMOBILE ENGINEERING

B.E. – AUTOMOBILE ENGINEERING

SNS COLLEGE OF TECHNOLOGY, COIMBATORE – 641035

(AN AUTONOMOUS INSTITUTION)

REGULATION – 2016

CHOICE BASED CREDIT SYSTEM

SUGGESTED CURRICULUM & SYLLABI

B. E. - AUTOMOBILE ENGINEERING

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN101	Technical English – I	HS	3	3	0	0	3	-
2.	16MA101	Engineering Mathematics – I	BS	4	3	1	0	4	-
3.	16PY101	Engineering Physics	BS	3	3	0	0	3	-
4.	16CH101	Engineering Chemistry	BS	3	3	0	0	3	-
5.	16CS101	Fundamentals of Computing and Programming	ES	3	3	0	0	3	-
6.	16ME101	Engineering Drawing	ES	5	3	0	2	4	-
7.	16GE111/ 16GE113	Career Development Programme – I	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16CS102	Fundamentals of Computing and Programming Laboratory	ES	4	0	0	4	2	-
9.	16CH103	Chemistry Laboratory	BS	2	0	0	2	1	-
10.	16EN103	Communication Skills Laboratory	HS	4	0	0	4	2	-
			TOTAL	**34**	**19**	**1**	**14**	**25+2***	

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN102	Technical English – II	HS	3	3	0	0	3	16EN101
2.	16MA102	Engineering Mathematics -II	BS	4	3	1	0	4	16MA101
3.	16PY102	Physics of Materials	BS	3	3	0	0	3	-
4.	16CH102	Environmental Science and Engineering	BS	3	3	0	0	3	-
5.	16EE101	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3	-
6.	16ME102	Engineering Mechanics	ES	4	3	2	0	4	-
7.	16GE112/ 16AU400	Career Development Programme– II / Career Development Programme – II (Basics of Automobile)	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16PY103	Physics Laboratory	BS	2	0	0	2	1	-
9.	16GE102	Engineering Practices Laboratory	ES	4	0	0	4	2	-
10.	16ME103	Computer Aided Drafting Laboratory	ES	2	0	0	2	1	-
			Total	**31**	**19**	**3**	**10**	**24+2***	

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA201	Transforms and Partial Differential Equations	BS	4	3	1	0	4	16MA102
2.	16ME207	Strength of Materials	ES	3	3	0	0	3	16ME102
3.	16ME201	Engineering Thermodynamics	ES	5	3	2	0	4	16PY102 16MA102
4.	16AU201	Automotive Engines	PC	3	3	0	0	3	-
5.	16AU202	Automotive Systems	PC	3	3	0	0	3	-
6.	16AU203	Automotive Electrical Systems	EEC	3	3	0	0	3	16GE101
7.	16GE211/ 16GE213	Career Development Programme – III	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16MC203	Strength of Materials Laboratory	PC	2	0	0	2	1	-
9.	16AU204	Automotive Systems Laboratory	PC	2	0	0	2	1	-
10.	16ME216	Computer Aided Machine Drawing Laboratory	ES	2	0	0	2	1	-
			Total	**30**	**19**	**3**	**8**	**23+2***	

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA202	Statistics and Numerical Methods	BS	4	3	1	0	4	16MA201
2.	16ME202	Fluid Mechanics & Machinery	ES	3	3	0	0	3	16CH102
3.	16AU209	Mechanics of Automobile Systems	PC	4	4	0	0	4	16ME102
4.	16AU205	Automotive Materials and Production Techniques	PC	3	3	0	0	3	16AU201
5.	16AU206	Electronic Engine Management Systems	EEC	3	3	0	0	3	16AU201
6.	16EC235	Electronics and Microprocessor	PC	3	3	0	0	3	-
7.	16GE212/ 16GE214	Career Development Programme– IV	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AU207	Fluid Mechanics & Dynamics laboratory	PC	2	0	0	2	1	-
9.	16AU208	Manufacturing Technology Laboratory	PC	2	0	0	2	1	-
10.	16EC236	Electronics and Microprocessor Laboratory	PC	2	0	0	2	1	-
			Total	**29**	**20**	**1**	**8**	**23+2***	

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16AU321	Fundamentals of Machine Design	PC	4	4	0	0	4	16ME207
2.	16AU301	Vehicle Design Data Characteristics	PC	4	4	0	0	4	16AU201 16AU202
3.	16AU302	Automotive Engine Components Design	PC	4	4	0	0	4	16AU201
4	16AU322	Automotive Fuels and Lubricants	PC	3	3	0	0	3	
5.		Professional Elective – I	PE	3	3	0	0	3	-
6.		Open Elective - I**	OE	3	3	0	0	3	-
7.	16AU399/ 16GE313	Career Development Programme - V – Professional	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AU303	Automotive Fuels and Lubricants Lab	PC	2	0	0	2	1	-
9.	16AU305	Automotive Electrical and Electronics Laboratory	PC	2	0	0	2	1	-
			Total	**28**	**22**	**0**	**6**	**23+2***	

SEMESTER VI

S.NO.	COURSECODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16AU306	Thermal Systems and Heat Transfer	PC	3	3	0	0	3	16ME201
2.	16AU307	Vehicle Dynamics	PC	3	3	0	0	3	16AU301
3.	16AU308	Automotive Chassis Components Design	PC	3	3	0	0	3	16AU202
4.		Professional Elective – II	PE	3	3	0	0	3	-
5.		Professional Elective – III	PE	3	3	0	0	3	-
6.		Open Elective - II**	OE	3	3	0	0	3	-
7.	16GE312/ 16GE314	Career Development Programme – VI	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AU304	Engine Testing and Emission Measurement Laboratory	PC	2	0	0	2	1	-
9.	16AU309	Computer Aided Engine &Chassis Design Laboratory	PC	2	0	0	2	1	-
10.	16AU310	Mini Project and Comprehension	EEC	4	0	0	4	2	-
			Total	**29**	**19**	**0**	**10**	**22+2***	

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16GE302	Engineering Economics and Cost Analysis	HS	3	3	0	0	3	-
2.	16AU405	Finite Element Methods &Analysis	PC	3	3	0	0	3	16ME207
3.		Professional Elective – IV	PE	3	3	0	0	3	-
4.		Professional Elective – V	PE	3	3	0	0	3	-
5.		Open Elective - III**	OE	3	3	0	0	3	-
THEORY CUM PRACTICAL									
6.	16AU402	Vehicle Maintenance &Reconditioning	PC	5	2	0	2	3	-
PRACTICAL									
7.	16AU401	Automotive Design and Analysis Laboratory	PC	2	0	0	2	1	-
8.	16AU403	Project Work Phase - I	EEC	4	0	0	4	2	-
			Total	**26**	**17**	**0**	**8**	**21**	

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16GE301	Professional Ethics	HS	3	3	0	0	3	-
2.		Professional Elective – VI	PE	3	3	0	0	3	-
3.		Professional Elective – VII	PE	3	3	0	0	3	-
PRACTICAL									
4.	16AU404	Project Work – II	EEC	20	0	0	20	10	16AU403
			Total	**29**	**9**	**0**	**20**	**19**	

TOTAL NO. OF CREDITS: 180

*Not included in the calculation of CGPA

**Courses from the curriculum of other UG Programmes

HUMANITIES AND SOCIAL SCIENCES (HS)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16EN101	Technical English – I	3	3	0	0	3	-
2.	16EN102	Technical English - II	3	3	0	0	3	16EN101
3.	16EN103	Communication Skills Laboratory	4	0	0	4	2	-
4.	16GE301	Professional Ethics	3	3	0	0	3	-
5.	16GE302	Engineering Economics and Cost Analysis	3	3	0	0	3	-

BASIC SCIENCES (BS)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MA101	Engineering Mathematics – I	4	3	1	0	4	-
2.	16PY101	Engineering Physics	3	3	0	0	3	-
3.	16CH101	Engineering Chemistry	3	3	0	0	3	-
4.	16MA102	Engineering Mathematics – II	4	3	1	0	4	16MA101
5.	16PY102	Physics of Materials	3	3	0	0	3	-
6.	16CH102	Environmental Science and Engineering	3	3	0	0	3	-
7.	16CH103	Chemistry Laboratory	2	0	0	2	1	-
8.	16PY103	Physics Laboratory	2	0	0	2	1	-
9.	16MA201	Transforms and Partial Differential Equations	4	3	1	0	4	16MA102
10.	16MA202	Statistics and Numerical Methods	4	3	1	0	4	16MA201

ENGINEERING SCIENCES (ES)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16CS101	Fundamentals of Computing and Programming	3	3	0	0	3	-
2.	16ME101	Engineering Drawing	5	3	0	2	4	-
3.	16EE101	Basic Electrical and Electronics Engineering	3	3	0	0	3	-
4.	16ME102	Engineering Mechanics	4	3	2	0	4	-
5.	16GE102	Engineering Practices Laboratory	4	0	0	4	2	-
6.	16CS102	Fundamentals of Computing and Programming Laboratory	4	0	0	4	2	-
7.	16ME103	Computer Aided Drafting Laboratory	2	0	0	2	1	-

8.	16ME207	Strength of Materials	3	3	0	0	3	16ME102
9.	16ME201	Engineering Thermodynamics	5	3	2	0	4	16PY102 16MA102
10.	16ME216	Computer Aided Machine Drawing Laboratory	2	0	0	2	1	-
11.	16ME202	Fluid Mechanics & Machinery	3	3	0	0	3	16CH102

PROFESSIONAL CORE (PC)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU201	Automotive Engines	3	3	0	0	3	-
2.	16AU202	Automotive Systems	3	3	0	0	3	-
3.	16AU209	Mechanics of Automobile Systems	4	4	0	0	4	16ME102
4.	16AU205	Automotive Materials and Production Techniques	3	3	0	0	3	16AU201
5.	16EC235	Electronics and Microprocessor	3	3	0	0	3	-
6.	16AU321	Fundamentals of Machine Design	4	4	0	0	4	16ME207
7.	16AU301	Vehicle Design Data Characteristics	4	4	0	0	4	16AU201 16AU202
8.	16AU302	Automotive Engine Components Design	4	4	0	0	4	16AU201
9.	16AU322	Automotive Fuels & Lubricants	3	3	0	0	3	-
10.	16AU306	Thermal Systems and Heat Transfer	3	3	0	0	3	16ME201
11.	16AU307	Vehicle Dynamics	3	3	0	0	3	16AU301
12.	16AU308	Automotive Chassis Components Design	3	3	0	0	3	16AU202
13.	16AU405	Finite Element Methods &Analysis	3	3	0	0	3	16ME207
14.	16MC203	Strength of Materials Laboratory	2	0	0	2	1	-
15.	16AU204	Automotive Systems Laboratory	2	0	0	2	1	-
16.	16AU207	Fluid Mechanics & Dynamics laboratory	2	0	0	2	1	-
17.	16AU208	Manufacturing Technology Laboratory	2	0	0	2	1	-
18.	16EC236	Electronics and Microprocessor Laboratory	2	0	0	2	1	-
19.	16AU303	Automotive Fuels & Lubricants Lab	2	0	0	2	1	-
20.	16AU305	Automotive Electrical and Electronics Laboratory	2	0	0	2	1	-
21.	16AU304	Engine Testing and Emission Measurement Laboratory	2	0	0	2	1	-
22.	16AU309	Computer Aided Engine & Chassis Design Laboratory	2	0	0	2	1	-
23.	16AU401	Automotive Design and	2	0	0	2	1	-

		Analysis Laboratory						
24.	16AU402	Vehicle Maintenance &Reconditioning (Theory Cum Practical)	5	2	0	2	3	-

PROFESSIONAL ELECTIVE (PE) I

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU311	Automotive Transmission	3	3	0	0	3	16AU202
2.	16AU312	Alternate Fuels and energy systems	3	3	0	0	3	16CH101
3.	16AU313	Unconventional Engines and Hybrid Vehicles	3	3	0	0	3	16AU201
4.	16AU314	Automotive Embedded Systems	3	3	0	0	3	16AU203
5.	16AU324	Computer Integrated Manufacturing	3	3	0	0	3	-
6.	16GE303	Total Quality Management	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) II

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU315	Computer Simulation of IC Engine Processes	3	3	0	0	3	16AU201
2.	16AU316	Advanced Theory of IC Engines	3	3	0	0	3	16AU201
3.	16AU317	Automatic Transmission	3	3	0	0	3	-
4.	16ME312	Operations Research	3	3	0	0	3	-
5.	16GE304	Principles of Management	3	3	0	0	3	-
6.	16AU323	Automotive Component Drawing	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) III

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU318	Automotive Vibration and Noise control	3	3	0	0	3	16AU301& 16AU306
2.	16AU319	Automotive Aerodynamics	3	3	0	0	3	16AU301& 16AU306
3.	16AU320	Engine and Vehicle Management systems	3	3	0	0	3	-
4.	16ME319	Computational Fluid Dynamics	3	3	0	0	3	16ME202 &16ME201
5.	16GE305	Intellectual Property Rights	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) IV

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU406	Fleet Management	3	3	0	0	3	-
2.	16AU407	Advanced Materials for Automobiles	3	3	0	0	3	16AU206
3.	16AU408	Automotive Safety and Infotronics	3	3	0	0	3	-
4.	16AU409	Electric Drives and Controls for Electric Vehicles	3	3	0	0	3	-
5.	16AU410	Automotive Control Systems	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) V

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU411	Product Development and Manufacturing	3	3	0	0	3	-
2.	16AU412	Special Vehicles	3	3	0	0	3	-
3.	16AU413	Tractor and Farm Equipments	3	3	0	0	3	-
4.	16AU414	Vehicle Air-Conditioning	3	3	0	0	3	-
5.	16GE306	HRM & Entrepreneurship	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) VI

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU415	Advanced Technologies of Vehicle systems	3	3	0	0	3	16AU201
2.	16AU416	Automotive Emission Control	3	3	0	0	3	-
3.	16AU417	Automotive Electronics	3	3	0	0	3	-
4.	16AU418	Rubber Technology for Automobiles	3	3	0	0	3	-
5.	16ME415	Entrepreneurship Development	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) VII

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU419	Two and Three Wheeler Technology	3	3	0	0	3	-
2.	16AU420	Fuel Cell & its Applications	3	3	0	0	3	-
3.	16GE308	Human Rights	3	3	0	0	3	-
4.	16ME408	Industrial Robotics	3	3	0	0	3	-
5.	16ME420	Additive Manufacturing	3	3	0	0	3	-

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16AU203	Automotive Electrical Systems	3	3	0	0	3	16GE101
2.	16AU206	Electronic Engine Management Systems	3	3	0	0	3	16AU201
3.	16AU310	Mini Project and Comprehension	4	0	0	4	2	-
4.	16AU403	Project Work Phase - I	4	0	0	4	2	-
5.	16AU404	Project Work Phase - II	20	0	0	20	10	-
6.	16GE111 / 16GE113	Career Development Programme- I	3	1	0	2	2*	-
7.	16GE112 / 16AU400	Career Development Programme- II	3	1	0	2	2*	-
8.	16GE211 / 16GE213	Career Development Programme- III	3	1	0	2	2*	-
9.	16GE212 / 16GE214	Career Development Programme- IV	3	1	0	2	2*	-
10.	16AU399 / 16GE313	Career Development Programme- V - Professional	3	1	0	2	2*	-
11.	16GE312 / 16GE314	Career Development Programme- VI	3	1	0	2	2*	-

OPEN ELECTIVE OFFERED TO OTHER UG PROGRAMMES

COURSE CODE	COURSE TITLE	L	T	P	C	PRE-REQUISITES
16AUOE1	Basics of Automobile Engineering	3	0	0	3	-
16AUOE2	Fundamentals of Alternative Fuels	3	0	0	3	-
16AUOE3	Two Wheeler Technology	3	0	0	3	-
16AUOE4	Automotive Maintenance	3	0	0	3	-
16AUOE5	Off Road Vehicles	3	0	0	3	-
16AUOE6	Recent Trends in Automobiles	3	0	0	3	-

ONE CREDIT COURSES

COURSE CODE	COURSE TITLE	THEORY / PRACTICAL	IN COLLABORATION WITH	L	T	P	C
16AUOC1	Testing & Inspection of Automotive Materials	Theory & Practical	NDT Tech & Service, Chennai	10	0	5	1
16AUOC2	Electronic Power Steering &Turbochargers	Theory & Practical	Ambal Auto, Coimbatore	10	0	5	1
16AUOC3	Automotive Styling	Theory	KKM SOFT, Chennai.	15	0	0	1
16AUOC4	Overview of Motorsports Engineering	Theory	Sun Auto Engineers, Coimbatore	15	0	0	1
16AUOC5	ECU Model Based System Design	Theory & Practical	Nandini Power Solutions	10	0	5	1
16AUOC6	Automotive Accident Investigation	Theory	Vertex R&D Centre	15	0	0	1

S. No.	SUBJECT AREA	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**	5	3	-	-	-	-	3	3	14
2	**BS**	11	11	4	4	-	-	-	-	30
3	**ES**	9	10	8	3	-	-	-	-	30
4	**PC**	-	-	8	13	17	11	7	-	56
5	**PE**	-	-	-	-	3	6	6	6	21
6	**OE**	-	-	-	-	3	3	3	-	9
7	**EEC**	-	-	3	3	-	2	2	10	20
	TOTAL	**25**	**24**	**23**	**23**	**23**	**22**	**21**	**19**	**180**
8.	**Non-Credit / Mandatory**	2*	2*	2*	2*	2*	2*	-	-	12*

16EN101	**TECHNICAL ENGLISH I**	**L**	**T**	**P**	**C**
	(Common to All B.E. / B. Tech.)	**3**	**0**	**0**	**3**

UNIT I   **9**

General Vocabulary (Word–formation - prefixes & suffixes, root words) – Tenses – Adjectives forms – Adverb forms - Compound nouns -Abbreviations and Acronyms–Techniques of reading – Autobiographical writing.

UNIT II   **9**

Active and Passive voice – Impersonal passive voice -Articles - Prepositions –Spelling and Punctuation – 'WH' Question forms – Yes / No question form – Reading& note-making – Paragraph writing - comparison and contrast.

UNIT III   **9**

Uses of Modal auxiliaries – Instructions– Definitions - Single line & Extended - Reading and understanding through Context –Transfer of information – bar chart, flowchart-Crafting advertisements.

UNIT IV   **9**

Concord (subject & verb agreement) – Cause and effect expressions – One word substitution - Letter writing- letter to the editor & permission letter (for Industrial Visit & In-plant training) - Paragraph writing-descriptive.

UNIT V   **9**

Empty verbs - 'If' conditionals – Gerund & Infinitive - Formal Letter writing – invitation, accepting & declining - Paragraph writing – analytical.

L :45   T: 0   P: 0   T: 45 PERIODS

TEXT BOOKS

1. Dhanavel.S.P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan , Chennai, 2011
2. Gunasekaran.S , ' Technical English I' Third Edition, Vishnu Prints Media, Chennai, 2016.

REFERENCES

1. Raman, Meenakshi&Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2011.
2. Regional Institute of English. English for Engineers, Cambridge University Press, New Delhi, 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
4. Department of English, Anna University, Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
5. Mitra K. Barun, " Effective Technical Communication – A Guide for Scientists and Engineers", Oxford University Press, New Delhi, 2006

COURSE OUTCOMES :

At the end of the course student should be able to

CO1 Employ their active and passive vocabulary and construct basic sentence structures.

CO2 Become active readers who appreciate ambiguity and complexity, and who can articulate their own interpretations.

CO3 Write effectively and flawlessly avoiding grammatical errors for a variety of professional and social settings.

CO4 Demonstrate the usage of language effectively, creatively and successfully in both general and specific contexts.

CO5 Exhibit letter writing skills for effective communication both in formal and informal Situations

16MA101	ENGINEERING MATHEMATICS I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	1	0	4

UNIT I   MATRICES   9+3

Characteristic equation – Eigen values and Eigen vectors of a real matrix –Properties–Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation – Cayley– Hamilton theorem (excluding proof).

UNIT II   THREE DIMENSIONAL ANALYTICAL GEOMETRY   9+3

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

UNIT III   DIFFERENTIAL CALCULUS   9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes.

UNIT IV   FUNCTIONS OF SEVERAL VARIABLES   9+3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Jacobians – Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT V   DIFFERENTIAL EQUATIONS OF HIGHER ORDER   9+3

Higher order linear differential equations with constant coefficients - Method of variation of parameters -Cauchy's and Legendre's linear differential equations.

L :45   T: 15   P: 0   TOTAL: 60 PERIODS

TEXT BOOKS

1. Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.
2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES

1. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.
3. Veerarajan, T., "Engineering Mathematics for First Year", Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2014.
4. Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013

COURSE OUTCOMES :

At the end of the course student should be able to

CO1 Know Eigen values and Eigen vectors and its role in the system of equations.

CO2 Explore the knowledge to solving problems involving Sphere, Cone and Cylinder.

CO3 Discover the radius, centre and circle of curvature of any curves.

CO4 Identify the maximum and minimum values of surfaces

CO5 Solve the ordinary differential equations of certain types.

16PY101   **ENGINEERING PHYSICS**   **L   T   P   C**
                    (Common to All B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   CRYSTAL PHYSICS   9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)

UNIT II   PROPERTIES OF MATTER AND THERMAL PHYSICS   9

Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever Young's modulus by uniform bending- I-shaped girders Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow -Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel).

UNIT III   QUANTUM PHYSICS   9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment- Physical significance of wave function - Schrödinger's wave equation – Time independent and time dependent equations– Particle in a one dimensional box –Electron microscope- Scanning electron microscope

UNIT IV   ACOUSTICS AND ULTRASONICS   9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Production of Ultrasonic's by magnetostriction and piezoelectric methods - acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram.

UNIT V   PHOTONICS AND FIBRE OPTICS   9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO , Semiconductor lasers –applications. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle- Typesofopticalfibres(material,refractiveindex,mode)–Lossesinopticalfibre- attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram)

                                        L :45   T: 0   P: 0   T: 45 PERIODS

TEXT BOOKS

  1   Naresh Kumar. P and Balasubramanian. V, Engineering Physics I, Gems Publishers,2015
  2   Avadhanalu.M.Nand Kshirsagar.P.G, A textbook of EngineeringPhysics,S.Chand&ompany Ltd, 2013

REFERENCES

  1   Searls and Zemansky, University Physics, 2009.
  2   Gaur R.K. And Gupta S.L, Engineering Physics, Dhanpat Rai publishers, 2009.
  3   Palanisamy P.K, Engineering Physics, SCITECH Publications, 2011.
  4   Rajendran.V,   Engineering   Physics,Tata   Mcgraw-Hill   Publishing Company Limited, New Delhi.2009.
  5   Dr.G.Senthilkumar, Engineering Physics-I, VRB Publishers Pvt.Ltd.Chennai.(2013).

COURSE OUTCOMES :

At the end of the course student should be able to

  CO1   Understand the properties of the crystalline materials.
  CO2   Analyze the elastic and thermal properties of the materials.
  CO3   Understand the basics of quantum mechanics.
  CO4   Identify the applications of acoustics and ultrasonic waves.
  CO5   Understand the basics and applications of photonics and fiber optics technology.

16CH101   **ENGINEERING CHEMISTRY**   **L   T   P   C**
                    (Common to All B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   ELECTRO CHEMISTRY   9

Electrochemical - EMF – Electrode potential – Nernst equation — problem – electrochemical series – significance– reference electrodes –Standard Hydrogen electrode - Calomel electrode – Ion selective electrode – glass electrode and measurement of pH and Fuel cells – hydrogen – oxygen fuel cell – batteries – Primary — Leclanche cell – secondary – Lead – acid battery – Lithium batteries (Li-TiS$_2$ and Li - S battery).

UNIT II   CORROSION AND ITS CONTROL   9

Chemical corrosion – oxidation corrosion – mechanism – Pilling – Bed worth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Gold plating).

UNIT III   SPECTROSCOPY   9

Beer-Lambert's law – problem – UV-visible spectroscopy and IR spectroscopy (principle – instrumentation) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principle – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy

UNIT IV   SURFACE CHEMISTRY & WATER TECHNOLOGY   9

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms — role of adsorbents in ion-exchange adsorption (Demineralization only). Water – hardness – problems –Domestic water treatment – disinfection methods (Chlorination, Ozonation, UV treatment) – break point chlorination – salinity – desalination by reverse osmosis

UNIT V   ENGINEERING MATERIALS   9

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication - properties – viscosity index, flash and fire points, cloud and pour points, oiliness) – solid lubricants – graphite and molybdenum sulphide.

                                     L :45   T: 0   P: 0   T:45 PERIODS

TEXT BOOKS

1   M.Manjuladevi, R.Anitha "Engineering Chemistry" Gem Pub. Coimbatore. 2013.

2. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi 2008.

REFERENCES

1   B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2009).

2   R. Sivakumar and N Sivakumar, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd. New Delhi.2009.

3   Dr.Gourkrishna and Dasmohapatra, "Engineering Chemistry" Vikas Pub. House Pvt.Ltd. 2011.

4   O.Gpalanna, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi.2009.

5   B.R. Puri, L.R. Sharma&M.S. Pathania, "Principles of Physical Chemistry" Vishalpublishing Co. Jalandhar, Punjab. 2013.

COURSE OUTCOMES:

At the end of the course student should be able to:

CO1   Assemble a battery and illustrate the phenomenon of production of electric current

CO2   Know the technical information about corrosion, corrosion control by galvanization and electroplating

CO3   Gain knowledge on the principles and instrumentation of spectroscopic techniques

CO4   Apply the theory of adsorption in real life situations

CO5   Acquire sound knowledge on different types of Engineering materials

16CS101	FUNDAMENTALS OF COMPUTING AND PROGRAMMING	L	T	P	C
	(Common to All B.E. / B. Tech.)	3	0	0	3

UNIT I INTRODUCTION TO COMPUTERS 8

Introduction – Characteristics of Computers –Computer Generations – Classification of Computers – Basic Computer organization – Number Systems- Algorithm –Pseudo code –Flow Chart- Computer Software –Types of Software– Internet Terminology

UNITII C PROGRAMMING BASICS 10

Introduction to 'C' programming –fundamental Rules–structure of a 'C' program –compilation and linking processes –Constants, Variables, keywords, Identifier, Delimiters –Declaring and Initializing variables–Data Types –Operators and Expressions–Managing Input and Output operations –Decision Making and Branching –Looping statements –solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 10

Arrays – Characteristics, Initialization – Declaration – One dimensional and two-dimensional arrays. String- String operations – String Arrays. Simple programs-sorting-searching –matrix operations (Addition, subtraction and Multiplication).

UNIT IV FUNCTIONS AND POINTERS 9

Function –definition of function – User-defined Functions - Declaration of function – Call by reference – Call by value –Recursion –Pointers -Definition –Initialization –Pointers arithmetic –Pointers and arrays-Example Problems.

UNIT V STRUCTURES AND UNIONS 8

Defining Structures and Unions–Structure declaration –need for structure data type - Structure within a structure- Union -Programs using structures and Unions- Pre-processor directives.

L :45   T: 0   P: 0   TOTAL: 45 PERIODS

TEXT BOOKS
1. E.Balagurusamy, "Fundamentals of Computing and Computer Programming", Tata McGRaw-Hill Publishing Company Limited, (2011).
2. Ashok.N.Kamthane," Computer Programming", Pearson Education (India) (2010).

REFERENCES
1. Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH Publications, (2006).
2. Stephan G kochan, "Programming in C" Pearson Education (2010).
3. P.Sudharson, "Computer Programming", RBA Publications (2008).
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Distinguish the differences among the various generation and classification of computers and solve problems in number system
CO2 Understand the basic concepts of C programming and write programs using various control statements
CO3 Implement programs using arrays and apply the concepts to solve basic problems
CO4 Write C programs to solve problems using functions and pointers
CO5 Understand the concepts structures and unions and apply them

16ME101   **ENGINEERING DRAWING**   **L T P C**

(Common to Aero, Agri, Auto, Civil, Civil & Planning, Mech,   **3 0 2 4**
MEA and MCT)

Concepts and conventions (Not for Examination)

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   PROJECTION OF POINTS, LINES AND PLANE SURFACES   12+8

Projection of points - Projection of straight lines located in the first quadrant -Determination of true lengths and true inclinations - Projection of polygonal surface and circular lamina inclined to both reference planes.

UNITII   PROJECTION OF SOLIDS   9+6

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

UNIT III   SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES   9+6

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other -Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids -Prisms, pyramids, cylinders and cones.

UNIT IV   PICTORIAL PROJECTIONS AND FREE HAND SKETCHING   9+6

Principles of isometric projection -isometric scale -isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.

Free hand sketching:

Representation of Three Dimensional objects -Need for importance of multiple views and their placement -First angle projection -layout views -Developing visualization skillsthroughfree hand sketching of multiple views from pictorial drawing.

UNIT V   BUILDING DRAWING   6+4

Drawing of a plan, Elevation and sectioning of security room and residential building (Two bed rooms, kitchen, hall,etc.)

L: 45   T:0 P: 30 TOTAL : 75 PERIODS

TEXT BOOKS
1. N.D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House, 53rd Edition, (2016).
2. K. R. Gopalakrishnan, "Engineering Drawing" (Vol.I& II), Subhas Publications (2014).

REFERENCES
1. K. V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2015).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2011),
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2014).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2011),
5. K.L. Narayanan and P. Kannaiah, "Engineering Drawing" SciTech Publications, 2nd edition, (2012).

COURSE OUTCOMES

CO1 Sketch the projections of a points, straight lines and plane surfaces.

CO2 Illustrate top view and front view of the solids.

CO3 Sketch sectioned views and develop area required.

CO4 Demonstrate knowledge about isometric, perspective and orthographic projections.

CO5 Design simple buildings with detailed plan and sectional elevation.

16GE111	**CAREER DEVELOPMENT PROGRAMME - I**	**L**	**T**	**P**	**C**
	(Common to All B.E. / B. Tech. Courses)	**1**	**0**	**2**	**2***

UNIT I   TRAINING FUNDAMENTALS   3+6

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II   LINGUISTIC SKILLS I   3+6

Parts of Speech – Noun, Verb, Participle, Articles, Pronoun, Preposition, Adverb, Conjunction – Logical sequence of words –Tense & Voice – Comparison – Comprehension –comprehend and understand a paragraph

UNIT III   QUANTITATIVE ABILITY I   3+6

Number theory – Percentage – Profit, loss and discount – Simple and compound interest.

UNIT IV   QUANTITATIVE ABILITY II   3+6

Ratio & Proportions – Partnership– Problems on Average & Ages – Clocks – Time sequence test.

UNIT V   COMMUNICATION SKILLS   3+6

Impromptu Speech – Group Discussion – Questioning Technique.

L:15   T:0   P:30   Total: 45 PERIODS

TEXT BOOKS

1   John Eastwood, "Oxford Practice Grammar", Oxford, 2006.

2.   Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.

REFERENCES

1   Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.

2   R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

3   R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt Limited, 2016.

4   Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5   Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Set their career goals through SWOT analysis.

CO2   Form sentences through logical sequence of words and understand passage
          through Comprehension

CO3   Apply the shortcut methods in quantitative aptitude.

CO4   Solve application orientated concepts in quantitative aptitude.

CO5   Communicate well and familiarize with the questioning techniques.

16GE113	CAREER DEVELOPMENT PROGRAMME - I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I   TRAINING FUNDAMENTALS   8

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II   LINGUISTIC SKILLS I   12

Parts of Speech – Error spotting, Logical sequence of words, Tense & Voice, Comparison, Paragraph completion.

UNIT III   LINGUISTIC SKILLS II   8

Comprehend – comprehend and understand a paragraph , Sentences - Simple, Compound & Complex sentences, Jumbled sentence, Idioms & Phrases.

UNIT IV   PERSONALITY DEVELOPMENT   9

Personality, Presentation Skills – stages, selection of topic, content & aids, Minutes of meeting, Public speaking.

UNIT V   COMMUNICATION SKILLS   8

Impromptu Speech – Group Discussion – Questioning Technique.

L:15   T:0   P: 30   Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford.

2. Barun K. Mithra, "Personality Development & Soft Skills", Oxford.

REFERENCES

1 Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.

2 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

3 R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt Limited, 2016.

4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand language structures and functioning of the language.

CO2 Analyse the parts of speech.

CO3 Demonstrate knowledge of personal beliefs and values.

CO4 Understand language attitudes.

CO5 Raise the basic language skills.

16CS102   FUNDAMENTALS OF COMPUTING AND PROGRAMMING   L   T   P   C
LABORATORY

(Common to All B.E. / B. Tech.)   **0   0   4   2**

LIST OF EXPERIMENTS

A) Word Processing

1. Document creation, Text manipulation with Scientific notations
2. Table creation, Table formatting and Conversion
3. Mail merge and Letter preparation
4. Drawing Flow Chart

B) Spread Sheet

1. Chart - Line, XY, Bar and Pie.
2. Formula - formula editor.
3. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
4. Sorting and Import / Export features.

C) Simple C Programming

1. Data types, Expression Evaluation, Condition Statements.
2. Arrays, Looping Statement
3. Functions, Pointers
4. Structures and Unions

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

- LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
- Printers – 3 Nos.

Software

- OS – Windows / UNIX Clone
- Application Package – Office suite
- Compiler – C

L: 0   T: 0   P:60   Total:60PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Create a document, insert formulas and pictures and prepare letters using MS office
CO2   Create tables and charts, use formula in calculations and protect worksheets in MS Excel
CO3   Write simple programs using basic C Concepts
CO4   Write C programs using concepts in control statements
CO5   Write C programs to solve problems using Arrays, Functions, Pointers, Unions, and Structures

16CH103   **CHEMISTRY LABORATORY**   **L   T   P   C**

(Common to All B.E. / B. Tech. Courses)   **0   0   2   1**

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA.
2. Determination of DO in water (Winkler's method)
3. Estimation of Chloride in Water sample (Argentometric).
4. Conductometric titration (Simple acid base).
5. Conductometric titration (Mixture of weak and strong acids vs strong base).
6. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$).
7. pH titration (acid & base).
8. Determination of inhibitor efficiency on the corrosion rate of steel in acid media by weight loss method.
9. Anodizing of aluminum and determination of thickness of anodic film.
10. Determination of cathode efficiency of nickel plating.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Electronic balance
- pH meter
- Potentiometer
- Conductivity bridge
- Spectro Photometer
- Colorimeter
- IC regulated power supply
- Hot air oven

L : 0   T: 0   P: 30   Total:30 PERIODS

COURSE OUTCOMES
At the end of the course student should be able to:

CO1   Gain the experimental knowledge of testing the water.

CO2   Carry out titration using conductivity meter, potentiometer and pH meter.

CO3   Estimate the metal ions in industrial effluents.

CO4   Set up mini electroplating unit.

CO5   Determine the inhibitor efficiency on the corrosion rate of steel.

16EN103   **COMMUNICATION SKILLS LABORATORY**   L   T   P   C
                     (Common to all B.E. / B. Tech. Courses)   0   0   4   2

UNIT I   LISTENING   15

Introduction to Business communication-Listening to Monologues-Listening for general content-Listening to dialogues-Listening to telephonic Conversation-Listening to conversation among three or more people-Listening to business conversations.

UNIT II   SPEAKING   15

Greetings, Formal and in formal introduction of self and others – Establishing business relationships and negotiating-Tongue twisters/pronunciation drills –Describing an object or event-Describing a working mechanism- Phrases for positive feedback, agreeing/disagreeing Group Discussion-Conversation techniques –Presentation skills-Interview techniques.

UNIT III   READING   10

Reading Techniques-Reading to understand –Facts, Inference, Main idea, Authors opinion and tone – Newspaper reading, Reading brochures- Reading and reviewing books, articles -Cloze exercises-Reading Comprehension- Reading a Technical Report-Critical Reading(Editorial):Creative and Critical Thinking.

UNIT IV   WRITING   15

Business Itinerary – Business Letters – Calling for Quotation-Placing Orders-Letter Seeking clarification- Letter requesting Information, explaining a situation- Resume & cover letter, Short prepared compositions on current affairs – Leaflets, Instruction Manual- Picture Perception-Encoding and decoding advertisements-Perceiving Visual Information-E-mail Etiquette and Correspondence-Expression indicating frequency/responding to situations and Providing solutions.

UNIT V   SOFT SKILLS   5

Emotional Intelligence- Inter & Intrapersonal skills-Teamwork/ Leadership skills -Decision making and Problem solving skills -Time & Stress management- Professional Ethics.

L :0   T: 0   P:60   Total: 60 PERIODS

TEXT BOOKS
1   Norman Whitby, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014
2. Guy Brook-Hart, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014

REFERENCES
1   Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, " Empower English", Cambridge University Press, NY, USA. Updated Edition, 2016.
2   Rizvi, Ashraf. M. "Effective Technical Communication". Tata McGraw-Hill, New Delhi. Updated Edition, 2015.
3   Department of English, Anna University,"Mindscapes: English for Technologists and Engineers",Chennai, Updated Edition, 2015.
4   Leo Jones, Richard Alexander, "New International Business English", Cambridge University Press, NY, USA. Updated Edition, 2009.
5   Jeff Butterfield, "Soft skills for everyone", Cengage Learning, New Delhi, 2011.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Face the challenges of the globalized world with confidence and with the best communicative skills.
CO2   Make learners imbibe listening and speaking skills in both formal and informal contexts.
CO3   Help them develop their reading skills by familiarizing them with different types of reading strategies.
CO4   Make them acquire language skills at their own pace by using e-materials and language lab components.
CO5   Enrich their creative and critical thinking and get through interviews successfully.

16EN102	TECHNICAL ENGLISH II	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I 9

Technical Vocabulary – meanings in context – Sentence pattern - Process description - Sequencing words - Uses of Pronouns - Paragraph writing – narrative.

UNITII 9

Numerical adjective - Phrasal verbs - Phrases / Structures indicating use / purpose – Introduction to communication & Barriers to communication - Non-verbal communication – Different grammatical forms of the same word.

UNIT III 9

Stress and Intonation – Word stress & Sentence stress – Formal Letter writing- quotations, clarification, placing orders, complaint letter – Writing – Using connectives (discourse makers) - Recommendations -Report writing – types of report, report format, recommendations/suggestions-(Fire Accident & Road Accident).

UNIT IV 9

Direct & Indirect speech – Argumentative paragraphs – Letter of application – content, format (CV / Resume) –Checklist– E-mail communication – Blog writing.

UNIT V 9

Auxiliary verbs - Preparing Agenda, Notices and Minutes – Proposal writing – project/business proposal-   Technical essay – Conversational skills – four types of speeches – extempore, manuscript, impromptu, memorized.

L :45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
 1   Gunasekaran.S , ' Technical English II' Third Edition, Vishnu Prints Media, Chennai, 2016.
 2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011.

REFERENCES
 1   Muralikrishna& Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011.
 2   Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007.
 3   Rizvi, Ashraf. M, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
 4   Mitra K. Barun, " Effective Technical Communication – A Guide for Scientists and Engineers", Oxford University Press, New Delhi, 2006.
 5   Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Apply knowledge about the various principles of communication and its various stages.
CO2   Imply the importance of verbal and non-verbal communication in the professional world along with its uses.
CO3   Review the grammar – verbs and its different forms and application of the different forms of advanced grammar.
CO4   Apply grammatical knowledge which enhances speaking and writing skills to prepare reports and resume in a professional manner.
CO5   Speak clearly, confidently, comprehensively, and communicate with one or many listeners using appropriate communicative strategies.

16MA102	ENGINEERING MATHEMATICS II	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	1	0	4

UNIT I   MULTIPLE INTEGRALS   9+3

Double integration in Cartesian co-ordinates – Change of order of integration – Triple Integrals – Simple problems – Area and volume by multiple integrals.

UNIT II   VECTOR CALCULUS   9+3

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple problems involving cubes and rectangular parallelepipeds.

UNIT III   COMPLEX DIFFERENTIATION   9+3

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions using Milne Thomson's method – Conformal mapping : $w = z + c$, cz, $1/z$, and bilinear transformation.

UNIT IV   COMPLEX INTEGRATION   9+3

Complex integration – Statement and Problems of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's expansion – Singular points – Residues – Residue theorem – Problems only.

UNIT V   LAPLACE TRANSFORMS   9+3

Laplace transform – Conditions for existence (statement only) – Transforms of standard functions – Properties (statement only) – Transforms of derivatives and integrals – Initial and Final value theorems (statement only) – Periodic functions - Inverse transforms – Convolution theorems (statement only) – Applications of Laplace transforms for solving the ordinary differential equations up to second order with constant co-efficient.

L :45   T:15   P:0   Total: 60 PERIODS

TEXT BOOKS
1. Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.
2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES
1. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.
3. Jain, R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House Pvt. Ltd., 2015.
4. Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure.
CO2   Know the gradient, divergence and curl, related theorems useful for engineering applications.
CO3   Test the analyticity and to construct the analytic function and transform complex functions from one plane to another plane graphically.
CO4   Evaluate real and complex integrals over suitable closed paths or contours.
CO5   Know the Applications of Laplace transform and its properties & to solve certain linear differential equations using Laplace transform technique.

16PY 102   **PHYSICS OF MATERIALS**   **L   T   P   C**

(Common to All B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   CONDUCTING AND SUPERCONDUCTING MATERIALS   9

Classification of materials based on conductivity- Conductors –Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.Superconductors – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) –High T_c superconductors – Application of superconductors –SQUID,Magnetic levitation.

UNIT II   SEMICONDUCTING MATERIALS   9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination –direct and indirect band gap semiconductors- derivation of carrier concentration in n-type and p-type semiconductors – variation of Fermi level with temperature and impurity concentration –– Hall effect –Determination of Hall coefficient – Applications.

UNIT III   MAGNETIC MATERIALS   9

Basic concepts – magnetic moment, susceptibility, permeability. Origin of magnetic moment– Bohrmagneton–Dia,Paraand Ferromagnetism–Domaintheory–Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications. Magnetic storage devices-magnetic hard disc, bubble memory.

UNIT IV   DIELECTRIC MATERIALS   9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internalfield – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V   ADVANCED ENGINEERING MATERIALS   9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, applications – Nanomaterials: Properties –Top-down process: Ball milling method- Bottom –up process: Chemical vapour deposition method- Carbon Nanotubes- Preparation by pulsed laser deposition method, properties and applications.

L :45   T: 0   P: 0   T: 45 PERIODS

TEXT BOOKS
1   Charles Kittel, Introduction to Solid State Physics, Wiley Publications, 2006.
2   Ragavan V, "Materials Science and Engineering:, PHI Learning Private, 2012.

REFERENCES
1   Rajendran.V, Engineering Physics,Tata Mcgraw-Hill Publishing Company Limited,New Delhi.2009.
2   Neil W.Ashcroft, N.DavidMermin, Solid state physics, Cengage Publication, 2011.
3   S.O.Pillai, Solid State Physics, New Age International, New Delhi, 2005.
4   William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
5   Dr.G.Senthilkumar, Engineering Physics-II, VRB Publishers Pvt.Ltd.Chennai.(2013).

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1   Understand the properties and applications of conducting, super conducting materials
CO2   Identify the electrical properties of semiconducting materials.
CO3   Classify the magnetic materials based on the properties and employ it to act as an memory storage device.
CO4   Understand the various types of polarisation and applications of dielectric materials.
CO5   Comprehend the preparation and properties of advanced engineering materials for industrial applications.

16CH 102   **ENVIRONMENTAL SCIENCE AND ENGINEERING**   **L   T   P   C**
                        (Common to All B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   ENVIRONMENT & BIODIVERSITY   9

Definition, scope and introduction –planet earth (atmosphere, lithosphere & hydrosphere) of environment. Introduction to biodiversity definition: genetic, species and ecosystem diversity –Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values–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   AIR &NOISE POLLUTION   9

Air pollution - Atmospheric chemistry - Chemical composition of the atmosphere-Definition- causes, effects and control measures. Control of particulate and gaseous emission - Electrostatic precipitator – automobile emission - catalytic convertor - Acid rain- Green house effect - Global warming- -Air (Prevention & control of pollution act) - Noise pollution – Definition, effects & control of noise pollution.

UNIT III   WATER & SOIL POLLUTION   9

Water and their environment significance-Water quality parameters-Physical, chemical and biological parameters-Dissolved Oxygen-Biological Oxygen demand – Chemical Oxygen Demand (Definition only) - Water pollution- causes, effect & control measures-Sewage water treatment – Water (prevention & control of pollution act) - Soil pollution-Definition, causes, effects of soil pollution

UNIT IV   CONVENTIONAL &NON CONVENTIONAL ENERGY RESOURCES   9

Conventional – Coal – Gross net calorific value (Definition only) – Coke – Manufacture of coke – Otto Hoffmann method – Petroleum- Fractional distillation - Natural gas - LPG and CNG-Need for alternative energy resources –Nuclear energy- Fission and fusion reactions- Light water nuclear reactor for power generation (block diagram only) – Solar energy – Wind energy-H_2O_2 fuel cell. Role of an individual in conservation of energy resources

UNIT V   GREEN CHEMISTRY & ENVIRONMENTAL MANAGEMENT   9

Green chemistry- Principles of green chemistry – Water conservation – Rain water harvesting - Solid waste management: causes, effects and control measures of municipal solid wastes. Disaster management – Floods, Earthquake – Population growth – Population explosion and its consequences - Role of information technology in environment and human health.

                                    L :45   T: 0   P: 0   T: 45 PERIODS

TEXT BOOKS

1   Dr.A.Ravikrishnan, "Environmental Science &Engineering"Sri Krishna Hitech Pub.Co.Pvt.Ltd.2013
2   Benny Joseph, "Environmental Science & Engineering" Tate McGraw-Hill Pub.Co.Ltd, New Delhi.2009.

REFERENCES

1   G.Tyler Miller, "Environmental Science" Cengage Learning India Pvt. Ltd.New Delhi.2011
2   Dr. Debang Solanki, "Principles of EnvironmentalChemistry" Prateeksha Pub.Jaipur.2011.
3   Gilbert M. Masters and Wendell. P.Ela, "Introduction to Environmental Engineering   and Science" PHI Learning Pvt. Ltd. New Delhi.2010
4   Deeksha Dave and S.S. Katewa, "Environmental Science & Engineering" Learning India Pvt. Ltd.New Delhi.2011
5   Benny Joseph "Environmental Science & Engineering" Tata McGraw-Hill Pub.Co.Ltd, New Delhi. 2009 .

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1   Understand the importance of fossil fuels as energy sources, development of alternative   sources of energy like solar, wind etc
CO2   Aware on green house effect, various types of pollutions and global warming
CO3   Know about the effects of automobile emission and its control measures
CO4   Gain knowledge about the protection of environment
CO5   Conscious on water conservation, rapid growth of population and advantages of   green chemistry

16EE101   **BASICELECTRICALANDELECTRONICSENGINEERING**   **L**   **T**   **P**   **C**
                              (Common to all Non circuit branches)   **3**   **0**   **0**   **3**

UNIT I   **ELECTRICALCIRCUITS&MEASURMENTS**   **9**

Ohm'sLaw–Kirchoff'sLaws–PowerandPowerfactor– Operating Principlesof Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters)andEnergymeters.

UNITII   **ELECTRICALMACHINES**   **9**

Construction, Principleof Operation, Basic Equations and Applications of DC Generators, DC Motors,SinglePhaseTransformer,singlephase inductionMotor.

UNIT III   **SEMICONDUCTORDEVICESANDAPPLICATIONS**   **9**

CharacteristicsofPNJunctionDiode–ZenerEffect–ZenerDiodeanditsCharacteristics–Half waveandFull waveRectifiers–Voltage Regulation. Bipolar JunctionTransistor – CB, CE, CC Configurations and Characteristics – ElementaryTreatment ofSmallSignal Amplifier.

UNIT IV   **DIGITALELECTRONICS**   **9**

BinaryNumberSystem–LogicGates–BooleanAlgebra–HalfandFullAdders–Flip-Flops   – A/DandD/AConversion(singleconcepts)

UNIT V   **FUNDAMENTALSOFCOMMUNICATIONENGINEERING**   **9**

Types ofSignals: Analog and Digital Signals – Modulation and Demodulation: Principles of AmplitudeandFrequencyModulations.
CommunicationSystems:Radio,TV,Microwave,SatelliteandOpticalFibre(BlockDiagram Approachonly).

                                L:45   **T: 0**   **P:0**   **Total: 45 PERIODS**

TEXT BOOKS

1. MuthusubramanianR,SalivahananS,"BasicElectrical andElectronicsEngineering", TataMcGrawHill, New Delhi (2012)
2. Bhattacharya. S.K, "BasicElectrical andElectronicsEngineering", Pearson Education , First Edition, (2011)

REFERENCES

1. N.Mittle"BasicElectricalEngineering", Second Edition, TataMcGrawHill Edition,NewDelhi, (2005)
2. MehtaVK, Mehta Rohit,"Principlesof Electrical Engineering and Electronics",S.Chand& CompanyLtd, (2010)
3. MehtaVK, Mehta Rohit, "PrinciplesofElectronics", S.Chand& CompanyLtd, (2005)
4. Anokhsingh, Chhabra .A. K, "Principlesof Communication Engineering", S.Chand& CompanyLtd, (1999)
5. Vincent Deltoro, " Electrical Engineering Fundamentals", Second Edition, Pearson Education, (2015)

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Apply the elementary concept of electric sources, elements and their properties in the circuits

CO2   Familiarize in the concepts of measuring instruments

CO3   Understand the construction and operation of electrical machines

CO4   Gain knowledge on the theory and applications of analog and digital electronics

CO5   Acquire the knowledge on basics of communication engineering

16ME102   **ENGINEERING MECHANICS**   L   T   P   C

(Common to Aero, Agri, Auto, Civil, Civil & Planning, Mech,
Mech & Automation and Mechatronics)   3   2   0   4

UNIT I   BASICS & STATICS OF PARTICLES   9+6

Introduction - Units and Dimensions - Vectorial representation of forces and moments – Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Resolution and Composition of forces -Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility -Single equivalent force - Free bodydiagram

UNITII   EQUILIBRIUM OF RIGID BODIES   9+6

Types of supports and their reactions -requirements of 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 - Equilibrium of Rigid bodies in two dimensions –Equilibrium of Rigid bodies in three dimensions-Examples

UNIT III   PROPERTIES OF SURFACES AND SOLIDS   10+6

Determination of Areas and Volumes -First moment of area and the centroid of sections - Rectangle, circle, triangle from integration -T section, I section, - Angle section, Hollow section by using standard formula -second and product moments of plane area -Rectangle, triangle, circle from integration -T section, I section, Angle section, Hollow section by using standard formula -Parallel axis theorem and perpendicular axis theorem -Polar moment of inertia -Principal moments of inertia of plane   areas   -Principal   axes   of   inertia   -Mass   moment   ofinertia- Derivationofmassmomentofinertiaforrectangularsection,prism,spherefromfirst principle -Relation to area moments of inertia.

UNIT IV   DYNAMICS OF PARTICLES   8+6

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

UNIT V   ELEMENTS OF RIGID BODY DYNAMICS   9+6

Translation and Rotation of Rigid Bodies -Velocity and acceleration -General Plane motion. Analysis of structures -Plane Trusses -simple trusses -Analysis by Method of joints - Method of sections - Frames -Analysis of a structure containing multi -force members

L: 45   T:30 P:0   TOTAL :75 PERIODS

TEXT BOOKS

1. ArthurP.Boresi andRichardJ.Schmidt,"EngineeringMechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.

2. Beer, F.P and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education 10th Edition (India) Pvt Ltd. (2013).

REFERENCES

1. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)
2. D.P.Sharma "Engineering Mechanics", Dorling Kindersley (India) Pvt. Ltd, New Delhi 2010.
3. Dr.I.S Gujral "Engineering Mechanical" second edition, 2011, Lakshmi Publication (P).Ltd.
4. J.L. MEriam& L.G. Karidge, Engineering Volume I) and engineering Mechanics: Dynamics,7th edition, Wiley student edition, 2013.
5. Hibbeller, R.C., "Engineering Mechanics", 13th edition, Prentice hall (2013).

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Recognize the basics of equilibrium of particles in 2D and 3D
CO2   Review the requirements of equilibrium of rigid bodies in 2D and 3D
CO3   Compute the center of mass and moment of inertia of surfaces and solids
CO4   Predict displacement, velocity and acceleration of dynamic particles

CO5   Solve for equilibrium and internal forces acting in a rigid body

16GE112   **CAREER DEVELOPMENT PROGRAMME - II**   L   T   P   C

(Common to All B.E. / B. Tech. Courses)   **1   0   2   2***

UNIT I   LINGUISTIC SKILLS II   15

Goal Settings, Insights into pre-placement requisites, SWOT Analysis, LSRW Skills

UNIT II   QUANTITATIVE ABILITY III   8

Time, speed and distance -Train problems-Boats and streams, Time and work – Pipes and cisterns, Calendars, Venn diagram.

UNIT III   QUANTITATIVE ABILITY IV   7

Probability, Permutation &Combination, Mixtures & Allegation, Mensuration, Data Interpretation.

UNIT IV   PERSONALITY DEVELOPMENT   8

Personality, Presentation Skills – stages, selection of topic, content & aids, Minutes of meeting, Public speaking.

UNIT V   COMMUNICATION SKILLS   7

Power point presentation, Speak for three minutes, Online typing, Passage reading.

L :15   T: 0   P: 30   T: 45 PERIODS

TEXT BOOKS
1   John Eastwood, "Oxford Practice Grammar", Oxford, 2006.
2   Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.
3   Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.

REFERENCES
1   R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
2   R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt Limited, 2016.

COURSE OUTCOMES
At the end of the course students should be able to

CO1   Understand the field Linguistic techniques.
CO2   Communicate at the basic level in public speaking and write reports.
CO3   Solve time related problems.
CO4   Get the critical concepts through the mixture & allegation & data interpretation sums.
CO5   Write minutes of meeting and versatile presentations.

16AU400	CAREER DEVELOPMENT PROGRAMME – II	L	T	P	C
	(Basics of Automobile)	1	0	2	2*

UNIT I   BASICS OF AUTOMOBILE SYSTEMS   9

General layout of Automobile Systems, Types of chassis, General arrangements for power transmission for front engine, rear engine vehicle, four-wheel drive vehicle, dead axle and axle less transmission

UNIT II   VEHICLE STYLING   9

Vehicle body types, body styles, front grill shapes, head light shapes, side vent, rear side shapes, overall profiles, visual features, aesthetic preference, specific brand image, vehicle color, color codes.

UNIT III   AUTOMOTIVE FUEL SYSTEM   9

Mono point, Multi point, Direct injection systems and Air assisted systems, Examples of Bosch injection systems. Construction and principle of Diesel Injection System, Electronic control of pumps. Common rail and unit injection system.

UNIT IV   VEHICLE MANAGEMENT SYSTEMS   9

Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System – crash sensor, seat belt tightening. Cruise control, Anti-lock Braking System. Collision avoidance Radar warning system.

UNIT V   RECENT ADVANCEMENTS IN AUTOMOBILE   9

Vehicle security systems- alarms, vehicle tracking system. On board diagnostics, Traffic Routing System Automated high way Systems, Lane Warning System, Hybrid/ Electric and Future Cars- Case Study.

L: 45 T: 0 P: 0 TOTAL: 45 PERIODS

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.
2. Jason Alfred Castelino, "Vehicle Styling and Aerodynamic Performance Evaluation", LAP Lambert Academic Publishing, 2012

REFERENCES
1. Jain K.K. and Asthana.R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. "Engine Management", Second Edition, Robert Bosch GmbH, 1999.
3. "Gasoline Engine Management", Second Edition, Robert Bosch GmbH, 2004.
4. Thomas Stevans, "Vehicle Management Systems", 2017.

COURSE OUTCOMES
At the end of the course students should be able to
CO1: Identify the chassis layout and transmission system of automobiles
CO2: Acquire the knowledge of automobile body styling.
CO3: Attain knowledge in the fuel injection systems in SI & CI engine management.
CO4: Illustrate recent developments of vehicle and engine management system.
CO5: Value the safety impact devices and its advancements.

16PY103   **PHYSICS LABORATORY**   **L   T   P   C**

(Common to All B.E. / B. Tech. Courses)   **0   0   2   1**
LIST OF EXPERIMENTS

1. Determination of wavelength of mercury spectrum – Spectrometergrating
2. Determination of Young's modulus of the material – uniformbending.
3. Determination of viscosity of liquid – Poiseuille'smethod.
    (a) Particle size determination using DiodeLaser.
    (b) Determination of Laser parameters – Wavelength.
4. Determinationofvelocityofsoundandcompressibilityofliquid– Ultrasonic Interferometer.
5. Determination of thickness of a thin wire – Air wedgemethod.
6. Determination of dispersive power of a prism usingspectrometer.
7. Determination of Young's modulus of the material – non uniformbending.
8. Torsional Pendulum - determination of rigidity modulus of wire and momentof inertia ofdisc.
9. Determination of Band gap of semiconductormaterial.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Spectrometer
- Young's modulus apparatus
- Poiseuille's method apparatus
- Diode Laser
- Ultrasonic Interferometer
- Air Wedge apparatus
- Torsional Pendulum Apparatus
- Bandgap determination kit

L : 0   T: 0   P:30   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Experiment the concept of stress, strain for the given material.

CO2   Utilize the concept of interference and diffraction in optical measuring instruments.

CO3   Experiment the concept of diffraction in determining the wavelength, velocity of ultrasonic waves.

CO4   Grasp the knowledge of dependency of viscosity of a liquid on its density and velocity of liquid motion.

CO5   Apply the concept of temperature dependence of resistance of a semiconducting

16GE102   **ENGINEERING PRACTICES LABORATORY**   **L   T   P   C**

                                                                                              0   0   4   2

LIST OF EXPERIMENTS

GROUP A (CIVIL &MECHANICAL) (36)

CIVIL ENGINEERING   (18)

1. Study of plumbing tools and Components
2. Preparation of threads in pipes
3. Preparation of single and multi tap connections for domestic
4. Study of carpentry tools and its applications
5. Preparation of Cross Lap and Dove Tail Joints.

MECHANICAL ENGINEERING   (18)

1. Study of different types of Welding and its applications
2. Preparation of Butt, Lap and Tee joints
3. Study of sheet metal and its applications
4. Preparation of Rectangular, Square Trays and Funnel
5. Demonstration of Lathe and Drilling Operations
6. Demonstration of Smithy and Foundry tools.

GROUP B (ELECTRICAL AND ELECTRONICS) (30)

ELECTRICAL ENGINEERING PRACTICE   (18)

1. Residential house wiring using switches, fuse, miniature circuit breaker, 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 energy using single phase energy meter.
6. Measurement of insulation resistance to earth of electrical equipment.
7. Measurement of single and three phase voltages.
8. Study of Iron Box, Emergency Lamp and Fan.

ELECTRONICS ENGINEERING PRACTICE (18)

1. Study of Electronic components and equipments –Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Verification of logic gates: AND, OR, Ex-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice –Components Devices and Circuits Using general purpose PCB.
5. Characteristics of a PN Junction diode

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

CIVIL

1 Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.

2 Carpentry vice(fitted to workbench)

3   Standard wood working tools
4   Models of industrial trusses, door joints, furniture joints
5   Power Tools:
     (a)Rotary Hammer
     (b)Demolition Hammer
     (c)Circular Saw
     (d)Planer
     (e)Hand Drilling Machine
     (f)Jigsaw

MECHANICAL

1   Arc welding transformer with cables and holders
2   Welding booth with exhaust facility
3   Welding accessories like welding shield, chipping hammer, wire brush, etc.
4   Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.
5   Centre lathe
6   Hearth furnace, anvil and smithy tools
7   Moulding table, foundry tools
8   Power Tool: Angle Grinder
9   Study-purpose items: centrifugal pump, air-conditioner

ELECTRICAL

1   Assorted electrical components for house wiring
2   Electrical measuring instruments
3   Study purpose items: Iron box, fan and regulator, emergency lamp
4   Megger (250V/500V)
5   Power Tools:
     (a) Range Finder
     (b) Digital Live-wire detector

ELECTRONICS

1   Soldering guns
2   Assorted electronic components for making circuits
3   Small PCBs
4   Multi Meters
5   Study purpose items: Telephone, FM radio, low-voltage power supply
6   Bread Board
7   CRO

L : 0   T: 0   P: 60   Total:60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Demonstrate plumbing system and Carpentry for the required applications.

CO2 Relate the basic machining operations with engineering problems.

CO3 Apply different types of Welding processes and Sheet metal processes for the Industrial applications

CO4 Illustrate Residential House wiring and simple wiring circuits.

CO5 Employ knowledge on measuring electrical quantities and usage of energy meters.

16ME103 **COMPUTER AIDED DRAFTING LABORATORY** **L T P C**

(Common to Aero, Agri, Auto, Civil, CEP, Mech, MAE and MCT) **0 0 2 1**

LIST OF EXPERIMENTS

1. Study of capabilities of software for Drafting and Modeling -Coordinate systems (Absolute, relative, polar, etc.) -Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like ellipse, parabola, Hyperbola, Cycloid and Involutes.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc
9. Creation of 3-D models of simple objects by using Revolve and Extrude option and also Convert 3D to2D
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawingsfrom3-D model.

L: 0   T: 0   P:30   TOTAL: 30 PERIODS

LIST OF EQUIPMENTSREQUIRED

1. Pentium IV computer or better hardware, with suitable graphics facility -30Nos.
2. Licensed software for Drafting and Modeling. -30Licenses
3. Laser Printer or Plotter to print / plot drawings -1Nos.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1 Use the concept of drafting and modeling with help of software.

CO2 Display various views of engineering objects.

CO3 Develop an idea in drawing truss like structures

CO4 Create 3D drawings of simple models.

CO5 Convert 3D to 2D views

16MA201   TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS   L   T   P   C

(Common to all B.E. / B. Tech. Courses)   **3   1   0   4**

UNIT I   FOURIER SERIES   9+3

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

UNIT II   FOURIER TRANSFORMS   9+3

Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem– Parseval's identity.

UNIT III   PARTIAL DIFFERENTIAL EQUATIONS   9+3

Formation of partial differential equations – Lagrange's linear equation –Solution of standard types of first order partial differential equations – Linear partial differential equations of second order with constant coefficients (Homogeneous Problems).

UNIT IV   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   9+3

Solutions of one dimensional wave equation – One dimensional equation of heat Conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT V   Z -TRANSFORMS AND DIFFERENCE EQUATIONS   9+3

Z- Transforms – Elementary properties – Inverse Z - Transform – Convolution theorem – Formation of difference equation – Solution of difference equations using Z - Transform.

L:45   T:15   P: 0   Total: 60 PERIODS

TEXT BOOKS
1   Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
2.   Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCES
1   Bali, N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", Fifth Edition, Laxmi Publications (P) Ltd., 2014.
2   Glyn James, "Advanced Modern Engineering Mathematics", Fourth Edition, Pearson Education, 2013.
3   Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, Wiley India, 2015.
4   Ronald Bracewell, "The Fourier transforms & its Applications" 3rd Edition, 2012.
5   Zachmanoglou, E.C., "Introduction to partial differential Equations with Application", 2012.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Know how to find the Fourier Series and half range Fourier Series of a function given explicitly or to find Fourier Series of numerical data using harmonic analysis.
CO2   Find the Fourier transform, sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals.
CO3   Form partial differential equations and solve certain types of partial differential equations.
CO4   Solve one dimensional wave equation, one dimensional heat equation and two dimensional heat equation in steady state using Fourier Series.
CO5   Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

16ME207   **STRENGTH OF MATERIALS**   **L   T   P   C**
                                                         3   0   0   3

UNIT I   STRESS STRAIN DEFORMATION OF SOLIDS   9

Rigid and Deformable bodies -Strength, Stiffness and Stability - Stresses; Tensile, Compressive and Shear - Deformation of simple and compound bars under axial load - Elastic constants and their relationship - Stresses in Stepped shafts and varying sections.

UNIT II   BEAMS -SHEAR FORCE, BENDING MOMENT AND THEORY OF   9
                    BENDING

Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever, simply supported and Overhanging beams -Point of contra Flexure - Stresses in beams: Bending and shear stress.

UNIT III   TORSION AND SPRINGS   9

Analysis of torsion of circular bars - Shear stress distribution - Bars of Solid and hollow circular section - Stepped shaft - Twist and torsion stiffness - Compound shafts - Fixed and simply supported shafts - Application to close - coiled helical springs - Maximum shear stress in spring section including Wahl Factor - Deflection of helical coil springs under axial loads - Design of helical coil springs - stresses in helical coil springs under torsion loads. Strain energy in Torsion.

UNIT IV   DEFLECTION OF BEAMS AND BUCKLING OF COLUMNS   9

Elastic curve of Neutral axis of the beam under normal loads - Evaluation of beam deflection and slope: Double integration method, Macaulay Method - Columns- End conditions -equivalent length of a column -Euler equation -Slenderness ratio -Rankine formula for columns.

UNIT V   ANALYSIS OF STRESSES IN TWO DIMENSIONS   9

Biaxial state of stresses - Thin cylindrical and spherical shells - Deformation in thin cylindrical and spherical shells -Biaxial stresses at a point - Stresses on inclined plane -Principal Planes Hoop stress and stresses - Mohr's circle for biaxial stresses - Maximum shear stress.

                                        L:45 T:0 P:0 TOTAL: 45 PERIODS

TEXT BOOKS
   1. Popov E.P, "Engineering Mechanics of Solids", Prentice - Hall of India, New Delhi,2012.
   2. R.K.Rajput, "Strength of Materials", S.Chand and Company Ltd., New Delhi 2015,

REFERENCES
   1. R.S.Khurmi, "Strength of Materials", S.Chand and Company Ltd. New Delhi 2015.
   2. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2012.
   3. Ryder G.H, "Strength of Materials, Macmillan India Ltd"., Third Edition, 2010
   4. Kazimi S.M.A, "Solid Mechanics", Tata McGraw - Hill Publishing Co., New Delhi, 2006.
   5. Singh D.K "Mechanics of Solids" Pearson Education 2014.

COURSE OUTCOMES
At the end of the course the student will be able to
 CO1 Describe the fundamentals about the simple stresses, strains and deformation in components due to external loads.
 CO2 Draw the shear force and bending moment diagrams for various beams.
 CO3 Explain the effect of torsion on shaft and springs.
 CO4 Determine the deflection of the beams and buckling of columns.
 CO5 Evaluate the 2D stresses.

16ME201   **ENGINEERING THERMODYNAMICS**   **L   T   P   C**
                      (Use of approved Steam tables is permitted)   **3   2   0   4**

UNIT I   BASIC CONCEPTS AND FIRST LAW   **9+6**

Basic concepts - concept of continuum - comparison of microscopic and macroscopic approach - Path and point functions - Intensive and extensive - total and specific quantities - System and their types - Thermodynamic Equilibrium State - path and process - Quasi - static- reversible and irreversible processes - Heat and work transfer - definition and comparison - sign convention - Displacement work and other modes of work - P - V diagram - Zeroth law of thermodynamics -concept of temperature and thermal equilibrium–relationship between temperature scales –new temperature scales - First law of thermodynamics –application to closed and open systems -steady flow processes.

UNIT II   PROPERTIES OF PURE SUBSTANCE   **9+6**

Formation of steam and its thermodynamic properties - P-V, P-T, T-V, T-s, h-s diagrams.P -V-T surface - Use of Steam Table and Mollier Chart - Determination of dryness fraction using Throttling, Separating and Throttling - Application of I law for puresubstances.

UNIT III   SECOND LAW   **9+6**

Second law of Thermodynamics - Statements of second law and its corollaries - Carnot cycle-Reversed Carnot cycle - Performance - Carnot theorem - Clausius equality - inequality- Concept of Entropy -T-s diagram -entropy change for pure substance - ideal gases - different processes - principle of increase in entropy - Applications of II Law.

UNIT IV   STEAM POWER CYCLES   **9+6**

Ideal and actual Rankine cycles - Cycle Improvement Methods - Reheat and Regenerative cycles, Qualitative Treatment only: Economiser -preheater-Cogeneration Introduction - Binary and Combined cycles.

UNIT V   IDEAL AND REAL GASES, GAS MIXTURE, THERMODYNAMIC   **9+6**
RELATIONS

Mole and Mass fraction - Dalton's and Amagat's Law. Properties of gas mixture -Molarmass-gasconstant-density-changeininternalenergy-enthalpy- entropyandGibbsfunction.Properties of Ideal gas - Ideal and real gas comparison - Equations of state for ideal and real Gases - Reduced Properties - Compressibility Factor - Principle of Corresponding states - Generalized Compressibility Chart (Qualitative Treatment) and its use - Maxwell relations - Tds Equations - Difference and ratio of heat Capacities - Energy Equation - Joule –Thomson Coefficient - Clausius - Clapeyron equation.

L:45   T:30 P:0 TOTAL :75 PERIODS

TEXT BOOKS
1. Nag.P.K., "Engineering Thermodynamics", 5[th]Edition, Tata McGraw - Hill, New Delhi, 2013.
2. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 8th Edition, Tata McGraw Hill, 2014.

REFERENCES

1. Natarajan E.,"EngineeringThermodynamics:Fundamentalsand Applications", Anuragam Publications, 2012
2. Holman.J.P."Thermodynamics", 3rd Edition, McGraw - Hill, 1995.
3. Rathakrishnan.E.,"Fundamentals of Engineering Thermodynamics", 2nd Edition,Prentice –Hall of India Pvt. Ltd, 2006
4. Arora C.P, "Thermodynamics", Tata McGraw - Hill, New Delhi, 2007.
5. Kau - Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2010 Indian Reprint.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Describe the laws of thermodynamics and their application to a wide range of systems.

CO2 Determine dryness fraction of pure substances undergoing processes using Mollier chart

CO3 Demonstrate Carnot, Clausius equality and Inequality theorems and apply the principles of entropy in real time applications

CO4 Illustrate the principles of various steam power cycles and to solve problems related to steam undergoing various processes.

CO5 Analyze the properties of ideal, real and its gas mixtures and apply the knowledge of mathematical relations in thermodynamic equations.

16AU201	AUTOMOTIVE ENGINES	L	T	P	C
		3	0	0	3

UNIT I   CONSTRUCTION AND OPERATION   9

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. Engine classification, firing order. 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 fixed venturi carburetor, Constant vacuum carburetor. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multihole nozzles, Unit injector and common rail injection systems. 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   SUPER CHARGING, TURBOCHARGING AND ENGINE TESTING   9

Supercharging and Turbo charging, Different methods of turbo charging, inter cooling, Turbocharger controls including, waster gate, variable geometry, variable nozzle types. Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure.

UNIT V   COOLING AND LUBRICATION SYSTEMS   9

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

L: 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 Ganesan V., "Internal Combustion Engines", Tata McGraw Hill, 2007
2 Ramalingam K.K., "Internal Combustion Engine", Sci-Tech Publications, 2005.

REFERENCES
1 Heisler, "Advanced Engine Technology" SAE Publication, 1995
2 Edward F. Obert "Internal Combustion Engines" 3 Edition, 1970
3 Gupta. H.N. "Fundamentals of Internal Combustion" Engines, reprint, PHI Learning Pvt. Ltd. 2006
4 Mathur and Sharma "Fundamental Combustion Engines" Dhanpat Rai and Sons, 2002
5 John B. Heywood, "Fundamentals of Internal Combustion Engines", 1988.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Understand the concept, construction and principle of operation of engine and various engine components
CO2   Acquire knowledge about fuel injection systems and air fuel ratio requirements
CO3   Design the fuel system and combustion chamber for a particular application
CO4   Apply the knowledge on engine performance, turbo and super charging modifications and maintenance
CO5   Illustrate the lubrication and cooling systems of an IC engine

16AU202   **AUTOMOTIVE SYSTEMS**   **L   T   P   C**
                                                                        3   0   0   3

UNIT I   VEHICLE STRUCTURE   9
Brief history, introduction to automobile, layout of an automobile, Role and requirement of a chassis frame. Types of chassis – Light, medium and heavy-duty vehicle chassis, ladder chassis, integral body. Design features of a body – Types of bodies, coach built, convertibles. Body accessories, bumpers.

UNIT II   STEERING SYSTEM   9
Desirable characteristics, principle of steering, steering linkage layouts for rigid axle suspension and independent suspension systems, reversible and irreversible steering. Steering gearbox – Purpose, types of steering gearboxes. Front wheel alignment and steering geometry, centre point steering. Power steering – Purpose, basic principle, types of power steering.

UNIT III   TRANSMISSION SYSTEMS   9
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints. Construction - Differential, rear axle. Types -Full Floating, Three Quarter Floating and Semi Floating Axles - Multi axles vehicles, Hotchkiss Drive.

UNIT IV   SUSPENSION SYSTEM   9
Desirable characteristics. Types of suspension systems – Rigid axle suspension and independent suspension systems. Types of suspension springs – Leaf springs, coil springs, torsion bar springs, air springs, rubber springs, hydro elastic springs. Linked suspension system. Shock absorbers – Role of shock absorber – Types of shock absorbers, construction and working of telescopic shock absorber.

UNIT V   BRAKING SYSTEM   9
Need, characteristics of good braking system, principle of working of a braking system, wheel locking and stopping distance. Types of brakes – Drum brakes, disc brakes. Types of brake actuating systems – Mechanical brakes, hydraulic brakes, power brakes, servo brakes. Wheels and Rims, Types of Tyres and their constructional details

                    L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.
2   K.K.Ramalingam, "Fundamentals of Automobile Engineering", Scitech Publications (India) Private Limited, Chennai, 2013

REFERENCES
1   Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2   Joseph Heitner, "Automotive Mechanics", Second Edition, East-West Press, 1999.
3   Giri. N.K., "Automotive Mechanics", Khanna Publishers, New Delhi, 2005
4   R. K. Rajput , "A Text Book of Automobile Engineering", Laksmi Publications (P) Ltd, New Delhi, 2007
5   Giancarlo Genta and L. Morello, "The Automotive Chassis: Volume 1: Components Design", Springer Science & Business Media, 2008

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Identify the vehicle based on its structure.
CO2   familiarize the layout and design features of an automobile
CO3   Understanding on different types of steering system, transmission systems and axles.
CO4   get the exposure to the suspension system
CO5   Understanding on tyres and braking system.

16AU203 **AUTOMOTIVE ELECTRICAL SYSTEMS** **L T P C**

3 0 0 3

UNIT I BATTERIES 8

Principle and construction of lead-acid battery.Principle and construction of Lithium – ion battery. Characteristics of battery, rating, capacity and efficiency of batteries. Various tests on battery condition, charging methods. Details of modern storage batteries.

UNIT II STARTING SYSTEM 9

Basic of starting – conventional starting, Modern starting system. Principle & construction of starter motor. Working of starter drive units – Bendix drive, Axial drive & over running clutch drive mechanisms. Care & maintenance of starter motor, Starter switches.

UNIT III CHARGING SYSTEM 9

Function, Components of DC and AC Charging System for Automobile, construction, operating principle, characteristics, charging circuit controls – cut out, relays, voltage and current regulators.

UNIT IV IGNITION SYSTEM 10

Types, construction & working of battery coil and magneto ignition systems. Relative merits, centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, Electronic Ignition system. Digital ignition system. Control Strategy of Electronic Ignition System.

UNIT V LIGHTING SYSTEM & ACCESSORIES 9

Details of head light, side light and Braking circuits. Head light dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system, Trafficator, wiring system.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS
1 Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi, 1975
2 Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman &Hall,London, 1992.

REFERENCES
1 Young,A.P.&Griffiths,L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990
2 Vinal,G.W., Storage Batteries, John Wiley & Sons Inc., New York, 1985
3 Crouse,W.H., Automobile Electrical Equipment, McGraw Hill Book Co. Inc., New York, 1980.
4 Spreadbury,F.G., Electrical Ignition Equipment, Constable & Co. Ltd., London,1962
5 Automotive Hand Book, fifth edition, Robert Bosch, Bently Publishers, 2003

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 know the working principle of battery
CO2 identify the components of starting system & different starter drive units
CO3 Analyze the structure and function of charging system.
CO4 understand the working of ignition system
CO5 understand the working of different dash board equipments

16GE211   **CAREER DEVELOPMENT PROGRAMME - III**   **L**   **T**   **P**   **C**

(Common to All B.E. / B. Tech. Courses)   **1**   **0**   **2**   **2***

UNIT I   PERSONALITY DEVELOPMENT & SOFT SKILLS   8

Body Language – Introduction, Grooming, Postures and Gestures, Dressing Etiquettes, Hygiene & Cleanliness, Time Management. Resume Building – Introduction, difference between Resume and CV, Strategy of resume writing Body of the resume, Clarity and Crispness, Format and Content, Code of Conduct.

UNIT II   LINGUISTIC SKILLS III   15

Synonyms & Antonyms, Error Spotting , Paragraph Writing ,Word Substitution, Jumbled words, Spellings, Dialogue Writing, Presentation.

UNIT III   VERBAL REASONING   I   8

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems.

UNIT IV   VERBAL REASONING   II   7

Logical reasoning – Number and Alpha series, Odd man out, Element series, Logical series, Coding anddecoding, Syllogisms, Alphabets.

UNIT V   PRACTICALS   7

Extempore speech, Online typing, Mock Interview, Case based interview, Passage writing.

L :15   T: 0   P: 30   TOTAL: 45 PERIODS

TEXT BOOKS
1. Barun K. Mithra, "Personality Development & Soft Skills", Oxford, 2006.
2. S.P.Bakshi, "Objective English" Arihant Publications, 2014.
3. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

REFERENCES
1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2013.

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Improves their personality through non-verbal communication and write good resume.

CO2   Write sentences and dialogues through paragraph & dialogue writing.

CO3   Apply their analytical thinking.

CO4   Think logically in critical situations.

CO5   Face the interviews confidently through attending the mock interview sessions.

16GE213	**CAREER DEVELOPMENT PROGRAMME - III**	**L**	**T**	**P**	**C**
	(Common to All B.E. / B. Tech. Courses)	**1**	**0**	**2**	**2***

UNIT I   LINGUISTIC SKILLS I   8

Parts of speech, Transformation of sentences-simple, complex, compound, Homonyms, Question tags.

UNIT II   LINGUISTIC SKILLS II   15

Synonyms, Antonyms, Cloze Test ,Voice, Idioms & Phrases. Verbal Analogies.

UNIT III   VERBAL ABILITY I   8

Logical sequence of words, Jumbled Words, Spellings, One word substitution.

UNIT IV   VERBAL ABILITY II   7

Comparison, Paragraph formation, Error spotting

UNIT V   VERBAL ABILITY III   7

Comprehension-comprehend and understand a passage, Dialogue Writing, Power point Presentation.

L :15   T: 0   P: 30   TOTAL: 45 PERIODS

TEXT BOOKS
1 Dr. Aggarwal R.S and Monika Agarwal, "Objective General English", New Delhi, Sultan Chand and Company Ltd., 1999.
2 Arun Sharma & Meenakshi Upadhay,"Verbal ability and Reading comprehension".Mc Graw Hill Education.

REFERENCES
1 "Aptimithra" , McGraw Hill Publications, 2012.
2 Ajaysingh ,"Verbal ability and Reading comprehension", Arihant publication.

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Understand the importance & fundamentals of communication.

CO2   Start speaking and writing in English without making any mistakes.

CO3   Develop presentation skills.

CO4   Think logically in critical situations.

CO5   Prepare the questionnaire.

16MC203   **STRENGTH OF MATERIALS LABORATORY**   **L   T   P   C**

(Common to Auto & Mechatronics)   **0   0   2   1**

LIST OF EXPERIMENTS

1. Tension test on mild steel rod

2. Compression test on wood

3. Double shear test on metal

4. Torsion test on mild steel

5. Impact test on metal specimen – (IZOD &Charpy)

6. Study on Vickers Hardness test

7. Hardness test on metals (Rockwell &Brinell Hardness Tests)

8. Deflection test on beam

9. Compression test on helical spring

Test on cement

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1) UTM of minimum 400 KN Capacity   1

2) Torsion Testing Machine for steel rods   1

3) IZOD and CHARPY Impact Testing Machine   1

4) Hardness Testing Machine Rockwell Brinell   1

5) Beam Deflection Test Apparatus   1

6) Extensometer   1

7) Compressometer   1

8) Dial Gauges   1

9) Le Chatelier''s Apparatus   1

L : 0   T: 0   P: 30   C: 0   Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Familiarize with tensile, compressive and shear test on UTM machine

CO2   Know the operation of impact test machine on different materials.

CO3   Able to found the twisting angle for various material.

CO4   Analyze the deflection of beam for different load condition at various length.

CO5   Evaluate the maximum stiffness of closed coiled spring

16AU204   **AUTOMOTIVE SYSTEMS LABORATORY**   **L   T   P   C**

                                                    0   0   2   1

LIST OF EXPERIMENTS

CHASSIS COMPONENTS

Study and Measurement of the Following Chassis Frames

1. Heavy duty vehicle frame (Example – Leyland / Tata)

2. Light duty vehicle frame (Example – Ambassador / Maruthi / M&M Jeep)

Study, Dismantling and Assembling of

3. Front Axle-Rzeppa joint assembly

4. Rear Axle

5. Clutch 2 types-Coil Spring & Diaphragm spring clutches

6. Gear Box- Sliding mesh, Constant mesh & Synchromesh gear box

7. Steering systems-Rack & Pinion, Re-circulating ball, Warm & Gear and Motorized power steering system

8. Braking systems- Air Braking System

9. Differential Mechanism

Engine Components

10. Dismantling and Assembling of Multi-Cylinder Petrol Engine

11. Dismantling and Assembling of Multi-Cylinder Diesel Engine

12. Dismantling and Assembling of petrol and diesel engine fuel system

13. Dismantling and Assembling of two-wheeler - two stroke and four stroke engines

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Heavy duty vehicle frame

- Light duty vehicle frame

- Front Axle – Rzeppa Joint assembly

- Rear Axle

- Coil Spring Type – clutch

- Diaphragm spring Type – clutch

- Gear box - Sliding mesh, Constant mesh & Synchromesh

- Steering systems - Rack& Pinion/ Re-circulating ball/Warm & Gear

- Motorized power Steering systems

- Air Braking System

- Differential Mechanism

- Multi-cylinder Petrol Engine

- Multi-cylinder Diesel Engine
- Petrol engine fuel system
- Diesel engine fuel system
- Two-wheeler - Two stroke engine
- Two-wheeler -Four stroke engine

L : 30   T: 0   P: 0   J: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know the constructional features of chassis.

CO2 Dismantle and assemble the transmission system and axle shafts.

CO3 Understand the operation of steering system and final drive

CO4 Identify the various parts of braking system

CO5 Dismantle and assemble the automobile engine components

16ME216	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. **RAWING STANDARDS**

   Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

2. **3D GEOMETRIC MODELLING**

   2.1 Introduction

   3D Modeling software such as SOLIDEDGE/AUTOCAD/PRO-E

   2.2 Real Components Drawing:

   Simple components are given, such as Bolts & Nut, Hacksaw frame, Brake shoe, etc…   and made to draw their views and to draw assembly drawing

   2.3 Creation of 3D assembly model of following machine elements using 3D Modelling software

   a. Flange Coupling
   b. Plummer Block
   c. Screw Jack
   d. Lathe Tailstock
   e. Universal Joint
   f. Machine Vice
   g. Stuffing box
   h. Crosshead
   i. Safety Valves
   j. Non-return valves
   k. Connecting rod
   l. Piston
   m. Crankshaft

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Pentium IV computer or better hardware, with suitable graphics facility -30

Software (SOLIDEDGE/AUTOCAD/PRO-E) for Drafting and Modeling

Laser Printer or Plotter to print / plot drawings   - 2

L: 0   T: 0   P: 30   C: 0   Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Categorize the various commands, codes and symbols of engineering drawings.

CO2   Recognize with Indian standards on drawing practices and standard components.

CO3   Convert 2 dimensional to 3 dimensional drawings and to assemble the part drawings

CO4   Interpret three dimensional models

CO5   Assemble various machine components.

16MA202	**STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
	(Common to AERO, AUTO, CIVIL, C&P, EEE, E&I, IT, MECH, MCT, MAE, BME)	**3**	**1**	**0**	**4**

UNIT I   TESTING OF HYPOTHESIS   **9+3**

Sampling distributions – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit- Independence of attributes.

UNIT II   DESIGNS OF EXPERIMENTS   **9+3**

Completely Randomized Design – Randomized block design – Latin square Design – 2^2 factorial design.

UNIT III   SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS   **9+3**

Newton Raphson method – Gauss Elimination method – Pivoting Gauss Jordan methods – Iterative methods of Gauss - Jacobi and Gauss - Seidal – Matrix Inversion by Gauss - Jordan method – Eigen values of a matrix by power method.

**UNIT IV   INTERPOLATION, NUMERICAL DIFFERENTIATION AND   9+3
                      NUMERICAL INTEGRATION**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ rules.

**UNIT V   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL   9+3
                      EQUATIONS**

Taylor's series method – Euler's method – Modified Euler's Method – Fourth order Runge-Kutta method for solving first and second order equations – Milne's Predictor – corrector methods for solving first order equations.

L:45   T:15   P: 0   Total: 60 PERIODS

TEXT BOOKS
1   Johnson, R.A., andGupta,C.B., Miller and Freund's, "Probability and statistics for Engineers", Pearson Education Asia,8th Edition, 2011.
2.   Grewal, B.S and Grewal, J.S, "Numerical methods in Engineering and Science", 9^{th}Edition, Khanna Publishers, New Delhi, 2012 .

REFERENCES
1   Spiegel,M.R., Schiller, J. and Srinivasan,R.A., "Schaum's Outlines Probabilty and Statistics", Tata McGraw Hill edition, 3rd Edition, 2011.
2   Chapra, S.C and Canale, R.P., "Numerical Methods for Engineers", 6th Edition, Tata McGraw Hill Edition, 2014 .
3   Gerald, C.F. and Wheatley, P.O. "Applied Numerical Analysis", 8th Edition, Pearson Education, Asia, New Delhi, 2014.
4   Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8^{th}Edition, Pearson Education, Asia, 2007.
5   Kandasamy, P., Thilagavathy. K and Gunavathy, K., "Numerical Methods", 3rd Edition, S.Chand& Company Pvt. Ltd, 2013.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Apply the statistical concepts and tools for engineering applications and to use different types of research methodology techniques for decision making under uncertainty.
CO2   Perform the ANOVA calculation which is needed for engineering research and project management.
CO3   Solve a set of algebraic equations representing steady state models formed in engineering problems
CO4   Find the trend information from discrete data set through numerical differentiation and summary information through numerical integration.
CO5   Predict the system dynamic behavior through solution of ODEs modeling the system.

16ME202   **FLUID MECHANICS AND MACHINERY**   **L   T   P   C**
                                                                    3   0   0   3

UNIT I   FLUID PROPERTIES AND FLOW CHARACTERISTICS   9

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristics -concept of control volume - application of control volume to continuity equation, energy equation and momentum equation

UNITII   DIMENSIONAL ANALYSIS AND SIMILITUDE   9

Need for dimensional analysis –methods of dimensional analysis -Similitude –types of similitude - Dimensionless parameters - Reynold's Number - Froude's Number - Euler's Number - Weber's Number - Mach's Number - application of dimensionless Parameters- Model analysis

UNIT III   FLOW OVER FLAT PLATE AND FLOW THROUGH CIRCULAR CONDUITS   9

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

UNIT IV   TURBINES   9

Classification of turbines -heads and efficiencies -velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines - working principles - work done by water on the runner -draft tube. Specific speed - unit quantities.

UNIT V   PUMPS   9

Impact of jets -Euler's equation - Theory of roto - dynamic machines- various efficiencies- velocity components at entry and exit of the rotor - velocity triangles -Centrifugal pumps- working principle - work done by the impeller - Reciprocating pump - working principle.

L:45   T:0   P:0   TOTAL:45 PERIODS

TEXT BOOKS
1. Yunus A. Çengel,John M. Cimbala., Fluid Mechanics: Fundamentals and Applications, McGraw - Hill Higher Education, 2010, 10thedition
2. Bansal, R.K., Fluid Mechanics and Hydraulics Machines,Laxmi Publications (P) Ltd.,New Delhi. 2011. 9[th]Editon

REFERENCES
1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, New Delhi 2013. 19[th]Editon
2. Robert W.Fox,alant.mcdonald,PhilipJ.Pritchard, "Fluid Mechanics and Machinery", 2011.
3. Kumar. K.L.,Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd., NewDelhi, 2010. 8th Edison
4. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2010. 9th Edition
5. Rajput. R. K, "A text book of Fluid Mechanics and Hydraulic Machines",S. Chand & Company Ltd., New Delhi, Fourth edition, 2010

COURSE OUTCOMES
At the end of the course students should be able to
CO1   Paraphrase and apply the properties of fluids with mathematical knowledge
CO2   Apply the control volume approach to produce the continuity equation
CO3   Predict the behavior of the prototype/model by applying model laws
CO4   Examine the change of fluid properties during flow through circular conduits
CO5   Estimate the performance of the rotary machines and reciprocating pump.

16AU209   **MECHANICS OF AUTOMOBILE SYSTEMS**   **L   T   P   C**

                                                                  4   0   0   4

UNIT I   BASICS OF MECHANISMS AND KINEMATICS   12

Mechanism – Basic terminology and definitions, degree of freedom, mobility. Grashoff's law. Kinematic inversions - 4-bar chain, slider crank chain. Determination of velocity and acceleration of simple mechanisms using relative velocity method.

UNITII   STATIC AND DYNAMIC FORCE ANALYSIS   12

Applied and Constrained Forces – Free body diagrams –superposition principle – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D-Alembert's principle –dynamic Force Analysis in simple machine members

UNIT III   MECHANISM OF CAMS   12

Fundamentals of cam, Classifications, displacement diagrams, uniform velocity, simple harmonic paths. Layout of plate cam profiles for different types of followers - knife - edged, roller, design, derivatives of follower motion.

UNIT IV   GEARING AND FRICTION DRIVES   12

Gear – Types and profile – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and epicyclic gear trains. Sliding and Rolling Friction angle – friction in threads – Belt and rope drives

UNIT V   BALANCING   12

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses - Balancing of single and multicylinder engines. Governors – Spring loaded and dead weight governors

L :60   T: 0   P: 0   Total: 60 PERIODS

TEXT BOOKS
1   Rattan.S.S, "Theory of Machines", Tata Mcgraw Hill Education Private Limited, 3rdEdition, 2009.
2   Thomas Bevan, "The Theory of Machines" 3rd Edition, CBS Publisher, 2005.

REFERENCES
1   Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition,
    New Age International (P) Ltd. Reprint, 2006
2   Ballaney.P.L, "Theory of Machines", Khanna Book Publishing Co. (P) Ltd, NewDelhi, 2008.
3   Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", East West
    Press, 3rdEdition, 2006.
4   R.S.Khurmi&J.K.Gupta, Theory of Machines - S.Chand and company Pvt Ltd, 14th Edition, 2005.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Describe different mechanisms and Linkages.
CO2   Analyze the contribution of force equilibrium in the machines.
CO3   Understand the Cam profile with follower motion.
CO4   Understand about gears, gear trains and friction drives.
CO5   Describe the methods of balancing the moving parts of the machines.

16AU205   **AUTOMOTIVE MATERIALS AND PRODUCTION**   **L   T   P   C**
                              TECHNIQUES

                                                              3   0   0   3

UNIT I   BEHAVIOUR OF MATERIALS   9

Elasticity-forms - Stress and strain relationship in engineering materials – Deformation mechanism - Strengthening material - Strain hardening, alloying, iron carbon diagram. Composite materials - Definition – Need – General Characteristics.

UNIT II   SELECTION OF MATERIALS   9

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

UNIT III   CASTING FOR AUTOMOTIVE ENGINE COMPONENTS   8

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 and other small auto parts.

UNIT IV   MACHINING OF AUTOMOTIVE ENGINE COMPONENTS   9

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 – Materials and properties.

UNIT V   HEAT TREATMENT AND SURFACE TREATMENT   10

Heat treatment of steel - Annealing - Types, normalizing, Types, hardening and tempering with specific relevance to automotive components, surface hardening techniques, Induction, flame and chemical hardening, coating of wear and corrosion resistance, Electroplating. Phosphating, Anodizing, hot dipping, thermal spraying, hard facing and thin film coatings.

                                        L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
  1   Khanna.O.P., " Material Science and Metallurgy ", Dhanapal Rai & Sons, 1992.
  2   Heldt,P.M., High Speed Combustion Engines, Oxford Publishing Co., New York,1990.

REFERENCES
  1   Kapoor, "Material Science and Processes ", New India Publishing House, 1987.
  2   Dieter.G.E., "Mechanical Metallurgy", McGraw Hill, New York, 1972.
  3   B.P. Bhardwaj, "The Complete Book on Production of Automobile Components & Allied Products" NIIR Project Consultancy Services, India, 2014
  4   Haslehurst,S.E., "Manufacturing Technology", ELBS, London, 1990.
  5   SeropeKalpakjian and Steven R.Schmit, " Manufacturing Engineering and Technology", Pearson Education India, 2009

COURSE OUTCOMES
At the end of the course student should be able to:
  CO1   Understand properties and behavior of engineering materials
  CO2   Know how to use information sources to select materials for automobile uses
  CO3   Acquire knowledge in manufacturing of different automobile components
  CO4   Have clear understanding about the machining of engine components
  CO5   Perform and analyze the various heat treatment and surface treatment process

16AU206	ELECTRONIC ENGINE MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

UNIT I   ELECTRONICS   9

Semiconductors, Transistors, Amplifiers – Integrated circuits – Analog and Digital, Logic Gates, Microcontrollers –Analog Digital / Digital Analog Converters.

UNIT II   SENSORS   9

Sensors for Air flow, Pressure, Temperature, Speed, Exhaust Oxygen, Knock, Altitude sensor, Fuel metering, detonation sensor, Throttle position sensors, solenoids, stepper motors, relays and Position in engine management systems – Principle of operation, construction, and characteristics.

UNIT III   GASOLINE INJECTION SYSTEM   9

Open loop and closed loop systems, Mono point, Multi point, Direct injection systems and Air assisted systems – Principles and Features, examples of Bosch injection systems. Idle speed, lambda, knock, and spark timing control. Three way catalytic converters, Lean NOx converters.

UNIT IV   DIESEL INJECTION SYSTEM   9

Heat release in the diesel engine and need for control of fuel injection. Construction and principle of operation, Electronic control of these pumps. Common rail and unit injector system – Construction and principle of operation.

UNIT V   IGNITION SYSTEMS   9

Ignition fundamentals, solid state ignition systems, high energy ignition distributors, Electronic spark timing and control. Combined ignition and fuel management systems. Dwell angle calculation, Ignition timing calculation. Contact less electronic ignition system.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Robert N. Brady, "Automotive Computers and Digital Instrumentation", Prentice Hall, 1988.
2   "Engine Management", Second Edition, Robert Bosch GmbH, 1999.

REFERENCES
1   Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company Inc., Publishers, 1987.
2   Tom Denton, "Automotive Electrical and Electronic Systems," Edward Amold, 1995.
3   "Gasoline Engine Management", Second Edition, Robert Bosch GmbH, 2004.
4   Eric Chowaniety, "Automobile Electronics", SAE Publications 1995.
5   William B. Ribbews, "Understanding Automotive Electronics", Fifth Edition, SAE Publications 1998.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Manage the details of basic electronics in engine management system.
CO2   Impart the knowledge in automotive sensors and their working.
CO3   Attain knowledge in the fuel injection systems in engine management.
CO4   Acquire knowledge about the various control techniques involved.
CO5   Understand the concept of various sensors and actuators

16EC235	ELECTRONICS AND MICROPROCESSOR	L	T	P	C
	(Common to Auto &Mechanical)	3	0	0	3

UNIT I   **REVIEW OF SEMICONDUCTOR DEVICES-ELECTRONICS**   **9**

                 CIRCUITS (Qualitative Study Only)

FET – JFET – MOSFET- FET Amplifiers Power amplifiers–class A, B and class C. Oscillator - Barkhausen criterion- Colpitts-Wien Bridge and Phase Shift Oscillators, basic of Operational Amplifier.

UNIT II   **TRANSDUCER AND MEASURING INSTRUMENTS** (Qualitative   **9**

                 StudyOnly)

Transducer: Working principle of potentiometer, strain gauges, piezoelectric crystals, thermistor, photodiodes and phototransistors.

Measuring Instruments: Multimeters, Digital Voltmeters, Signal Generators, CRO.

UNIT III   **DIGITAL ELECTRONICS**   **9**

Minimization Techniques: Boolean Expressions, SOP, POS, K-Map, Tabulation Method, Don't CareConditions.

Digital Logic Families: Logic Gates, NAND, NOR Implementation, Comparison of RTL, DTL, TTL.

Combinational and Sequential Logic Circuit: Multiplexers, Encoders and Decoders, Registers,Counters.

UNIT IV   **INTRODUCTION TO MICROPROCESSOR AND**   **9**

                 MICROCONTROLLERS

Architecture of Intel 8085, 8051 - Instruction - Addressing modes - Applications and Interfacing 8051 with stepper motor, Traffic light and LCD Display.

UNITV   **I/O DEVICES**   **9**

Memory and I/O devices and interfacing RAM, ROM, EPROM – Printers - I/O ports-Key boards - Asynchronous and synchronous data transfer schemes - interrupt driven data transfer- DMA data transfer - Simple applications ofMicroprocessors.

                                L:45   **T: 0**   **P: 0**   **Total: 45 PERIODS**

TEXT BOOKS
1. Albert Malvino, David A Bates, "Electronic Principles", Tata McGraw Hill, Seventh Edition, 2008.
2. Morris Mano, "Digital logic and computerDesign", 3rdedition Prentice Hall of India,2002.
3. Adithya P. Mathur, "Introduction to Microprocessor", Tata McGraw Hill, 6th Edition,2002.

REFERENCES
1. Kalsi H S "Electronics Instrumentation", Tata Mcgraw Hill, 2nd Edition reprint 2006.
2. Kenneth J. Ayala "The 8051 Microcontroller" Cengage Learning, 2004.
3. Malvino& Leach, "Digital Principl es and Applications", Tata McGraw-Hill, 1996
4. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd., 1994
5. DouglesV.Hall, "Microprocessor and Inter facing", Programming and Hardware, Tata McGraw-Hill, 1999.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Manage learn about various semiconductor devices

CO2   Familiarize with transducer and measuring instruments

CO3   Work with microprocessors applications.

CO4   Analyze basic electronic circuits and write simple microprocessor based programs.

CO5   Design simple microprocessor based systems based on user specifications.

16GE212   **CAREER DEVELOPMENT PROGRAMME IV**   **L**   **T**   **P**   **C**

                    (Common to all B.E. / B. Tech. Courses)   **1**   **0**   **2**   **2***

UNIT I   **COMMUNICATION & SOFT SKILLS**   **7**

Group Discussion – Types, guidelines, roles, Do's and Don'ts during GD, Mock GD. Interview Etiquettes – Meaning, Purpose, Interview Process and Types, Checklist – Do's and Don'ts, Preparation of Self Introduction.

UNIT II   **LINGUISTIC SKILLS IV**   **15**

Cloze test, Direct & Indirect speech, Question Tags, Homonyms, HIGH LEVEL- Synonyms, Antonyms, Idioms and Phrases.

UNIT III   **VERBAL REASONING - III**   **7**

Logical reasoning - Machine Input & Output, Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

UNIT IV   **VERBAL &NON-VERBAL REASONING - IV**   **8**

Critical reasoning-   Statement – Argument & Assumption, Courses of Action, Inferences.

Non-Verbal reasoning- Insert the missing character, Figure series, Odd man out, Cubes & Dices, Logical Venn diagram.

UNIT V   **PRACTICALS**   **8**

Group Discussion, Online typing, Mock Interview, Company website references.

            L:15   T:0   P:30   TOTAL: 45 PERIODS

TEXT BOOKS
1. Barun K. Mithra, "Personality Development & Soft Skills", Oxford, 2006.
2. S.P.Bakshi, "Objective English" Arihant Publications, 2014.
3. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

REFERENCES
1. Dr. R.S.Agarwal, "A modern approach to Verbal & Non-verbal Reasoning", S.Chand& Company Pvt Limited, 2013.

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Bring behavioral changes through interview etiquettes & communicate well.

CO2   Improve their thinking ability.

CO3   Solve the puzzles through their lateral thinking ability.

CO4   Think critically and attain solutions for the problems.

CO5   Speak better in GD and thorough with the company details.

16GE214	CAREER DEVELOPMENT PROGRAMME IV	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I   **BODY LANGUAGE**   **9**

Body Language – Introduction, Elements, Grooming, Body Language –Postures and Gestures, Dressing Etiquette, Hygiene and Cleanliness, Time Management, Body Language - Positive and Negative ,Importance of body language in Communication.

UNIT II   **INTERVIEW ETIQUETTE**   **9**

Interview Etiquettes – Meaning, Purpose, Process, Types, Do's and Dont's, Dress Code, Self Introduction, Code of Conduct for Interviews, Mock Interview

UNIT III   **RESUME BUILDING**   **9**

Resume Building –Introduction, difference between Resume and CV, Strategy of resume writing, Body of the resume, clarity and crispness, format and content, Resume Etiquettes – Do's and Dont's, model resume writing.

UNIT IV   **GROUP DISCUSSION**   **9**

Group Discussion – Types, Key steps to succeed in GD, Skills required for GD, Importance of GD, Guidelines – Do's and Dont's during GD, the technique of Summing up, Mock GD.

UNIT V   **PRACTICALS**   **9**

Extempore Speech, Company website References, Short speech.

                             L:15   T:0   P:30   Total: 45 PERIODS

TEXT BOOKS
1.   John Eastwood, "Oxford Practice Grammar", Oxford.
2.   Barun K. Mithra, "Personality Development & Soft Skills", Oxford.
3.   R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

REFERENCES
1.   Sanjay Kumar "Communication Skills", Oxford University 2015.

COURSE OUTCOMES
At the end of the course students should be able to

CO1   Exhibit appropriate body language and interview skills.

CO2   Speak effectively in group discussion and acquire interpersonal skills.

CO3   Acquire the professional skills of Group discussion and Resume writing.

CO4   Improve thinking, listening and speaking skills.

CO5   Demonstrate an understanding of the principles of active listening.

16AU207   **FLUID MECHANICS AND DYNAMICS**   **L   T   P   C**
                     LABORATORY

                                                              0   0   2   1
                              LIST OF EXPERIMENTS
FLUID MECHANICS LABORATORY
1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Performance studies of centrifugal pump/ submergible pump
4. Determination of friction factor for a given set of pipes.
5. Performance studies of reciprocating pump.
6. Performance studies of Gear pump.

DYNAMICS LABORATORY
1. Study of gyroscopic effect and couple.
2. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
3. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
4. Vibration of Equivalent Spring mass system – undamped and damped vibration.
5. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
7. a) Balancing of rotating masses b) Balancing of reciprocating masses.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED
1. Orifice meter setup
2. Venturi meter setup
3. Major and minor losses measuring setup
4. Centrifugal pump/submergible pump setup
5. Reciprocating pump setup
6. Gear pump setup
7. Motorized Gyroscope
8. Governor
9. Cams
10. Single degree of freedom - Spring mass system
11. Whirling of shafts
12. Balancing of rotating & reciprocating masses

                    L : 30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Perform flow measurements using different devices and also perform calculation related to losses in pipes
CO2 Know about the performance characteristic of pumps.
CO3 Know the principle of gyroscope and also will perform calculations on various governors
CO4 Analyze the cam motion curves
CO5 Understand how certain measuring devices are used for dynamic testing.

16AU208   **MANUFACTURING TECHNOLOGY**   **L   T   P   C**
LABORATORY

                                                    0   0   2   1

LIST OF EXPERIMENTS

LATHE PRACTICE

1. Prepare the component using the following operations- Facing, Turning, Step turning, Taper turning and Knurling.
2. Prepare the component using the following operations- Facing, Turning and Thread cutting (Single start only)

DRILLING PRACTICE

3. Prepare the component using the following operations- Drilling, Tapping and Reaming

MILLING

4. Prepare the component using the Surface Milling operations
5. Prepare the component using the Gear Cutting operations

PLANNING / SHAPING

6. Prepare the component using Planer or Shaper
    a. Key way cutting   b. Dove tail machining.

FOUNDRY

7. Prepare the mould using the following patterns:
    a. Single piece pattern
    b. Split pattern
    c. Pattern with self-core
    d. Pattern with core box

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Lathe
2. Drilling machine
3. Milling Machine
4. Planning / Shaping machine
5. Pattern, Mould box, & Tools

                          L : 30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Perform various machining operations using lathe machine
CO2   Use different special machine tools to manufacture
CO3   Generate various gear profiles
CO4   Get exposure by using different types of patterns
CO5   Prepare the different types of mould.

16EC236   **ELECTRONICS AND MICROPROCESSOR**   **L**   **T**   **P**   **C**
LABORATORY

                                                          0   **0**   **2**   **1**

LIST OF EXPERIMENTS

1. Characteristics of PN diodes and Zener diode.

2. Study of Rectifiers - Half wave, Full wave Bridge rectifier

3. Characteristics of CE configuration.

4. Adder, Integrators and Current to Voltage Converters OP-AMP.

5. Combination logic realization: Adder and Subtractor.

6. Sequential logic: Counters, Shift Registers.

7. Arithmetic and logical operations using 8085.

8. Interfacing 8051 with stepper motor and LCD Display.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

- Variable DC Power Supply(0-30V)

- CRO 30 MHz

- Digital Trainer kit

- Transformer(6V-0-6V)

- Microprocessor 8085 kit and Microcontroller 8051kit

- Stepper motor Interface

L : 0   T: 0   P: 30   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the operation of the semiconductor electronic devices.

CO2   Do the experiments with registers

CO3   Understand the digital logic circuits.

CO4   Do the microprocessor programming.

CO5   Execute the programs with 8051 microcontrollers

16AU321	FUNDAMENTALS OF MACHINE DESIGN	L	T	P	C
		4	0	0	4

UNIT I   STEADY STRESSES IN MACHINE MEMBER   12

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 - design based on strength and stiffness –factor of safety - theories of failure.

UNITII   PROCESS CAPABILITY AND TOLERANCES   12

Geometric tolerances: applications, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard, surface finish, review of relationship between attainable tolerance grades and different machining processes. Process capability, mean, process capability metrics, Cp, Cpk, cost aspects. Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions, Statistical tolerance indication in mechanical drawings population parameter zone in the μ, σ plane defined using Cp, Cpk.

UNIT III   TOLERANCE CHARTING TECHNIQUE   12

Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

UNIT IV   VARIABLE STRESSES IN MACHINE MEMBER AND JOINTS   12

Stress concentration – design for variable loading -Soderberg, Goodman and Gerber relations knuckle joints, cotter joints – welded joints. Keys & Keyways, Design of couplings.

UNIT V   DESIGN OF BEARINGS   12

Selection of bearings – sliding contact and rolling contact types – cubic mean load – design of journal bearings – Sommerfeld number and Mckees equation –calculation of bearing dimensions.

L :60   T: 0   P: 0   Total: 60 PERIODS

TEXT BOOKS
1. Bhandari V, "Design of Machine Elements", 4rd Edition, Tata McGraw-Hill Book Co, New Delhi, 2016
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, New Delhi, 2015

REFERENCES
1. Sundararajamoorthy T. V. Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2003
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 7th Edition, Wiley, 2016
3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", 3rd Edition Tata McGraw-Hill BookCo(Schaums Outline), New Delhi, 2010
4. Matousek, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London, 1974.
5. Orthwein W, "Machine Component Design", 3rd Edition Jaico Publishing Co, New Delhi, 2003

COURSE OUTCOMES
At the end of the course student should be able to:
- **CO1**   Appraise the principle involved in evaluating the shape and dimensions of a component for Static Loading condition
- **CO2**   Design the Cyclic Loading Machine component based on application.
- **CO3**   Select the proper dimensions for the Shafts, Keys and Coupling.
- **CO4**   Interpret the different Parameter involved in the Energy absorbing Material
- **CO5**   Design of Bearings based on different Load Combination

16AU301   **VEHICLE DESIGN DATA CHARACTERISTICS**   **L   T   P   C**

                                                                               4   0   0   4

UNIT I   INTRODUCTION   12

Assumptions to be made in designing a vehicle Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, Gradability in different gears, Basics of Automobile Design.

UNITII   RESISTANCE TO VEHICLE MOTION   12

Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation.

UNIT III   PERFORMANCE CURVES   12

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length

UNIT IV   PERFORMANCE CURVES – II   12

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration againstCrank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

UNIT V   GEAR RATIOS   12

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on vehicle performance.

L :60   T: 0   P: 0   Total: 60 PERIODS

TEXT BOOKS
1   Giri. N. K., "Automotive Mechanics," Khanna Publishers, New Delhi, 2008.
2   Heldt, P.M., "High Speed Combustion Engines", Oxford and I.B.H.Publishing Co., Kolkata,2002

REFERENCES
1   William H. Crouse, "Automotive mechanics" – 10th Edition, Tata Mc,Graw Hill Publications Co. New Delhi, 2016
2   John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.
3   Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.
4   Gupta. R.B., "Automobile Engineering", Sathya Prakashan, 8 edu., 2013
5   R.S.Khurmi&Gupta.J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2011.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Analyze various design parameters for vehicle.
CO2   Determine parameters influencing vehicle motion.
CO3   Explain the influence of scalar parameters in vehicle performance.
CO4   Examine the vehicle performance based on vector parameters.
CO5   Formulate the required gear ratios based on the requirement.

16AU302   **AUTOMOTIVE ENGINE COMPONENTS DESIGN**   **L   T   P   C**

                                                                          4   0   0   4

UNIT I   INTRODUCTION   12

Engineering materials - Introduction endurance limit, notch sensitivity. Tolerances, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness, Rankine's formula - Johnson formula- design of pushrods.

UNIT II   DESIGN OF CYLINDER, PISTON AND CONNECTING ROD   12

Choice of material for cylinder and piston, Design assumptions and procedure for cylinder and piston. Design of cylinder, piston, and piston pin, piston rings, piston failures, lubrication of piston assembly. Material for connecting rod, determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts.

UNIT III   DESIGN OF CRANKSHAFT   12

Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting (Centre Crankshaft), balancing weight calculations, development of short and long crank arms. Front and rear-end details.

UNIT IV   DESIGN OF FLYWHEELS   12

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

UNIT V   DESIGN OF VALVES AND VALVE TRAIN   12

Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets, and valve train. Design of cam & camshaft. Design of rocker arm. Cam profile generation

                                        L : 60   T: 0   P: 0   Total: 60 PERIODS

TEXT BOOKS
  1   R.S.Khurmi& Gupta.J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2011.
  2   S.Md.Jalaludeen , "A text book of Machine Design" ,Anuradha Publications , 2014

REFERENCES
  1   T.V.Sundararajamoorthy, N.Shanmugam, "Machine Design", Anuradha Publications, 2015.
  2   N.K.Giri, "Automotive Mechanics" 9th Reprint, Khanna Publishers 2014.
  3   Mathur &Sharma, "A course in I.C. Engine", Dhanput Rai & Sons, 2016
  4   V.B.Bhandari , "Introduction to Machine Design" ,Mc Graw Hill Education, 2013
  5   William H. Crouse, "Automotive mechanics"-, Tata McGraw Hill Publications Co.,2006

COURSE OUTCOMES
At the end of the course students should be able to
CO1: Collect the knowledge about the types of materials and material properties.
CO2: Devise the cylinder, Piston and connecting rod based on the engine specification and application.
CO3: Design the crankshaft and its parts.
CO4: Design the flywheel and its parts.
CO5: Infer the valves operations and its mechanism.

16AU322　　　　　**AUTOMOTIVE FUELS AND LUBRICANTS**　　**L　T　P　C**

(Use of Approved Data Book is permitted in the End Semester Examination)　　　**3　0　0　3**

UNIT I　　　　**MANUFACTURE OF FUELS AND LUBRICANTS**　　　　**9**

Structure of petroleum, refining process, fuels, thermal and catalytic cracking, polymerization, alkylation, isomerization, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants

UNIT II　　　　**THEORY OF LUBRICATION**　　　　**9**

Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

UNIT III　　　　**LUBRICANTS**　　　　**9**

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease.

UNIT IV　　　　**PROPERTIES AND TESTING OF FUELS**　　　　**9**

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc.

UNIT V　　　　**COMBUSTION & FUEL RATING**　　　　**9**

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives – specifications of fuels.

L : 45　　T: 0　P: 0　Total: 45 PERIODS

TEXT BOOKS
1　Francis, W, "Fuels and Fuel Technology", Vol. I & II, Pergamon, 1965.
2　M. L. Mathur and P. Sharma "A Course in internal combustion engines," Dhanpatrai Publications, 2012.

REFERENCES
1　Brame, J.S.S. and King, J.G. – "Fuels Solids, Liquids, Gaseous". Edward Arnold, 196.
2　Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
3　Lansdown. A.R., Lubrication, "A practical guide to lubricant selection," Pergamon press, 1982.
4　Raymond. C. Gunther, "Lubrication", Chilton Book Co., 1971.
5　Obert.E.F "Internal Combustion Engineering and Air Pollution," International book Co., 1988.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1　Gain the knowledge on various fuel and lubrication manufacturing techniques
CO2　Learn the detailed conception on lubrication
CO3　Evaluate the various lubrication and it application
CO4　Practice the different fuel standardization techniques at laboratory level
CO5　Be familiar with fuel rating

16AU399	CAREER DEVELOPMENT PROGRAMME - V	L	T	P	C
		1	0	2	2*

UNIT I   AUTOMOBILE SYSTEMS   7

Types of chassis, Chassis layout, vehicle body, chassis lubrication, four-wheel drive and transfer box rear engine vehicles. Materials of chassis and body. Requirements of transmission system, general arrangements for power transmission for front engine, rear engine vehicle, four-wheel drive vehicle, dead axle and axle less transmission

UNITII   VEHICLE STYLING   6

Vehicle body types, body styles, front grill shapes, head light shapes, side vent, rear side shapes, overall profiles, visual features, aesthetic preference, specific brand image, vehicle color, color codes, Introduction to computer aided concept design system, recent technologies.

UNIT III   LUBRICATION   5

Importance of lubrication, advantages because of lubrication, lubricants, properties, lubrication system for automobiles.

UNIT IV   COMPUTER AIDED MANUFACTURING   6

CAD Hierarchy, Integrating CAD, NC and CAM, NC programming using G and M codes adoptable to FANUC controller for lathe and milling, Programming on CNC, DNC, Adaptive control system, CIM, CAPP

UNIT V   AUTOMOTIVE NOISE SOURCES AND CONTROL TECHNIQUES   6

Methods for control of engine noise, Transmission noise, Intake and Exhaust noise, Aerodynamic noise, Tire noise, Brake noise control strategy, noise control at source, along the path, isolation, damping, balancing, resonators, absorption, barriers and enclosures

L :30   T: 0   P: 0   Total: 30 PERIODS

TEXT BOOKS
1. Dr. Kripal Singh, "Automobile Engineering vol 1" 13th Edition, standard publishers, 2012
2. Jason Alfred Castelino "Vehicle Styling and Aerodynamic Performance Evaluation", LAP Lambert Academic Publishing, 2012

REFERENCES
1. Arthur J. Caines, Roger F. Haycock "Automotive Lubricants Reference Book", Society of Automotive Engineers Inc, 2004
2. M.P. Groover, "Automation, production systems and computer integrated manufacturing", - 4th Edition Prentice Hall of India, 2016
3. Introduction to CAD / CAM, P.N. Rao., Tata McGraw Hill Publishing Co, 2010
4. "Noise and Vibration Control" (IISc Lecture Notes Series) World Scientific Publishing Company 2013
5. Ambekar.A. G, "Mechanical Vibrations and Noise Engineering"., Prentice Hall of India New Delhi, 2006

COURSE OUTCOMES
At the end of the course student should be able to:
- **CO1** Identify the chassis layout and transmission system of automobiles
- **CO2** Acquire the knowledge of automobile body styling
- **CO3** Understand the importance of the automobile lubrication systems.
- **CO4** Apply the knowledge of the G and M codes in CNC systems
- **CO5** Acquire knowledge of controlling the noises in automobiles

16GE313　　　　**CAREER DEVELOPMENT PROGRAMME V**　　　**L　T　P　C**

(Common to all B.E. / B. Tech. Courses)　　　　**1　0　2　2***

UNIT I　　　　**QUANTITATIVE ABILITY I**　　　　　　　　**9**

Number theory- Shortcuts, Divisibility criteria- Unit place deduction-LCM &HCF, Square root and Cube Root, Decimal & Fraction, Percentage.

UNIT II　　　　**QUANTITATIVE ABILITY II**　　　　　　　　**9**

Profit, loss and discount, Simple and compound interest, Ratio & Proportions, Mixtures & Allegation, Partnership.

UNIT III　　　　**QUANTITATIVE ABILITY III**　　　　　　　　**9**

Problems on Ages, Average, Venn diagram, Clocks, Calendar, Data Interpretation- Bar chart- Pie chart- Line chart-Tables chart.

UNIT IV　　　　**VERBAL REASONING I**　　　　　　　　**9**

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems, Puzzle.

UNIT V　　　　**VERBAL REASONING II**　　　　　　　　**9**

Logical reasoning - Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Analogy, Alphabets, Logical sequence of words.

L : 15　T:0　　P:30　　Total: 45 PERIODS

TEXT BOOKS
1　　Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
2　　BS Sijwali- InduSijwali, A New Approach to "Reasoning Verbal, Non-Verbal & Analytical", Arihant Publications.

REFERENCES
1　　R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2　　R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt Limited

COURSE OUTCOMES
At the end of the course students should be able to
CO1　　Know the both analytical and logical reasoning
CO2　　Apply the shortcut methods in quantitative aptitude.
CO3　　Solve application orientated concepts in quantitative aptitude.
CO4　　Improve the quality of the student as a finished product for their corporate life.
CO5　　Understand and practice Logical reasoning.

16AU303	AUTOMOTIVE FUELS AND LUBRICANTS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

AUTOMOTIVE FUELS

1. ASTM distillation test of liquid fuels
2. Aniline Point test of diesel
3. Calorific value of liquid fuel
4. Reid vapour pressure test.
5. Flash and Fire points of petrol and diesel.
6. Copper strip Corrosion Test
7. Cloud & Pour point Test
8. Temperature dependence of viscosity using Redwood Viscometer
9. Viscosity Index of Fuels using Say bolt Viscometer

AUTOMOTIVE LUBRICANTS

1. Temperature dependence of viscosity of lubricants using Redwood Viscometer
2. Viscosity Index of lubricants using Say bolt Viscometer
3. Ash content and Carbon Residue Test
4. Drop point of grease and mechanical penetration in grease.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Flash and fire point apparatus (for petrol)
2. Aniline point Apparatus
3. Reid vapor pressure test Apparatus
4. Bomb and Gas Calorimeters
5. Carbon Residue Test Apparatus
6. Copper Strip Corrosion Test Apparatus
7. Cloud and Pour Point Apparatus
8. Redwood Viscometer
9. Say bolt Viscometer
10. ASTM distillation test Apparatus
11. Ash content Test Apparatus
12. Drop point and penetration Apparatus for grease

L:30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Aware the National and International standards of fuels and lubricants
CO2   Recall the properties of fuels
CO3   Conduct different tests on fuels.
CO4   Acquire knowledge about Lubricants and various lubricating systems
CO5   Apply various tests on lubricants

**16AU305   AUTOMOTIVE ELECTRICAL AND ELECTRONICS   L   T   P   C
LABORATORY**

0   0   2   1

LIST OF EXPERIMENTS

Electrical Laboratory

1. Testing of batteries and battery maintenance
   a. Hydrometer test
   b. High-rate discharge test
   c. Open circuit voltage test
2. Testing of starting motors and AC generators
3. Study of regulators and cut – outs
4. Study of ignition systems
5. Study of Automobile electrical wiring

Electronics Laboratory

6. Study of transistor configuration
7. Design of half wave and bridge rectifiers
8. Design of Low Pass Filter & High Pass Filter
9. Interfacing of RTD and LVDT sensors
10. Interfacing ADC and DAC
11. Microcontroller programming & interfacing using
    a. DC motor
    b. Stepper motor
    c. Traffic light controller
12. Study of MPFI System
13. Study of CRDI System

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Battery, hydrometer, High-Rate Discharge tester
2. Starter motor, regulator, cut-out
3. Distributor, ignition coil, spark plug
4. Auto electrical wiring system
5. RPS 0-30 V
6. CRO (0-30 MHz)
7. Function Generator (0-3MHz)
8. Micro Controller Interfacing boards
9. DC Motor Controller, Stepper motor Controller, Traffic Light controller
10. ADC interface board
11. DAC interface board
12. Sensors (RTD, Load cell, LVDT)

L:30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Examine the condition of battery, starter motor and generators.
CO2   Understand the working of regulators, cut out relays & ignition system
CO3   Design rectifiers and filters
CO4   Recognize the working of RTD & LVDT sensors
CO5   Interface various actuators with microcontroller

16AU306	THERMAL SYSTEMS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychometric Chart permitted)

UNIT I GAS POWER CYCLES 10

Air standard cycles-Otto-Diesel-Dual-Work output, Efficiency and MEP calculations – comparison of the cycles for same compression ratio and heat addition, same compression ratio and heat rejection, same peak pressure, peak temperature and heat rejection, same peak pressure and heat input, same peak pressure and work output, Brayton cycle

UNITII RECIPROCATING AIRCOMPRESSORS & AIR CONDITIONING 10

Single acting and double acting air compressors, work required, effect of clearance volume, volumetric efficiency, isothermal efficiency, free air delivery, Fundamentals of air conditioning – psychrometry-Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls. Automotive air conditioners – Lay out and components.

UNIT III CONDUCTION 10

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall and Cylinders. Conduction with Internal Heat Generation – Extended Surfaces.

UNIT IV CONVECTION 8

Basic Concepts – Convective Heat Transfer Coefficients – Types of Convection – Forced Convection – External Flow – Flow over Plates and Cylinders. Internal Flow – Laminar and Turbulent Flow – Flow over Bank of tubes – Free Convection – Flow over Vertical Plate.

UNIT V RADIATION 7

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

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1 Rajput. R. K., "Thermal Engineering" S. Chand Publishers, 2017

2 Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010

REFERENCES

1 Kothandaraman.C.P, "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006

2   Rajput. R. K., "Refrigeration and Air Conditioning", S. Chand Publishers, 2016

3   Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2011

4   Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2011

5   Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2012

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Identify and describe the various gas power cycles.

CO2   Demonstrate the operations of different air compressors and air conditioning systems.

CO3   Infer the physical behavior of various modes of heat transfer like conduction, convection & radiation.

CO4   Analyze problems involving steady state heat conduction in simple geometries.

CO5   Understand the concept of black body, grey body, view factor & Radiation Shield.

16AU307	VEHICLE DYNAMICS	L	T	P	C
		3	0	0	3

UNIT I   CONCEPT OF VIBRATION   9

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

UNITII   TIRES   8

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. Magic formulae tire model, Estimation of tire road friction. Test on Various Road surfaces. Tire vibration.

UNIT III   VERTICAL DYNAMICS   10

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

UNIT IV   LONGITUDINAL DYNAMICS AND CONTROL   9

Aerodynamic forces and moments. Equation of motion. Tire forces, rolling resistance, LoadDistribution 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, and Traction control.

UNIT V   LATERAL DYNAMICS   9

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, during turn. Effect of suspension on cornering.

L: 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1 Rajesh Rajamani, "Vehicle Dynamics and Control", 2nd Edition, Springer 2012.

2 Singiresu Rao, "Mechanical Vibration" 5th Edition, Prentice Hall, 2011.

REFERENCES

1 Hans Pacajka, "Tire and Vehicle Dynamics" 3rd Edition, Elseveir 2012.

2 Reza N. Jazer, "Vehicle Dynamics: Theory and Application" 2nd Edition, Springer 2013.

3 Karl Popp & Werner Schiechlen, "Ground Vehicle Dynamics" Springer 2010.

4 N.K. Giri, "Automotive Mechanics" 9th Reprint, Khanna Publishers 2014.

5 Dean Karnopp, "Vehicle Dynamics, Stability & Control" 2nd Edition, CRC Press 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Recognize the response characteristics of vibrating system.

CO2 Estimate the property and performance of tire on various road surfaces.

CO3 Interpret the vehicle dynamics characteristics of automotive suspension system.

CO4 Predict longitudinal behavior of three & four-wheeler and its controls.

CO5 Compute lateral dynamic characteristics of vehicles under steady state and transient conditions.

16AU308   **AUTOMOTIVE CHASSIS COMPONENTS DESIGN**   **L   T   P   C**

                                                                        3   0   0   3

Use of Approved Data Book is permitted in the End Semester Examination

UNIT I   **VEHICLE FRAME AND SUSPENSION**   **9**

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.

UNIT II   **FRONT AXLE AND STEERING SYSTEMS**   **9**

Analysis of loads-moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of Bearings. Determination of optimum dimensions and proportions for steering linkages, ensuring minimum error in steering. Design of front axle beam.

UNIT III   **CLUTCH AND BRAKES**   **9**

Design of single plate clutch, multiplate clutch and cone clutch. Torque capacity of clutch. Design of clutch components, Design details of roller and sprag type of clutches. Brakes, Types of Brakes, Energy absorbed by a brake, Design and analysis of brake shoes and friction pads.

UNIT IV   **GEAR BOX**   **9**

Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speeds and four speed gearboxes.

UNIT V   **DRIVE LINE AND REAR AXLE**   **9**

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi floating, and three-quarter floating rear shafts and rear axle housings and design aspects of final drive.

                                        L:45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   N.K.Giri, "Automotive Mechanics" 9th Reprint, Khanna Publishers 2014.
2   R.S.Khurmi&Gupta.J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2011.

REFERENCES
1   S.Md.Jalaludeen, "A text book of Machine Design", Anuradha Publications, 2014
2   Heldt, P.M., "Automotive Chassis", literary licensing. 2012.
3   Julian Happian-Smith, "An Introduction to Modern Vehicle Design", Butterworth Heinemann Publishers, 2004
4   Dean Averns, "Automobile Chassis Design", Illife Book Co., 2016.
5   John Fenton, "Handbook of Automotive Power trains and Chassis Design", Professional Engineering Publishing, 1998.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Collect knowledge with various types of loads, stresses acting on frame and suspension of vehicles.
CO2   Design the automotive front axle and steering systems.
CO3   Apply the knowledge gained through various design of clutches for modifications.
CO4   Discover the design of gearboxes for three speeds, four speed and its bearings.
CO5   Evaluate the design considerations in automotive drive line, rear axle and brakes.

16GE312	CAREER DEVELOPMENT PROGRAMME VI	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I   LINGUISTIC SKILLS   10

Parts of Speech, Sentences - Simple, Compound & Complex sentences, Logical sequence of words, Reading Comprehension, Paragraph writing, Jumbled words, Jumbled sentences, Error Spotting, Idioms & Phrases, Word Substitution, Synonyms & Antonyms.

UNIT II   QUANTITATIVE ABILITY   10

Number theory, Percentage, Profit loss and discount, Simple and compound interest, Problems on Average & Ages, Ratio & Proportions, Partnership, Mixtures and allegation, Time speed and distance, Time and work, Probability, Permutation and combination, Mensuration, Clocks, Calendars.

UNIT III   VERBAL & NON-VERBAL REASONING   10

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems, Decision making.

Logical reasoning - Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Syllogisms, Alphabets Machine Input & Output Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

Critical reasoning-Statement – Argument & Assumption, Causes & effects, Courses of Action Inferences.

Non-Verbal reasoning - Insert the missing character, Figure series, Cubes & Dices, Logical Venn diagram.

UNIT IV   PERSONALITY DEVELOPMENT & SOFT SKILLS   8

Body Language – Introduction, Grooming, Body Language - Postures and Gestures, Dressing Etiquettes, Hygiene & Cleanliness, Time Management

Interview Etiquettes – Meaning, Purpose, Interview process and types, checklist – do's and don'ts, Dress code, Self-Introduction.

Resume Building – Introduction, transformation between Resume and CV, Strategy of Resume Writing, Body of the resume, clarity and crispness, format and content.

Group Discussion – Types, Key steps to succeed in Group Discussion, Guidelines – Do's and Don'ts during Group Discussion, the technique of summing up.

UNIT V   COMPANY SPECIFIC TRAINING   7

Company specific training.

L:15   T:0   P:30   Total: 45 PERIODS

TEXT BOOKS
1   John Eastwood, "Oxford Practice Grammar", Oxford.
2   Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
3   M.K.Panday, "Analytical Reasoning", Magical Series.

REFERENCES
1   R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.

2   R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt
        Limited.
3   S.P.Bakshi, "Objective English" Arihant Publications.
4   Edgar Thorpe &Showick Thorpe, "Winning Interviews", Pearson Publications.

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Communicate well both in oral and written English.
CO2   Solve the complicated problems with the thorough knowledge on the basics.
CO3   Think both critical and logical to solve the problems.
CO4   Be a better personality in their professional and social life.
CO5   Face the recruitment challenges.

16GE314   **CAREER DEVELOPMENT PROGRAMME VI**   **L   T   P   C**

(Common to all B.E. / B. Tech. Courses)   **1   0   2   2***

UNIT I   QUANTITATIVE ABILITY IV   9

Time, speed & distance-Average speed- Relative speed- Train problems- Boats and streams- Races, Chain rule, Time and work -Pipes and cisterns.

UNIT II   QUANTITATIVE ABILITY V   9

Permutation & Combination, Probability, Mensuration, Data sufficiency (Quants).

UNIT III   VERBAL REASONING   III   9

Machine Input and Output, Coded Inequalities, syllogisms, Problems on Cubes, Data sufficiency (Reasoning).

UNIT IV   CRITICAL REASONING   9

Statement and Argument, Statement and Assumption, Statement and Conclusion, Course of action, Inference, Decision Making.

UNIT V   NON- VERBAL REASONING   9

Figure series, Odd man out, Mirror Image, Water image, Embedded Image, Cubes and Dices, shape construction, Insert the Missing Characters, Analytical reasoning, Logicalvenn diagram.

L:15   T:0   P:30   Total: 45 PERIODS

TEXT BOOKS

1   Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
2   BS Sijwali- InduSijwali, A New Approach to "Reasoning Verbal, Non-Verbal & Analytical", Arihant Publications.

REFERENCES

1   R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2   R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand& Company Pvt Limited.

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Increase the students knowledge in both analytical and logical reasoning
CO2   Apply the shortcut methods in quantitative Aptitude
CO3   Solve application orientated concepts in quantitative aptitude.
CO4   Improve the quality of the student as a finished product for their corporate life
CO5   Use their logical thinking and analytical abilities to solve Quantitative aptitude questions.

16AU304	ENGINE TESTING AND EMISSION MEASUREMENT LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Valve timing and port timing diagram.

2. Performance test on two-wheeler SI engine.

3. Emission test on two-wheeler SI engine.

4. Performance test on automotive multi-cylinder SI engine

5. Emission test on automotive multi-cylinder SI engine

6. Performance test on automotive multi-cylinder CI engine.

7. Emission test on automotive multi-cylinder CI engine.

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

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

10. Morse test on multi-cylinder SI engine.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Single cylinder diesel engine with Hydraulic dynamometer test rig

2. Single cylinder diesel engine with Eddy current dynamometer test rig

3. Single cylinder two stroke cut section engine

4. Single cylinder four stroke cut section engine

5. Two-wheeler engine test rig.

6. Automotive multi cylinder SI engine test rig with heat balance arrangement

7. Automotive multi cylinder CI engine test rig with heat balance arrangement

8. Emission Measuring Instruments for Petrol & Diesel Engines

L : 30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Discuss about valve timing, port timing and need of dynamometers in engine testing.

CO2 Analyze the Performance and Emission of two-wheeler SI engine, multi cylinder SI and CI Engine, morse test on multi cylinder SI Engine.

CO3 Analyze the Emission of two-wheeler SI engine, multi cylinder SI and CI Engine, morse test on multi cylinder SI Engine.

CO4 Conduct Energy balance test on multi cylinder SI & CI Engine.

CO5 Determine various parameters that influences the IC Engine and to evaluate the digital output of the IC engine performance

16AU309   **COMPUTER AIDED ENGINE AND CHASSIS   L   T   P   C
DESIGN LABORATORY**

0   0   2   1

LIST OF EXPERIMENTS

1. Design and drawing of piston, piston pin and piston rings and drawing of these components.
2. Design of connecting rod small end and big end, shank design, design of big end cap, bolts, and drawing of the connecting rod assembly.
3. Development of short and long crank arms, front end and rear end details, drawing of the crankshaft assembly.
4. Design and drawing of flywheel.
5. Design and drawing of the inlet and exhaust valves.
6. Design of cam and camshaft, cam profile generation, drawing of cam and camshaft.
7. Design of clutch components.
8. Part modelling of vehicle frame

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Computer nodes
2. Drafting and Modeling Software

L : 30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Design the various clutch components and assemble them using drafting software

CO2 Derive the calculations for gear train and bearings based on its application

CO3 Illustrate the step-by-step assembly of gear box with the aid of drafting software

CO4 Recommend the design details of propeller shaft

CO5 Prioritize the important design aspects of final drive.

MINI PROJECT AND COMPREHENSION L T P C

0 0 4 2

GUIDELINES

1. Selection of a topic or project title in consultation with help of a staff member and the subjects where he/she learned in all five semesters.
2. Develop a project planning strategy.
3. If it is an industry – sponsored project, a concurrent letter from industry is required.
4. A maximum of four students per group will do the project.
5. The project may be done in one of the labs under the supervision of a guide or in the selected industry.
6. Preparing a project brief proposal including
   • Problem identification
   • A statement of system / process specification proposed to be developed (Block diagram / concept tree)
   • List of possible solutions including alternative and constraints
   • Cost benefit analysis
   • Time Line of activities
7. At the end of the project, a report will be prepared by the schedule also he/she will provide a technical presentation along with the demonstration model prepared.
8. A presentation including the following:
   • Implementation Phase (Hardware / Software / both)
   • Testing & Validation of the developed system
   • Learning in the Project
9. The report, project demonstration and technical presentation will be evaluated by the internal and external examiners

Comprehension Examination Evaluation Procedure

1. Comprehension examination will be a written cum oral examination covering broadly all courses so far completed. This examination consists of two parts. Part A - a written test and the other an Part B - a oral one. The written examination shall be objective type of 1 hour duration and shall have 50 marks and is to be conducted by the concerned department.

2. Chairman of the oral examination board shall be a senior faculty in the department and the members include two other faculty members of the department and an external expert from another department. Oral examination shall carry 50 marks. Comprehensive examination may be conducted at the end of the semester with sufficient notice given to the students

L: 0   T: 0   P: 60   Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course students should be able to
 CO1: Prepare plans for mini projects.
 CO2: Make use the knowledge gained in automobile
 CO3: Develop models / projects related to their skills acquired in the previous semesters to practical problems.
 CO4: Brings out innovative ideas to the students
 CO5: Prepare process planning, assembly methods, testing and cost analysis.

16GE302   ENGINEERING ECONOMICS AND COST ANALYSIS   L   T   P   C
                              (Common to all B.E. / B. Tech. Courses)   3   0   0   3

UNIT I   BASIC ECONOMICS   9

Definition of economics - nature and scope of economic science - nature and scope of managerial economics - basic terms and concepts - goods - utility - value - wealth - factors of production - land - its peculiarities - labour - economies of large and small scale - consumption -wants - its characteristics and classification - law of diminishing marginal utility – relation between economic decision and technical decision.

UNIT II   DEMAND AND SCHEDULE   9

Demand - demand schedule - demand curve - law of demand - elasticity of demand - types of elasticity - factors determining elasticity - measurement – its significance - supply – supply schedule - supply curve - law of supply - elasticity of supply - time element in the determination of value - market price and normal price - perfect competition - monopoly – monopolistic competition.

UNIT III   ORGANISATION   9

Forms of business - proprietorship - partnership - joint stock company - cooperative organization - state enterprise - mixed economy - money and banking - banking - kinds - commercial banks - central banking functions - control of credit - monetary policy - credit instrument.

UNIT IV   FINANCING   9

Types of financing - Short term borrowing - Long term borrowing – Internal generation of funds - External commercial borrowings - Assistance from government budgeting support and international finance corporations - analysis of financial statement – Balance Sheet - Profit and Loss account - Funds flow statement.

UNIT V   COST AND BREAK EVEN ANALYSES   9

Types of costing – traditional costing approach - activity base costing - Fixed Cost – variable cost – marginal cost – cost output relationship in the short run and in long run – pricing practice– full cost pricing – marginal cost pricing – going rate pricing – bid pricing – pricing for a rate of return – appraising project profitability –internal rate of return – pay back period – net present value – cost benefit analysis – feasibility reports – appraisal process – technical feasibility economic feasibility – financial feasibility. Break even analysis - basic assumptions – break even chart – managerial uses of break even analysis.

                                                  L:45   T: 0   P:0   Total: 45 PERIODS

TEXT BOOKS
1 Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand & Co., 2006.
2. Sharma JC "Construction Management and Accounts" Satya Prakashan, New Delhi, 2006.

REFERENCES
1 Barthwal R.R., Industrial Economics - An Introductory Text Book, New Age, 2007.
2 Jhingan M.L., Micro Economic Theory, Konark,1989.
3 Samuelson P.A., Economics - An Introductory Analysis, McGraw Hill.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Know the basic terms and concepts of economic.
CO2   Understand the major capability and limitations of cash flow analysis for proposed capital investment.
CO3   Recognize, formulate, analyze and solve cash flow models in practical   situations.
CO4   Develop the ability to account for time value of money using engineering economy factors and
          formulas, as well as implication and importance of considering taxes, depreciation and inflation.
CO5   Evaluate engineering alternatives by economic analysis techniques and   models.

16AU405	FINITE ELEMENT METHODS AND ANALYSIS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Basic concepts of FEM – Historical Back ground – Relevance and scope for FEM – Need for Approximation – Weighted Residual, Ritz and Galerkin method – Variational formulation.

UNITII GENERAL PROCEDURE OF FEM 9

Discretization, Interpolation, shape function, formulation of element characteristic matrices, assembly and solution.

**UNIT III FORMULATION OF ELEMENT CHARACTERISTIC MATRICES AND 9
VECTORS FOR ELASTICITY PROBLEMS**

One dimensional elasticity – Two-dimensional elasticity – Three-dimensional elasticity – Axisymmetric elasticity. Formulation of element characteristic matrices and vectors for Field Problems Thermal problems – one dimensional, Two dimensional and three-dimensional heat transfer – Axisymmetric heat transfer – Torsion problems.

UNIT IV HIGHER ORDER AND ISOPARAMETRIC FORMULATIONS 9

Natural coordinate system and Numerical Integration – Higher-order, one-dimensional, two-dimensional and three-dimensional elements – Structural beam, plate and shell elements – Isoparametric elements – Isoparametric formulation

UNIT V COMPUTER IMPLEMENTATION 9

An overview of FE analysis program – preprocessing – solution – post processing.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS
1 J.N. Reddy, "An Introduction to Finite Element Method", McGraw Hill,3rd Edition.2017.
2 S.S.Rao, "The finite element method in Engg.", Pergamon Press, 2005

REFERENCES
1 S. S. Bhavikatti, "Finite Element Analysis", New Age International Publishers, 2005
2 P.Seshu, "Finite Element Analysis", PHI Learning Private Ltd., 2012
3 Chandrupatla, "Introduction to Finite Elements in Engineering",4thEdition, Pearson India Ltd. 2015.
4 Y. M. Desai, "Finite Element Method with Applications in Engineering", Pearson Education India 2011
5 Logan D.L., "A First course in the Finite Element Method", CL Engineering; 5th edition, 2010

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis.
CO2 Understand the behavior of various finite elements.
CO3 Derive finite element equations for simplex and complex elements.
CO4 Solve problems in solid mechanics and heat transfer using FEM.
CO5 Analyze more complex problems (in solid mechanics or thermal analysis) using the commercial FEM code.

16AU402   **VEHICLE MAINTENANCE AND RECONDITIONING**   **L T P C**
(Theory & Practical)

         2 0 2 3

UNIT I   MAINTENANCE OF RECORDS AND SCHEDULES   9

Requirements and importance of maintenance, types of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. Motor vehicle acts, insurance etc and traffic rules, motor vehicle driving rules and regulation.

UNIT II   ENGINE MAINTENANCE – REPAIR AND OVERHAULING   5

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up, including modern engines.

UNIT III   CHASSIS MAINTENANCE - REPAIR AND OVERHAULING   9

Mechanical and automobile clutch, fluid flywheel, torque converter, automatic transmission and gear box, servicing and maintenance. Maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

UNIT IV   ELECTRICAL AND ELECTRONIC SYSTEM MAINTENANCE - SERVICING AND REPAIRS   9

Testing methods for checking electrical and electronic components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

UNIT V   MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY   9

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

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. 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.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED
1. Engine Analyzer
2. Cylinder compression pressure gauge
3. Vacuum gauge
4. Spark plug cleaner and tester
5. Cam angle and rpm tester
6. Tachometer
7. Wheel alignment apparatus
8. Gas welding equipment
9. Tyre remover
10. Bearing puller
11. Head light alignment gauge
12. Service manuals of petrol, diesel engines
13. Cylinder reboring machine
14. Valve grinding machine
15. Valve lapping machine
16. Fuel injection calibration test bench with nozzle tester
17. HRD tester, Clamp on meter, Hydrometer

L : 30   T: 0   P: 30   Total: 60 PERIODS

TEXT BOOKS
1   Clifton E. Owen "Basic Automotive Service and Systems "– 4th Edition, Cengage Learning 2010.
2   Tim Gilles "Automotive Service" – 5th Edition, Cengage Learning 2015.

REFERENCES
1   N.K.Giri, "Automotive Mechanics" 9 th Reprint, Khanna Publishers 2014.
2   James D Halderman, "Advanced Engine Performance Diagnosis" Prentice Hall India Learning Private Limited 2015
3   Doshi.J.A, "Vehicle Maintenance and Garage Practice" Prentice Hall India Learning Private Limited 2014
4   Dr. Kripal Singh, "Automobile Engineering vol 1" 13th Edition, standard publishers 2012
5   W.H.Crouse, "Automotive Mechanics" 10th Edition , Tata Mc Graw Hill Publications, 2006

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Identify the faults and knowledge on maintenance.
CO2   Impart the knowledge in working of automobile components.
CO3   Diagnosis the faults and rectify the faults in vehicle.
CO4   Describe the minor and major tuning of diesel and petrol engines.
CO5   Adjust the pedal play in clutch brake, hand brake and steering wheel.

16AU401   **AUTOMOTIVE DESIGN AND ANALYSIS**   **L   T   P   C**
LABORATORY

0   0   2   1

LIST OF EXPERIMENTS

1. Study of different commercial FEA tools used for design and analysis

2. Stress analysis of Crankshaft

3. Thermal analysis of cylinder liners

4. Stress analysis of leaf spring

5. Design and analysis of torsion bar

6. Cam Profile analysis

7. Stress analysis of composite body panels

8. Design and analysis of piston crown

9. Design and analysis of chassis frames

10. Modal analysis of Aerofoil profile

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

1. Computer nodes

2. Analysing Software

L : 30   T: 0   P: 0   C: 0   Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Use the concept of drafting and modeling with help of software.

CO2   Display various views of engineering objects.

CO3   Develop an idea in drawing truss like structures

CO4   Model and simulate the thermal and stress analysis

CO5   Analyze the various design aspects in different conditions

16AU403	PROJECT WORK PHASE I	L	T	P	C
		0	0	4	2

PROJECT WORK GUIDELINES

- The students in convenient groups of members on a project involving theoretical and experimental studies related to automobile engineering. Every project work shall have a guide who is the member of the faculty of the institution.

- Four periods per week shall be allotted in the time table and this time shall be utilized by the students for carrying out the project work.

GENERAL GUIDELINES

1. Selection of a topic or project title in consultation with a staff member.

2. Develop a project planning strategy.

3. If it is an industry – sponsored project, a concurrent letter from industry is required.

4. A maximum of 4 students per group will do the project.

5. The project may be done in one of the labs under the supervision of a guide or in the selected industry.

6. At the end of the project, a report will be written and a technical presentation along with demonstration will be made by the students.

The report, project demonstration and technical presentation will be evaluated by the internal and external examiners. Selection of a topic or project title in consultation with a staff member.

L: 0   T: 0   P: 60   Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course students should be able to

CO 1: Design, analyze, and fabricate the device and mechanisms of specific automotive.

CO 2: Provide opportunity for the students to implement their skills acquired in the previous semesters practical problems.

CO 3: Brings out innovative ideas to the students.

CO 4: Prepare models / projects related to their skills acquired in the previous semesters practical problems

CO 5: Prepare process planning, assembly methods, testing and cost analysis.

16GE301	PROFESSIONAL ETHICS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I   ENGINEERING ETHICS   9

Senses of Engineering ethics – Variety of moral issues – Types of inquiry- Moral dilemmas. Moral autonomy – Kolberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideals and virtues – theories about right action – self-interest – customs and religion – use of ethical theories.

UNIT II   ENGINEERING AS SOCIAL EXPERIMENTATION   9

Engineering as social experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – Case studies.

UNIT III   ENGINEERS RESPONSIBILITY FOR SAFETY   9

Safety and risk – assessment of safety and risk – risk benefit analysis – reducing risk – Case studies.

UNIT IV   RESPONSIBILITIES AND RIGHTS   9

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest –occupational crime – professional rights –employee right – discrimination – intellectual property rights, Case studies.

UNIT V   GLOBAL ISSUE   9

Multinational corporations – environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – sample code of conduct, Case studies.

L:45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 Mike Martin and Roland Schinzinger, "Ethics in Engineering" McGraw hill, NewYork, 2004.
2. Govindarajan. M, Natarajan. S,Senthilkumar. V.S, "Engineering Ethics" Prentice Hall, New Delhi, 2004.

REFERENCES
1 Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics– Concepts and Cases", Cengage Learning, 2009 .
2 Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt.Ltd., New Delhi 2013 .
3 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4 Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004).
5 David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories.
CO2   Identify various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
CO3   Realize the responsibilities of an engineer for safety and risk benefit analysis.
CO4   Recognize the professional rights and responsibilities of an engineer.
CO5   Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional career.

16AU404   **PROJECT WORK PHASE II**   L   T   P   C

                                                                   0   0   20 10

THE PROJECT WORK INVOLVES THE FOLLOWING

1. Preparing a project brief proposal including

    - Problem identification

    - A statement of system / process specification proposed to be developed (Block diagram / concept tree)

    - List of possible solutions including alternative and constraints

    - Cost benefit analysis

    - Time Line of activities

2. A report highlighting the design finalization (based on functional requirements & standards (if any)

3. A presentation including the following:

    - Implementation Phase (Hardware / Software / both)

    - Testing & Validation of the developed system

    - Learning in the Project

    - Consolidated project report preparation

GENERAL GUIDELINES

1. The progress of the project is evaluated based on a minimum of three reviews.

2. The review committee may be constituted by the Head of the Department.

3. A project and project reports are required at the end of the semester.

The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

L: 0   T: 0   P: 300   Total: 300 PERIODS

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Take up industrial design and fabrication projects.

CO2: Create innovative ideas to solve real time engineering problems.

CO3: Design their conceptual methods for Automobile Engineering sector

16AU311	**AUTOMOTIVE TRANSMISSION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I   **CLUTCH AND GEAR BOX**   **9**

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 in different speeds. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNITII   **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 Poly phase torque converters, Converter coupling – free wheel – characteristic performance.

UNIT III   **EPICYCLIC GEARBOXES USED IN AUTOMATIC TRANSMISSION**   **9**

Principle of Planetary gear trains – Construction and operation of Ford – T model gear box, Wilson Gear box, Cotal electromagnetic transmission.

UNIT IV   **AUTOMATIC TRANSMISSION APPLICATIONS**   **9**

Need for automatic transmission, four speed longitudinally mounted automatic transmission - Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT. Hydraulic control system for Automatic Transmission.

UNIT V   **HYDROSTATIC AND ELECTRIC DRIVE**   **9**

Hydrostatic drive; various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction, and working of typical Janney hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control System-Advantages & limitations.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1. Harald Naunheimer., Bernd Bertsche, "Automotive transmission-fundamental, selection, design& application'', Springer, 2015.
2. Crouse, W.H., Anglin, D.L.," Automotive Mechanics", McGraw Hill, 2017

REFERENCES
1. Robert Fischer, "Automotive Transmission", Springer international publishing AG, 2015
2. Design Practices: "Passenger Car Automatic Transmissions" SAE-International with a Product Code of AE-29, ISBN of 978-0-7680-1125-8,2012
3. Gustavo Costa, Nariman Sepehri.,"Hydrostatic transmissions and actuators", John Wiley & sons ltd., 2015.
4. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
5. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2004.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Infer various types of gear box, its principle and applications.

CO2   Illustrate the construction, principle of Fluid Coupling & Torque Convertor.

CO3   Indicate the principle and construction of epicyclic gear system.

CO4   Understand the construction, working and applications of automatic transmission.

CO5   Interpret about the various types and principles of hydrostatic drives and electric drives

16AU312   **ALTERNATE FUELS AND ENERGY SYSTEMS**   L   T   P   C
                                                                              3   0   0   3

UNIT I   ALCOHOLS AS FUELS   9

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNITII   VEGETABLE OILS AS FUELS   9

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT III   HYDROGEN AS ENGINE FUEL   9

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT IV   BIOGAS, NATURAL GAS AND LPG AS FUELS   9

Production methods of Biogas- bio diesel and its characteristics- Compressed Natural gas and LPG. Properties studies. CO_2 and H_2S scrubbing in Biogas. Modification required to use in SI and CI Engines- Performance and emission characteristics of CNG and LPG in SI and CI engines.

UNIT V   ELECTRIC, HYBRID AND FUEL CELL VEHICLES   9

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

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Thipse S.S., "Alternate Fuels – Concepts, Technologies and Developments", Jaico Publishing House, Delhi, 2010.
2   Sunggyu Lee, James G. Speight, Sudarshan K. Loyalka, "Handbook of Alternative Fuel Technologies", CRC Press-Second Edition, 2014.

REFERENCES
1   A S Ramadhas, "Alternative Fuels for Transportation", CRC Press, 2011.
2   Thomas F. McGowan, Michael L. Brown, "Biomass and Alternate Fuel Systems: An Engineering and Economic Guide", John Wiley & Sons, 2009.
3   Richard Folkson, "Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance", Woodhead Publishing, 2014.
4   National Research Council, "Transitions to alternative Fuels and vehicles", The National Academies press, 2013.
5   AyhanDemirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', ISBN-13: 9781846289941, Springer-Verlag London Limited, 2008.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Analyze the properties and characteristics of alcohol as fuel.

CO2 Examine various vegetable oils and its characteristics as fuel.

CO3 Evaluate the properties of hydrogen as alternate fuel.

CO4 Compare and contrast different gaseous fuel

CO5 Recognize the potentials of electric, hybrid and fuel cell technologies for conventional

16AU313   **UNCONVENTIONAL ENGINES AND HYBRID VEHICLE**   L   T   P   C

                                                                          3   0   0   3

UNIT I   **STIRLING ENGINE**   9

Working Principle, two piston engine, control system, fuel requirement, emissions, merits and demerits, applications.

UNIT II   **WANKEL ENGINE & VARIABLE COMPRESSION RATIO ENGINE**   9

WANKEL ENGINE: Special features, construction and working, engine sealing, lubrication and cooling, fuel requirement and combustion, performance, emissions, merits and demerits, applications. VARIABLE COMPRESSION RATIO ENGINE: Necessity, theoretical analysis, different methods.

UNIT III   **FREE PISTON ENGINE**   9

Different types, construction and working, stability and speed of pistons, performance, merits and demerits, applications.

UNIT IV   **ELECTRIC & HYBRID VEHICLES**   9

Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy, and power density batteries, hybrid vehicle – types, merits and demerits.

UNIT V   **FUEL CELLS & SOLAR CARS**   9

Fuel cell, Structures, construction, working, Operations, and properties of Fuel cells – possible fuel sources, (Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Molten Carbonate Fuel Cell) - equations, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and cost comparison.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1. Mathur L and Sharma R P, "Internal Combustion Engines" Dhanpat Rai Publications (P), Ltd., 2016.

2. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRS Press, 2010.

REFERENCES

1. H N Gupta, "Internal combustion engines", PHI Learning Pvt Ltd., 2013.

2. V. Ganesan, "Internal Combustion Engines", Tata McGraw Hill Publishing company, New Delhi, 2016.

3. Tom Denton, "Electric and Hybrid vehicles", Taylor & Francis group., 2016.

4. Chris Mi; M. Abul Masrur& David Wenzhong Gao,"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons ltd., 2011.

5. James Larminie and John Loury, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Infer the principle and working of Stirling engine.

CO2   Recognize construction and working of wankel and VCR engine.

CO3   Illustrate types, construction and working of free piston engine.

CO4   Describe layout, advantages and limitations of electric and hybrid vehicles.

CO5   Indicate the construction, working and operation of fuel cell and solar cars.

16AU314	AUTOMOTIVE EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I ELECTRONICS IN AUTOMOBILE 9

Power train Management – MPFI, GDI & CRDI, ignition systems, body and convenience electronics, vehicle power supply controllers, lighting modules, door control modules, safety -anti-lock braking system, electronic stability program, supplementary restraint system, traction control system – 42 V technology.

UNIT II DRIVE-BY-WIRE 9

Challenges and opportunities of X-by-wire system & design requirements, steer-by-wire, brake-by-wire, electronic throttle including adaptive cruise control, shift-by-wire. Semiconductor concepts for X-by-wire systems

UNIT III HARDWARE MODULES 10

16-bit Infineon microcontrollers-architectural overview of C166 family-memory organization, fundamental CPU concepts and optimization measures, on-chip system resources, peripheral event controller (PEC) and interrupt control, external bus interface, parallel ports, general purpose timers(GPT), watchdog timer, serial channels, capture/compare units, pulse width modulation unit, analog to digital converter, real time clock, on-chip I2C bus module, on-chip CAN module, universal serial bus (USB) interface, SDLM interface, power management monitoring features, special features of XC166 family. Introduction to 32-bit tri-core architecture.

UNIT IV SOFTWARE DEVELOPMENT TOOLS 9

Introduction to KEIL integrated development environment (IDE), creating new project, creating new file, adding files to project, options for target, compile and building project, simulation and debugging, set breakpoints, monitor on-chip peripherals using simulators, study of example programs. Introduction to digital application virtual engineer (DAVE) software, configuring the on-chip resources using DAVE software, automatic code generation using DAVE software.

UNIT V INTEGRATION OF HARDWARE AND SOFTWARE 8

Introduction to Infineon microcontroller development kit (easy kit), developing project using KEIL software, downloading embedded software into target system, introduction to on-chip debugging resources, debugging target system using on-chip debugging support . CASE STUDY: Driving of a brushless DC Motor without sensors

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Eight Edition, Elsevier Science & Technology,2017.
2 Nicolas Navet, Francoise Simonot-Lion, "Automotive Embedded Systems Handbook", CRC Press, 2010.

REFERENCES
1 Raj Kamal, "Embedded Systems: Architecture, Programming and Design" Tata McGraw-Hill Education, 2011.

2   KenzoNonami, MuljowidodoKartidjo, Kwang-Joon Yoon &AgusBudiyono, "Autonomous Control Systems and Vehicles: Intelligent Unmanned Systems", Springer Science & Business Media, 2013.

3   Christopher Hallinan, "Books on Google Play Embedded Linux Primer: A Practical Real-World Approach," Pearson Education, 2010.

4   Marilyn Wolf, "Computers as Components: Principles of Embedded Computing System Design" Elsevier, 2012.

5   Bagnato, Alessandra, "Handbook of Research on Embedded Systems Design," IGI Global, 2014.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Infer the basics of electronics in automobile.

CO2   Identify the operation of drive by wire systems.

CO3   Illustrate the various hardware modules in a vehicle.

CO4   Recognize various software development tools used in embedded systems.

CO5   Infer the technique of integration hardware and software tools.

16AU324	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION TO CIM   9

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems. Manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

UNIT II   GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING   9

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems facility design using G.T. - benefits of G.T. - cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

UNIT III   SHOP FLOOR CONTROL AND INTRODUCTION OF FMS   9

Shop floor control-phases -factory data collection system –automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation - material handling and storage systems- FMS layout -computer control systems-application and benefits.

UNIT IV   CIM IMPLEMENTATION AND DATA COMMUNICATION   9

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software. Communication fundamentals- local area networks - topology –LAN implementations - network management and installations.

UNIT V   OPEN SYSTEM AND DATABASE FOR CIM   9

Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases - database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Mikell P.Groover, "Automation, Production Systems and computer integrated manufacturing", Pearson Education, 2008.
2   Radhakrishnan P, Subramanyan S and Raju V, "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

REFERENCES
1   Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill, 1987.
2   David D Bedworth, Mark R.Hendersan, Phillip M.Wolfe, "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
3   Roger Hanman, "Computer Intergrated Manufacturing", Addison – Wesley, 1997.

4   Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
5   Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Relate the computer programming in production activity
CO2   Familiar in design and manufacturing concepts of Group technology, part families, FMS/FMC
CO3   Have a better idea about application of computer in manufacturing.
CO4   Know about CIM implementation and data communication in manufacturing.
CO5   Illustrate the basic knowledge of open system and database for CIM.

16GE303	TOTAL QUALITY MANAGEMENT	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

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, and Customer retention - Costs of quality.

UNITII 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 STATISTICAL PROCESS CONTROL (SPC) 9

Statistical fundamentals – Measures of central Tendency and Dispersion - Population and Sample, Control Charts for variables and attributes, Industrial Examples. Process capability. Concept of six sigma – New seven Management tools.

UNIT IV TQM TOOLS 9

Bench marking -Reason to bench mark, Bench marking process - FMEA - Stages, Types. Quality Function Deployment (QFD) - House of Quality - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems - ISO 9001-2015 Quality System - Elements, Implementation of Quality System Documentation, Quality Auditing - QS 9000 – BS-OHSAS 18001: 2007, ISO 20000, ISO 22000 IATF 16949: 2016, ISO 14001:2015, AS9100– Concept, Requirements and Benefits- Case studies.

L:45 T:0 P:0 TOTAL: 45 PERIODS

TEXT BOOKS
1 Dale H. Besterfiled, "Total Quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2016.
2 SubburajRamasamy" Total Quality Management" Tata Mcg raw hill edition, 2015.

REFERENCES
1 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.
2 James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012. .
3 Dr S. Kumar, "Total Quality Management", Laxmi Publications Ltd., New Delhi 2006.
4 P. N. Muherjee, "Total Quality Management", Prentice Hall of India, New Delhi, 2015.
5 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 State about the recent techniques followed in quality approach.

CO2 Improve Leadership Skills.

CO3 Implement the Concepts of SPC Tools in Industrial Activity.

CO4 Examine the TQM Tools in Several Engineering fields.

CO5 Explain about the ISO and QS certification process and its need for the industries.

16AU315   **COMPUTER SIMULATION OF IC ENGINE PROCESSES**   **L   T   P   C**

                                                                           3   0   0   3

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

Introduction to Simulation, Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models – Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylinder models. Step by step approach in SI engine simulation.

UNITII   **COMBUSTION AND STOICHIOMETERY**   **9**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

UNIT III   **ADIABATIC FLAME TEMPERATURE**   **9**

Combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle.

UNIT IV   **SI ENGINE SIMULATION WITH ADIABATIC COMBUSTION**   **9**

Introduction, Engine details, temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation, SI Engines simulation with progressive combustion. Wiebe's law combustion analysis.

UNIT V   **SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS**   **9**

Introduction, gas exchange process, Heat transfer process, friction calculations, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance.

                                              L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderabad, 2010.

2. Ganesan.V, "Computer Simulation of Compression-Ignition Engine Processes", University Press (I) Ltd, Hyderabad, 2010.

REFERENCES

1. V. Ganesan,"Internal Combustion Engines", Tata McGraw Hill Publishing company, New Delhi, 2016.

2. P M V Subbarao., "Thermo Dynamic Theories andCombustion Engines ", Pergamon Press, oxford, 1979.

3. Richard Stone, "Introduction to Internal Combustion Engines",Tata McGraw Hill Publishing company, New Delhi, 2014.2012.

4. Colin R. Ferguson, Allan T. Kirkpatrick., " Internal Combustion Engines: Applied   Thermosciences", John Wiley & Sons Ltd., 2016.

5   Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley &Sons, Newyork, 1986.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand simulation of IC engine combustion processes

CO2   Calculate air requirement for the combustion process.

CO3   Apply the simulation techniques to develop new engines

CO4   Implement the simulation techniques for modification of combustion chamber

CO5   Know the working of an engine during part-throttle and full-throttle condition.

16AU316	ADVANCED THEORY OF IC ENGINES	L	T	P	C
		3	0	0	3

UNIT I   CYCLE ANALYSIS   9

Otto, diesel, dual, Stirling and Brayton cycles, comparison of air standard, fuel air and actual cycles, simple problems on the above topics.

UNIT II   COMBUSTION   9

Combustion reactions and Stoichiometric, heat of reaction, adiabatic flame temperature in constant pressure and constant volume systems, fuels for internal combustion engines and their properties, premixed and diffusion combustion as applicable to SI and CI engines, concepts of burning rate and flame velocity, fuel spray characteristics and combustion in diesel engines.

UNIT III   COMBUSTION OF FUELS   9

Combustion stoichiometry of petrol, diesel, alcohol and hydrogen fuels, chemical energy and heating values, chemical equilibrium and maximum temperature, flame velocity and area of flame front, fuel spray characteristics - Droplet size, penetration and atomization.

UNIT IV   NON-CONVENTIONAL IC ENGINES   9

Concept of L.H.R. engine and its recent developments. Variable compression ratio engine and its use in engine research. Wankel rotary combustion engine. Free piston engine.

UNIT V   ADVANCED IC ENGINES   9

Adiabatic and low heat rejection engines, homogeneously charged compression ignition engines - MAN combustion chamber and multi-fuel engines, stratified charged and lean burn engines.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1. Ganesan,V., "Internal combustion engines", Tata McGraw Hill Publishing Co., 2014.
2. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd, Hyderabad, 2010.

REFERENCES
1. Ramalingam. K.K., "Internal combustion engine", scitech publications, Chennai, 2013
2. Heywood J B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., USA, 2009.
3. John,B., Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 2009.
4. Benson,R.S., Whitehouse,N.D., "Internal Combustion Engines", Pergamon Press, Oxford, 2012.
5. Obert E F, "Internal Combustion Engine analysis and Practice," International Text Book Co., Scranton, Pennsylvania, 2011.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Describe the various engine cycles.
CO2 Describe the combustion in I.C. Engines.
CO3 Derive the combustion of fuels.
CO4 Acquire the basic concepts of non-conventional internal combustion engines.
CO5 Apply the new techniques to improve the performance of internal combustion engine.

16AU317	AUTOMATIC TRANSMISSION	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Principles of automatic transmission, advantages, limitations, types - Mechanical, hydrodynamic, hydro mechanical, hydro static and electric. Principle of centrifugal clutches, comparison between conventional and centrifugal clutches, centrifugal clutches used in two wheelers, over drives – Principle, operation, types, advantages and limitations.

UNITII HYDRODYNAMIC DRIVES 9

Principle of fluid coupling, construction, operation and characteristics, fluid coupling with conventional gear boxes. Introduction to torque converters, comparison between fluid coupling and torque converters, performance characteristics, slip, principles of torque multiplication, types of torque converters.

UNIT III HYDRO-MECHANICAL DRIVES 9

Major components, principle of planetary gear trains, actuating mechanism, controls system – Types - Manual, governor, throttle and hydraulic control systems. Principle of automatic gear shifting. Positive displacement pumps, automatic variable displacement pump. Typical automatic transmissions.

UNIT IV HYDROSTATIC DRIVES 9

Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pump and constant displacement motor, variable displacement pump and constant displacement motor, constant displacement pump and variable displacement motor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor, advantages and limitations, typical hydrostatic drives.

UNIT V ELECTRIC DRIVES 9

Early Ward Leonard control system - Main features, generator, merits, reverse motion, modified Ward Leonard control system - Main features, modifications. Modern electric drives - Main features, performance characteristics, advantages and limitations.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1. Jack Erjavec, "Automatic Transmissions and Transaxles", Cengage Learning Yes Dee Publishing Pvt.Ltd, 2010.

2. Heinz Heisler, "Advanced Vehicle Technology", SAE, 2002.

REFERENCES

1. Theraja B L, "Fundamentals of Electrical Engineering and Electronics", S Chand & Company Ltd, 2009.

2. Mathias F B, "Automatic Transmission", Prentice Hall, 1998.

3. John J P, Tyler G H, "Industrial Hydraulics", MGH Published, 1980.

4   CDX Automotive, "Automatic Transmission and Transaxle", Jones & Bartlett Learning 2011

5   Tom Denton, "Automatic Transmission and Transaxle", Pearson Prentice Hall, Digital University Press, 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the purpose of clutch.

CO2   Acquire the basic concepts hydrodynamic drives.

CO3   Compare various types of transmission system.

CO4   Describe the basic concept of hydrostatic drives.

CO5   Understand the various types of drives.

16ME312   **OPERATIONS RESEARCH**   **L   T   P   C**

(Common to Mechanical, Automobile)   **3   0   0   3**

UNIT-I   LINEAR MODELS   9

Origin of Operations Research – Study, The phase of an operation research - study – Linear programming – Formation of Linear Programming model - Graphical method– Simplex algorithm – Artificial variables technique – Big 'M' method - Two phase method.

UNIT-II   TRANSPORTATION AND ASSIGNMENT MODELS   9

Transportation Problems: Optimal solution by North West corner method – VAM – Least cost method – MODI method. Assignment Problems Formulation - Unbalanced Assignment Problem – Hungarian algorithm – Traveling Salesman Problem.

UNIT-III   NETWORK MODEL AND SEQUENCING   9

Network Basic terminologies, constructing a project network, network computations in CPM and PERT. Sequencing Processing 'n' jobs through two machines, processing 'n' jobs through three machines - processing 'n' jobs through 'm' machines.

UNIT-IV   REPLACEMENT MODELS   9

Replacement – Need for replacement - Replacement of Items due to deterioration with time value of Money - Replacement of Items due to deterioration without time value of Money - Group replacement policy.

UNIT-V   QUEUEING MODELS   9

Queuing models Queuing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population.

L:45   T: 0   P: 0   TOTAL : 45 PERIODS

TEXT BOOKS
1.   Philip D.T. and Ravindran A., "Operations Research", John Wiley, New Jersey,6thEdition 2012
2.   Bhaskar. S., "Operations Research" Anuradha Publications, 3rd Edition, 2014

REFERENCES
1.   Taha H.A., "Operations Research", Prentice Hall of India, New Delhi, 6thEdition 2009
2.   Shennoy G.V. and Srivastava U.K., "Operation Research for Management", New Age International, New Delhi, 3rd Edition, 2010
3.   Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley,New Jersey, 4th Edition 2010
4.   Budnick F.S. and Richard D Irwin "Principles of Operations Research for Management", 3rd Edition 2008
5.   Hillier and Libermann " Introduction to Operations Research" McGraw hill edition,2007

COURSE OUTCOMES
At the end of the course students should be able to
CO1 Describe the basic concepts of linear models
CO2 Analyse the transportation and assignment models for various logistic applications
CO3 Develop the network and machining sequence for operations.
CO4 Formulate the replacement models for an industry.
CO5 Employ the queuing models to industrial processes.

16GE304   **PRINCIPLES OF MANAGEMENT**   **L   T   P   C**

(Common to all B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   INTRODUCTION TO MANAGEMENT   9

Management: Definition - Evolution of Management Studies –Nature, Functions, Levels and role of management - Basic Principles and Process of Management - Management vs. Administration – Taylor & Fayol's contribution to Management - Role of Managers.

UNIT II   PLANNING   9

Planning: Basic types of planning – Characteristics of a good plan- Features - Planning process- Obstacles in planning - MBO, Policy - Policy formulation - Types of policies - Forecasting, Process, Importance – Decision making process.

UNIT III   ORGANISING   9

Organization: Need - forms of organization - features of a good organization. Departmentation –- manuals - span of management, factors affecting span of management – delegation of authority and responsibility - centralization and decentralization.

UNIT IV   STAFFING & DIRECTING   9

Staffing: Meaning, Nature, Need, and Process. Directing - Characteristics, Importance and Techniques of directing. Event & Time Management - Scope, Importance - Coordination - Need for coordination.

UNIT V   CONTROLING   9

Concept of Control – Importance of control- Essentials of control system - Process of control – Communication - Process of Communication - Types - Barriers - Management Information Systems.

L:45   T:0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 Harold Koontz, and Weihrich, 'Essential of Management' 8th Edition, Tata Mc Graw Hill Education, Delhi, (2010) .
2. Tripathy.P.C and Reddy.P.N., 'Higher Principles of Management' Tata Mc-Graw Hill Publishing Company limited, New Delhi (2011).

REFERENCES
1 Stephen.P.Robbins, Mary coulter, NeharikaVohra 'Management', 10th Edition, Tata Mc-Graw Hill Publishing Company limited, New Delhi (2010).
2 Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2011).
3 VSP Rao, V.Hari Krishna, 'Management, Excel Books (2010).
4 Dr.Kumkum Mukherjee, 'Principles of Management, 2nd Edition, Tata Mc Graw Hill, (2009).

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Discuss and communicate the management evolution and how it will affect future managers.
CO2   Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.
CO3   Practice the process of management's four functions: planning, organizing, leading, and controlling.
CO4   Use appropriate methods of communication in the Business Environment.
CO5   Gather and analyze both qualitative and quantitative information to isolate issues and formulate best control methods.

16AU323	AUTOMOTIVE COMPONENT DRAWING	L	T	P	C
		3	0	0	3

UNIT I   BASIC CONCEPTS OF MACHINE DRAWING   9

BIS codes for Engineering Drawing – Abbreviations – Conventional representation of standard components – Systems of dimensioning and dimensioning of common components – surface finish, symbols and representing surface finish on drawing – sectioning conventions – Representation of welded joints, riveted joints and screw threads

UNITII   FITS AND TOLERANCES   9

Types of fits – types of tolerance – representation of tolerance on drawing – calculation ofminimum and maximum clearances and allowances – Geometrical tolerance – form and position tolerances – symbols –indicating geometrical tolerances on drawings – Introduction to selective assembly and interchangeable manufacture.

UNIT III   FASTENERS, JOINTS AND COUPLINGS   9

Making free hand sketches of the following assemblies: Fasteners – square threaded nut and bolt – Hexagonal headed nut and bolt – cotter joint with sleeve – knuckle joint – Gib and cotter joint – couplings – protected and unprotected type flanged coupling.

UNIT IV   PART AND ASSEMBLY DRAWING OF BEARING AND VALVES   9

Plummer block – Foot step ball bearing – Foot step journal bearing – Feed Check valve – Safety valves.

UNIT V   ASSEMBLY OF MACHINE PARTS   9

Screw jack – Tailstock – Tool head of shaper – Machine vice –Piston-Crank- Connecting rod.

TOTAL : 45 PERIODS

TEXT BOOKS
1.   Gopalakrishna, K.R., "Machine Drawing", Subhas publishing House, Bangalore, 2002.
2.   Sidheswar, N., Kannaiah, P., and Sastri, V.V.S., "Machine Drawing", TMH New Delhi,2006.

REFERENCES
1.   John, K.C., and Verghese, P.L., "Machine Drawing", Jovast Publishers, Trissur, 2004.
2.   "Faculty of Mechanical Engineering", "PSG Design Data Book", DPV Printers, 2006.
3.   Ajeetsingh, "Machine Drawing", TMH, New Delhi, 2008.
4.   Narayanan, K.L., Kanniah, P., and Venkata Reddy, K., "Machine Drawing", New Age International Publications, 2004.
5.   Bhatt N.D "Machine Drawing", Charotar Publishing House Pvt. Ltd., 2008

COURSE OUTCOMES
At the end of the course students should be able to
CO 1 Recall basic concepts of machine drawing and define fits and tolerance.
CO 2 Understand the various types of fits and tolerances.
CO 3 Develop sectional views of fasteners, joints and couplings.
CO 4 Develop assembled drawings of bearings and valves
CO 5 Draw the assembled view of machine parts.

16AU318　　　　**AUTOMOTIVE VIBRATION AND NOISE CONTROL**　　**L　T　P　C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

UNIT I　　　　**FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION**　　　**9**

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping.

UNITII　　　**EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE**　**9**

Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People.

UNIT III　　　**TRANSPORTATION NOISE AND VIBRATION—SOURCES,**　　　**9**
　　　　　　　　PREDICTION, AND CONTROL

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

UNIT IV　　　**INTERIOR TRANSPORTATION NOISE AND VIBRATION SOURCES**　**7**
　　　　　　　　– PREDICTION AND CONTROL

Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors- Prediction and Control

UNIT V　　　**NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT,**　**11**
　　　　　　　　SIGNAL PROCESSING, AND MEASURING TECHNIQUES

Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis.

　　　　　　　　　　　　　　　　L : 45　　T: 0　　P: 0　　Total: 45 PERIODS

TEXT BOOKS

1　David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice" Spon Press, London, 2009

2　Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.

REFERENCES

1　Clarence W. de Silva, "Vibration Monitoring, Testing, and Instrumentation", CRC Press, 2007.

2   Allan G. Piersol, Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill, New Delhi, 2010

3   Colin H Hansen "Understanding Active Noise Cancellation ", Spon Press, London 2003.

4   Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles ", Elsevier Butterworth-Heinemann, Burlington, 2004.

5   S. Graham kelly, "Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New Delhi, 2000.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Acquire the basic knowledge in fundamentals of automotive acoustics

CO2   Summarize the impact of noise, vibration and shock on people.

CO3   Identify the sources, effects of transportation noise

CO4   Impart knowledge in the interior transportation noise and vibration

CO5   Measure noise and vibration pertain to an automobile.

16AU319	AUTOMOTIVE AERODYNAMICS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics. Engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

UNITII AERODYNAMIC DRAG OF CARS 9

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CARS 9

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.

UNIT IV VEHICLE HANDLING 9

forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles and racing cars.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9

principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. CFD analysis.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Hucho.W.H., "Aerodynamic of Road Vehicles", Butterworths Co., Ltd., 1997
2   T. Yomi Obidi, "Theory and Applications of Aerodynamics for Ground Vehicles" SAE International, 2014

REFERENCES
1   Pope, "Wind Tunnel Testing", 2nd Edition, John Wiley & Sons New York, 1974.
2   "Automotive Aerodynamic", Update SP-706, Society of Automotive Engineers Inc,1987
3   "Vehicle Aerodynamics", SP-1145, Society of Automotive Engineers Inc, 1996.
4   R. H. Barnard, "Road Vehicle Aerodynamic Design: An Introduction" Mech Aero Publishing, 2009
5   "Vehicle Aerodynamics Design and Technology", SAE special publication: Society of Automotive Engineers, 2001

COURSE OUTCOMES
At the end of the course student should be able to:
 CO1   Acquire the knowledge in fundamentals of aerodynamics, vehicle body optimization, measuring aerodynamics forces etc.
 CO2   Analyze the influence of aerodynamic drag forces in car
 CO3   Demonstrate various aerodynamic shapes of car.
 CO4   Identify the various forces that controls vehicle handling
 CO5   Apply the concept of wind tunnel for aerodynamic design of automobiles.

16AU320	ENGINE AND VEHICLE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I   FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS   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. Parameters to be controlled in SI and CI engines.

UNITII   SENSORS   9

Inductive, Hall Effect, hot wire, thermistor, piezoelectric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, tire pressure, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors.

UNIT III   SI ENGINE MANAGEMENT   9

Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cut-off. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control.

UNIT IV   CI ENGINE MANAGEMENT   9

Fuel injection system parameters affecting combustion, noise, and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves.

UNIT V   VEHICLE MANAGEMENT SYSTEMS   9

Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems-alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1   William B Ribbens "Understanding Automotive Electronics," SAE Publications, 2017.
2   Tom Denton, "Automotive Electrical and Electronic Systems", Edward Amold, 2011.

REFERENCES

1   Eric Chowanietz "Automobile Electronics" SAE Publications, 2014.
2   Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics" Robert Bosch GmbH Publications, 2013.
3   Konrad Reif, "Automotive Mechatronics", Bosch Professional Automotive Information, Horst, 2014.
4   Robert N. Brady, "Automotive Computers and Digital Instrumentation," Prentice Hall, 2011.
5   Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company Inc.,Publishers, 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the fundamental of automotive electronics in vehicle management system.

CO2   Demonstrate the working of sensors used in engine and vehicle management system.

CO3   Interpret various petrol engine management systems.

CO4   Infer the basics of diesel engine management system.

CO5   Illustrate recent developments of vehicle and engine management system

16ME319	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
	(Common to Mechanical, Automobile)	3	0	0	3

UNIT I   GOVERNING EQUATIONS AND BOUNDARY CONDITIONS   8

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Mathematical behaviour of PDEs on CFD-Elliptic, Parabolic and Hyperbolic equations.

UNIT II   FINITE DIFFERENCE METHOD   9

Finite difference method-forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods-stability analysis, error estimation, difference between the FDM and FVM methods-Iterative solution Methods– Example problems on elliptic and parabolic equations.

UNIT III   FINITE VOLUME METHOD (FVM) FOR HEAT CONDUCTION   9

Finite volume formulation for steady state One, Two and Three-dimensional heat conduction problems. One dimensional unsteady heat conduction through Explicit, Crank–Nicolson and fully implicit schemes.

UNIT IV   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, Spalding's SIMPLE algorithm, QUICK Schemes.

UNIT V   CALCULATION FLOW FIELD BY FVM   9

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. Turbulence models, mixing length model, Two equation (k-$\in$) and(k- ω)models– High and low Reynolds number models.

L:45   T:0   P: 0   TOTAL: 45 PERIODS

TEXT BOOKS

1. Suhas V Patankar , "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004

2. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics The Finite Volume Method",Pearson Education,2nd Edition,2011

REFERENCES

1. John D Anderson, "Computational Fluid Dynamics-The   Basics with Applications", McGraw -Hill Education, New York, 2012

2. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Alpha Science International,2nd Edition,2003

3. Anderson, D.A., Tannehill, J.C.,and Pletcher,R.H., "Computational Fluid Mechanics and Heat Transfer " , CRC Press, 3rd Edition, 2012,

4. Ghoshdasdidar,P.S.," Computer Simulation of flow and heat transfer" Tata McGraw Hill Publishing CompanyLtd.,1998

5. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Classify basic governing equations and study the mathematical behavior of PDE on them.

CO2 Identify different types of finite different methods and distinguish between FDM and FVM methods

CO3 Formulate different types of heat conduction equations and solve them by explicit and implicit schemes.

CO4 Develop the basic concepts of discretization schemes and apply knowledge in real time convection and diffusion problems

CO5 Categorize the various models of turbulence equations and rate the complexity of turbulence flow field problems.

16GE305   **INTELLECTUAL PROPERTY RIGHTS**   **L   T   P   C**

(Common to all B.E. / B. Tech. Courses)   **3   0   0   3**

UNIT I   INTRODUCTION   9

Meaning, Relevance, Business Impact, Protection of Intellectual Property - Copyrights, Trademarks, Patents, Designs, Utility Models, Trade Secrets and Geographical Indications.

UNIT II   PATENTS   9

Concept of Patent - Product / Process Patents & Terminology - Duration of Patents- Law and Policy Consideration Elements of Patentability - Procedure for Filing of Patent Application and types of Applications - Ownership and Maintenance of Patents - Assignment and licensing of Patents.

UNIT III   TRADEMARK   9

The rationale of protection of trademark as (a) an aspect of commercial and (b) of consumer rights - Definition and concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Procedure for Registration of Trademarks.

UNIT IV   COPYRIGHT   9

Nature of Copyright - Author & Ownership of Copyright - Rights Conferred by Copyright - Assignment, Transmission, Licensing of Copyrights - Copyright pertaining to Software/Internet and other Digital media.

UNIT V   INDUSTRIAL DESIGNS   9

What is a Registrable Design - Novelty & Originality - Procedure for Registration of Designs - Copyright under Design - Assignment, Transmission, Licenses - Procedure for Cancellation of Design.

L:45   T:0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1   Aswani Kumar Bansal, 'Law of Trademarks in India', Commercial Law Publisher, 3rd edition, 2014.
2.   B L Wadehra, 'Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications', Universal Law Publishing Co, Fifth Edition, 2014.

REFERENCES

1   Krishnamurthy G.V.G, 'The Law of Trademarks, Copyright, Patents and Design'. Macmillan Publishers Limited, 2012.
2   Satyawrat Ponkse, 'The Management of Intellectual Property', Bhate & Ponkshe Publishers, 1991.
3   Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
4   Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
5   V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.
CO2   Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development
CO3   Identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights in products and technology development
CO4   Familiar with the processes of Intellectual Property Management (IPM) and various approaches for IPM and conducting IP and IPM auditing and explain how IP can be managed as a strategic resource and suggest IPM strategy.
CO5   Apply the different procedures in IP of various IPs

16AU406	FLEET MANAGEMENT	L	T	P	C
		3	0	0	3

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 tested.

UNITII   TRANSPORT SYSTEMS   9

Introduction to various transport systems - 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

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

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   John Dolce, "Fleet Management ", McGraw-Hill Co, USA -1984 Digitized in 2007
2   Kitchin.L.D.,"Bus Operation ", Illiffee and Sons Co., London, III edition – 1992.

REFERENCES
1   Teodar Gabriel Crainic, Gilbert Laprte, "Fleet Management and Logistics" Springer Science and Business Media, 2012.
2   Government Motor Vehicle Act –Publication on latest act to be used as on date.
3   Motor Vehicles Act, 1988 along with Comparative Tables of Old and New Acts - (Bare Act) – Eastern Book Company, Lucknow – 26th Edition, 2017.
4   The Motor Vehicle Act 1988–Universal Law Publishing Co. Pvt. Ltd, India – 2011.
5   Edmund J. Gubbins, "Managing Transport Operations" Kogan Page Publishers, 2003.

COURSE OUTCOMES
At the end of the course student should be able to:
 CO1   Impart knowledge on transport and personnel management
 CO2   Identify the various procedure in motor transport administration
 CO3   Manage a transport fleet and their related activities for minimizing operational cost.
 CO4   Understand the meaning of traffic signs and various motor vehicle acts
 CO5   Realize the importance of various maintenance system in transport industry

16AU407   **ADVANCED MATERIALS FOR AUTOMOBILES**   **L   T   P   C**

                                                                              3   0   0   3

UNIT I   HIGH STRENGTH STEELS   9

Bake hardening (BH) grades, Isotropic steels, Interstitial free (IF) grade steels, Rephosphorized steels, High strength micro alloy steels, Dual phase steels, TRIP steels, Boron steels, Multiphase steels; Hydro forming process, Auto applications and future.

UNITII   AUTOMOTIVE COMPOSITES   9

Types of composites, volume fraction - lamellar composites production and properties of whiskers of silicon carbide, graphite, fibres of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibres applications.

UNIT III   SMART MATERIALS   9

Smart Materials and its Functional properties; Piezoelectric materials, Electoactive materials, Shape memory alloys (SMA), Optical fibers, Nano-composites – definition, types, structure and classification, Application and future trends – Automobiles, Coatings, Adhesives

UNIT IV   NOISE, VIBRATION AND HARSHNESS MATERIALS   9

NVH Materials: Basics of NVH and its materials. Design of materials and properties for NVH control – Elastomers, Composites, Woven fabrics, Sandwich materials, Transducer materials, Dampers and Absorbers, Injection molded barriers, Adhesives, sealants 32 and foams, smart materials, Intelligent material systems.

UNIT V   MEMS   9

Introduction - **Materials for MEMS manufacturing** - Silicon-Polymers-Metals-**MEMS basic Processes** - **Deposition process**-Physical Vapor Deposition ,Chemical Vapor Deposition – **Patterning**-Lithography-Photolithography, Electron beam Lithography, Ion Beam lithography ray Lithography, Diamond Patterning - **Etching Processes**: **Wet etching**-Isotropic etching, Anisotropic etching-HF etching-Electrochemical etching, **Dry etching**-Vapor etching**-**Xenon difluoride etching-**Plasma etching**-Sputtering, Reactive ion etching(RIE) - **Die preparation** - **MEMS manufacturing Technologies** - Bulk micromachining, Surface micromachining, High aspect ratio(HAR) silicon micromachining –**Applications**

                              L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
  1   Jason Rowe, "Advanced Materials in Automotive Engineering" Elsevier, 2012
  2   P. J. Winkler, "Materials for transportation technology, Volume 1" Wiley-VCH, 2000

REFERENCES
  1   U C Jindal, Experimental Stress Analysis, Pearson, 2013
  2   Ray &Bousmania, "Polymer Nanocomposites and their Applications"; ASP 2006
  3   Advani, "Processing and Properties of Nanocomposites" World Scientific, 2007
  4   M.V. Gandhi, Brian S. Thompson, "Smart Materials and Structures" Springer Science & Business Media, 1992
  5   Xu Wang, "Vehicle Noise and Vibration Refinement" Elsevier, 2010

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Impart knowledge on High Strength steels.

CO2 Implement the Natural fiber composites in automobile application.

CO3 Understand the properties of shape memory alloys and nano composites

CO4 Realize the role of NVH materials in vibration damping

CO5 Design the various MEMS manufacturing system for automobile system.

16AU408	AUTOMOTIVE SAFETY AND INFOTRONICS	L	T	P	C
		3	0	0	3

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.

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 AND COMFORT SYSTEM 9

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety, Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, Active suspension system.

UNIT IV COLLISION WARNING AND AVOIDANCE 8

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT V INFOTRONICS FOR AUTOMOBILES 10

TELEMATICS: Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems

ADAPTIVE CONTROL SYSTEMS: Adaptive cruise control - adaptive noise control - active roll control system - cylinder cut- off technology**.**

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   George A. Peters, Barbara J. Peters, "Automotive Vehicle Safety" CRC Press, 2002.
2   Richard Bishop, "Intelligent Vehicle Technology and Trends" Artech House, 2005.

REFERENCES
1   William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Eight Edition, Elsevier Science & Technology Books - 2017.
2   Vivek D. "Ergonomics in the Automotive Design Process" Bhise publisher CRC press, Taylor and Francis group, - 2016
3   Jullian Happian Smith "An Introduction to Modern Vehicle Design", SAE, 2004
4   Geoffrey Davies., "Materials for Automobile Bodies", Elsevier, 2012
5   Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Recognize the need of design for safety
CO2   Demonstrate about various safety concepts
CO3   Summarize the safety equipment's and comfort system
CO4   Explain collision warning and avoidance system
CO5   Justify Infotronics for Automobile

16AU409   **ELECTRIC DRIVES AND CONTROLS FOR ELECTRIC**   **L   T   P   C**
VEHICLES

3   0   0   3

UNIT I   MOTOR AND DEVICE CHARACTERISTICS   9

Review of motor principles, motor load dynamics, starting, braking & speed control of dc and ac motors- power semiconductor SCRs, IGBTs and MOSFETs.

UNITII   ELECTRIC DRIVE CONCEPTS   9

Basic drive, choice of electric drives, advantages, nature and classification of drives, control and stability of electric drives, feedback control of drives, thermal effects in electrical machines, selection of motor and rating.

UNIT III   DC DRIVES   9

Transient analysis of separately excited dc motors, converter - single phase uncontrolled, half and fully controlled rectifiers, chopper control, closed loop control of solid state DC drives.

UNIT IV   AC DRIVES   9

Operation of induction and induction motor, direct torque and flux control of induction motor drives, starting methods and speed control of single phase induction motors, self-controlled synchronous motor drive, selection of motor and rating vector control of synchronous motor.

UNIT V   DRIVES FOR SPECIAL ELECTRICAL MACHINES   9

Drives for variable reluctance motors, microprocessor/ microcontroller –gate trigger signal generation applications to special electrical machines, switched reluctance motor drives, brushless DC motor drives, permanent magnet drives.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Gopal K D," Fundamentals of Electric Drives", Narosa Publishing House Pvt. Ltd., 2010.
2   Pillai S K," A first course on Electrical Drives", Wiley Eastern Ltd, Bombay 2015.

REFERENCES
1   Ali Elamadi, "Handbook Automotive Power Electronics and Drives", CRC publishers, 2008.
2   Bimal K Bose, "Modern Power Electronics and Drives", Elsevier publishers, Butterworth Hinnemann, 2008
3   Krishnan R, "Permanent Magnet synchronous and Brushless DC Motor Drives", CRC Publishers, 2010.
4   Krishnan R, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Applications", CRC Publishers, 2008.
5   Ion Boldea, Syed A. Nasar, "Electric Drives", Third Edition,CRC Publishers, 2016.

COURSE OUTCOMES
At the end of the course student should be able to:
 CO1   Impart basic knowledge on electric motors and electronic devices.
 CO2   Implement electric drive concepts for e-vehicle
 CO3   Understand the DC drives and its control circuits
 CO4   Compare and Contrast Control Circuits of AC & DC Drive.
 CO5   Identify the required drives for special electrical machines.

16AU410	AUTOMOTIVE CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Basics of controls systems – different types, tuning of PID controller, fault tolerant sliding model control design and analysis – Case study of armature controlled DC motor for electric power steering.

UNITII ENGINE CONTROL SYSTEMS 9

Introduction –lambda control – engine model for lambda control- lambda control circuit adaptive Lambda control- Idle speed control – use of state space control –knock control- knock sensors adaptive knock control –Air fuel ratio model for open and closed loop systems using Root Locus sketch and Bode plot- Modeling and simulation of Nyquist stability criteria for lambda oxygen sensor.

UNIT III TRANSMISSION AND DRIVE LINE CONTROL 9

Goals of drive line control(static and dynamic gear shift experiments) – Basic drive line equation-modeling neutral gear- state space formulation controller formulation-speed control with active damping –simulations – Driveline control for gear shifting –Influence of sensor locations –transmission torque control design.

UNIT IV VEHICLE CONTROL SYSTEM 9

ABS control systems –control of yaw dynamics- road and driver model control – PID driver model and hybrid driver model- modeling and analysis of electric and Hybrid Vehicle using PID controller.

UNIT V VEHICLE STABLITY ANALYSIS 9

Linear vehicle model- non-linear vehicle model- vehicle stability model using Routh Hurwitz criteria-Nyquist stability criteria – modeling and analysis of Roll and Yaw Stability in control Mode.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   UWE Kiencke, Lars Nielsen, "Automotive control systems", Springer, 2005
2   Tom Weathers, Claud C. Hunter, "Automotive computers and controls", Prentice-Hall 1984.

REFERENCES
1   GalipUlsoy and Huei Peng, "Automotive control Systems", Cambridge University press.2012
2   Norman C S. Nise, "Control system Engineering", John Wiley & Sons, Singapore, 2015.
3   Masato Abe, "Vehicle Handling Dynamics", Butterworth-Heinemann, UK, 2009.
4   Nagrath I J and Gopal M, "Control Systems Engineering", Prentice Hall of India, New Delhi, 2002.
5   Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Understand the basics of automotive control systems
CO2   Identify the various engine control systems and its application
CO3   Examine the various transmission and drive line control system
CO4   Formulate the required vehicle control systems for any vehicle.
CO5   Analyze the vehicle stability

16AU411   **PRODUCT DEVELOPMENT & MANUFACTURING**   L   T   P   C
                                                           3   0   0   3

UNIT I   INTRODUCTION, DEVELOPMENT PROCESS, ORGANIZATION   9

Introduction, Characteristics of successful product development, Design and development of products. Duration and cost of product development. The challenges of product development. A generic development processes. Concept development. The front end processes. Adopting the generic product development process.

UNIT II   PRODUCT PLANNING   9

The product planning process. Identify opportunities. Evaluate and prioritize projects. Allocate resources and plan timing. Complete pre-project planning. Reflect all the results and the process. Identifying customer needs. Gather raw dats in terms of customer needs. Organize the needs into a hierarchy. Establish the relative importance of the needs and reflect on the result. Organize the needs into a hierarchy

UNIT III   PRODUCT SPECIFICATIONS AND CONCEPTS   9

Specifications, when are specifications established, establishing target

Specifications, setting the final specifications. Concept generation. The activity of concept generation. Clarify the problem. Search externally, internally. Concept selection. Overview of methodology. Concept screening, scoring. Concept testing. Define the purpose of concept test. Choose a survey population. Choose a survey format

UNIT IV   INDUSTRIAL DESIGN   8

Industrial Design. Assessing the need for industrial design. The impact of industrial design. Industrial design process. Managing the industrial design process. Assessing the quality of industrial design process, managing the industrial design process, assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING   10

Definition. Estimation of manufacturing cost. Reducing the cost of components, assembly. Supporting production. Impact of DFM on other factors. Prototyping basics. Principles of prototyping. Technologies. Planning for prototypes. Managing projects. Understanding and representing task. Baseline project planning. Accelerating projects. Project execution. Project post-mortem. Project evaluation.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1   Karl.T.Ulrich, Steven D Eppinger - Irwin , "Product Design and Development", McGrawHill, 2017
2   G.K.Lal and N.Venkata Reddy, "Fundamentals of Design and Manufacturing",Narosa Book Distributors Pvt Ltd, 2014.

REFERENCES

1   A C Chitale and R C Gupta, "Product Design and Manufacturing", PH1, - 6th edition 2014.

2   Timjones. Butterworth Heinmann "New Product Development ", Oxford. UCI -1997

3   Geoffery Boothroyd, Peter Dewhurst and Winston, Knight "Product Design for Manufacture and Assembly**",** I K International Pvt. Ltd, 2002.

4   Kevien Otto and Kristin Wood, "Product Design". Pearson Publication, 2009

5   Stephen Rosenthal, "Effective Product Design and Development", Mc Graw Hill, 1992.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the importance of design

CO2   Acquire the knowledge of Production planning & customer needs

CO3   Acquire the knowledge of Product specifications

CO4   Understanding the concepts of industrial design

CO5   Acquire knowledge on prototype design

16AU412	SPECIAL VEHICLES	L	T	P	C
		3	0	0	3

UNIT I   EARTH MOVING EQUIPMENTS   10

Construction layout, capacity, and applications of earthmovers like dumpers, front-end loaders, bulldozers, backhoe loaders, scrappers, Bucket conveyors etc. Selection criteria of prime mover for dumpers and front-end loaders based on vehicle performance characteristics.

UNITII   CONSTRUCTIONAL EQUIPMENTS   9

Layout of Constructional equipment, excavators, Jip Cranes, hoist, motor graders, mixing machine, concrete ready mixers, drillers, ramming machines for construction of bridges and working principles, Power generators.

UNIT III   TRACTORS AND POWER TRAILERS   9

Classification of tractors – Main components of tractor.Front end loaders, factors affecting efficiency of output of tractors- Working attachment of tractors – Auxiliary equipment – Trailers and body tipping mechanism - plowing - paddy plantation machine harvesting machines. Sugarcane harvesting, power trailers.

UNIT IV   FORK LIFTS AND CRANES   9

Constructional features, capacity and stability of jib cranes. Vibratory compactors, forklifts-fork lift trucks, alternative front-end equipment (attachments) – Jib arm, shovel bucket, squeeze clamp, boom, fork extensions, barrel forks. Scissors lift trucks - Applications in industry, advantages and disadvantages Towing vehicles. Case studies.

UNIT V   MILITARY AND COMBAT VEHICLES   8

Ride and stability characteristics, power take off, special implementations. Special features and constructional details of tankers, gun carriers and transport vehicles, bridge builders, communication vehicles.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1   Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.

2   Steve Parker, Military Machines, Mason Crest Publishers, 2010.

REFERENCES

1   Ia. S. Ageikin "Off the road wheeled and combined traction devices", Ashgate Publishing Co. Ltd. 1998.

2   Liljedahl, John.B., Paul K. Turnquist, David W. Smith and MokotoHoki. "Tractor and their power units" fourth edition, CSB Publishers and Distributors, New Delhi, 2002

3   Ashok G. Powar& Vijay V. Aware, "Farm Machinery and Power", New india publishing agency, New Delhi, 2007

4   George W. Green, "Special Use Vehicles", Mcfarland& Company Press, 2003.

5   William H. Crouse, "Automotive mechanics" – 10th Edition, Tata McGraw Hill Publications Co. New Delhi, 2006

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the knowledge of earth moving equipment and construction layouts.

CO2   Acquire the knowledge ofhoist, conveyors, elevators and cranes applications.

CO3   Describe the basic concepts tractors and power trailers.

CO4   Apply the knowledge of the concepts of jib cranes in automobile industries.

CO5   Acquire knowledge on military vehicles and their applications.

16AU413	TRACTOR AND FARM EQUIPMENTS	L	T	P	C
		3	0	0	3

UNIT I   **GENERAL DESIGN OF TRACTORS**   **8**

Classification of Tractors-Main components of Tractor-Safety Rules.

UNITII   **CONTROL OF THE TRACTOR AND FUNDAMENTALS OF ENGINE**   **9**
                       OPERATION

Tractor controls and the starting of the tractor engines-Basic notions and definition-Engine Cycles-Operation of multi cylinder engines-General engine design - Basic engine performance characteristics.

UNIT III   **ENGINE FRAME WORK AND VALVE MECHANISM OF TRACTOR**   **9**

Cylinder and pistons-Connecting rods and crankshafts Engine balancing – Construction and operation of the valve mechanism-Valve mechanism components – Valve mechanism troubles.

UNIT IV   **COOLING SYSTEM AND LUBRICATING SYSTEM OF TRACTOR**   **9**

Cooling Systems, Lubrication System and Fuel System of a Tractor: Cooling system – Classification – Liquid cooling system – Components, Lubricating system servicing and troubles – Air cleaner and turbocharger – Fuel tanks and filters –Fuel pumps.

UNIT V   **FARM TRACTOR TRANSMISSION SYSTEM & FARM EQUIPMENTS**   **10**

Farm Tractor Transmission System: layout, Load Distribution, transmission and drive line, steering, braking system. Farm Equipment: Working attachment of tractors – Farm equipment – Classification – Auxiliary equipment – Trailers and body dipping Mechanism.

                                    L : 45   **T: 0**   **P: 0**   **Total: 45 PERIODS**

TEXT BOOKS
1. Liljedahl, John.B., Paul K. Turnquist, David W.Smith and MokotoHoki. Tractor and their power units" fourth edition, CSB Publishers and Distributors, New Delhi, 2012
2. Nakra C P, Tractor and Automobiles, DhanpatRai Publishing Company (P) Ltd-New Delhi, 2016.

REFERENCES
1. K. Srinivasan, Tractors and Agricultural Machinery, New India Publishing Agency, Delhi, 2011.
2. Ashok G. Powar& Vijay V. Aware, Farm Machinery and Power, New India publishing agency, New Delhi, 2015.
3. Jain S.C and Grace Philip, 'Farm Machinery – an approach", Standard Publishers Distributors, Delhi, 2011.
4. Amitosh De, Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad, 2015
5. Sharma D.N. &Mukesh., Design of agriculture tractors, Jain Brothers Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Understand basic design and safety factors of a Tractor.
CO2   Explain the controls and fundamentals of engine operation in a Tractor.
CO3   Demonstrate the engine frame work and valve mechanism of tractor.
CO4   Interpret the cooling system and lubrication system in a tractor.
CO5   Infer the knowledge of transmission system, tractor tailor mechanism and farm equipment's in a tractor.

16AU414	VEHICLE AIR-CONDITIONING	L	T	P	C
		3	0	0	3

UNIT I　　AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS　　9

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

UNITII　　AUTOMOTIVE COOLING AND HEATING SYSTEM　　9

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

UNIT III　　AIR CONDITIOING CONTROLS, DELIVERY SYSTEM, AND　　9
　　　　　REFRIGERANTS

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

UNIT IV　　AUTOMATIC TEMPERATURE CONTROL　　9

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

UNIT V　　SYSTEM SERVICING AND TESTING　　9

Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system- Automatic Temperature Control system diagnosis and service.

L : 45　　T: 0　P: 0　Total: 45 PERIODS

TEXT BOOKS
1. Russel Carrigan, John Eichelberer, "Automotive Technology Heating and Air Conditioning",Cengage Learning, Stamford, 2011
2. Steven Daly "Automotive Air Conditioning and climate control systems", Butterworth Heinemann, Burlington, 2011

REFERENCES
1. Boyce H Dwiggins, "Automotive Air conditioning," Cengage Learning, Stamford, 2002.
2. Arora C.P, "Refrigeration & Air conditioning" Tata McGraw Hill, New Delhi 2000.
3. William H Crouse and Donald L Anglin, Automotive Air conditioning, McGraw Hill Inc., 1990.
4. Mitchell Information Services, Inc., Mitchell Automatic Heating, and Air Conditioning Systems, Prentice

Hall Inc., 1989.

5   Mark Schnubel, "Automotive Engineering Heating & Air Conditioning," Cengage Learning, Stamford, 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Identify and describe the basic principles of air conditioning system.

CO2   Apply the concept of heating systems in air conditioner.

CO3   Identify the types of refrigerants, its applications and properties.

CO4   Describe the working principles of the components of the air conditioning system.

CO5   Identify and describe the current developments relating to the automotive air conditioning

16GE306	HRM AND ENTREPRENEURSHIP	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I   INTRODUCTION TO HRM AND FRAMEWORK   9

Nature of HRM, Scope of HRM, Functions and objectives, HRM: policies and Practices, Role of HRM in changing business environment.

UNIT II   JOB ANALYSIS AND DESIGN & HUMAN RESOURCE   9
**   PLANNING**

Job Analysis: Introduction, Importance of Job analysis, The need for man power planning, Objectives, importance, benefits, process of HRP.

UNIT III   RECRUITMENT, SELECTION AND TRAINING   9

Recruitment - Selection – Induction - Types of training methods - Purpose – benefits – resistance - Types of training methods - Purpose – Benefits - Resistance.

UNIT IV   ENTREPRENEURSHIP ENVIRONMENT   9

Evaluation of the concept of Entrepreneur - Role of entrepreneurship - Knowledge and skills of entrepreneur - Need for EDP

UNIT V   ENTREPRENEURSHIP DEVELOPMENT   PROGRAMME   9

Criteria for selection of a product - Matching Entrepreneur with the project - Report preparation and evaluation criteria.

**   L : 45   T:0   P: 0   Total: 45 PERIODS**

TEXT BOOKS
 1   K. Aswathappa, 'Human Resource Management: Text and Cases', 7th Edition, (2013).
 2. S.S. Kanka, Entrepreneurial Development, S.Chand & Company, First Edition, 1999.
 3   Mamoria C.B. and Mamoria S. 'Personnel Management', 1st Edition, Himalaya Publishers.

REFERENCES
 1   V S P Rao, 'Human Resource Management', 3rd Edition, Excel Books, New Delhi, (2010).
 2   Dessler, 'Human Resource Management', 12th Edition, Pearson India, (2011).
 3   David A. Decenzo, 'Human Resource Management', WILEY India PVT. Ltd, New Delhi.
 4   David H.Holt, Asoke K. Ghosh, Porentice New Venture Creation, Sixth Edition, 2002.
 5   R.K.Singal, Entrepreneurship Development and Management, Published by S.K KATARIA ,Darya Ganj, New Delhi, 2009.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Develop the knowledge, skills and concepts needed to resolve actual human resource management problems or issues.
CO2   Manage the employment relationship, which is a shared responsibility between employers, management, human resources specialists, and employees.
CO3   Investigate how HRM is responding to current business trends, opportunities, and challenges.
CO4   Develop the knowledge, skills and concepts of Entrepreneurship.
CO5   Evaluate the procedures and practices used for setting up an enterprise.

16AU415 **ADVANCED TECHNOLOGIES OF VEHICLE SYSTEMS** **L   T   P   C**
                                                        3   0   0   3

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

Understanding autonomy –review of the role of control in autonomy - Role of sensors and actuators. Examples of autonomy cruise control and ABS – Case study on Autonomous Vehicle.

UNITII **ENGINE CONTROL SYSTEM** **9**

Fuel control-Ignition control in SI engines- Lambda control- idle speed control- Knock control- cylinder balancing.

UNIT III **DRIVE LINE CONTROL SYSTEM** **9**

Speed control – gear shifting control – traction control- steering- suspension – vehicle handling and ride characteristics of road vehicles- adaptive cruise control.

UNIT IV **INTELLIGENT TRANSPORTATION SYSTEM** **9**

Overview – control architecture – collision avoidance control – traffic routing system- automated high way systems- lane warning system- driver information system- data communication within the car.

UNIT V **SAFETY IMPACTING DEVICES** **9**

Vision enhancement- driver conditioning warming- anti-lock braking systems – route guidance and navigation systems – in-vehicle computing – commercial vehicle diagnostic/ prognostics – hybrid/ electric and future cars- case study.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1   U.Kienckeand L. Nielson "Automotive control systems" , SAE and springer - Verlag, 2000
2   Benjamin C.Kuo and Farid Golnaraghi, Automatic Control System, John Wiley & Sons, Eight edition, 2003.

REFERENCES

1   Crouse, W.H. &Anglin,D.L., "Automotive Mechanics", Tata Mc Graw Hill, New Delhi. 2010.
2   Artamonov, M.D., Harionov,V.A.& Morin, M.m. "Motor Vehicle",MirPublishers,Moscow 1978.
3   Richard C.Dorf and Robert H.Bishop, Modern Control Systems, Pearson Prentice Hall,2008
4   Stockel Martin W and Stocker Martin T., Auto Mechanics Fundamentals, Goodheart wilcox, South Holland, Illinois,1982.
5   Robert Bosch,"Automotive Handbook", Sixth Edition,2004

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the technologies involved in autonomous vehicles
CO2   Demonstrate the Various Engine Control Systems.
CO3   Examine the drive line control system in automobiles.
CO4   Criticize the intelligent transportation system.
CO5   Value the safety impact devices and its advancements

16AU416	AUTOMOTIVE EMISSION CONTROL	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION   9

Pollutants – sources – formation – effects of pollution on environment – effects of fuel properties and additives - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards.

UNITII   EMISSIONS IN SI ENGINE   9

Chemistry of SI engine combustion – HC and CO formation in SI engines – NOx formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

UNIT III   EMISSIONS IN CI ENGINE   9

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

UNIT IV   CONTROL TECHNIQUES FOR REDUCTION OF EMISSION   9

Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation – SCR – Fumigation – Secondary Air injection – PCV system – Particulate Trap – CCS – Exhaust treatment in SI engines –Thermal reactors – Catalytic converters – Catalysts – Use of unleaded petrol.

UNIT V   TESTING & EMISSION MEASUREMENT   9

Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas Chromatograph – Smoke meters –SHED test.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Springer and Patterson, "Engine Emission", Plenum Press, 2012.
2   Pundir. B.P., "IC Engines Combustion and Emissions" Narosa Publishers, 2010.

REFERENCES
1   Ramalingam. K.K., "Internal Combustion Engines", Scitech Publications, 2011
2   SAE Transactions, "Vehicle Emission," 3 volumes, 1982.
3   Obert, E.F., "Internal Combustion Engines", 1982.
4   Taylor,C.F, "Internal Combustion Engines", MIT Press, 1972.
5   Automobiles and Pollution SAE Transaction, 1995.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Understand the basics of emission and its effect.
CO2   Relate the petrol engine emission and formation of emission compounds.
CO3   Describe the formation of emission compounds in diesel engines
CO4   Apply the various emission control techniques
CO5   Inspect the various emission testing with aid of modern tools

16AU417	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

UNIT I   MECHATRONICS, SENSORS AND TRANSDUCERS   9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors

UNIT II   ACTUATIONSYSTEMS   9

Pneumatic and Hydraulic Systems   – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors.

UNIT III   SYSTEMMODELSANDCONTROLLERS   9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

UNIT IV   PROGRAMMINGLOGICCONTROLLERS   8

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

UNIT V   DESIGNOFMECHATRONICS SYSTEM   10

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot- Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1. Bolton,W, "Mechatronics", Pearson education, 4[th]edition, fifth Indian Reprint, 2014
2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008

REFERENCES
1. Rajput.R.K, "A textbook of mechatronics", S. Chand & Co, 2007.
2. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems," McGraw-Hill International Editions, 2000
3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.
4. Dan Necsulesu, "Mechatronics," Pearson Education Asia, 2002 (Indian Reprint).
5. NitaigourPremchandMahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Acquire the knowledge in working of Sensors, Transducers and basics of automotive electronics

CO2   Knowledge about actuation system.

CO3   Analyze the various system models and controllers.

CO4   Create circuits using PLC and analyze them.

CO5   Design a Mechatronics system

16AU418	RUBBER TECHNOLOGY FOR AUTOMOBILES	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION   9

Identification of plastics / rubber components in automobiles - function - selection criteria.

UNITII   STRUCTURE-PROPERTY RELATIONSHIP OF RUBBER   9

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behavior in dynamic applications

UNIT III   VIBRATION AND RUBBER SPRING   9

Principle of vibration isolation - Rubber mounts - spring design - comparison with metallic springs - shape factor and its effect - forced and free vibrations with damping - typical mounts, compounding and manufacture.

UNIT IV   FLUID SEALINGS AND FLEXIBLE COUPLING AND HOSES   9

Seals for static and dynamic applications - effect of heat/ oil ageing - frictional behaviour - fundamental of sealability.

UNIT V   COMPOUNDING AND MANUFACTURE   9

Types of couplings - specification and selection- torque Vs deflection relationships - brake fluid /hydraulic hoses, materials, manufacture and shaping process for rubber products

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1 M. Morton, "Rubber Technology",Springer Science & Business Media, 2013

2 Andrew Ciesielski, "An Introduction to Rubber Technology" Smithers Rapra Publishing, 1999

REFERENCES

1 Hobel,E.F., Rubber Springs Design, Newnes-Butterworth 1974

2 C. Hepburn, "Rubber Technology and Manufacture", Butterworth-Heinemann, 2009

3 Kothandaraman, "Rubber Materials", Ane Books Pvt Ltd, 2008

4 James Lindsay White, "Rubber Processing: Technology, Materials, Principles" Hanser Publishers, 1995

5 Anil K. Bhowmick, "Rubber Products Manufacturing Technology" CRC Press, 1994

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Identify and select the suitable polymer components for the automobile application

CO2   Differentiate the structure and property relationship of rubber

CO3   Impart the knowledge about vibration isolation, spring design and typical mounts

CO4   Attain the knowledge about fundamental of seal ability

CO5   Demonstrate the rubber manufacturing methods

	L	**T**	**P**	**C**
16ME415 **ENTREPRENEURSHIP DEVELOPMENT**	**3**	**0**	**0**	**3**

UNIT I   ENTREPRENEURSHIP   9

Entrepreneur–Definition–Characteristics and Functions of an Entrepreneur–Common Myths about entrepreneurs–Importance of Entrepreneurship-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–Needs and objectives.

UNIT III   BUSINESS   9

Small Enterprises–Definition, Classification–Characteristics, Ownership Structures- Types of Business–Project Formulation–Steps involved in setting up a Business– identifying, selecting a Good Business opportunity, Market Survey and Research, Preparation of Preliminary Project Reports–Project Appraisal–Sources of Information– Classification of Needs and Agencies.

UNIT IV   FINANCING ACCOUNTING AND MARKETING   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. Industry Analysis–Competitor Analysis–Marketing Research for the New Venture –Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analysing and Interpreting the Results –The Marketing Process – Bank Schemes.

UNIT V   SUPPORT TO ENTREPRENEURS   9

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.

L : 45   T: 0   P: 0   TOTAL: 45 PERIODS

TEXT BOOKS

1. Khanka.S.S.,"Entrepreneurial Development"S.ChandandCo.Ltd.,RamNagar,New Delhi,2013
2. Donald F Kuratko," Entreprenuership– Theory, Process and Practice",9th Edition, Cengage Learning, 2014

REFERENCES

1. HisrichRD,Peters M P,"Entrepreneurship"9th Edition,TataMcGraw-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

4. S.AnillKumar, S.C Poomina, M.K Abraham "Entrepreneurship Development"NewagePublishers,2009

5. JAF Stoner, Freeman R.E and Daniel R Gilbert"Management",6th Edition, Pearson Education,2004

COURSE OUTCOMES

At the end of the course students should be able to

CO1   Describe the strength of entrepreneurship

CO2   Gain knowledge about entrepreneur skills and motivation.

CO3   Evaluate the business efficiencies

CO4   Discover the financing source in Entrepreneurship.

CO5   Relate the scheme and support for the entrepreneurs.

16AU419   **TWO AND THREE WHEELER TECHNOLOGY**   **L   T   P   C**

                                                                  3   0   0   3

UNIT I   THE POWER UNIT   9

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits. Symmetrical and unsymmetrical valve & port timing diagrams. Scavenging process. Construction and operation of Rotary valve engines.

UNIT II   FUEL AND IGNITION SYSTEMS   9

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, Variable timing ignition system (VTI). Starting system - Kick starter system – Self-starter system. Recent technologies.

UNIT III   CHASSIS AND SUB-SYSTEMS   9

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

UNIT IV   BRAKES AND WHEELS   8

Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links layouts. Brake actuation mechanism. Spoked wheel, cast wheel, Disc wheel & its merits and demerits. Tyres and tubes Construction & its Types. Anti-lock braking systems.

UNIT V   TWO & THREE WHEELERS – CASE STUDY   10

Case study of Sports bike-Kawasaki Ninja ZX-14R,Suzuki Hayabusa, Ducati 1199 Panigale R,KTM 1190 RC8R, Motor cycles-Mahindra kine, Honda Dio, Honda Shine, Bajaj Avenger. Auto rickshaws Pick up van, Delivery van, and Trailer. Servicing and maintenance. Recent developments.

                                        L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1   Dhruv Panchal, "Two and Three Wheeler Technology", PHI learning Pvt ltd, Delhi, 2015.
2   S.K.Gupta, "A Textbook of Automobile Engineering", S.Chand& Company Pvt ltd., New Delhi, 2016.
REFERENCES
1   Ben Spies., Mark Lindemann, "The Total Motorcycling Manual", Cycle World, 2013.
2   Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai, 2012.
3   John Robinson, "Motorcycle Fuel Systems TechBook", HayneesTechBook Pvt ltd., 2015.
4   Edmundson David D,"Motorcycles: Fundamentals- Service- Repair", Editors of Haynees Pvt Ltd., 2016.
5   Raymond Broad Lambretta – "A practical guide to maintenance and repair," Edition-2010.
COURSE OUTCOMES
At the end of the course student should be able to:
CO1   Define the power generation unit of two & three wheelers and operation of rotary valve.
CO2   Understand the fuel and ignition systems in the two and three wheelers.
CO3   Demonstrate the various chassis and subsystems of the two and three wheelers.
CO4   Infer knowledge on transmission and braking unit of two and three wheelers.
CO5   Recognize the servicing and maintenance of various vehicles.

16AU420	FUEL CELL AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO FUEL CELLS 9

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, Liquid and methanol types, Proton exchange membrane fuel cell solid oxide, Hydrogen fuel cells – Thermodynamics and electrochemical kinetics of fuel cells.

UNITII FUEL CELLS FOR AUTOMOTIVE APPLICATIONS 9

Fuel cells for automotive applications – Technology advances in fuel cell vehicle systems – Onboard hydrogen storage – Liquid hydrogen and compressed hydrogen – Metal hydrides, Fuel cell control system – Alkaline fuel cell – Road map to market.

UNIT III FUEL CELL COMPONENTS AND THEIR IMPACT ON 9
PERFORMANCE

Fuel cell performance characteristics – Current/voltage, Voltage efficiency and power density, ohmic resistance, Kinetic performance, Mass transfer effects – Membrane electrode assembly components, Fuel cell stack, Bi-polar plate, Humidifiers and cooling plates.

UNIT IV FUELING 9

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

UNIT V FUEL CYCLE ANALYSIS 9

Introduction to fuel cycle analysis – Application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS
 1 FranoBarbir, "PEM Fuel Cells",Elseveir,2013
 2. DetlefStolten, "Hydrogen and Fuel Cells" Wiley VCH,2010

REFERENCES
 1 "Fuel Cell Handbook", LULU Press 2016.
 2 N.Sammes, "Fuel cell Technology",Springer, 2016
 3 Vladimir S. Bagotsky, "Fuel Cells: Problems and Solutions", Wiley VCH2008
 4 Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Analyze the thermodynamics & electrochemical kinetics of fuel cells. Be familiar with the automotive applications of Fuel Cells
CO2 Impart the knowledge about vibration isolation, spring design and typical mounts
CO3 Update himself to the current advances in Fuel Cell Vehicle Technologies.
CO4 Be familiar with the various components of the fuel cells
CO5 Be familiar with the various types of Fueling techniques followed in the Fuel cells, Do a comparative study of the Fuel cells with other Alternate Fuels.

16GE308	HUMAN RIGHTS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I   HUMAN RIGHTS   9

Human rights – Meaning , Origin and Development. Notion and classification of rights – Natural , Moral and Legal rights. Civil and Political rights. Economic, Social and Cultural Rights: Collective / Solidarity Rights.

UNIT II   EVOLUTION OF HUMAN RIGHTS   9

Evolution of the concept of Human Rights Magana carta- Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III   UN LAWS   9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV   HUMAN RIGHTS IN INDIA   9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V   HUMAN RIGHTS FOR DIFFERENT SECTORS   9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and state Human Rights Commission – Judiciary – Role of NGO's Media. Educational Institutions, Social Movements.

L:45   T:0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 Kapoor S.K., "Human Rights under international law and Indian law and Indian laws". Central Law Agency, Allahabad, 2014.
2 Chandra U.," Human Rights" , Allahabad, 2014.

REFERENCES
1 Upendra Baxi, The Future Of Human Rights., Oxford University Press, New Delhi.
2 Jack Donnelly, Universal Human Rights in Theory and Practice 3 rd Edition , Cornell University Press, 2013.
3 Ashwani Peetus H, Human Rights India and the West Oxford University Press, New Delhi, 2015.

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Demonstrate a good understanding of the provisions under the Constitution of India dealing with human rights.
CO2 Understand the historical growth of the idea of human rights.
CO3 Explore global human rights institutions, law, and processes, and assess the impact of their interaction with national and local cultural practices and norms.
CO4 Indicate ways of extending human rights practice and apply human rights theory to quickly evolving situations.
CO5 Acquire an improved ability to conduct research on human rights.

16ME408   **INDUSTRIAL ROBOTICS**   L   T   P   C
                                                                    3   0   0   3

UNIT I   INTRODUCTION   9

Definition need and scope of Industrial robots–Robot anatomy-Basic components–Work volume – Functions and Specification of Robot Systems - Precision movement. Robot Classification-Arm geometry–Degrees of freedom-Types of motion-Path control.

UNIT II   ROBOT DRIVES AND CONTROL   9

Controlling the Robot motion–Position and velocity sensing devices–Drive systems– Hydraulic and Pneumatic drives–Linear and rotary actuators and control valves–Electro hydraulic servo valves, electric drives–Motors–End effectors–Vacuum, magnetic and Air operated grippers.

UNIT III   ROBOT SENSORS AND VISION SYSTEMS   9

Transducers and Sensors –Sensors in Robot –Tactile sensor–Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Gribbing– Image Processing and analysis–Image segmentation–Pattern recognition–Training of vision system-Robot Languages.

UNIT IV   ROBOT CELL DESIGN AND APPLICATION   9

Robot work cell design and control–Safety in Robotics–Robot cell layouts–Multiple

robots and machine interference–Robot cycle time analysis. Industrial applications of robots.

UNIT V   ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND   9
             EXPERT SYSTEMS

Methods of robot Programming–Characteristics of task level languages lead through programming methods–Motion interpolation. Artificial intelligence– Basics– Goals of artificial intelligence– AI techniques–problem representation in AI–Problem reduction and solution techniques-Application of AI in Robots. SCARA robots, wheeled robots, Bipedal robots (humanoid robots), hexapod robots-Robot Expert Systems.

L: 45 T: 0 P:0   TOTAL : 45 PERIODS

TEXT BOOKS

1.   M.P .Groover, Industrial Robotics–Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt Ltd., NewDelhi,2012

2.   D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, ''Robotics Engineering – An Integrated Approach'', Prentice Hall of India , New Delhi,2008

REFERENCES

1.   K.S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 2008.

2.   Yoram Koren,"Robotics for Engineers ''McGraw-Hill, 2005.

3.   S.R.Deb , Sankha Deb, ''Robotics technology and flexible automation'', Tata McGraw Hill Publishing Company Pvt Ltd., NewDelhi,2010

4. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1992

5. Rajput R.K., "Robotics and Industrial Automation", S.ChandandCompany,2010

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Recognize the anatomy and Specification of Robot Systems.

CO2 Distinguish the working principle of Different type of gripper

CO3 Describe the working principle of various sensors.

CO4 Synthesis the industrial Robots based on the applications.

CO5 Write the robot programming and application of artificial intelligence.

16ME420 **ADDITIVE MANUFACTURING** **L T P C**
3 0 0 3

UNIT I   INTRODUCTION   9

Need - Development of AM systems – Challenges in AM - AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes - Benefits Applications

UNIT II   REVERSE ENGINEERING AND CAD MODELING   9

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: Types of CAD Modelling Techniques, CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling– data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING   9
SYSTEMS

Stereo lithography Apparatus (SLA): Principle, processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modelling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications – Thermal Phase change inkjets, Case studies.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS   9

Selective Laser Sintering (SLS): Principle, process, - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications–Case Studies.

UNIT V   OTHER ADDITIVE MANUFACTURING SYSTEMS   9

Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Selective Laser Melting, Electron Beam Melting.

L:45   T:0   P:0   TOTAL : 45 PERIODS

TEXT BOOKS

1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010
2. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

REFERENCES

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

2. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003

3. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011

4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

5. Murthy R L, "Precision Engineering in Manufacturing", New Age International Publishers, Chennai, 1996.

COURSE OUTCOMES

At the end of the course students should be able to

CO 1 Describe about additive manufacturing working, classification and application

CO 2 Explain about procedure about CAD model preparation and reverse engineering

CO 3 Interpret about the working mechanisms, application and process parameter about solid and liquid based additive manufacturing.

CO 4 Assess the process parameters of powder based additive manufacturing.

CO 5 Compare the different additive manufacturing process based on specific applications

16AUOE1   **BASICS OF AUTOMOBILE ENGINEERING**   L   T   P   C

                                                                 3   0   0   3

UNIT I   **VEHICLE STRUCTURE AND ENGINES**   9

History of automobiles, Types of automobiles, vehicle construction and different layouts, chassis, frame and vehicle body terminologies, IC engines –classifications, components, functions and materials, variable valve timing (VVT).

UNITII   **ENGINE AUXILIARY SYSTEMS**   9

Electronically controlled gasoline injection system for SI engines, electronically controlled diesel injection system-Unit injector system - Common Rail Direct Injection system, Electronic ignition system - Transistorized coil ignition system - capacitive discharge ignition system, superchargers and Turbo chargers, Engine emission control by three way catalytic converter system - Emission norms (Euro and BS).

UNIT III   **TRANSMISSION SYSTEMS**   9

Clutch-types and construction, gear boxes- manual and automatic,Continuous variable Transmission, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Torque Tube Drive and self-starting motor drive.

UNIT IV   **STEERING, BRAKES AND SUSPENSION SYSTEMS**   9

Steering geometry, wheel geometry and types of steering gear box-Power Steering, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, air bags, Antilock Braking System (ABS), Electronic brake distribution, Electronic stability programme, Adaptive cruise control, Traction Control and climate control.

UNIT V   **ALTERNATIVE ENERGY SOURCES**   9

Need of alternative fuels, Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Biogas, and Hydrogen in Automobiles- comparison of properties of bio diesel with conventional fuels, Electric and Hybrid Vehicles, plug-in hybrid vehicles, Fuel Cell.

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

                                        L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
 1   Kirpal Singh., "Automobile Engineering", Volume. I & II, Eleventh Edition, Standard Publishers, New Delhi, 2011.
 2.   Jain K.K. and Asthana. R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002

REFERENCES
 1   Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 2006
 2   Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 2002
 3   Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012
 4   H. M. Sethi, "Automobile Technology", Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2007
 5   Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart – Will Cox Company Inc, USA , 2007

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Summarize the IC Engine components and different layouts of vehicles.

CO2 Recognize the control over various automotive systems.

CO3 Criticize the transmission and power train in automotive systems

CO4 Apply innovations in vehicle handling systems.

CO5 Exhibit the scope of alternative energy resources towards energy crisis

16AUOE2 FUNDAMENTALS OF ALTERNATIVE FUELS L T P C
                                                3 0 0 3

UNIT I INTRODUCTION 9

Working process of I.C. Engine. Different properties of fuel,Sources of fossil fuel, scope of availability of fossil fuel in future-Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Effects of constituents of Exhaust gas emission on environmental condition of earth (N_2, CO_2, CO, NO_x, SO_2, O_2) Pollution created by Exhaust gas emission in atmosphere.

UNITII ALCOHOLS AS FUELS 9

Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Surface ignition and oxygenated additives. Improvement / Change in emission characteristics with respect to % blending of Alcohol.

UNIT III VEGETABLE OILS AS FUELS 9

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, Transesterification of Vegetable oils – Performance and Emission Characteristics in diesel engines

UNIT IV HYDROGEN AS ENGINE FUEL 9

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT V BIOGAS, NATURAL GAS AND LPG AS FUELS 9

Production methods of Biogas- Biogasand its characteristics- Compressed Natural gas and LPG. Properties studies. CO_2 and H_2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of CNG and LPG in SI and CI engines

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Thipse S.S., "Alternate Fuels – Concepts, Technologies and Developments", Jaico Publishing House, Delhi, 2010.

2. AyhanDemirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008, ISBN-13: 978184628994

REFERENCES

1 James L. Smith, Jonathan P. Workman "Alcohols as motor fuels",Colorado State University Extension Service, 2004

2 Richard L Bechtold P.E., Transportation fuels for Today and Tomorrow, Society of Automotive Engineers, 2002

3 Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

4 "The properties and performance of modern alternate fuels" - SAE Paper No.841210.

5 "Alternative Fuels Guidebook: Properties, Storage, Dispensing, and Vehicle Facility Modifications", SAE Publication, 1997.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Distinguish various types of alternative fuels based on need and scope

CO2 Understand the different methods of using vegetable oils and alcohols in I.C engines and performance characteristics of vegetable oils and alcohols.

CO3 Understand the different methods of using alcohols in I.C engines and performance characteristics of alcohols.

CO4 Analyse the Performance, emission and combustion analysis of hydrogen using in engines

CO5 Impart the knowledge about different configuration of hybrid vehicles and Electric vehicle

16AUOE3	TWO WHEELER TECHNOLOGY	L	T	P	C
		3	0	0	3

UNIT I   THE POWER UNIT   9

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits. Scavenging process.

UNIT II   FUEL AND IGNITION SYSTEMS   9

Fuel system in two wheelers, fuel injection system. Lubrication system, Ignition systems. Starting system.

UNIT III   CHASSIS AND SUB-SYSTEMS   9

Main frame for two wheelers.Types of clutches. Gear box and its and various gear controls in two wheelers. Suspension systems.

UNIT IV   BRAKES AND WHEELS   9

Drum brakes & Disc brakes Construction and Working.Wheel types. Tyres and tubes Construction.

UNIT V   TWO WHEELERS – CASE STUDY   9

Case study of Sports bike-Kawasaki Ninja ZX-14R, Suzuki Hayabusa, Ducati 1199 Panigale R, KTM 1190 RC8R.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS

1

2. S.K.Gupta, "A Textbook of Automobile Engineering", S.Chand& Company Pvt ltd., New Delhi, 2016.

REFERENCES

1 Ben Spies., Mark Lindemann,"The Total Motorcycling Manual", Cycle World, 2013.

2 Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai, 2012

3 John Robinson, "Motorcycle Fuel Systems TechBook", HayneesTechBook Pvt ltd., 2015.

4 Edmundson David D,"Motorcycles: Fundamentals- Service- Repair", Editors of Haynees Pvt Ltd., 2016.

5 Raymond Broad Lambretta – "A practical guide to maintenance and repair," Edition-2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Define the power generation unit of two & three wheelers and operation of rotary valve.

CO2 Understand the fuel and ignition systems in the two and three wheelers.

CO3 Demonstrate the various chassis and subsystems of the two and three wheelers.

CO4 Infer knowledge on transmission and braking unit of two and three wheelers.

CO5 Recognize the servicing and maintenance of various vehicles.

16AUOE4	AUTOMOTIVE MAINTENANCE	L	T	P	C
		3	0	0	3

UNIT I MAINTENANCE OF RECORDS AND SCHEDULES 10

Requirements and importance of maintenance, types of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. Motor vehicle acts, insurance etc and traffic rules, motor vehicle driving rules and regulation.

UNITII ENGINE MAINTENANCE – REPAIR AND OVERHAULING 9

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up, including modern engines.

UNIT III CHASSIS MAINTENANCE - REPAIR AND OVERHAULING 10

Mechanical and automobile clutch, fluid flywheel, torque converter, automatic transmission and gear box, servicing and maintenance. Maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

UNIT IV ELECTRICAL AND ELECTRONIC SYSTEM MAINTENANCE - 9
SERVICING AND REPAIRS

Testing methods for checking electrical and electronic components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

UNIT V MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, 9
LUBRICATION SYSTEM AND VECHICLE BODY

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS
1 Clifton E. Owen "Basic Automotive Service and Systems "– 4th Edition, Cengage Learning 2010.
2. Tim Gilles "Automotive Service" – 5th Edition, Cengage Learning 2015.
REFERENCES
1 N.K.Giri, "Automotive Mechanics" 9 th Reprint, Khanna Publishers 2014.
2 James D Halderman, "Advanced Engine Performance Diagnosis" Prentice Hall India Learning Private

Limited 2015
3   Doshi.J.A**,** "Vehicle Maintenance and Garage Practice" Prentice Hall India Learning Private Limited 2014
4   Dr. Kripal Singh, "Automobile Engineering vol 1" 13th Edition, standard publishers 2012
5   W.H.Crouse, "Automotive Mechanics" 10th Edition , Tata Mc Graw Hill Publications, 2006

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Apply the knowledge on the vehicles maintenance.

CO2   Analyse the various procedure available to carry out vehicle maintenance.

CO3   Dismantle study, perform corrections and assemble the various parts of the vehicle.

CO4   Attain the knowledge of maintenance for the transport vehicles.

CO5   Describe the maintenance procedures of various systems like steering systems, braking system, suspension system and engine cooling system etc.

16AUOE5	OFF ROAD VEHICLES	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION TO OFFROADVEHICLES   9

Construction layout, capacity and applications. Power Plants, Chassis and Transmission, Multi axle vehicles

UNITII   9

Earth movers like dumpers, loaders-single bucket, Multi packet and rotary types-bulldozers, excavators, backhoe loaders, scrappers, drag and self-powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earth moving machines.

UNIT III   SCRAPPERS,GRADERS,SHOVELSANDDITCHERS   9

Scrappers, elevating graders, motor graders, self-powered scrappers and graders, Power shovel, revolving and stripper shovels– draglines – ditchers – capacity of shovels.

UNIT IV   MILITARYANDCOMBATVEHICLES   9

Power takeoff, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles

UNIT V   VEHICLESYSTEMS,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.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1. Rodichev and G.Rodicheva, "Tractor and Automobiles", MIR Publishers, 1987.
2. Steve Parker, "Military Machines", Mason Crest Publishers, 2010.

REFERENCES
1. Ia. S. Ageikin "Off the road wheeled and combined traction devices", Ashgate Publishing Co. Ltd. 1998.
2. Liljedahl, John.B., Paul K. Turnquist, David W.Smith and MokotoHoki. "Tractor and their power units" fourth edition, CSB Publishers and Distributors, New Delhi, 2002
3. Ashok G. Powar& Vijay V. Aware, "Farm Machinery and Power", New india publishing agency, New Delhi, 2007
4. George W. Green, "Special Use Vehicles", Mcfarl& Company Press, 2003.
5. William H. Crouse, "Automotive mechanics" – 10th Edition, Tata Mc Graw Hill Publications Co. New Delhi, 2006

COURSE OUTCOMES
At the end of the course student should be able to:
- **CO1** Understand the knowledge of earth moving equipment and construction layouts.
- **CO2** Acquire the knowledge of hoist, conveyors, elevators and cranes applications.
- **CO3** Describe the basic concepts tractors and power trailers.
- **CO4** Apply the knowledge of the concepts of jib cranes in automobile industries.
- **CO5** Acquire knowledge on military vehicles and their applications

16AUOE6	RECENT TRENDS IN AUTOMOBILES	L	T	P	C
		3	0	0	3

UNIT I   DRIVER ASSISTANCE SYSYTEMS   9

Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring.

UNITII   TELEMATICS   9

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

UNIT III   SAFETY AND SECURITY SYSTEMS   9

Airbags, seat belt tightening system, collision warning systems, child lock, anti lock braking systems. Anti theft technologies, smart card system, number plate coding

UNIT IV   COMFORT SYSTEMS   9

Active suspension systems, requirement and characteristics, different types, power steering,

Collapsible and tiltable steering column, power windows.

UNIT V   ADAPTIVE CONTROL SYSTEMS   9

Adaptive cruise control, adaptive noise control, anti spin regulation, traction control systems, cylinder cut- off technology.

L : 45   T: 0   P: 0   Total: 45 PERIODS

TEXT BOOKS
1 LjuboVlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001.
2. Ronald K Jurgen, "Navigation and Intelligent Transportation Systems – Progress in Technology", Automotive Electronics Series, SAE, USA, 1998.

REFERENCES
1 Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002.
2 William B Riddens, "Understanding Automotive Electronics", 5[th]edition, Butter worth Heinemann Woburn, 1998.
3 Richard C.Dorf and Robert H.Bishop, Modern Control Systems, Pearson Prentice Hall,2008
4 Bechhold, "Understanding Automotive Electronics", SAE, 1998.
5 Robert Bosch, "Automotive Handbook", Sixth Edition,2004

COURSE OUTCOMES
At the end of the course student should be able to:
CO1 Understand the systems which helps the drivers while running
CO2 Understand the information provided by various systems.
CO3 Understand the working of safety and security systems
CO4 Understand the road handling comfort of modern vehicles.
CO5 Understand the various adaptive systems equipped in Automobile.

16AUOC1   **TESTING & INSPECTION OF AUTOMOTIVE**   **L   T   P   C**
                                          MATERIALS

                                                                                                      1

Basic Welding Terminology, Importance of Testing Materials, Introduction of Destructive & Non-Destructive Testing, Types - Liquid Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiographic Testing, Film Interpretation, Ultrasonic Thickness Gauging

                                                   L : 10   T: 0   P: 5   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Apply the various Non-Destructive Testing principles and testing methods.

CO2   Describe the applications of NDT testing in several engineering fields.

CO3   Characterize the testing methods for various industrial components.

16AUOC2   **ELECTRONIC POWER STEERING &**   **L   T   P   C**
                              TURBOCHARGERS

                                                                        1

Electronic Power Steering – Advantages – Components – Layout – Functions – Inspections – DTC –
Voltage checking in sensors – DTC clearance – Special tools

Turbocharger – Types of Turbocharger – Troubleshooting of Turbocharger.

                                      L : 10   T: 0   P: 5   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Know about the electronic power steering and its troubleshooting.

CO2   Know about the turbocharger and its troubleshooting.

16AUOC3   **AUTOMOTIVE STYLING**   **L   T   P   C**

                                                                              1

UNIT I   DESIGN EXPRESSIONS   4

Design methodology, Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles and product aesthetics

UNIT II   INTRODUCTION TO CONCEPT CARS   4

Importance of concept cars, Blending technology, Form in concept cars

UNIT III   CAR DESIGN   4

Art and colour, Product styling, Introduction to human factors engineering, Digital design, Concept to reality, auto show vehicles

UNIT IV   VISUAL FACTORS IN DESIGN   3

Colour harmony, Colour in design, Artist's spectrum, Basic colour schemes

                                    L : 15   T: 0   P: 0   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the design trends of concept cars

CO2   Apply the concept of ergonomics in designing concept cars

16AUOC4   **OVERVIEW OF MOTORSPORTS ENGINEERING**   **L   T   P   C**

                                                                                        1

UNIT I   **INTRODUCTION TO MOTORSPORT ENGINEERING**   **2**

The history of motorsport engineering-Review of motorsport engineering-Pioneers of Motorsport engineering -Motorsport technology evolution review.

UNIT II   **LIST OF MOTORSPORT COMPETITIONS FOR STUDENTS**   **3**

A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage

UNIT III   **PROFESSIONAL MOTORSPORT EVENTS**   **4**

The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – MotoGP, Superbike, Endurance, Motocross, Supermoto, Freestyle, Trials, Crosscountry rallies, Speedway, Board track, drag racing

UNIT IV   **RULES AND REGULATIONS OF MOTORSPORTS**   **3**

Introduction about the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races

UNIT V   **CAREER IN MOTORSPORTS ENGINEERING**   **3**

Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician - Aerodynamics Engineer - Race official / steward

                                        L : 15   T: 0   P: 0   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Understand the various events of motorsport engineering

CO2   Understanding the rules and regulation for the different motor sports events

CO3   Understanding the career opportunities in motor sports engineering

16AUOC5   **ECU MODEL BASED SYSTEM DESIGN**   **L   T   P   C**

                                                                                      1

UNIT I   ECU DESIGN CONCEPT   5

The concepts of ECU design for automotive applications- Need for ECUs- advances in ECUs for automotive- design complexities of ECUs-V-Model for Automotive ECU 's Architecture of an advanced microcontroller used in the design of automobile ECUs analog and digital Interfaces-Controllers for ECUs: Understanding different ECUs in an automobile-challenges and design requirements of ECU design - selection of sensors and interfaces for ECU design.

UNIT II   MODEL BASED SYSTEM DESIGN   5

Introduction to Model based system design -hardware in-the-loop simulation- continuous and discrete simulation basics-modeling basics. Connection between Hardware and Simulation-Coupling concepts-simulator coupling and co-simulation, synchronization of co-simulations, basic coupling principles-Event Discrete Simulation-Real Time Workshop. Introduction to basic Simulink blocks, xPC target, Real Time Workshop-State flow and Real Time Embedded coder.

                                  L : 10   T: 0   P: 5   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Familiarize on concepts of ECU design for automotive applications.

CO2   Acquire the knowledge to solve complex problems in Model based system design & hardware in the-loop simulation

16AUOC6   AUTOMOTIVE ACCIDENT INVESTIGATION   L   T   P   C

1

UNIT I   ACCIDENT RECONSTRUCTION TECHNIQUES   7

Tyre marks and vehicle damage: skid marks; scuff marks; deceleration scuff and Tyre prints; debris; secondary impact; vehicle position before and after impact. Accident scene construction plans: the immediate scene, intermediate scene, extended scene; sketch plans and scale plans; triangulation, base line and offsets; use of computer software e.g. CAD

UNIT II   DAMAGE ASSESSMENT AND COST EVALUATION   8

Damage assessment: vehicle details; vehicle condition; body repair; mechanical components; geometry; production of damage assessment report; post-repair inspection. Repair costing Thatcham repair times; manufacturers repair times computer estimating paint and materials; cash in lieu of repairs Repair methods and materials: suitability of repair methods; vehicle construction; materials used in vehicle construction; method and types of joining; plastic repairs

L : 15   T: 0   P: 0   Total: 15 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1   Develop knowledge on the Accident reconstruction techniques

CO2   Gain knowledge on damage assessment and cost estimation