Dr. Mahalingam College of Engineering and Technology

(An Autonomous Institution)

Pollachi - 642 003

Curriculum and Syllabus

B.E. AUTOMOBILE ENGINEERING

SEMESTER I to VIII

REGULATIONS 2014

DR MAHALINGAM

MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

Department of Automobile Engineering

Curriculum for Automobile Engineering from Semester I to VIII

REGULATION 2014-R (Batch 2015 Onwards)

SEMESTER I

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0101	Communication Skills - I	2	0	2	3	100
140AU0102	Engineering Mathematics – I	3	1	0	4	100
140AU0103	Applied Physics	2	1	0	3	100
140AU0104	Applied Chemistry	2	1	0	3	100
140AU0105	Introduction to Engineering	2	0	2	3	100
140AU0106	Engineering Graphics	1	3	0	4	100
PRACTICAL						
140AU0107	Engineering Practices Laboratory	0	0	2	1	100
140AU0108	Physics and Chemistry Laboratory	0	0	2	1	100
PROFESSIONAL SKILL COURSE						
140AU0109	Promotion of Students' Wellness	0	0	2	1	100
	TOTAL	**12**	**6**	**10**	**23**	**900**

SEMESTER II

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0201	Communication Skills – II	2	0	2	3	100
140AU0202	Engineering Mathematics – II	3	1	0	4	100
140AU0203	Material Science	2	0	2	3	100
140AU0204	Engineering Mechanics	3	1	0	4	100
140AU0205	Engineering Metrology and Measurements	2	0	2	3	100
140AU0206	Manufacturing Processes - I	3	1	0	4	100
PRACTICAL						
140AU0207	Manufacturing Process Laboratory- I	0	0	2	1	100
140AU0208	Computer Aided Drafting and Modelling Laboratory	0	0	2	1	100
PROFESSIONAL SKILL COURSE						
140AU0209	Sports For Wellness	0	0	2	1	100
	TOTAL	**15**	**3**	**12**	**24**	**900**

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SEMESTER III

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0301	Engineering Mathematics – III	4	0	0	4	100
140AU0302	Engineering Thermodynamics	4	0	0	4	100
140AU0303	Manufacturing Processes - II	4	0	0	4	100
140AU0304	Fluid Mechanics and Machinery	4	0	0	4	100
140AU0305	I C Engines	2	0	2	3	100
140AU0306	Automotive Electrical and Electronics- I	2	1	0	3	100
PRACTICAL						
140AU0307	Manufacturing Processes Laboratory - II	0	0	4	2	100
140AU0308	Fluid Mechanics and Machinery Laboratory	0	0	4	2	100
PROFESSIONAL SKILL COURSE						
140AU0309	Personal Effectiveness	0	0	2	1	100
ONE CREDIT COURSE		0	0	2	1	100
	TOTAL	**20**	**1**	**14**	**28**	**1000**

SEMESTER IV

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0401	Numerical Methods	2	2	0	4	100
140AU0402	Strength of Materials	4	0	0	4	100
140AU0403	Engineering Metallurgy	3	0	0	3	100
140AU0404	Kinematics of Machines	3	0	2	4	100
140AU0405	Automotive Fuels and Lubricants	2	0	2	3	100
140AU0406	Automotive Chassis	3	0	0	3	100
PRACTICAL						
140AU0407	Strength of Materials and Metallurgy Laboratory	0	0	4	2	100
140AU0408	Engine Performance and Emission Testing Lab	0	0	4	2	100
PROFESSIONAL SKILL COURSE						
140AU0409	Ethical and Moral Responsibility	0	0	2	1	100
ONE CREDIT COURSE		0	0	2	1	100
	TOTAL	**17**	**2**	**16**	**27**	**1000**

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SEMESTER V

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0501	Heat and Mass Transfer	4	0	0	4	100
140AU0502	Design of Machine Elements	4	0	0	4	100
140AU0503	Mechanics of Road Vehicles	3	0	2	4	100
140AU0504	Automotive Transmission	3	0	0	3	100
140AU0505	Automotive Electrical and Electronics - II	2	0	2	3	100
XXX	Professional Elective – I	3	0	0	3	100
PRACTICAL						
140AU0507	Heat Power Laboratory	0	0	4	2	100
140AU0508	Computer Aided Machine Drawing Laboratory	0	0	4	2	100
PROFESSIONAL SKILL COURSE						
140AU0509	Teamness and Inter-Personal Skills	0	0	2	1	100
ONE CREDIT COURSE		0	0	2	1	100
	TOTAL	**19**	**0**	**16**	**27**	**1000**

SEMESTER VI

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0601	Finite Element Analysis	4	0	0	4	100
140AU0602	Design of IC Engine Components	4	0	0	4	100
140AU0603	Vehicle Dynamics	4	0	0	4	100
140AU0604	Automotive Embedded Systems	3	0	0	3	100
140AU0605	Environmental studies	3	0	0	3	100
XXX	Professional Elective – II	3	0	0	3	100
PRACTICAL						
140AU0607	Simulation and Analysis Laboratory	0	0	4	2	100
140AU0608	Automotive Embedded Systems Laboratory	0	0	4	2	100
PROFESSIONAL SKILL COURSE						
140AU0609	Campus to Corporate	0	0	2	1	100
ONE CREDIT COURSE		0	0	2	1	100
	TOTAL	**21**	**0**	**12**	**27**	**1000**

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SEMESTER VII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140AU0701	Design of Automotive Chassis Components	4	0	0	4	100
140AU0702	Automotive Pollution Control	3	0	0	3	100
XXX	Professional Elective – III	3	0	0	3	100
XXX	Open Elective – I	3	0	0	3	100
PRACTICAL						
140AU0707	Vehicle Maintenance Laboratory	0	0	4	2	100
140AU0708	Modeling and Analysis of Automotive Subsystems Laboratory	0	0	4	2	100
140AU0709	Innovative and Creative Project	0	0	8	4	100
	TOTAL	**13**	**0**	**16**	**21**	**700**

SEMESTER VIII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
XXX	Professional Elective -IV	3	0	0	3	100
XXX	Professional Elective -V	3	0	0	3	100
XXX	Professional Elective -VI	3	0	0	3	100
PRACTICAL						
140AU0809	Project	0	0	20	10	200
	TOTAL	**9**	**0**	**20**	**19**	**500**

SUMMARY	
Core Curriculum Credits	186
Professional Skills Credits	6
One credit courses credits	4
Total No. of Credits	**196**
Core Curriculum Courses	59
Professional Skills Courses	6
One Credit Courses	4
Total No. of Courses	**69**

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B.E. Automobile Engineering - List of Electives
(Applicable for the students admitted from 2015 onwards)

Course Code	Course Title	Hours/ Week			Credits	Marks
		L	T	P		
Design Stream						
140AU9111	IC Engines for Special Applications	3	0	0	3	100
140AU9112	Automotive Aerodynamics	3	0	0	3	100
140AU9113	Noise, Vibration and Harshness	3	0	0	3	100
140AU9114	Vehicle Safety and Comfort Systems	3	0	0	3	100
140AU9115	Supercharging and Scavenging	3	0	0	3	100
140AU9116	Gas Dynamics and Jet Propulsion	3	0	0	3	100
140AU9117	Computational Fluid Dynamics	3	0	0	3	100
140AU9118	Design for Manufacture, Assembly and Environment	3	0	0	3	100
140AU9119	Product Design and Development	3	0	0	3	100
140AU9120	Failure Analysis and Design	3	0	0	3	100
140AU9121	Mechanical System Design	3	0	0	3	100
140AU9122	Advanced Theory of IC Engines	3	0	0	3	100
140AU9123	Advanced Vehicle Systems	3	0	0	3	100
140AU9124	Electric, Hybrid and Fuel Cell Vehicles	3	0	0	3	100
140AU9125	Off Road vehicles	3	0	0	3	100
140AU9126	Vehicle Control Systems	3	0	0	3	100
140AU9127	Hydraulic and Pneumatic Systems	3	0	0	3	100
140AU9154	Optimization Techniques	3	0	0	3	100
140AU9155	Product Innovation through TRIZ	3	0	0	3	100
140AU9156	C Programing	3	0	0	3	100
Manufacturing Stream						
140AU9128	Computer Integrated Manufacturing	3	0	0	3	100
140AU9129	Non-destructive Testing Methods	3	0	0	3	100
140AU9130	Composite Materials	3	0	0	3	100
140AU9131	Lean Manufacturing	3	0	0	3	100
140AU9132	Unconventional Machining Processes	3	0	0	3	100
140AU9133	Industrial Robotics and Automation	3	0	0	3	100
140AU9134	Rapid Prototyping and Tooling	3	0	0	3	100
140AU9135	Plant Layout and Material Handling	3	0	0	3	100
140AU9136	Micro Manufacturing	3	0	0	3	100
140AU9137	Process Planning and Cost Estimation	3	0	0	3	100
140AU9138	Reliability and Maintenance Engineering	3	0	0	3	100
140AU9139	Production Planning and Control	3	0	0	3	100
140AU9140	Total Productive Maintenance	3	0	0	3	100
140AU9157	Engineering Economics and Cost Analysis	3	0	0	3	100

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Course Code	Course Title	Hours/ Week			Credits	Marks
		L	T	P		
Service stream						
140AU9141	Vehicle Body Engineering	3	0	0	3	100
140AU9142	Transport Management	3	0	0	3	100
140AU9143	Automotive Instrumentation and control	3	0	0	3	100
140AU9145	Marketing Management	3	0	0	3	100
140AU9146	Refrigeration and Air-Conditioning	3	0	0	3	100
140AU9147	Vehicle Maintenance	3	0	0	3	100
Open Electives						
141OE0901	Green Vehicle Technology	3	0	0	3	100
141OE0902	Operations Research	3	0	0	3	100
141OE0903	Two and Three Wheelers	3	0	0	3	100

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SEMESTER I

Course Code: 140AU0101	**Course Title :** COMMUNICATION SKILLS – I (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 0 : 2 : 3
Type : Theory	Total Contact hours:	**60 Hours**

Course Objectives

The course is intended to:

1. Recognize and use a wide range of vocabulary
2. Compose paragraphs, essays and write for academic and business purposes
3. Organize and articulate ideas logically, lucidly and persuasively
4. Use various techniques to read, comprehend, appreciate and interpret content

Course Content

UNIT I FUNCTIONAL GRAMMAR AND VOCABULARY **6+6**

Importance of learning a Language Need for a right attitude Nominal word group adjectival word group verbal word group complementation concord pronoun noun agreement subject verb agreement appropriate verb (tense and voice) vocabulary roots affixation and compounding collocation hyponym mnemonics homophones and homographs idioms and phrases condensing one word substitution

UNIT II LISTENING **6+6**

Listening to informal conversations and participating situation based dialogues conversations Understanding the structure of conversations tone intonation sounds Listening to a telephone conversation video conferencing model interviews lectures dialogues film clippings with questions Listening for making inferences for main points and sub-points for note taking Listening for specific details and information themes and facts.

UNIT III SPEAKING **6+6**

Elements of effective speech exchange of basic personal information, narration talk on general topics describing events and people Process description, Extempore Group Discussion debate marketing a product or service. Mock interview Just Minute talk pep talk small talk.

UNIT IV READING **6+6**

Elements of effective reading skimming, scanning, intensive and extensive reading dictionary usage extract specific information identify main and subordinate ideas summarize, précis writing, paraphrase comprehension making inferences reading critically determining fact versus opinion spoken interaction understand the description of events, feelings and wishes in personal letters understand familiar context specific names, words and sentences, for example on notices, posters and catalogues.

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UNIT V WRITING 6+6

Rules and conventions relating sentences, prewriting- paragraphs, essays cohesive devices and discourse markers thesis statement punctuation and proof reading Clarity and conciseness summarizing report writing, transcoding information business writing letters quotation seeking, order placing, complaint letter, cover letter, resume and email writing.

Course Outcomes

At the end of the course students will be able to:

CO1. Recognize and use a wide range of vocabulary in speaking and writing
CO2. Compose paragraphs, essays and write for academic and business purposes with coherence and accuracy
CO3. Organize and articulate ideas logically, lucidly and persuasively within a given time frame
CO4. Use various techniques to read, comprehend, appreciate and interpret content effectively

Text Books

1. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill Education Pvt. Ltd., New Delhi 2005.

References

1. Halliday M.A.K., Introduction to Functional Grammar, Routledge, London 2014
2. Stuart Redman, English Vocabulary in Use - Pre-intermediate and Intermediate, Second Edition, Cambridge University Press, U.K. 2003
3. Suzanne W. Woodward, Fun With Grammar, Prentice Hall, New Jersey 1997
4. Essentials of Effective Public Speaking, Research and Education Association, New Jersey, 2004
5. Clare West, Reading Techniques, Cambridge University Press, Cambridge, 2010
6. Julie Robitaille and Robert Connelly, Writer's Resources, Second Edition, Thomson Wadsworth, USA 2007.

Web references

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.pearsonlongman.com/intelligent_business/bec_tests/preliminary.html

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Course Code: 140AU0102	**Course Title :** ENGINEERING MATHEMATICS – I (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	3: 1 : 0 : 4
Type : Theory	Total Contact hours:	**60 Hours**

Course Objectives

The course is intended to:

1. Calculate Eigen values and Eigen vectors
2. Apply the concepts of differentiation to curvatures
3. Identify the extreme values for two variable functions
4. Apply multiple integrals to find area and volume
5. Formulate simple problems of engineering dynamics

Course Content

UNIT I MATRICES 9+3

Solution of system of equations-Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation–Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 9+3

Curvature – Cartesian and polar coordinates – Radius and Centre of curvature-Circle of curvature – Involutes andEvolutes – Envelopes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

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

UNIT IV MULTIPLE INTEGRALS 9+3

Double integration-Cartesian and polar coordinates-Change of order of integration-Transformation from Cartesian to polar, spherical and cylindrical coordinates-Triple integration in Cartesian Coordinates-Applications: Evaluating area and volume using multiple integrals.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER 9+3

Formation of ordinary differential equation-Solution of differential equations of first order and first degree: homogeneous form, linear form and exact differential equations - Applications to engineering problems related to resisted motion.

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Course Outcomes

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

CO1 Calculate Eigen values and Eigen vectors for a given real matrix

CO2 Apply the concepts of differentiation to curvatures

CO3 Identify the extreme values for two variable functions

CO4 Apply multiple integrals to find area and volume

CO5 Formulate simple problems of engineering dynamics as first order ordinary differential equations and state the underlying assumptions

Text Books

1. Ray Wylie C and Louis C Barret , "Advanced Engineering Mathematics", 6th Edition McGraw-Hill, 2003
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.

References

1. Peter V. O'Neil, Advanced engineering mathematics, 6thEdition, Thomson Nelson, Toronto, 2007.
2. K.A. Stroud and Dexter J. Booth Advanced Engineering Mathematics, 5thEdition, Palgrave, Macmillan,2011.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

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Course Code: 140AU0103	**Course Title :** APPLIED PHYSICS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 1 : 0 : 3
Type : Theory	Total Contact hours:	**45 Hours**

Course Objectives

The course is intended to:

1. Calculate the values of elastic and frictional properties of materials
2. Compute the amount of heat transfer by conduction and radiation in materials
3. Apply the knowledge of ultra-Sonic's to inspect the quality of materials
4. Use the different types of pumps and gauges
5. Apply lasers in various industrial applications

Course Content

UNIT I PROPERTIES OF MATTER 6+3

Elasticity: Hooke's law , Elastic modulii Poisson's ratio relation between them Factors affecting elasticity Expression for bending moment, I-shaped girders determination of Young's modulus by cantilever depression method Static Tension Expression for couple per unit twist Torsional oscillation. Friction: Static friction, laws of friction, sliding friction, angle of friction, cone of friction.

UNIT II TRANSMISSION OF HEAT 6+ 3

Conduction Co-efficient of the thermal conductivity Cylindrical flow of heat determination of thermal conductivity of bad conductor Lee's disc method. Experimental determination of Specific heat of liquid, variation of specific heat and atomic heat with temperature. Radiation Black body Wein's Law Rayleigh Jeans Law Stefan's law Experimental Determination of Stefan's constant Mathematical derivation of Stephan's law Solar constant Solar Spectrum.

UNIT III ULTRASONICS AND NDT 6+ 3

Properties of Ultrasonic waves, Production of ultrasonics by magnetostriciton and piezoelectric methods Detection of ultrasonics: Kundt's tube, Thermal method, acoustic grating Cavitation -Industrial applications: ultrasonic cleaning, welding and cutting. Non Destructive Testing: Principle of Ultrasonic testing ultrasonic transducer Couplant *Inspection techniques:* Liquid Penetrant Method, Radiographic testing, Ultrasonic flaw detector: Pulse echo system, transmission, A, B & C scan displays. Inspection standards.

UNIT IV VACUUM SCIENCE AND TECHNOLOGY 6+ 3

Introduction concepts of vacuum throughput, pumping speed, effective pumping speed and conductance. Types of pumps working principle and construction of rotary pump, diffusion pump, turbo molecular pump. Operation of pressure gauges pressure range, measurement of vacuum using Pirani and Penning gauges, merits and limitations. Working of a vacuum system, applications and scope.

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UNIT V LASER PHYSICS AND APPLICATIONS 6+ 3

Laser principles: Stimulated and spontaneous emissions of radiations Population inversion and pumping methods Properties of lasers Nd: YAG laser and CO_2 molecular laser Applications of Lasers: welding, brazing, drilling, cutting and heat treatment of materials.

Course Outcomes

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

CO1. Calculate the values of elastic and frictional properties of materials
CO2. Compute the amount of heat transfer by conduction and radiation in materials
CO3. Apply the knowledge of ultra-Sonic's to inspect the quality of materials through NDT
CO4. Use the different types of pumps and gauges
CO5. Apply lasers in various industrial applications

Text Books

1. D. S. Mathur, "Elements of Properties of Matter" S. Chand & Company Ltd., New Delhi, 2012
2. BrijLal and Dr. N. Subrahmanyam, "Heat and Thermodynamics", S. Chand & Company Ltd., New Delhi, 1997.

References

1. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics Extended, Ninth Edition, Wiley India.
2. R.K. Gaur, S.L. Gupta, Engineering Physics, DhanpatRai, 2013
3. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007.
4. Murugeshan, R., "Properties of Matter & Acoustics" S. Chand & Company Ltd., New Delhi, 2012
5. Rajendran, "Engineering Physics", Tata McGraw Hill Publishing Company limited. New Delhi, 2009.
6. Rao V V, Ghosh T. B. and Chopra K L, "Vacuum Science and Technology", Allied Publishers Limited, New Delhi, 1998
7. TarasovL,"Laser Physics and Applications", Mir Publications.

Web References

- http://nptel.ac.in/courses/115106061/
- www.apsu.edu
- www.physicsclassroom.com
- www.study.com
- www.physics.org

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Course Code: 140AU0104	**Course Title :** APPLIED CHEMISTRY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 1 : 0 : 3
Type : Theory	Total Contact hours:	**45 Hours**

Course Objectives

The course is intended to:

1. Explain the chemistry of water and specify the water treatment processes.
2. Select batteries based on the life cycle, working principle and their applications
3. Determine the rate of corrosion of a given metal in a given environment and Identify appropriate control techniques to avoid corrosion.
4. Select a polymeric material for a specific engineering application and decide the handling, disposal methods and identify substitute bio-degradable polymeric materials for conventional polymeric materials
5. Describe the efficiency of fuels in different state based on its composition and calorific value
6. Identify appropriate lubricant for different engineering applications
7. Explain the significance of adsorption in catalytic phenomena and pollution abatement

Course Content

UNIT I WATER AND IT'S TREATMENT **6 + 3**

Introduction, Hardness, Degree of hardness, Determination of hardness by Complexometric method (EDTA method), Municipal Water Supply, Requisites of drinking water, water quality standards- BIS, WHO, purification process. Water for steam making: Sludge and scale formation, caustic embrittlement and boiler corrosion. Methods of Boiler Water Treatment: Internal and external conditioning - Demineralization. Industrial wastewater and sewage treatment. Desalination -reverse osmosis.

UNIT II ELECTROCHEMISTRY AND BATTERIES **6 +3**

Concept of Electro Chemistry, Electrochemical cells reversible and irreversible cells. EMF Single electrode potential Electrochemical series, Application of Nernst equation in electrochemical analysis - Galvanic Cells, Concentration Cells, Types of Electrodes- Reference Electrode (SCE), Ion Selective Electrodes (Glass Electrode), Electrochemical methods of analysis - Potentiometric titrations, conductometric titrations, pH metric titrations.

Batteries: Types Dry cell, Lead-Acid, Ni-Cd, Lithium ion construction, working and application. Fuel cells construction and working of hydrogen oxygen fuel cell, application.

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UNIT III CORROSION AND CONTROL 6+3

Chemical Corrosion Pilling-Bed worth rule Electrochemical corrosion different types galvanic corrosion, differential aeration corrosion, Galvanic series, factors influencing corrosion. Mass loss method of corrosion testing, units to express corrosion rate.

Corrosion control sacrificial anode and impressed cathodic current methods corrosion inhibitors protective coating galvanizing and tinning electroplating and electroless Nickel-plating. Paint and its constituents, Special paints fluorescent paint, high temperature paints, fire retardant paints constituents and functions.

UNIT IV POLYMER CHEMISTRY AND SURFACE CHEMISTRY 6+3

Classification of polymers, Polymerization types Addition, condensation and copolymerization, Properties of polymers: Molecular weight, Tg, Tactility, polydispersity index. Compounding of plastics, Commodity plastics PVC, PE, and PET. Engineering plastics Preparation, properties and uses of PC, Teflon, Nylon. Recycling of plastics, biopolymers.

Surface Chemistry: Adsorption types, application of adsorption technology in industries activated carbon its applications in water purification and air purification, Catalysis types, application of catalytic convertors in IC engine emission control.

UNIT V FUELS AND LUBRICANTS 6 +3

Calorific value Coal proximate and ultimate analysis (method only), metallurgical coke manufacture by Otto Hoffmann method Fractional distillation of petroleum knocking octane number and cetane number. Gaseous fuels CNG and LPG composition, properties and uses. Lubricants types, mechanism of lubrication, liquid lubricants properties and impact on lubrication viscosity, viscosity index, flash and fire points, cloud and pour points, oiliness, aniline point, solid lubricants graphite and molybdenum sulphide structure properties and uses. Greases types, composition and uses.

Course Outcomes

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

CO1. Explain the chemistry of water and specify the water treatment processes.

CO2. Select batteries based on the life cycle, working principle and their applications

CO3. Determine the rate of corrosion of a given metal in a given environment and Identify appropriate control techniques to avoid corrosion.

CO4. Select a polymeric material for a specific engineering application and decide the handling, disposal methods and identify substitute bio-degradable polymeric materials for conventional polymeric materials

CO5. Describe the efficiency of fuels in different state based on its composition and calorific value

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CO6. Identify appropriate lubricant for different engineering applications

CO7. Explain the significance of adsorption in catalytic phenomena and pollution abatement

Text Books

1. P.C.Jain and Monica Jain, "Engineering Chemistry", 16th Ed., DhanpatRai Pub, Co., New Delhi (2004).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).

References

3. L. Brown and T. Holme, Chemistry for Engineering Students, 3rd edition, Cengage Learning (2010).
4. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 9th Ed. (Indian Student Edition) (2011).
5. S. Chawla, A Text Book of Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi (2013).
6. O.G. Palanna, Engineering Chemistry, Fourth Reprint. Tata McGraw Hill Education Pvt. Ltd. New Delhi (2009).
7. Wiley Engineering Chemistry, Second Edition, Wiley India Pvt. Ltd. New Delhi (2011).
8. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai (2006).

Web References

- http://nptel.ac.in/courses/122101001/downloads/lec-23.pdf
- http://nptel.ac.in/courses/122101001/downloads/lec-25.pdf
- http://nptel.ac.in/courses/104105039/

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Course Code: 140AU0105	**Course Title :** INTRODUCTION TO ENGINEERING (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 0 : 2 : 3
Type : Theory	Total Contact hours:	**60 Hours**

Course Objectives

The course is intended to:

1. Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies.
2. Explain the lab facilities and learning resources available in the institution and how they can utilize them effectively.
3. List the products that are used in day-to-day life of students and family.
4. Explain how these products work/function.
5. Explain the different engineering disciplines used in this product.
6. Observe every product with an engineering perspective.

Course Content

UNIT I ENGINEERING EDUCATION 6 +6

Expectations and Aspirations of engineering students, Graduate Engineering Attributes, Outcome based Engineering Curriculum, Engineering Skills – Technical and Professional. Courses, course map, Concepts and Theories of Learning – Higher Order Thinking Skills, Multiple Intelligences, learning styles inventory, teaching/learning process and methodologies (Lectures, tutorials, activities, lab/workshop exercises, factory visits, internships, projects, alignment to co-curricular activities and hobby projects) Rubrics, Assessment.

UNIT II LEARNING RESOURCE MANAGEMENT 6 +6

Awareness and effective use of resources for learning:- library resources, professional societies, centres of excellences, and value-added divisions. Code of conduct for resource utilization.

UNIT III SCIENCE AND ENGINEERING IN PRODUCTS 6 +6

Products used in day-to-day life, functions, science and engineering principles applied in the products disciplines, Working of the product, individual parts of the product, Scientific / Engineering principle. + Demonstration with Refrigerator, Wet Grinder, Laptop, Motorbike. Activity to explore working of products used in day to day life.

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UNIT IV MULTI-DISCIPLINARY ENGINEERING 6 +6

Mechanical Engineering: Introduction to manufacturing methods, materials, relative motion between parts (Linear and Circular) Fastening methods

Electrical and Electronics Engineering: Electricity system used for domestic and industrial purpose (AC vs DC, AC signal, Single-phase, Three-phase, prime movers(motors) in products used in day to day life, DC, Electrical components: resistor, capacitor, and inductor, Electronic components: diode, and transistor. IC and PCB.

Computer science Engineering: Processor board, Computer peripherals, Operating system.

UNIT V PRODUCT APPRECIATION 6 +6

Essential needs in day-to-day life, Connections between the needs and the products, Product appreciation with engineering perspective.

Course Outcomes

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

CO1 Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies.
CO2 Explain the lab facilities and learning resources available in the institution and how they can utilize them effectively.
CO3 List the products that are used in day-to-day life of students and family.
CO4 Explain how these products work/function.
CO5 Explain the different engineering disciplines used in this product.
CO6 Observe every product with an engineering perspective.

References

1. C. David, "How it works: Printing and Processes", LadyBird books publication
2. S. Peter, "How it works: Rockets and Space craft", LadyBird books publication
3. Granada, " How things work", Granada, 1978.
4. J. L. Adams, "Flying Buttresses, Entropy, and O-Rings: The World of an Engineer".
5. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor".
6. R.P. Feynman," Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher", 2011

Web References

- https://en.wikibooks.org/wiki/General_Engineering_Introduction/Engineering_Science
- http://science.howstuffworks.com/engineering-channel.htm

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Course Code: 140AU0106	**Course Title :** ENGINEERING GRAPHICS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	1 : 3 : 0 : 4
Type : Practical	Total Contact hours:	**60 Hours**

Course Objectives

The course is intended to:

1. Sketch different engineering curves and explain its application.
2. Prepare orthographic and isometric drawings of simple solids
3. Prepare development of lateral surfaces of simple objects.
4. Prepare perspective drawings of regular solids

UNIT I CURVES USED IN ENGINEERING PRACTICES 3+9

Importance of graphics in engineering applications –BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning- Methods of Dimensioning. Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method –Construction of cycloid and involutes of square and circle – Drawing of tangents and normal to the above curves. Mathematical representation of these curves and their applications.

UNIT II ORTHOGRAPHIC AND ISOMETRIC PROJECTION 3+9

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout of views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Orthographic projection of solids – Practices on three view projection of solids. Isometric Projection of solids – practices on simple solids.

UNIT III PROJECTION OF LINES AND PLANE SURFACES 3+9

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

UNIT IV PROJECTION OF SOLIDS AND ITS SECTION 3+9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane. Need for sectioning of solids – Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

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UNIT V DEVELOPMENT OF SURFACES AND PERSPECTIVE PROJECTIONS

3+9

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones. Concepts of Perspective projection of prisms, pyramids and cylinders by visual ray method.

Course Outcomes

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

CO1. Sketch different engineering curves and explain its application.

CO2. Prepare orthographic and isometric drawings of simple solids

CO3. Prepare development of lateral surfaces of simple objects.

CO4. Prepare perspective drawings of regular solids

Text Books

1. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2013).
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).

References

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).
2. Cencil Jensen, Jay D. Helsel and Dennis R. Short Engineering Drawing and Design. Tata McGraw Hill Publishing Company Limited (2012).
3. John.K.C and Verghese.P.I "Machine Drawing", Jovast Publishers, Trissur,2007.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

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

Web References

- http://nptel.ac.in/courses/112103019/
- https://en.wikipedia.org/wiki/Engineering_drawing

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Course Code: 140AU0107	**Course Title :** ENGINEERING PRACTICES LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0: 0 : 2 :1
Type : Practical	Total Contact hours:	**45 Hours**

List of Experiments

1. Make a wooden window frame to the required dimensions.
2. Make a steel table using fitting process to the required dimensions
3. Make a Castor Bracket using welding process to the required dimensions
4. Make a winnowing basket in sheet metal to the required dimensions
5. Assemble a pipe line from overhead tank to kitchen sink and dining wash basin
6. a) Make a Domestic wiring circuit to connect a lamp, a fan with regulator and a socket.

   b) Make the internal wiring of a tube light and check the connection
7. Make a Stair case wiring for controlling a lamp from two different locations
8. Do the continuity check in the given PCB and rectify the faults
9. Make an electronic circuit for bi-cycle horn
10. Install the given OS in the computer system
11. Do formatting and partitioning of Hard Disk Drive

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Course Code: 140AU0108	**Course Title :** PHYSICS AND CHEMISTRY LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 2 : 1
Type : Practical	Total Contact hours:	**45 Hours**

PHYSICS LABORATORY

List Of Experiments

1. Young's modulus of the material – Cantilever bending method
2. Rigidity modulus of the metallic wire – Torsional pendulum method
3. Thermal conductivity of insulator – Lee's disc method
4. Comparison Co-efficient of viscosity of the liquids
5. Wavelength of laser and determination of particle size using laser
6. Hysteresis loss of ferromagnetic material
7. Thickness of the sample using Air wedge
8. Efficiency of Solar cell

CHEMISTRY LABORATORY

List Of Experiments

I Water analysis

1. Determination of total hardness of water sample by EDTA method.
2. Determination of DO in water by Winkler's method.

II Viscometry

1. Determination of molecular weight of a polymer – Oswald viscometric method (demonstration only).

III Electrochemistry

1. To determine the strength of given acid – pH metrically
2. To determine the amount of Ferrous ions by potentiometry
3. To determine the strength of mixture of strong and weak acid by conductometric titrations.

IV Corrosion testing

1. Determination of corrosion rate and inhibitor efficiency– weight loss method.

References

1. Jeffery, G.H., Bassett, J., Mendham, J. and Denny, R.C., Vogel's Text book of quantitative Chemical Analysis, Oxford, ELBS, London,2002.
2. Shoemaker D.P. and C. W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co. Ltd., London, 2003.

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Course Code: 140AU0109	Course Title : PROMOTION OF STUDENTS WELLNESS (Common to All branches of B.E / B.Tech)	
Core / Elective: Core	L: T : P: C	0 : 0 : 2 : 1
Type : Practical	Total Contact hours:	30 Hours

Course Objectives

The course is intended to:

1. Maintain physical wellbeing
2. Maintain mental wellbeing
3. Maintain social wellbeing

UNIT I PHYSICAL HEALTH

Physical structure and functions of human body – simplified physical exercises (hand exercises, Leg exercises, breathing exercises, eye exercises – kapalapathi – Maharasanas 1-2 – Massages – Acupuncture – relaxation – importance and benefits. Suryanamaskar.

UNIT II MENTAL HEALTH

Maintenance of youthfulness and life force – kayakalpa yoga – anti ageing process – benefits. Mind and its functions – mind wave frequency – meditation process – Agna, shanthi, thuriam – benefits

UNIT III PERSONALITY DEVELOPMENT – I

Purpose of life and analysis of thought – philosophy of life – introspection – practice. Moralization of desires and neutralization of anger - practices

UNIT IV PERSONALITY DEVELOPMENT – II

Eradication of worries and benefits of blessings – wave theory –practices. Genetic centre – purification – cause and effect theory

UNIT V SOCIAL HEALTH

Greatness of guru – cultural education – love and compassion – fivefold culture. Greatness of friendship and social welfare – individual, family and world peace.

Course Outcomes

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

CO1 Maintain physical wellbeing - grooming, BMI, flexibility, muscle strength, body compositions (vatha, pitha, kapa)

CO2 Maintain mental wellbeing - perceptions, attention/concentration, memory, gunas

CO3 Maintain social wellbeing - etiquettes, emotional and psychological aspects, stress management, morality and values

Text Book

1. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar ,"Value education for harmonious life (Manavalakalai Yoga)", Vethathiri Publications, Erode, I Ed. (2010)

References

1. Dr.R.Nagarathna, Dr.H.R.Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.
2. Dr.R.Nagarathna, Dr.H.R.Nagendra , "New perspectives in stress management", Swami Vivekananda Yoga Prakashana, Bangalore, I Ed June 1986

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OPERATIONAL MODALITIES

- 4-day programme of 6 hours /day for syllabus coverage
- Offered after the college orientation and bridge course to all students at a stretch.
- Two faculty members from Aliyar and 10 facilitators from local centre

Programme Schedule

Forenoon		Afternoon	
9 am to 10.30 am	Session I	1.30 pm to 3.00 pm	Session III
10.30 am to 11.00 am	Break	3.00 pm to 3.30 pm	Break
11.00 am to 12.30 pm	Session II	3.30 pm to 5.00 pm	Session IV
12.30 pm to 1.30 pm	Lunch	--	--

FOLLOW-UP PRACTICE

12 weeks x 2 hours/week: 24 hours

EVALUATION

During 4-day programme

Unit I : Practical
Unit II & Unit III : Written (Objective type test)
Unit IV & Unit V : Written (Objective type test)
Mid semester : Practical
End semester : Written and Practical

Assessment: Using measurement gadgets and questionnaires (as suggested by SVYASA and scoring sheets (from Aliyar)

DIMENSIONS AND TOOLS IN MEASUREMENT

Dimension	Sub dimension	Measurement tools
Physical	BMI	Electronic Weighing Machine, Height Measurement
	Flexibility	Sit & Reach
	Muscle Strength	Handgrip Dynamometer
	Prakruti	Dr Ramakrishna's Prakruti Questionnaire
Mental	Perception	Critical Flicker Fusion
	Attention	Digit Letter substitution Test
		Six Letter Cancellation Test
		Stroop Test
	Memory	Digit backward & Forward
Social	Interpersonal Effectiveness & Self Concept	FIRO B
	Psychological Well Being	Short wellbeing scale
		Short Happiness scale
		Barrat Impulsive Scale

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END OF SEMESTER- I

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SEMESTER II

Course Code: 140AU0201	**Course Title :** COMMUNICATION SKILLS – II (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 0 : 2 : 3
Type : Theory	Total Contact hours:	**60 Hours**

Prerequisites

The student should have undergone the courses:

- Communication Skills – I

Course Objectives

The course is intended to:

1. Use various strategies to listen, infer the meaning and respond
2. Use formal, informal language and appropriate non-verbal skills in speaking
3. Use appropriate reading techniques, make notes and respond critically
4. Write effectively for a variety of professional and social settings
5. Use modern technologies to enhance communication

Course Content

UNIT I LISTENING 6+6

Types of Listening - discriminative, comprehensive, therapeutic, critical and appreciative listening - competitive, attentive and reflective listening models - Perception, Bias, Red flag words, Emotions and language barriers - Wh questions, Open-ended and close- ended questions, Predict vocabulary - Recognizing stress and intonation – Comprehension - Listening to business lecture & presentation - SQL2R, Surveying, questioning, listening, recall and review. Symbols and abbreviations - metacognition, literal and critical comprehension - Inferring meaning, emotions, opinions and contexts

UNIT II SPEAKING 6+6

Informal conversation - day-to-day conversations - Small talk, conversation about other people, facts & opinions - conversing within oneself (intrapersonal) – **Informal language** - colloquial expressions, clichés, contraction, hesitation fillers, usage of personal pronouns, usage of verbs and adverbs, informal vocabularies, imperative sentences - **Non-verbal skills** – importance - types - kinesics - facial expressions, eye contact, gestures, postures, appearance, proxemics, time language, paralanguage, touch **Formal situations** - workplace conversations - downward, upward, horizontal, diagonal, inward, outward conversations - Oral Instructions, speeches, meeting, and negotiations **Formal language** modal auxiliaries, polite expressions, impersonal passive voice, avoiding second person pronouns.

UNIT III READING 6+6

Reading techniques - skimming, scanning, intensive reading - **Extensive reading** and its importance - **Fast Reading** – strategies, speed reading, eye fixation, regression, read in chunks or phrases and linear reading - Newspaper, user manuals, understanding reports, proposals,short stories and novels - R.K. Narayan's "Swami and his Friends "**Note-making** – mechanics, tropicalizing, schematizing, reduction devices, organization techniques and sequencing **Critical Reading** - SQ3R - survey, question, read, recall and review - Usage of dictionary - Book review Jumpha Lahiri's *Interpreter of Maladies (9 stories)*

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UNIT IV WRITING 6+6

Importance of written business communication - Mind mapping- plotting ideas - accuracy of vocabulary, grammatical structures, appropriate register, connectives, signal words and format, notice, circular, agenda, minutes of the meeting, memo, E-mail, Proposal - difference between professional and social communication use of Imperative, modal auxiliary verbs- caption and slogan writing recommendations and instructions writing.

UNIT V MODERN TECHNOLOGY AND COMMUNICATION SKILLS 6+6

Technology advances in learning language - tone and style of language - Pros and cons of modern technologies in language learning process - Do's and Don'ts on online content - Structure of podcast, blogging and social media sites - greetings, grammar, punctuation – sms informal and formal language.

Course Outcomes

At the end of the course students will be able to:

CO1. Use various strategies to listen, infer the meaning and respond
CO2. Use formal, informal language and appropriate non-verbal skills in speaking
CO3. Use appropriate reading techniques, make notes and respond critically
CO4. Write effectively for a variety of professional and social settings
CO5. Use modern technologies to enhance communication

Text books

1. Herta A. Murphy, Herbert W. Hildebrandt, Jane P. Thomas, Effective Business Communication, Tata McGraw Hill, New Delhi, 2008.
2. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill Education Pvt. Ltd., New Delhi, 2005.

References

1. Meenakshi Raman, Business Communication, Oxford University Press, New Delhi 2006
2. Sehgal M.K., VandanaKhetarpal, Business Communication, Excel Books, New Delhi 2006
3. R C. Sharma, Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill Publishing Co., Ltd., New Delhi 2002

Web References

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.examenglish.com/BEC/BEC_Vantage.html
- www.splendid-speaking.com/exams/bec_speaking.htmlhtml

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Course Code: 140AU0202	**Course Title :** ENGINEERING MATHEMATICS – II (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	3 : 1 : 0 : 4
Type : Theory	Total Contact hours:	**60 Hours**

Prerequisites:

The student should have undergone the courses:

- Engineering Mathematics-I

Course Objectives

The course is intended to:

1. Model simple physical phenomena into a set of differential equations.
2. Solve the second and higher order ordinary differential equations.
3. Apply the concepts of gradient, divergence and curl to solve engineering problems.
4. Construct an analytic function.
5. Apply the concept of complex integration to evaluate integrals.
6. Apply the Laplace transform techniques to solve differential equations.

Course Content

UNIT I DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER **9+3**

Second and higher order linear differential equations with constant coefficients. Solution by variation of parameters, first order simultaneous differential equations.

UNIT II VECTOR CALCULUS **9+3**

Gradient, divergence and curl, irrotational and solenoidal vector fields- Directional derivatives-Green's theorem in a plane (without proof)-Gauss divergence theorem (without proof) – Stoke's theorem (without proof)-evaluation of integrals using Green's, Gauss's and Stoke's theorem.

UNIT III ANALYTIC FUNCTIONS **9+3**

Function of a complex variable-Analytic function –Singular points –Cauchy Riemann equations (without proof) – Properties-Construction of analytic functions.

UNIT IV COMPLEX INTEGRATION **9+3**

Cauchy's fundamental theorem (without proof) – Cauchy's Integral formula- Taylor and Laurent expansions- Types of singularity – Residues-Cauchy Residue theorem.

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UNIT V LAPLACE TRANSFORM 9+3

Laplace transform-Conditions for existence-Transform of elementary functions- Properties-Transform of derivatives– Transformation of periodic functions-Inverse Laplace transform-Convolution theorem- Solution of linear ODE of second order with constant coefficients using Laplace transform.

Course Outcomes

At the end of the course students will be able to:

CO1. Model simple physical phenomena into a set of differential equations.

CO2. Solve the second and higher order ordinary differential equations.

CO3. Apply the concepts of gradient, divergence and curl to solve engineering problems.

CO4. Construct an analytic function.

CO5. Apply the concept of complex integration to evaluate integrals.

CO6. Apply the Laplace transform techniques to solve differential equations

Text Books

1. Ray Wylie C and Louis C Barret , "Advanced Engineering Mathematics", McGraw-Hill, 2001
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, Wiley India, 2007.

References

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Bali &Iyengar, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi, 6th Edition, 2006
3. Ramanna B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2008.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

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Course Code: 140AU0203	**Course Title :** MATERIAL SCIENCE (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2: 0 : 2 : 3
Type : Theory	Total Contact hours:	**60 Hours**

Course Objectives

The course is intended to:

1. Calculate crystal parameters and analyze different crystal structures
2. Explain the mechanical, thermal and magnetic properties of bulk materials
3. Demonstrate the Mechanical and Thermal behaviors of bulk materials
4. Choose a suitable material for specific application

Course Content

UNIT I CRYSTAL STRUCTURE ON MATERIAL BEHAVIOR 6+6

Introduction: Crystalline and Non crystalline Materials: Single crystals, polycrystalline materials, Anisotropy **Crystal Parameters:** Atomic radius, Number of atoms per unit cell, Co-ordination number, Atomic Packing factor for SC, BCC, FCC and HCP – Influence of grain structure on material behavior. **Crystal Planes:** Miller indices, Bragg's law, Debye Scherrer method, Interplanar distance – Polymorphism and allotrophy. **Crystal imperfections:** Point, line surface and Volume.

UNIT II MECHANICAL PROPERTIES OF METALS 6+6

Elasticity and plasticity of bulk material, Ductility, malleabililty and brittleness, Stress and strain behavior, Hooke's law, Yield strength, Impact strength, Tensile strength, Resilience, Hardness, Rockwell hardness, Brinell hardness, Vicker's hardness, Micro indentation hardness. **Failure of Metals (Quantitative):** Fracture behavior, Ductile and Brittle fracture, Toughness, Fatigue, Endurance limit, SN curve, Creep, Stages of creep.

UNIT III THERMAL & MAGNETIC PROPERTIES OF MATERIALS 6+6

Thermal Properties of materials: Melting Point, Specific heat, Thermal Expansion, Thermal conductivity, Thermal diffusivity, Thermal shock resistance, Thermal stability and Heat resistance.

Magnetic Properties of materials: Basic concepts, Diamagnetism, Paramagnetism, Ferromagnetism, Domains and hysteresis, Soft and Hard magnetic materials, Antiferromagnetism, Ferrimagnetism, Influence of temperature on magnetic behavior.

UNIT IV POLYMERS AND CERAMIC MATERIALS 6+6

Polymers: Introduction: Hydrocarbon molecules, Polymer molecules, Molecular weight and molecular shape, Molecular structure. **Classification of polymers:** Thermoplastics, Thermosets & Elastomers – Common polymeric materials and Industrial application of polymers (Quantative) **Ceramics** – Constituents, properties and applications of Diamond, silicon carbide (SiC), zirconia (ZrO_2), Alumina (Al_2O_3), boron carbide (B_4C), and titanium diboride (TiB_2).

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UNIT V COMPOSITES 6+6

Introduction, properties, functions of matrix and reinforcement in composites – Law of mixtures. **Classification of composites**: Particle-reinforced, Fiber-reinforced and Structural composites **Types of composite materials:** Polymer-matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon composites and Hybrid composite – Applications

Course Outcomes

At the end of the course students will be able to:

CO1. Calculate crystal parameters and analyze different crystal structures

CO2. Explain the mechanical, thermal and magnetic properties of bulk materials

CO3. Demonstrate the Mechanical and Thermal behaviors of bulk materials

CO4. Choose a suitable material for specific application

Textbooks

1. William D. Callister Jr, Materials Science and Engineering – an Introduction, John Wiley and Sons Inc., Sixth Edition, New York, 2007.
2. Khanna. O.P. A text book of Materials Science and Metallurgy, Khanna Publishers, 2003.

References

1. Vijaya. M.S. and G. Rangarajan, Material Science, Tata McGraw-Hill, 2007
2. P.K. Palanisamy, Material Science for Mechanical Engineers, Scitech Publication (India) Pvt Ltd, 2005.
3. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.

Web References

- www.nptel.ac.in
- www.ocw.mit.edu

MATERIAL SCIENCE LABORATORY

List of Experiments

1. Coercivity, Retentivity, Saturated magnetism, Permeability – Hysteresis loop
2. Conductivity, Resistivity – Four Probe method
3. Melting point of wax – Thermocouple
4. Hardness and Toughness measurement of FRP
5. Stress strain behavior of FRP – Using UTM

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Course Code: 140AU0204	**Course Title :** ENGINEERING MECHANICS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	3 : 1 : 0 : 4
Type : Theory	Total Contact hours:	**60 Hours**

Prerequisites

The student should have undergone the course:

- Engineering Graphics

Course Objectives

The course is intended to:

1. Use the laws of mechanics to determine the equilibrium condition
2. Construct free-body diagrams and calculate the unknown forces
3. Calculate geometric properties such as centroids and moment of inertia
4. Analyze the effect of dry friction in contact surfaces
5. Calculate and plot the motion of a particle

Course Content

UNIT I BASICS AND EQUILIBRIUM OF PARTICLES 9+3

Review of mathematical operations required for engineering mechanics -scalar and vector-vector operations-trigonometry. Review of Fundamental laws of mechanics-Newton's law of mechanics, Gravitational law.

Particles and rigid body, Concept of force and its effect on rigid body-system of forces-Free body diagram-Triangle law, parallelogram law and Lami's theorem-principle of transmissibility-equilibrium conditions-equilibrium of particles subjected to coplanar and non-coplanar force system.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Moment and couple. Free body diagram. Equilibrium conditions applicable to rigid bodies. Varignon's theorem. Moment about point and axis. Problems in equilibrium of rigid body. Beams-types of supports and their reactions-types of forces-method of finding reactions in statically determinate beams. Machine members subjected to coplanar and non-coplanar force systems -unknown forces necessary to ensure static equilibrium of machine members subjected to coplanar force system. Introduction to Supports and connections for 3D machine members and their reactions. Problems related to reactions in machine members supported with ball and socket joints only.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

Properties of surface-centroid, Centroid of simple regular sections using integration (Rectangle, circle and triangle).Method of calculating centroid of composite sections. Problems involving centroid for composite planes such as **L, I, T.** Area Moment of Inertia - important of moment of inertia. Moment of inertia for simple sections using integration such as Rectangle, circle and triangle. Parallel and perpendicular axis theorem- concept of polar moment of inertia. problems involving moment of inertia for composite sections such as T,I,L. principal MI and principal axis for composite section such as T,I,L. Properties of solid geometry- centroid and centre of gravity. Centre of gravity of simple solids. Mass moment of inertia for simple solids. Pappus-Guldinus theorem. Relation to area moment of inertia. Problems involving mass moment of inertia for composite solids consist of block, cylinder, cone, and sphere.

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UNIT IV FRICTION **6+3**

Characteristics of dry friction, law of dry friction, theory of friction- free body diagram for equilibrium and impending motion conditions. Equilibrium conditions involving dry friction, problems involving wedge, screw, ladder and flat belt drive. Problems in impending motion condition involving dry friction at some points.

UNIT V DYNAMICS OF PARTICLES **9+3**

Kinematic parameters - displacement, velocity, acceleration and time. Types of motion-uniform, non-uniform motion, motion of particles in plane - Rectilinear and curvilinear motion of particles-normal and tangential component-motion of projectile- Relative motion-Dependent motion.Kinetics of particles-D'Alemberts principle-works energy and impulse momentum method.

Note: Use of Excel /MATLAB for solving the problems is encouraged (Not for external evaluation only for internal evaluation)

Course Outcomes

At the end of the course students will be able to:

CO1. Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.

CO2. Construct free-body diagrams and calculate the unknown forces necessary to ensure static equilibrium.

CO3. Calculate geometric properties such as centroids and moment of inertia

CO4. Analyze the effect of dry friction in contact surfaces (ladder, wedge, screw and belt)

CO5. Calculate and plot the motion of a particle

Textbooks

1. R.C. Hibbeller, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009
2. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers – Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2012

References

1. James L. Meriam and L.Glenn Kraige, "Engineering Mechanics (Statics and Dynamics)", John Wiley & Sons, 2008
2. Shames.I.H, and Krishna Mohana Rao.G, "Engineering Mechanics (Statics and Dynamics)", Dorling Kindersley (India) Pvt. Ltd. Pearson Education,2006.
3. S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.

Web References

- http://nptel.ac.in/courses/112103109/
- https://en.wikipedia.org/wiki/Mechanics

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Course Code: 140AU0205	**Course Title :** ENGINEERING METROLOGY AND MEASUREMENTS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 0 : 2 : 3
Type : Theory	Total Contact hours:	**60 Hours**

Prerequisites

Nil

Course Objectives

The course is intended to:

1. Explain Metrology and Various Measuring Instruments and methods
2. Explain the Geometric Dimensioning and Tolerancing (GD&T) Principles
3. Evaluate dimensional accuracy of components
4. Demonstrate form measurement methods.
5. Describe advanced methods and automation in measurements

Course Content

UNIT I INTRODUCTION TO ENGINEERING METROLOGY 6+2

General Concepts of metrology-Importance of metrology-Types of metrology-Dynamic, legal, deterministic-Measurement systems-units, standards, accuracy, precision-dimensional accuracy and precision-Methods of measurement-Sensitivity-Errors in measurements-Method of measurement-various measuring instruments.

UNIT II FORM AND SIZE TOLERANCE 6+6

Fundamental drawing rules-Tolerance grade and fundamental deviations- Fits, Limits and Tolerances and its needs on CAD/CAM –Datums- Application of datums- Datum feature identification - Cylindrical and Inclined- Form- Flatness, straightness, cylindricity and circularity-Orientation -Angularity, perpendicularity and parallelism –Position- Types of position - Clearance hole, Threaded hole and coaxiality-Concentricity and symmetry – Examples of concentricity and symmetry-Runout-Types of run out - circular, total-Profile-Profile tolerance-Profile of conical features-Profile inspection.

UNIT-III LINEAR AND ANGULAR MEASUREMENTS 8+6

Introduction to linear measurement-Linear measuring instruments-Scale, Vernier, micrometer-types-Gauges-slip gauges,plug gauge,ring gauge, snap gauge-comparators-mechanical, electrical, pneumatic-Introduction to Angular measurement-angular measuring instruments-Sine bar, bevel protractor, autocollimator, angle dekkor.

UNIT IV FORM MEASUREMENTS 8+6

Screw thread terminology - Errors in threads - Internal and external screw thread measurements - Screw thread measuring elements - Major diameter, Minor diameter, Pitch diameter & Thread form - Gear terminology - Types of gears - Gear errors - Gear measurement techniques -parkinson gear tester, Autocollimator ,Profile projector - Surface texture -Elements of surface texture - Surface finish methods- Average roughness, Peak to

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vally, Form factor - Surface finish measuring instruments – Surface Measurement - Straightness and Flatness - Roundness Measurements

UNIT V LASER METROLOGY AND CMM **6+6**

Laser metrology- Laser interferometer - Michelson, Dual frequency, Twyman green, Laser viewers -Types of CMM - Bridge, Cantilever, Horizontal boring mill type, Vertical mill type - Errors in CMM - Application, advantages & disadvantages of CMM - Coordinate Measuring Machine

NOTE: (Use of approved Data Book is permitted in the End semester examination)

Course Outcomes

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

CO1 Explain Metrology and Various Measuring Instruments and methods
CO2 Explain the Geometric Dimensioning and Tolerancing (GD&T) Principles and Symbol
CO3 Evaluate dimensional accuracy of components using linear and angular measuring Instruments.
CO4 Demonstrate form measurement methods.
CO5 Describe advanced methods and automation in measurements

Textbooks

1. K.R.Gopalakrishna, "Machine Drawing" Subhas Publication, 2002
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005

References

1. Cencel .H.Jensen and J.D.Helsel, "Engineering drawing and design" McGrawHill science 7th Edition,2007.
2. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
3. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications,2000
4. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997

Web References

- http://nptel.ac.in/courses/112106138/
- https://en.wikipedia.org/wiki/Metrology

List of Experiments

1. Measure the dimensions of the given component using vernier calliper.
2. Determine the diameter of a cylindrical component to accuracy of 0.01mm using micrometer and to check the result with digital micrometer.
3. Measure the height of the machined component using vernier height gauge.
4. Determine the thickness of the ground MS plate using slip gauges.
5. Measure the thickness of gear tooth by using gear tooth vernier and profile projector.

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Course Code: 140AU0206	**Course Title :** MANUFACTURING PROCESS – I (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	3 : 1 : 0 : 4
Type : Theory	Total Contact hours:	**60 Hours**

Prerequisites

The student should have undergone the course: Nil

Course Objectives

The course is intended to:

1 Explain operational and procedural steps required in casting process
2 Illustrate operational and procedural steps required in sheet metal process
3 Choose appropriate welding process for the required weld joint
4 Describe procedural steps in forging process
5 Select appropriate processes and its sequence required for manufacture of a given design requirement

Course Content

UNIT I CASTING **9+3**

Sand casting process, Types of patterns, pattern materials and allowances, Types of sand and sand properties, Mould preparation, Tools and equipments, Core making, types, moulding sand, sand properties and operational characteristics, Non- disposable casting processes, Centrifugal casting processes (True, Semi, Centrifuging), Continuous casting, Casting metals, properties, Importance of thickness of casting, Gating and metal flow system, Working principle of Cupola furnace, Crucible furnace, Electric arc furnace, Induction furnace

UNIT II SHEET METAL PROCESSES **9+3**

Sheet metal characteristics, Shearing processes (Punching, Piercing, Perforation, Blanking process, Trimming, Notching, Nibbling, Shaving processes) Progressive, Compound and Combination dies, Types of shearing machines, Specifications of shearing presses, Working principle of shearing machines, Bending operations [Angle bending (Die bending, V-bending, Edge bending), Roll bending, Roll forming, Seaming], Spring back, Bending allowance, Force required for bending, Process parameters in bending, Drawing processes (Shallow drawing, Deep drawing, Reverse drawing and redrawing), Rigid die forming processes (Embossing, Coining and Stamping), Stretch forming, Defects in sheet metal operations.

UNIT III WELDING **9+3**

Fusion welding processes: Arc welding processes, Manual metal arc welding, TIG & MIG welding, Submerged arc welding, Electro slag welding, Gas welding process (Oxy-acetylene), Types of flames, Working principle of Oxy-acetylene welding, Equipments involved in Oxy-acetylene welding (Nozzle, cylinders, hoses, regulator), Gas cutting, Non-fusion welding processes: Electrical resistance welding (ERW), Types of ERW (Spot, seam, percussion, projection, flash butt), Soldering (Soldering iron, Fillers, Fluxes, Soft & Hard soldering), Brazing (Silver brazing, torch brazing, furnace brazing), Weld material preparation (Edge), Importance of Orientation, Direction , Weld speed, Types of electrodes, Significance of current characteristics, Weld symbol.

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UNIT IV ADVANCED PROCESSES IN CASTING, SHEET METAL AND WELDING **9+3**

Casting:

Lost wax process, Shell mould casting, Die casting (Cold chamber / Hot chamber), Process parameters in casting, Casting defects, Inspection and testing of cast components

Sheet Metal:

Flexible die forming processes (Rubber pad, Hydro forming), High energy rate forming (Explosive, electromagnetic), Metal spinning, Super plastic forming, Inspection and testing of Sheet metal components, Formability testing (Simulative drawing testing)

Welding:

Thermit welding, Electron beam welding, Laser beam welding. Process parameters in welding, types of weld defects. Testing methods of welds (Destructive, Non-destructive)

UNIT V MECHANICAL WORKING OF METALS **9+3**

Hot working / Cold working of metals:

Rolling: Rolling mills, Load calculations, Roll passes and sequences, Rolling defects;

Forging: Types (Smith, Drop, Press & Machine), Forging operations (Drawing down / Swaging, Upsetting, Punching, Bending, Coining); Forging defects

Extrusion: Types (Direct, Indirect, Impact, Tube, etc.,), Extrusion operations (Tube extrusion, Wire drawing)

Course Outcomes

At the end of the course students will be able to:

CO1. Explain operational and procedural steps required in casting process
CO2. Illustrate operational and procedural steps required in sheet metal process
CO3. Choose appropriate welding process for the required weld joint
CO4. Describe procedural steps in forging process
CO5. Select appropriate processes and its sequence required for manufacture of a given design requirement which involves casting, welding, forging and sheet metal processes.

Text Books

1. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials" –Pearson Education, 4th Edition, 2003.
2. Sharma. P.C., "A Text Book of Production Technology", S. Chand and Company, 2001.
3. Jain. R.K., "Production Technology", Khanna Publishers, New Delhi, 2001.

Reference

1. HMT Bangalore, "Production Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 2001.
2. Hajra Choudhary etal, "Elements of Production Technology –Vol.II", Asia Publishing House, 2000.
3. Rao, P.N. "Manufacturing Technology", TMH Ltd., 2003

Web References

- http://nptel.ac.in/courses/112107144/

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Course Code: 140AU0207	**Course Title :** MANUFACTURING PROCESS LABORATORY – I (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0: 0 : 2 : 1
Type : Practical	Total Contact hours:	**45 Hours**

Prerequisites

The student should have undergone the course: Nil

List of Experiments

1. Casting of Aluminum wheel
    a. Review of melting properties of metal, Ex. Cast iron , steel, Aluminum
    b. Review of pattern allowances and pattern design
    c. Manufacture of pattern for the given cast product
    d. Preparation of mould cavity (with core, if needed)
    e. Casting of Aluminum wheel
2. Welding of support bracket
    a. Cutting of flats and preparation of weld edges
    b. Review of weld parameters
    c. Welding and finishing the component to the design requirement
3. Forging of wheel shaft
    a. Review of forging parameters for the given component
    b. Upsetting of pin head
    c. Punching hole for split pin
4. Fabricating sheet metal guard for the wheel
    a. Development of surface of the metal guard
    b. Forming the sheet to the required geometry
5. Assembly of castor wheel and validating for functional requirement

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Course Code: 140AU0208	**Course Title :** COMPUTER AIDED DRAFTING AND MODELING LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0: 0 : 2 : 1
Type : Practical	Total Contact hours:	**45 Hours**

Prerequisites

The student should have undergone the course: Nil

Course Objectives

The course is intended to:

1 .Develop part and assembly models using CAD Software.

2 .Prepare production drawing for manufacturing process using CAD software.

UNIT I STANDARDS, SYMBOLS & CONVENTIONS 6

Conventional representation of machine components and materials, Designation of Standard parts - keys, pin joints, fasteners, hexagonal and square head bolts and nuts, conventional representation of threads. BIS codes for practice of Machine Drawing - Dimensioning, abbreviations and conventions, welding symbols, surface finish symbols, screws, bolts, nuts and rivets.

UNIT II CAD SOFTWARE FEATURES 12

Capabilities of CAD software - Parametric modeling-Concepts, 3D software packages features-reference planes – 2D sketching tools - relationships and constraints -partmodelling tools – extrusion, revolve, sweep – modifying tools.

UNIT III DEVELOPMENT OF PARTAND ASSEMBLY MODELS 12

Drawing front view, top view and side view of objects from the given pictorial views. Preparation of 2-D drawings of standard machine elements.-Assembly tools features of modelling software. Creation of assembly models with functional features.

UNIT IV PART DRAWING OF MACHINE COMPONENTS 9

Create part drawing using CAD software with manufacturing considerations. Exercise on bolt & nut (square and hexagon), studs and washers. Exercise on different types of keys, screws, spring etc.

UNIT- V PRODUCTION DRAWING 6

Preparation of Production drawing - Multiple views of part modelsand machine components –Bill of materials - Drawing Layout.

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List of Experiments

1. Preparation of isometric view for the orthographic views of simple parts
2. Exercise on square, hexagonal bolt and nuts
3. Exercise on different types of keys
4. Exercise on screws , rivets and springs
5. Preparation of part drawing - aluminum wheel.
6. Preparation of part drawing - support bracket
7. Preparation of part drawing -sheet metal guard
8. Preparation of Assembly drawing - castor wheel
9. Preparation of production drawing -aluminum wheel assembly

Course Outcomes

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

CO1 .Develop part and assembly models using CAD Software.

CO2 .Prepare production drawing for manufacturing process using CAD software.

Text Books

1. Gopalakrishna,K.R, "Machine Drawing", 16th Edition Subhas publishing House, Bangalore, 2002 .
2. Maitra Prasad, "Hand Book of Mechanical Design", Second edition, Tata McGraw Hill, Noida 1995.

References

1. Cencil Jensen, Jay D. Helsel and Dennis R. Short Engineering Drawing and Design. Tata McGraw Hill Publishing Company Limited (2012).
2. Sidheswar.N, Kannaiah.P, Sastri.V.V.S "Machine Drawing", Reprint, TMH, New Delhi 2006.
3. Faculty of Mechanical Engineering,"PSG Design Data Book", DPV Printers, Coimbatore 2006.

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Course Code: 140AU0209	Course Title : SPORTS FOR WELLNESS (Common to Automobile and Mechanical)	
Core / Elective: Core	L: T : P: C	0 : 0 :2 : 1
Type : Practical	Total Contact hours:	36 Hours

Course Objectives

The course is intended to:

1. Explain the significance of physical fitness for healthy living
2. Maintain physical fitness through exercises
3. Exhibit mental agility

Course Content

UNIT I HEALTH

Meaning of health - Components of health - physical, mental, social, emotional, spiritual - importance of health - Personal hygiene - Heredity and environment –Adopting healthy habits

UNIT II FITNESS & WELLNESS

Fitness and wellness – what is physical fitness - categories - components of health related physical fitness- components of skill related physical fitness-values of physical fitness – Physical fitness development.

What is wellness - importance of wellness for engineers –factors promoting wellness – Physiology and health: cardio-respiratory, muscular and nervous systems – ageing

UNIT III FOOD & HEALTH

Energy balance and body composition – nutrients- problems of surplus and deficiency - balanced diet - good food habits for better health – hazards of junk food - food and the gunas.

UNIT IV FITNESS DEVELOPMENT I

Exercises related ailment and injuries - safety and precautions - first aid.

Muscular strength – exercises (calisthenics): pull-up, sit-up, push-up and weight training.

Explosive power – exercises: vertical jump, long jump, Cardio respiratory endurance– exercises: walking, jogging, treadmill, stair climbing, bicycling, skipping. Flexibility – exercises: stretching

UNIT V FITNESS DEVELOPMENT II

Speed, agility, balance and coordination – exercises: sprint, cone drill, ladder drill, hurdle drill, ball throw - mental agility tests.

Dexterity - 12 minutes cooper test – long run – adventure games.Team games.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the significance of physical fitness for healthy living

CO2. Maintain physical fitness through exercises

CO3. Exhibit mental agility

References

1. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English)
2. Padmakshan Padmanabhan, Handbook of Health & Fitness, Indus Source Books, First Edition, 2014.

OPERATIONAL MODALITIES WITH PROGRAM SCHEDULE

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Special lectures by invited resource persons at semester beginning (for Units I, II, III)
3 lectures x 4 hours = 12 hours

Practical: 2 hours/week; (6th and 7th hour)
12 weeks x 2 hours/week = 24 hours

Evaluation: Unit I, II, III = Theory
Unit IV and V = Practical
Mid semester: Written (objective type and short answers) and Exercises: (40% weightage)
End semester exam: Written and exercises: (60% weightage)
Criteria for passing: 50% put together.

MEASUREMENTS: At the Beginning + At Semester End

SCHEDULE OF EXERCISES FOR STUDENTS WITH DIFFERENT PHYSICAL CONDITIONS

Underweight	Normal	Obese
Flexibility exercises - stretching	Flexibility exercises - stretching	- Brisk walking
Minor games -forward running relay -backward running relay - over&under relay -circle games, etc.	-Walking - Walking-cum-jogging	- Minor games -
Strength Training - Calisthenics	Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling - long distance running	flexibility exercises - stretching - Cycling (static)
Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling	Agility - ladder drills - hurdle drill - cone drill	Cardio/Functional Fitness Skipping Jogging bicycling
Agility exercises - ladder drills - hurdle drill - cone drill	Strength Training -Calisthenics -gym workout for major muscles	Strength Training - Calisthenics - gym workouts
Diet Considerations	Diet considerations	Diet considerations
Measurements		
BMI Hand grip strength test 12 m Cooper run Sit & reach	BMI 12 m Cooper run Sit & reach test Illinois agility test	BMI Body fat percentage Waist-to-hip ratio Sit & reach

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END OF SEMESTER- II

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SEMESTER III

Course Code: 140AU0301	**Course Title :** ENGINEERING MATHEMATICS- III (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Mathematics- I
- Engineering Mathematics- II

Course Objectives
The course is intended to:

1. Compute the Fourier series expansion for given periodic functions.
2. Compute the Fourier transform for aperiodic functions.
3. Determine the solution of first and second order PDE.
4. Solve the one dimensional wave equation.
5. Solve one dimensional and two dimensional heat flow equations.

Course Content **Hours**

UNIT I FOURIER SERIES **12**

Periodic function - general Fourier series- Dirichlet's conditions- Euler's formulae - Fourier series expansion for a given periodic function - Fourier series expansion for a odd or even periodic function - half range Fourier cosine and sine series expansion for a given function - Parseval's identity.

UNIT II FOURIER TRANSFORM **12**

Fourier transforms - Fourier cosine and sine transforms - Inverse transforms - Convolution theorem and Parseval's identity for Fourier transforms.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV SOLUTION OF ONE DIMENSIONAL WAVE EQUATION **12**

Method of separation of variables - Classification of second order linear partial differential equations - Variable separable solution of one dimensional wave equation.

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UNIT V SOLUTION OF ONE AND TWO DIMENSIONAL HEAT FLOW EQUATION **12**

One dimensional equation of heat conduction - Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) - Variable separable solutions of the heat equation.

Course Outcomes

At the end of the course students will be able to:

CO1. Compute the Fourier series expansion for given periodic functions.
CO2. Compute the Fourier transform for aperiodic functions.
CO3. Determine the solution of first and second order PDE.
CO4. Solve the one dimensional wave equation.
CO5. Solve one dimensional and two dimensional heat flow equations

TEXT BOOK

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, Wiley India, 2007.

REFERENCES

1. Grewal B.S. "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40thEdition, 2007.
2. Bali &Iyengar, "A Text Book of Engineeing Mathematics", Laxmi Publications (P) Ltd, New Delhi, 7th Edition, 2007.
3. Ramana B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2008.

WEB REFERENCES

- http://nptel.ac.in/video.php?subjectId=122107036

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Course Code: 140AU0302	**Course Title :** ENGINEERING THERMODYNAMICS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Applied Physics
- Applied Chemistry

Course Objectives

The course is intended to:

1. Explain the basic concepts of thermodynamics and gas properties.
2. Apply the first law of thermodynamics to closed and open systems viz. Nozzle, diffuser, compressor, turbine, pump and heat exchanger.
3. Use second law of thermodynamics and the concept of entropy for evaluating the performance of heat engine, refrigerator and eat pump.
4. Evaluate the performance of vapor power cycles viz. Rankine, reheat and regenerative cycles.
5. Estimate the heating and cooling loads for automotive, domestic and industrial air conditioning systems.

Course Content **Hours**

UNIT I BASIC CONCEPTS 9+3

Concept of continuum, classical and statistical thermodynamics, thermodynamic systems, concept of equilibrium, zeroth law of thermodynamics, quasi static process, thermodynamic equilibrium, state, path, process and cycle, point function and path function, properties of system, first law of thermodynamics, types of work, problems on heat and work interactions. Properties of Ideal and real gases - Gas laws, Ideal and real gas properties, vander walls equation, generalized compressibility chart – properties of gas mixtures – problems.

UNIT II FIRST LAW OF THERMODYNAMICS 9+3

Steady and unsteady flow processes, steady flow energy equation, first law of thermodynamics to open system viz. nozzles, diffuser, compressor, turbine, pump and heat exchanger. Modes of expansions of gases, first law of thermodynamics to closed (fixed mass) system, PMM-I, limitations of first law of thermodynamics.

UNIT III SECOND LAW OF THERMODYNAMICS 9+3

Need for second law of thermodynamics, Kelvin - Plank and Clausius statements, PMM-II. Carnot cycle, Carnot theorem and irreversibility, Clausius inequality, concept of entropy, entropy analysis for open and closed systems, availability. Heat engine, refrigerator and heat pump -performance.

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UNIT IV PROPERTIES OF PURE SUBSTANCE AND VAPOR POWER CYCLES 9+3

Phase rule, properties of pure substance (water) in three phases - P-V diagram, T-S diagram, H-S diagram, P-V-T surface. Third law of thermodynamics, thermodynamic properties of steam. Vapor power cycles- steam rate, heat rate, efficiency calculation of Rankine, Reheat and Regenerative cycles.

UNIT V PSYCHROMETRY 9+3

Psychrometry- properties, chart, properties of air vapour mixture, property calculations, psychrometric processes - sensible heating and sensible cooling processes, humidification and dehumidification. Heating and cooling loads for Automotive, Domestic and Industrial air conditioning systems.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the basic concepts of thermodynamics and gas properties.
CO2. Apply the first law of thermodynamics to closed and open systems viz. Nozzle, diffuser, compressor, turbine, pump and heat exchanger.
CO3. Use second law of thermodynamics and the concept of entropy for evaluating the performance of heat engine, refrigerator and eat pump.
CO4. Evaluate the performance of vapor power cycles viz. Rankine, reheat and regenerative cycles.
CO5. Estimate the heating and cooling loads for automotive, domestic and industrial air conditioning systems.

TEXTBOOKS

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi,2007.
2. Cengel, "Thermodynamics – An Engineering Approach" 3rd Edition – 2003 – Tata McGraw Hill, New Delhi

REFERENCES

1. Holman.J.P., "Thermodynamics", 3rd Edition McGraw-Hill, 1995.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
3. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

WEB REFERENCES

- http://nptel.ac.in/courses/112105123/1
- https://en.wikipedia.org/wiki/Thermodynamics

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Course Code: 140AU0303	**Course Title :** MANUFACTURING PROCESSES – II (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Processes-I

Course Objectives

The course is intended to:

1. Select appropriate metal cutting processes to manufacture a machined part.
2. Select the metal finishing processes for the given design requirement
3. Develop process sequence for the given machined part
4. Use Lathe, Automat, Drilling and Milling machines
5. Describe modern manufacturing systems like CNC, RP & PM

Course Content **Hours**

UNIT I THEORY OF METAL CUTTING 9+3

Metal removal processes, Orthogonal cutting, Oblique cutting, Cutting tools, Tool geometry of single point cutting tool, Types of chips, Continuous chips, Discontinuous chips, Chips with built up edge, Serrated chips, Characteristics of a cutting tool material, Materials for cutting tool, Mechanics of orthogonal cutting, Velocities in metal cutting, Cutting force, Machinability, Tool life using Taylors equation, Types of tool wear, Functions of cutting fluids, Types of cutting fluids, Introduction to Machine Tools (Rotary / Reciprocating metal cutting)

UNIT II MACHINING CYLIDRICAL FEATURES 9+3

LATHE

Constructional Features, Parts of a Centre lathe, Functions of parts, Operations performed on Centre lathe, Operations, Taper turning methods, Thread cutting methods, Attachments/Accessories, Process parameters in turning and related operations, Calculation of Machining time and power required in lathe, Capstan lathe and Turret lathe, Parts, Functions, Types of automatic lathes, Constructional features of automatic lathes, Turret indexing mechanism, Bar feeding mechanism, Operations performed in semi -automatic and automatic lathes, Tooling layout for machining a job.

DRILLING

Constructional features of drilling machine, upright drilling machine, radial drilling machine, Operations, Drilling, Boring, Reaming, Tapping, Process parameters, machining time, power required

UNIT III MACHINING PRISMATIC COMPONENTS WITH MILLING MACHINES 9+3

Types of milling machines (Column and knee, fixed bed type),Types of milling cutters (Plain, Side, End, Face, Slit, Angle), Nomenclature of milling cutter, Horizontal milling machine, Vertical milling machine, Up milling & Down milling, Slab milling, Face milling, End milling, Straddle milling, Gang milling, Gear Form cutting, Process parameters in Milling, Machining time, Estimation of power required for machining in milling machine

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UNIT IV GRINDING, HONING, LAPPING 9+3

Grinding: Types of grinding machines (Portable, Bench, belt, cylindrical, centreless, surface, internal), Types of grinding wheels (Based on abrasive, bond, grade and structure: Based on shape: Straight, cup, cylinder, dish), Grinding wheel designation, Classification of grinding machines and grinding wheels, Constructional features of cylindrical grinding machines, Surface grinding machines, Significance of cutting speed, feed and depth of cut, Calculation of MRR and machining time.

Honing, Types of honing, Lapping, Types of lapping (Equalising, form), Types of lapping machines, Burnishing, Polishing and Buffing.

UNIT V MODERN MANUFACTURING SYSTEMS 9+3

Fundamentals of NC/CNC Machines, Constructional features, Machining centre, Part programming, Principles of Rapid Manufacturing, Applications in Product Development, Reverse Engineering Introduction to Powder metallurgy, powder milling, compounding, compaction, sintering, heat treatment, applications

Course Outcomes

At the end of the course students will be able to:

CO1. Select appropriate metal cutting processes which involve Lathe, Automat, Drilling and Milling machines to manufacture a machined part.

CO2. Select the metal finishing processes like grinding, honing, burnishing and lapping for the given design requirement

CO3. Develop process sequence for the given machined part

CO4. Use Lathe, Automat, Drilling and Milling machines to manufacture a machined part

CO5. Describe modern manufacturing systems like CNC, RP & PM

TEXTBOOKS

1. Rao P C, "Manufacturing Technology, Vol 2, Metal Cutting and Machine Tools", 2nd Edition, Tata McGraw Hill, New Delhi, 13th reprint 2012
2. Kalpakjian, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company, 3rd edition, 1995.

REFERENCES

1. HMT Bangalore, "Production Technology", McGraw Hill Education Pvt. Ltd., New Delhi, Reprint 2011.
2. Rajput R K, "A Text Book of Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, Reprint 2010
3. Sharma P C, "A Text book of Production Engineering", S Chand & Co Ltd., Reprint 2003
4. Jain R K, "Production Technology", Khanna Publishers, New Delhi, 4th edition, 1999
5. Roy A Lindberg, "Processes and Materials of Manufacture", PHI, 4th edition, 8th reprint, 1999

WEB REFERENCES

- http://nptel.ac.in/courses/112107144/

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Course Code: 140AU0304	**Course Title :** FLUID MECHANICS AND MACHINERY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Applied Physics
- Engineering Mathematics- I & II

Course Objectives
The course is intended to:

1. Calculate the properties of fluids.
2. Apply the principles of kinematics and dynamics of fluid.
3. Determine flow rates and head losses in viscous and turbulent flows.
4. Evaluate the performance of turbines
5. Evaluate the performance of pumps

Course Content **Hours**

UNIT I FLUID PROPERTIES AND STATICS 9+3

Fundamental Units and Dimensions, Properties-mass density, specific weight, specific gravity, specific volume, surface tension, capillarity and compressibility- Problems, Viscosity- Newton's law of viscosity and dynamic viscosity, kinematic viscosity - Problems, types of Fluids, concept of Continuum, Statics - Pressure, Pressure head, Pascal's law- Problems, Simple and differential manometers- Problems, Centre of pressure and total pressure- Problems, buoyancy- Problems.

UNIT II PRINCIPLES OF KINEMATICS AND DYNAMICS IN FLUID FLOW 9+3

Types of Fluid flow-Steady, unsteady, uniform, non-uniform, Laminar, turbulent, rotational, ir-rotational, compressible, incompressible, 1D, 2D and 3D flows, application of control volume to continuity equation, Kinematics-Lagrangian and Eularian approach – Stream lines, path lines and streak lines, Dynamics-Euler's equation (Bernoulli's equation)-applications-Venturimeter Orificemater and pitot tube - Problems, Velocity and Acceleration of fluid flow, Newton's second law of motion - momentum equation for a fluid- Problems, Moment of momentum equation, Boundary layer Theory.

UNIT III FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS 9+3

Hagen Poiseulle's formulae- Problems in Viscous flow through pipes, Major Head losses in pipes - Darcy Weisbach's equation, Chezy's equation- Problems, Minor losses in Pipe bent, entry, exit, sudden enlargement, sudden contraction – Problems, Flow through Pipes - series pipe, Equivalent pipe, Parallel pipe, Branch pipe, Hydraulic Gradient line and total energy line, Dimensional Homogeinity and Buckingham's π Theorem– Problems, Dimensionless numbers, Model analysis, Similarities.

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UNIT IV HYDRAULIC TURBINES 9+3

Impact of jets - Stationary vertical plates, Stationary curved plates, Moving vertical Plate, Moving curved plate – Problems, Turbines - working principles, classification, Draft tube, heads and efficiency, specific speed, unit quantities, Velocity triangle- impulse and reaction turbines, Work done and Power delivered by the turbine- Performance of turbines.

UNIT V HYDRAULIC PUMPS 9+3

Centrifugal pumps - working principle and types, specific speed, unit quantities, heads and efficiency, Priming, Cavitation, Performance curves, Net Positive Suction Head, Reciprocating pump and rotary pump – working, types, Performance of positive displacement pumps

Course Outcomes

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

CO1. Calculate the properties of fluids.
CO2. Apply the principles of kinematics and dynamics of fluid.
CO3. Determine flow rates and head losses in viscous and turbulent flows.
CO4. Evaluate the performance of turbines
CO5. Evaluate the performance of pumps

TEXTBOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd.,
   New Delhi, 2005.
2. Yunus Cengel, John Cimbalal , "Fluid Mechanics- Fundamentals and Applications", Tata McGraw-Hill Education, 2013.

REFERENCES

1. Rajput, R.K., "A Text Book of Fluid Mechanics" ,Chand S and Co., New Delhi - 2007
2. Som S. K, Biswas G " Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2008
3. Ramamritham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 1988.
4. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 1995.

WEB REFERENCES

- http://nptel.ac.in/courses/112105171/1

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Course Code: 140AU0305	Course Title : IC ENGINES	
Core / Elective: Core	L: T : P: C	2 : 0 : 2 : 3
Type :Theory & Practical	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Applied Physics

Course Objectives

The course is intended to:

1. Compare the construction and working principles of IC Engines
2. Compare the thermodynamic parameters of engine operating cycles (Otto & Diesel)
3. Explain the working principle of subsystems of IC engines
4. Describe the influences of combustion chamber geometry on combustion
5. Select the appropriate cooling and lubrication system for low power and high power application
6. Choose the suitable IC engines for ON road vehicles based on load and speed

Course Content **Hours**

UNIT I CONSTRUCTION AND WORKING OF IC ENGINES 6+6

Heat engine – types. IC Engine – Classification – Reciprocating engine – Terminologies. SI Engine and CI engine – construction – working principle. 2S and 4S Engine – construction – working principle – Port timing diagram – Valve timing diagram. Engine operating cycle – Air standard cycle – Otto cycle – Diesel cycle – Dual Cycle – Analysis – Problems.

UNIT II INDUCTION AND IGNITION SYSTEM 6+6

Carburetion – Air- fuel ratio – Importance of air fuel mixture – Requirements of air fuel mixture – Simple carburetor – working – Throttle body injection – port injection – direct injection. Fuel injection system – Functional requirements – Working – Inline, rotary and common rail injection systems working – Fuel feed pump – fuel atomizer – injection pump – fuel injector and nozzles. CRDI.Ignition system – Requirements – Ignition timing – Spark advance mechanism – Centrifugal and vacuum advance mechanism – Classification of ignition system – Battery coil, magneto, CDI and Distributor-less –Construction – working. Spark plug – Working.

UNIT III COMBUSTION AND COMBUSTION CHAMBERS 6+6

Richard's combustion theory – SI Engine – Combustion Stages – Ignition delay and its influence n combustion – factors influences on SI Engine combustion – knocking – engine variables on knocking. SI Engine combustion chamber – Types.CI Engine – combustion stages – factors affecting delay period – abnormal combustion. CI engine combustion chambers – classification – factors controlling combustion chamber design. Air motion – importance – swirl, squish, and turbulence.

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UNIT IV COOLING AND LUBRICATION SYSTEMS 6+6

Cooling System: Engine heat transfer – importance of heat transfer – importance of cooling– under cooling – over cooling – Cooling system – classification – air cooling system – liquid cooling system –coolant properties – thermostat – thermosyphon – forced circulation cooling – evaporative cooling – components – working – Advantages – disadvantages.Lubrication System: Friction on engine components – factors influence the engine friction – need for lubrication – Stribeck Curve – classification – mist lubrication – dry sump lubrication – wet sump lubrication – working.

UNIT V SUPERCHARGER, TURBOCHARGER AND ENGINE TESTING 6+6

Need for supercharging – supercharger – turbocharger – methods – working – advantages and disadvantages. Engine testing – engine specification – performance parameters - Power – Torque – specific fuel consumption – mean effective pressure – efficiencies – dynamometers – rope brake dynamometer – eddy current dynamometer – fuel consumption measurement – engine speed measurement – air consumption measurement – brake power measurement – engine testing procedure – engine testing standards – engine speed and vehicle speed relation.

Course Outcomes

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

CO1. Compare the construction and working principles of IC Engines
CO2. Compare the thermodynamic parameters of engine operating cycles (Otto & Diesel)
CO3. Explain the working principle of subsystems of IC engines
CO4. Describe the influences of combustion chamber geometry on combustion
CO5. Select the appropriate cooling and lubrication system for low power and high power application
CO6. Choose the suitable IC engines for ON road vehicles based on load and speed

TEXTBOOKS

1. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 2007.
2. Ramalingam K.K., "Internal Combustion Engines", Sci-Tech Publications, 2005.
3. Mathur P.L and Sharma, "Internal Combustion Engines", Dhanpat Rai and Sons, 2002.

REFERENCES

1. John B. Heywood, "Internal Combustion EnginesFundamentals",McGraw Hill, New York, 2011.
2. Richard stone, "Introduction to Internal Combustion Engines",4th edition, SAE International and Macmillan Press, 2012.
3. Willard W. Pulkrabek, "Engineering Fundamentals of the Internal Combustion Engine", Pearson Prentice Hall, 2004.
4. Martyr A.J.Plint M.A."Engine Testing: Theory and Practice",Butterworth-Heinemann publications, 2007.

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LIST OF EXPERIMENTS

1. Demonstration of single cylinder engine components assembly
2. Plot valve timing and port timing diagram
3. Study of Induction and Ignition system using demo kit
4. Study of cooling and lubrication system components

CASE STUDIES

1. Construction and Working of IC Engine (Ex: DTSi, VVT)
2. Cooling and Lubrication system used for low power engines.
3. Interpretation of vehicle manufacturing engine specification based on load and speed.

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Course Code: 140AU0306	Course Title : AUTOMOTIVE ELECTRICAL AND ELECTRONICS – I	
Core / Elective: Core	L: T : P: C	2 : 1 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Applied Physics

Course Objectives

The course is intended to:

1. Calculate the electrical parameters in a given circuit
2. Describe and differentiate the architecture of Microprocessor and Microcontroller
3. Explain the construction, working and characteristics of battery charging system
4. Calculate the torque of DC Electrical motors that drive automotive systems
5. Explain the characteristics of AC Electrical motors
6. Choose the Electrical wires, fuses and lighting systems for given load rating

Course Content **Hours**

UNIT I CIRCUIT ANALYSIS **6+3**

Circuit reduction: Series, parallel and combinational Resistance circuit-Star circuit to Delta circuit-delta circuit to star circuit-voltage and current divider rule-mesh, super mesh, node and super node analysis

UNIT II ELECTRONICS AND MICROPROCESSOR **6+3**

Logic gates: AND, OR, NOT, NAND, NOR, Circuit reduction using karnaugh map, Half Adder and Full Adder-Decoder-Encoder-MUX-Demux- flip-flops-4bit counter -Architecture of 8085 Microprocessor and 8051 Microcontroller.

UNIT III BATTERY CHARGING SYSTEMS **6+3**

DC generator-Output emf –Characteristics -Alternator -Output emf -Characteristics-Automobile regulator Functions - Three phase bridge rectifier -Nine diode rectifier-Mechanical and IC Voltage Regulators-characteristics

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UNIT IV ELECTRICAL MOTORS 6+3

DC motor-Armature torque- shunt and series motor characteristics -Brushless DC Motor - Brushless DC (BLDC) Driver circuit - BLDC motor characteristics - Different DC motors torque equations - torque Calculations - Power window-Starting system-torque to drive power window-torque to drive Engine-3phase and single phase AC motor construction and characteristics

UNIT V AUTOMOBILE LIGHTING SYSTEM 6+3

Cables and wiring basics-Voltage and current in serial and parallel connections-voltage drop in a Cable- Wire selection- Wire rating -current flow through the circuit-fuse rating. Lamp: Tungsten halogen, Gas discharge and LED Construction and Working-Lamp glow Current – Parabolic, Bifocal, Homifocal reflector construction and function-Vertical and Horizontal deflector construction and function-plano convex, cylindrical lens and Poly-ellipsoid (PES) construction and function -lamp Location-switching types and switch rating

Course Outcomes

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

CO1. Calculate the electrical parameters in a given circuit
CO2. Describe and differentiate the architecture of Microprocessor and Microcontroller
CO3. Explain the construction, working and characteristics of battery charging system in automobile
CO4. Calculate the torque of DC Electrical motors that drive automotive systems
CO5. Explain the characteristics of AC Electrical motors
CO6. Choose Electrical wires, fuses and lighting systems for given load rating in an automotive vehicle

TEXTBOOK

1. Tom Denton, "Automobile Electrical and Electronic systems", 3rd Edition, Elsevier publications.

REFERENCES

1. Mckenzie Smith I, John Hiley and Keith Brown, "Hughes Electrical and electronics technology", 8th Edition.
2. Cathey J J, Nasar S A, "Basic electrical engineering" by 2nd Edition, McGraw-Hill.
3. Jegathesan V, Vinoth kumar K and Saravana kumar R "Basic electrical and electronics engineering" Wiley India.

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Course Code: 140AU0307	**Course Title :** MANUFACTURING PROCESSES LABORATORY – II (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0: 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Manufacturing Processes laboratory-I

Course Objectives
The course is intended to:

1. Use Lathe, Automat, Drilling and Milling machines to manufacture a machined part
2. Develop process sequence for the given machined part

LIST OF EXPERIMENTS

1. Exercise on Cylindrical Grinding.
2. Exercise on Key-way Milling.
3. Exercise on Spur Gear Cutting.
4. Exercise on Surface Grinding.
5. Exercise on Machining of bolt.
6. Exercise on Shaping- Male dove tail part.
7. Exercise on Shaping-Female dove tail part.
8. Exercise on Drilling, Reaming and Tapping.
9. Exercise on Key-way Machining in Slotting machine.
10. Exercise on Assembly of machined components (includes welding of gear housing)

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

CO1. Use Lathe, Automat, Drilling and Milling machines to manufacture a machined part
CO2. Develop process sequence for the given machined part

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Course Code: 140AU0308	**Course Title :** FLUID MECHANICS AND MACHINERY LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0: 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Applied Physics

Course Objectives
The course is intended to:

1. Evaluate the performance of turbines
2. Evaluate the performance of pumps

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter
3. Determination of the velocity of flow using Pitot Tube
4. Calculation of the rate of flow using Rota meter.
5. Determination of friction factor of given set of pipes.
6. Draw the characteristic curves of centrifugal pump
7. Draw the characteristic curves of reciprocating pump.
8. Draw the characteristic curves of Gear pump.
9. Draw the characteristic curves of Pelton wheel.
10. Draw the characteristics curves of Francis turbine.
11. Draw the characteristic curves of Kaplan turbine.
12. Study of Impact of jets
13. Visualization of Reynolds Number

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

CO1. Conduct tests and evaluate the performance of turbines
CO2. Conduct tests and evaluate the performance of pumps

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Course Code: 140AU0309	**Course Title :** PERSONAL EFFECTIVENESS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 2 : 1
Type : Practical	Total Contact hours:	30 Hours

Course Objectives

The course is intended to:

1. Identify the strengths, weaknesses and opportunities
2. Set well-articulated goals for academics, career, and personal aspirations
3. Establish the road map to realize the goals
4. Apply time management techniques to complete planned tasks on time
5. Create time and pursue activities of self-interest that add value

Course Content

UNIT I THE IMPORTANCE OF ENVISIONING

Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people – Importance of goal setting –Importance of planning and working to time

UNIT II FUNDAMENTAL PRINCIPLES OF GOAL SETTING AND WORKING TO TIME

Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, what you see depends on the role you assume

UNIT III GOAL SETTING AND ACTION ORIENTATION

Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress

UNIT IV TIME MANAGEMENT - TOOLS AND TECHNIQUES

Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination

UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews

Course Outcomes

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

CO1. Identify the strengths, weaknesses and opportunities
CO2. Set well-articulated goals for academics, career, and personal aspirations
CO3. Establish the road map to realize the goals
CO4. Apply time management techniques to complete planned tasks on time
CO5. Create time and pursue activities of self-interest that add value

Course hand outs (compiled by PS team, MCET)

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1. Learner's workbook
2. Personal efficiency Journal
3. Reading material for Personal Effectiveness

Further Reading:

1. Stephen R Covey, "First things first", Simon & Schuster Uk, Aug 1997.
2. Sean Covey, "Seven habits of highly effective teenagers", Simon & Schuster Uk, 2004.
3. College student's guide to time management (e-book)
4. Michael S Dobson, Susan B Wilson, "Goal setting" (e-book)

Operational modality:

Enablement through learning workshops	Conducted by external experts and trained internal faculty	2 days 7 hours each	14 hours
Progress monitoring (face to face interaction with student and checking workbook/Journal	Internal faculty	1 hour per week for a minimum of 10 weeks	10 hours
Mid semester reinforcement- workshop	External expert	1 day	6 hours
Total			30 hours
No: of credits			1

Assessments:

Assessment	Details	Weightage	Administration	By Whom	When
Knowledge Test*	Multiple choice questions (20)	20%	Pen and paper	Internal team	Immediately after the initial workshop
Final comprehensive Knowledge test*	Multiple choice questions (40)	30%		Internal team	End of semester
Scenario based knowledge test*	Multiple choice scenario responses (15)	30%	Pen and paper	Internal team	Immediately after mid-semester reinforcement
Review of student journal	Student held journal with enough pages for the whole semester	10%	Student journals to be reviewed	Trained Internal faculty	Once in a week.
Review of student journal by external expert		10%	Student journal comprehend sive review	External expert and Internal reviewer	End of semester

*Prepared by external expert team.

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END OF SEMESTER- III

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SEMESTER-IV

Course Code: 140AU0401	**Course Title :** NUMERICAL METHODS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	2 : 2 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites

The student should have undergone the course:

- Engineering Mathematics I
- Engineering Mathematics II

Course Objectives

The course is intended to:

1. Solve the system of linear equations and calculate the dominant Eigen value
2. Solve the non-linear equations and apply the principle of least squares to fit a curve for the given data.
3. Predict the unknown values from the given set of data and to evaluate integrals.
4. Solve first order ordinary differential equation using numerical techniques
5. Solve partial differential equation using numerical techniques.

Course Content **Hours**

UNIT I SOLUTION OF SYSTEM OF LINEAR EQUATIONS 9+3

Solution of system of linear equations-Direct method: Gaussian elimination method, Choleski method, Iterative methods: Gauss-Seidel - sufficient conditions for convergence. Power method to find the dominant Eigen value and the corresponding Eigen vector.

UNIT II SOLUTION OF NON-LINEAR EQUATION & CURVE FITTING 9+3

Solution of non-linear equation: Method of false position - Newton- Raphson method -Order of convergence of these methods. Curve fitting - Method of least squares.

UNIT III NTERPOLATION, NUMERICAL DIFFERENTIATION & INTEGRATION 9+3

Newton's forward, backward interpolation – Lagrange's interpolation. Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 rule – Gaussian two point and three point quadrature formula –Double integration using Trapezoidal rule.

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UNIT IV SOLUTION OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 9+3

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series- Euler's method - Runge-Kutta method of fourth order – Multi step method: Adams' method.

UNIT-V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method.

Course Outcomes

At the end of the course students will be able to:

CO1. Solve the system of linear equations and calculate the dominant Eigen value
CO2. Solve the non-linear equations and apply the principle of least squares to fit a curve for the given data.
CO3. Predict the unknown values from the given set of data's; apply numerical techniques to find derivatives and to evaluate integrals.
CO4. Solve first order ordinary differential equation using numerical techniques
CO5. Solve partial differential equation using numerical techniques.

TEXT BOOKS

1. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", First Edition, Oxford University Press, New Delhi, 2015.
2. Grewal, B.S. and Grewal, J. S., "Numerical Methods in Engineering and Science", Sixth Edition, Khanna Publishers, New Delhi, 2004.

REFERENCES

1. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.
2. Jain M. K., Iyengar, S. R. and Jain, R. K, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Company.

WEB REFERENCES

- http://nptel.ac.in/courses/122102009/

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Course Code: 140AU0402	**Course Title :** STRENGTH OF MATERIALS (Common to Automobile and Mechanical Engineering)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites

The student should have undergone the course:

- Engineering Mechanics

Course Objectives

The course is intended to:

1. Calculate the stresses and strains on normal and inclined plane of a structural member.
2. Determine and illustrate shear force, bending moment and deflections of beam structures.
3. Analyze the torsion of shafts and springs.
4. Analyze columns subjected to buckling loads.
5. Calculate the stresses and strains associated with thin-wall cylindrical pressure vessels.

Course Content **Hours**

UNIT I STRESS AND STRAIN OF SOLIDS 9+3

Rigid body and deformable body, Stiffness - types of stresses and strains-stresses in simple and compound bars under axial load- factor of safety- Poisson's ratio- elastic constants - Modulus of Elasticity- bulk Modulus- modulus of rigidity-Relationship between elastic constants- temperature stress and strain- Strain energy .

UNIT II ANALYSIS OF STRESSES IN TWO DIMENSIONS 9+3

Stresses on inclined planes-principal planes and stresses-Mohr's circle for biaxial stresses (Concepts only), Truss- Method of joints. Thin wall pressure vessel and it types- The Longitudinal Stress - Hoop stress - application - Stresses and Strain in cylindrical thin shells

UNIT III BEAMS - LOADS AND STRESSES 9+3

Beam- Types of beams- transverse loads and its types- Shear force and bending moment - cantilever simply supported beams and overhanging beams (simple problems only).
Theory of simple bending - bending equation – bending stress -Neutral axis – transverse shear stress - shear stress for I section and T section of beams.

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UNIT IV DEFLECTION OF BEAM AND COLUMN 9+3

Deflection beams- Macaulay's method, Moment area method Failure of a column-Euler's Column Theory - Limitation of Euler's formula- End conditions for long columns- Effective length-Slenderness Ratio- Rankine's formula.

UNIT V TORSION 9+3

Torsion- assumptions in the theory of pure torsion- torsional rigidity – torque transmitted by a solid and hollow bar of circular cross section- torque transmitted by a stepped shaft - torque transmitted by a compound shafts. Springs and its types- close coil Helical springs subjected to compressive loads

Course Outcomes

At the end of the course students will be able to:

CO1. Calculate the stresses and strains on normal and inclined plane of a structural member subjected to external loading such as axial loads and thermal loads.
CO2. Determine and illustrate shear force, bending moment and deflections of beam structures experiencing a combined loading.
CO3. Analyze the torsion of shafts and springs.
CO4. Analyze columns subjected to buckling loads.
CO5. Calculate the stresses and strains associated with thin-wall cylindrical pressure vessels.

TEXT BOOKS

1. Hibbeler RC, "Mechanics of Materials", Prentice-Hall of India, New Delhi, 2013.
2. James M Gere, "Mechanics of Materials", Cengage Learning, India, 2012.

REFERENCES

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997
2. Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.
3. Nash W.A, "Theory and Problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995

WEB REFERENCES

- http://nptel.ac.in/courses/112107147/

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Course Code: 140AU0403	Course Title : ENGINEERING METALLURGY (Common to Automobile and Mechanical)	
Core / Elective: Core	L: T : P: C	3 : 0 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Material Science

Course Objectives

The course is intended to:

1. Analyze a phase diagram and explain iron-carbon equilibrium diagram.
2. Select an appropriate heat treatment process.
3. Select an appropriate surface treatment process
4. Choose an appropriate alloying element for a given ferrous alloy.
5. Choose an appropriate alloying element for a given nonferrous alloy.

Course Content **Hours**

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

Constitution of alloys- Solid solutions- Substitutional and Interstitial . Phase diagrams- Interpretation of Phase diagram, Lever rule, Gibbs phase rule. cooling curve for pure metal, binary solid solution and binary eutectic system. Iron – Iron Carbide equilibrium diagram. Micro constituents in Fe_3C diagram (Austenite, Ferrite, Cememtite, Pearlite, Martensite, Bainite) Pearlite transformation.

UNIT III HEAT TREATMENT **9**

Heat treatment process-purpose heat treatment. Types of heat treatment: Full Annealing, Process annealing, Stress relief annealing, Speroidising, Isothermal annealing Normalizing, Hardening, Tempering of steel-Low tempering, medium tempering, high tempering. Austempering and Martempering .Quenching and quenching media. Isothermal transformation Diagram(TTT Diagram). Cooling curves superimposed on TTT diagram.CCR. Hardenability- Definition. Method to determine Hardenability- Jominy end quench test. Ideal Critical diameter.

UNIT III SURFACE TREATEMENT **9**

Surface treatment process – Purpose of surface treatment .Case hardeneing- Carburizing-types- Pack carburizing Liquid carburizing, Gas carburizing, Nitriding ,Cynaiding, Flame and Induction hardening-working principle, merits, demerits and applications.

UNIT IV FERROUS ALLOYS **9**

Ferrous metals-Definition .Steel - Types (Low carbon, medium carbon and High carbon steels). Effect of alloying elements on properties of steel (Ms, Si, Cr, Mn, Va and W). Properties and applications of Stainless Steel and Tool steel. HSLA steels- Maraging steels. TRIP steels. Cast Iron-Types - White, Malleable, Grey and Spheroidal – Microstructure, properties and applications.

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UNIT V NON-FERROUS ALLOYS 9

Non-ferrous metals – Types – Aluminium and its alloys -Designation system, Copper and its alloys, Nickel and its alloys Magnesium and its alloys, Titanium and its alloy – Composition, Properties, Applications.

Course Outcomes

At the end of the course students will be able to:

CO1. Analyze a phase diagram and explain iron-carbon equilibrium diagram.
CO2. Select an appropriate heat treatment process to impart a desired property for a given ferrous alloy and determine its hardenability.
CO3. Select an appropriate surface treatment process for ferrous and non-ferrous alloys.
CO4. Choose an appropriate alloying element to impart a desired property for a given ferrous alloy.
CO5. Choose an appropriate alloying element to impart a desired property for a given nonferrous alloy.

TEXT BOOKS

1. William D Callister "Material Science and Engineering", John Wiley and Sons 2010.
2. Anup Goel,S.S.Sabharwal, "Engineering Materials and Metallurgy", Technical Publication 2014

REFERENCES

1. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
2. Dieter G. E., "Mechanical Metallurgy", Mc Graw Hill Book Company, 2006.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.

WEB REFERENCES

- http://nptel.ac.in/courses/113106032/
- http://www.nptel.ac.in/courses/112108150/
- https://en.wikipedia.org/wiki/Materials_science

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Department of Automobile Engineering
Dr. MCET, Pollachi - 642 003.

Course Code: 140AU0404	**Course Title :** KINEMATICS OF MACHINES	
Core / Elective: Core	**L: T : P: C**	3 : 0 : 2: 4
Type : Theory & Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Mechanics

Course Objectives
The course is intended to:

1. Calculate the degrees of freedom of simple mechanisms.
2. Calculate the velocity and acceleration of various links of simple mechanisms.
3. Develop cam profile for different follower motions.
4. Calculate the kinematic parameters of gears
5. Calculate the kinematic parameters of gear trains

Course Content **Hours**

UNIT I INTRODUCTION TO MECHANISMS **6+2**

Mechanism, machine and structure, constrained motion and its types, working of simple mechanisms such as Four bar mechanism, single slider crank mechanism, double slider crank mechanism and their inversions, Kutzbach criterion, Grubler's criterion, Grashof's law, Degree of freedom of simple mechanisms.

UNIT II VELOCITY AND ACCELERATION IN SIMPLE MECHANISMS 12+4

Linear and angular velocities, absolute and relative velocities, rubbing velocity, Graphical method: Relative velocity and instantaneous centre method for four bar mechanism and single slider crank mechanism.Tangential, radial and Coriolis components of acceleration, Graphical method acceleration of the links, Expressions for the position, velocity and acceleration of the links in a Slider crank mechanism

UNIT III DESIGN OF CAM PROFILE **9+3**

Types of cams, types of followers, radial cam, terminology of radial cam, types of follower motions: uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, cam profile for knife edge, roller and flat faced follower – Graphical method

UNIT IV KINEMATICS OF GEARS **9+3**

Types of gears, spur, Helical, Bevel and worm gear terminologies, law of gearing, Conjugate action and conjugate curves, merits and demerits of involute and cycloidal profiles, length of path of contact, length of arc of contact, contact ratio, interference and undercutting, Minimum number of teeth on the pinion to avoid Interference

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UNIT V KINEMATICS OF GEAR TRAINS 9+3

Classification of gear trains, calculation of Gear ratio, number of teeth for the gears in the gear trains, velocities of the gears in gear trains such as Simple, Compound, Reverted & Epicyclic (using tabulation method) gear trains, Differential gear train.

Course Outcomes

At the end of the course students will be able to:

CO1. Calculate the degrees of freedom of simple mechanisms.
CO2. Calculate the velocity and acceleration of various links of simple mechanisms.
CO3. Develop cam profile for different follower motions.
CO4. Calculate the kinematic parameters of gears
CO5. Calculate the kinematic parameters of gear trains such as simple, compound and epicyclic gear trains.

TEXT BOOKS

1. Rattan SS, "Theory of machines" – Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009.
2. Ambekar A.G., "Mechanism and machine Theory", Prentice Hall of India New Delhi, 2007.

REFERENCES

1. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009..
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.

LIST OF EXPERIMENTS

1. Study of mechanisms and their inversions
   a. Four bar mechanism
   b. Crank lever mechanism
   c. Double crank mechanism
2. Computer simulation of simple mechanisms
3. Cam analysis
4. Kinematics of gear trains
   a. Compound gear train
   b. Epicyclic gear train
   c. Differential gear train

S S R Ganjolle

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Department of Automobile Engineering
Dr. MCET, Pollachi - 642 003.

Course Code: 140AU0405	Course Title : AUTOMOTIVE FUELS AND LUBRICANTS	
Core / Elective: Core	L: T : P: C	2 : 0 : 2 : 3
Type :Theory & Practical	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Applied Chemistry

Course Objectives

The course is intended to:

1. Describe the petroleum oil refining process and manufacturing process of lubricants.
2. Demonstrate the testing of procedures of fuels and lubricants as per ASTM standard.
3. Calculate the combustion properties A/F ratio, enthalpies of formation and combustion products composition.
4. Explain the effect of additives for fuels and lubricants.

Course Content **Hours**

UNIT I INTRODUCTION **9**

Crude petroleum – structure – constituents – refining process – thermal cracking, catalytic cracking, polymerisation, alkylation, isomerisation, reforming, blending – products of refining process.

Lubricant – base stocks – classification – grades of base stocks – viscosity – properties of base stock – base oil processes – manufacturing process of lubricants.

UNIT II FUELS AND TESTING **15**

Automotive fuel – classifications – diesel, petrol, biodiesel, LPG & CNG – chemical composition – ASTM testing – octane number – self ignition temperature – cetane number – distillation temperature measurement – viscosity measurement – flash point & fire point measurement – calorific value measurement – aniline point measurement – effects of fuel properties on engine performance.

UNIT III COMBUSTION OF FUELS **12**

Flames – classification. Combustion – stoichiometry – A/F ratio calculation – enthalpies of formation – heating values – adiabatic combustion process – combustion products – composition calculation.

UNIT IV LUBRICANTSAND TESTING **15**

Lubricants – Classification – components of lubricants – functions – selection of lubricating oils – properties – nomenclature and specifications – SAE Rating – synthetic lubricants – grease – properties – NLGI Numbers – ASTM testing – viscosity measurement – flash point & fire point measurement – pour point & cloud point measurement – effects of lubricant properties on engine performance.

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UNIT V ADDITIVES 9

Fuel additives – gasoline additives – anti-static additives – metal deactivators, dyes – de-mulsifiers – corrosion inhibitors – oxidant additive – antioxidants – anti-valve seat recession additives – deposit control additives. Diesel additives – wax crystal modifiers/middle distillate flow improvers – Wax Anti-Settling Additives, corrosion inhibitors – de-mulsifiers – antifoams – diesel fuel stabilizers – color stabilizers – detergents – Cetane improvers – lubricity improvers.

Lubricant additive – need of additives – functions – anti-wear & EP Agent – corrosion and Rust Inhibitor – detergents – dispersant – friction modifier – pour point depressant – seal swell agent – viscosity modifier – anti-foamant – antioxidant.

Course Outcomes

At the end of the course students will be able to:

CO1. Describe the petroleum oil refining process and manufacturing process of lubricants.

CO2. Demonstrate the testing of procedures of fuels and lubricants as per ASTM standard.

CO3. Calculate the combustion properties A/F ratio, enthalpies of formation and combustion products composition.

CO4. Explain the effect of additives for fuels and lubricants

TEXTBOOKS

1. V. Ganesan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 2007.
2. P.L.Mathur and Sharma, "Internal Combustion Engines", Dhanpat Rai and Sons, 2010.

REFERENCES

1. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw Hill, New York, 2011
2. George E. Totten, "Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing", ASTM International, 2003
3. Surinder Parkash, "Petroleum Fuels Manufacturing Handbook", McGraw-Hill, New York, 2010.

LIST OF EXPERIMENTS:

1. ASTM distillation test of liquid fuels
2. Aniline point test of diesel
3. Calorific value of liquid fuel.
4. Flash and fire points of petrol and diesel.
5. Cloud and pour point Test.
6. Temperature dependence of viscosity of lubricants by Redwood viscometer.
7. Viscosity index of lubricants by Saybolt viscometer
8. Study of ASTM standard test method for dropping point of lubricating grease

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Course Code: 140AU0406	**Course Title :** AUTOMOTIVE CHASSIS	
Core / Elective: Core	**L: T : P: C**	3: 0 : 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Engineering Mechanics
- Strength of Materials

Course Objectives

The course is intended to:

1. Illustrate the various types of chassis frames
2. Illustrate the different types of steering system
3. Explain the construction and working details of axles, wheels and tyres
4. Describe the influence of suspension system on vehicle comfort
5. Compare the construction and working principles of various braking system

Course Content **Hours**

UNIT I FRAMES **9**

Classification of Automobile based on load carrying capacity, Types of chassis layout with reference to power plant locations, drives, number of driving wheels and based on load control,vehicle frames, Loads on frames, various types of frames – Conventional, Integral frame, tubular frame - constructional details, defects in chassis frames, unitized frame body construction.

UNIT II AXLES, WHEELS AND TYRES **9**

Types of front axles and constructional and working details. Construction of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three – Quarter Floating and Semi – Floating Axles, stub axle – types and constructional details, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Tyre nomenclature, Different Types of tyres and their constructional details

UNIT III STEERING SYSTEM **9**

Steering system- purpose, requirements, working mechanism and steering parts, front wheel geometry: castor, camber, king pin inclination, toe-in. conditions for true rolling motion of wheels during steering, steering geometry, Ackermann and Davis steering system, constructional details of steering linkages, Construction and working of different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering-Principle and Types.

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UNIT IV SUSPENSION SYSTEM 9

Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, independent suspension, pneumatic suspension, MR fluids, semi and fully active suspension system, shock absorbers – types and constructional details.

UNIT V BRAKING SYSTEM 9

Theory of braking – Purpose, requirements, stopping distance, braking torque, stopping time and braking efficiency, Effect of weight transfer during braking, classification of brakes, drum brakes and disc brakes, constructional details, concept of dual brake system, parking brake, mechanical braking system, hydraulic system, vacuum assisted system, air brake system, regenerative braking system, antilock braking, EBD, ESC

Course Outcomes

At the end of the course students will be able to:

CO1. Illustrate the various types of chassis frames based on load and terrain conditions
CO2. Illustrate the different types of steering system with its steering mechanism
CO3. Explain the construction and working details of axles, wheels and tyres
CO4. Describe the influence of suspension system on vehicle comfort
CO5. Compare the construction and working principles of various braking system

TEXT BOOKS

1. Heinz heizler - "Advanced Vehicle Technology" – ButterworthHeinemann.2002
2. Newton Steeds and Garrot- "Motor Vehicles"- Butterworths, London- 2000

REFERENCES

1. Heldt.P.M.- "Automotive Chassis"- Chilton Co., New York- 1990
2. Judge A.W- "Mechanism of the Car"- Chapman and Halls Ltd., London- 1986
3. Giles.J.G- "Steering, Suspension and Tyres"- Iiiffe Book Co., London- 1988.

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Course Code: 140AU0407	**Course Title :** STRENGTH OF MATERIALS AND METALLURGY LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Course Objectives.

The course is intended to:

1. Demonstrate the basic concepts of strength and mechanics of a given material under external loading
2. Demonstrate the micro structural characterization and the effect of heat treatment on a given material

LIST OF EXPERIMENTS

STRENGTH OF MATERIALS LAB

1. Study of UTM and Test specimen- specification and standards
2. Conduct tension test on the given mild steel rod using universal testing machine for determining the yield stress, ultimate stress, breaking stress, percentage of reduction in area and percentage of elongation over a gauge length and Young's modulus.
3. Conduct shear test on Mild steel and Aluminium rods by Double shear.
4. Calculate the modulus of rigidity of mild steel rod by Torsion test
5. Determine the toughness of the given mild steel specimen using IZOD and CHARPY impact test.
6. Analyse the Hardness Number of metals by Brinell and Rockwell Hardness
7. Determine the flexural rigidity and verify the Maxwell Reciprocal Theorem of given rectangular beam by deflection test.
8. Estimate the stiffness and modulus of rigidity of the helical spring by Compression test.

METALLURGY LAB

9. Prepare a specimen using mounting press for metallographic examination.
10. Draw the microstructure of cast iron, copper and aluminum using Metallurgical microscope
11. Compare the hardness number and impact strength for unhardened, hardened and tempered mild steel specimens
12. Determine the hardenability of steel by Jominy End Quench test

Course Outcomes

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

CO1: Demonstrate the basic concepts of strength and mechanics of a given material under external loading

CO2: Demonstrate the micro structural characterization and the effect of heat treatment on a given material

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Course Code: 140AU0408	Course Title : ENGINE PERFORMANCE AND EMISSION TESTING LABORATORY	
Core / Elective: Core	L: T : P: C	0 : 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Course Objectives

At the end of the course, the students will be able to

CO1: Evaluate the performance of IC engines

CO2: Evaluate the emission characteristics of IC engines

LIST OF EXPERIMENTS

1. Performance and emission test on single cylinder CI engine with rope brake dynamometer
2. Performance and emission test on single cylinder SI engine
3. Performance and emission test for variable compression ratio (coupled with eddy current dynamometer)
4. Performance and emission test on MPFI engine
5. Performance and emission test on CRDI engine
6. Examination of frictional and indicated power in MPFI engine using morse test method
7. Heat balance analysis on single cylinder engine
8. Performance and emission test on turbocharged diesel engine
9. Comparison among performance of electronic fuel injection such as CRDI and MPFI, turbocharged engine and conventional engine
10. Compare the emissions of EFI and conventional type engines with BS IV emission standards

Course Outcomes

At the end of the course, the students will be able to

CO1: Evaluate the performance of IC engines

CO2: Evaluate the emission characteristics of IC engines

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Course Code: 140AU0409	**Course Title** : ETHICAL AND MORAL RESPONSIBILITY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 2 : 1
Type : Practical	Total Contact hours:	30 Hours

Course Objectives

The course is intended to:

1. Articulate the importance of ethical and moral responsibilities.
2. Explain the fundamental aspects of ethical practices.
3. Validate one's appropriate and inappropriate behaviors in various roles.
4. Elaborate code of conduct of professional bodies.
5 Explain the importance of professional practices as a future employee/entrepreneur.

Course Content **Hours**

UNIT I ETHICAL PRACTICES – IMPORTANCE 8

Why ethical practices; The current day scenario of ethical practices – parents, society, politics & business; Awareness of skewedness of information – news, advertisements and other media; The need for ethical and moral responsibility on a personal level; Handling oneself amidst peer pressure and societal pressure;

UNIT II ETHICAL PRACTICES – FUNDAMENTALS 6

Morality & Ethics; Moral issues, inquiry, moral dilemmas; Moral autonomy – Kohlberg's theory and Gilligan's refinement; Theories on "right action" – virtue ethics, utilitarianism, duty ethics, rights ethics – resolving moral dilemmas; justifying moral obligations;

UNIT III CODES OF CONDUCT 8

Importance of code of conduct and its role; Evolving draft Code of conduct for different roles – son/daughter, student, future employee & citizen; Reflection on real time incidences at the college.

Engineers as responsible experimenters; Faith of the Engineer (ABET); Pledge and Code of ethics as per National Society of Professional Engineers (NSPE); Code of Ethics of Institution of Engineers (India); Case studies and discussions in professional context

UNIT IV PROFESSIONAL PRACTICES AT WORK 8

Transition from a student to a professional; Importance of professional practices at work; Integrity as the topmost virtue of a professional; Self-awareness: Where competence ends and professionalism takes over; Professional qualities; Need to align oneself to culture & values of organizations; Need to embrace diversity in organizations.

*- Includes review sessions

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Assessments:

Assessment	Details	Wt:	Administration	When
Class room participation	Group assignments presentation; Case discussions participation	70%	Continuous assessment in class	During class
Knowledge test	Multiple choice questions	10%	Pen and Paper	End of course
Scenario based assessments	Multiple choice questions	20%	Pen and Paper	End of course

No. of hours& credits:

Enablement through class room lecture, case discussions and group presentations	Conducted by trained internal faculty	30 hours – 1 credit
At least two guest lectures	Delivered by senior people from Industries/Government organizations	

COURSE HANDOUTS (compiled by Professional Skills team, MCET)

1. Instructor's Manual (for the faculty)
2. Learner's workbook (for the student)

Course Outcomes

At the end of the course students will be able to:

CO1. Articulate the importance of ethical and moral responsibilities.
CO2. Explain the fundamental aspects of ethical practices.
CO3. Validate one's appropriate and inappropriate behaviors in various roles.
CO4. Elaborate code of conduct of professional bodies.
CO5 Explain the importance of professional practices as a future employee/entrepreneur

REFERENCES

1. Mike W Martin & Roland Schinzenger, Ethics in Engineering, Latest Edition, Tata McGraw-Hill
2. Code of conduct document, MCET student handbook
3. Gail D Baura, Engineering Ethics - an industrial perspective, Academic Press, Elsevier,
4. Subrato Bagchi, The professional - Defining the new standard of Excellence at work, Penguin Books India

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END OF SEMESTER IV

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SEMESTER V

Course Code: 140AU0501	**Course Title :** HEAT AND MASS TRANSFER (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Fluid Mechanics & Machinery
- Engineering Thermodynamics

Course Objectives

The course is intended to:

1. Solve one dimensional steady state conduction heat transfer in simple geometries, fins and internal heat generation
2. Solve forced and natural convection heat transfer for external and internal flows
3. Apply phase change heat transfer in heat exchanger design
4. Calculate radiation heat transfer between different sections
5. Solve diffusion mass transfer through plane membrane
6. Describe the different applications of Heat transfer

Course Content **Hours**

UNIT I ONE DIMENSIONAL STEADY STATE CONDUCTION 12

Basic concepts-Modes of heat transfer – Conduction, Convection and Radiation-Cartesian coordinate- Simple geometries-Plane wall, Cylinder, Sphere, Composite wall , cylinder and Sphere – simple problems.

Fins – Short fin end insulated, Short fin end not insulated and long fin – Simple problems. Internal heat generation – Plane wall and cylinder – Simple problems. One dimensional Unsteady state heat conduction (Qualitative treatment only)

UNIT II CONVECTION 12

Basics – dimensionless numbers, boundary layer concepts- external flow – flow over plates, cylinders and spheres – bank of tubes – Simple problems, internal flow – flow through cylinders – simple problems. Free convection – flow over horizontal plate, flow over vertical plate and flow through cylinders and spheres – simple problems.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Phase change heat transfer – boiling- pool and flow boiling - condensation – simple problems. Heat exchangers – Classifications - parallel flow, counter flow and cross flow- LMTD and NTU methods –simple problems.

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UNIT IV RADIATION **12**

Basic concepts – absorptivity, reflectivity and transmissivity – black body and grey body concepts – Laws of radiation – Stefan Boltzmann law, Kirchoff's law, Planck's law, Wien's law and Lambert's cosine law – shape factor algebra – between plates and discs – simple problems, Radiation shield – single and 'n' number of shields – simple problems.

UNIT V DIFFUSION MASS TRANSFER AND HEAT TRANSFER APPLICATIONS **12**

Basic concepts – properties of mixtures – mass concentration and mass fraction – mole concentration and mole fraction – diffusion mass transfer – Fick's law of diffusion – diffusion through plane membrane- simple problems. Applications of heat transfer – domestic applications – Refrigerator, Air conditioning, process industrial applications- Food industry, Sugar Industry and automotive applications – Engine, radiators.

NOTE: (Use of approved Data Book is permitted in the End semester examination)

Course Outcomes

At the end of the course students will be able to:

CO1. Solve one dimensional steady state conduction heat transfer in simple geometries, fins and internal heat generation
CO2. Solve forced and natural convection heat transfer for external and internal flows
CO3. Apply phase change heat transfer in heat exchanger design
CO4. Calculate radiation heat transfer between different sections
CO5. Solve diffusion mass transfer through plane membrane
CO6. Describe the different applications of Heat transfer

TEXT BOOKS

1. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2012
2. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2010.

REFERENCES

1. Yadav R "Heat and Mass Transfer" Central Publishing House, 1995.
2. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.
3. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2011

WEB REFERENCES

- http://nptel.ac.in/courses/112101097/
- http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New_index1.html

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Department of Automobile Engineering
Dr. MCET, Pollachi - 642 003.

Course Code: 140AU0502	Course Title : DESIGN OF MACHINE ELEMENTS	
Core / Elective: Core	L: T : P: C	4 : 0 : 0 : 4
Type :Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Kinematics of Machines
- Strength of Materials

Course Objectives

The course is intended to:

1. Design the machine elements subjected to simple and combined static loads.
2. Design the machine elements against fluctuating loads and impact loads
3. Calculate the design parameters for power transmitting element such as shaft, key and coupling.
4. Determine the design parameters of helical and leaf spring for given application.
5. Design/Select a suitable bearing for the given application.

Course Content

UNIT I DESIGN FOR STATIC LOAD OR STEADY STRESSES 12

Design Processes and its types. Static stress- yield stress and ultimate stress, direct, bending, bearing and shear stresses - factor of safety, selection. Selection of materials and its properties. eccentric loading-stress due to eccentric loading, problems. Theories of failure, simple problems.

UNIT II DESIGN FOR FLUCTUATING AND IMPACT LOADS 12

Fatigue, types, Endurance limit, modifying factors, relation between endurance limit, ultimate tensile strength and yield strength, problems on different fatigue loading conditions. Stress concentration, stress concentration factor, causes of stress concentration, method of reducing stress concentration, stress concentration factor for different material configuration. Notch sensitivity, factors affecting notch sensitivity. Impact loading, shock loading, simple problems.

UNIT III DESIGN OF SHAFTS, KEYS, and COUPLINGS 12

Difference between shaft, axle and spindle, Shaft materials, criteria of shaft design, different transmitting elements on a shaft, shaft design against static loading for given application. Shaft design for fatigue loading. Keys, types of keys, stresses developed in the key. Spline, stresses in spline shaft, design of shunk key and spline. Couplings, types of coupling, design of coupling based on given speed and load conditions, Design of flexible coupling based on given speed and load conditions.

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UNIT IV DESIGN OF SPRINGS 12

Springs, types of springs, applications, spring terminology. Stresses in helical springs, Design of helical and concentric spring for given loading. Leaf springs, NIP in leaf springs, Design of leaf spring for given application.

UNIT V DESIGN OF BEARING 12

Bearings, bearing types, Parts of the bearing, rolling contact bearing, its applications. Load carrying capacity, equivalent load, Life of bearing, Load life relationship, Problems. Selection of ball bearings from manufactures catalogue. Sliding contact bearings, types and Nomenclature. Hydrodynamic bearing, load carrying capacity, lubrication, selection of lubricant, equivalent load, minimum oil film thickness- length to diameter ratio- bearing pressure, radial clearance. Mckees equation, Somer field equations -Bearing characteristic number problems.

NOTE: (Use of approved Design Data Book is permitted in the End semester examination)

Course Outcomes

At the end of the course students will be able to:

CO1. Design the machine elements subjected to simple and combined static loads.
CO2. Design the machine elements against fluctuating loads and impact loads
CO3. Calculate the design parameters for power transmitting element such as shaft, key, and coupling.
CO4. Determine the design parameters of helical and leaf spring for given application.
CO5. Design/Select a suitable bearing for the given application.

TEXT BOOKS

1. V.B. Bhandari. "Design of machine elements" Tata McGraw Hills Education , 3rd edition 2014.
2. P. C Sharma and A. K Agarwal. "Machine design" (SI units). S.K. Kataria & Sons. Reprint 2013.

REFERENCES

1. Shigley J.E and Mischke C.R.,"Mechanical Engineering Design", Sixth Edition,Tata McGraw Hill, 2012
2. Ugural A.C, "Mechanical Design – An Integral Approach", McGraw-Hill Book Co 2010
3. Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education 2012.

WEB REFERENCES

- http://nptel.ac.in/courses/112105124/
- http://www.nptel.ac.in/downloads/112105125/
- http://nptel.ac.in/courses/112106137/
- http://www.skf.com/in/index.html

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Course Code: 140AU0503	Course Title : MECHANICS OF ROAD VEHICLES	
Core / Elective: Core	L: T : P: C	3 : 0 : 2 : 4
Type :Theory & Practical	Total Contact hours:	75 Hours

Prerequisites:

The student should have undergone the course(s):

- Engineering Mechanics
- IC Engines
- Automotive Chassis

Course Objectives

The course is intended to:

1. Determine the static and dynamic forces acting in reciprocating engines
2. Calculate the balancing forces of rotating and reciprocating masses
3. Analyze the effects of gyroscopic and fuel governing mechanisms in automobile
4. Calculate the tractive characteristics for different type of drives (front, rear and four wheel drives) and tracks (banked, curved and grade)
5. Calculate the braking characteristics for different type of drives (front, rear and four wheel drives) and tracks (banked, curved and grade)

Course Content **Hours**

UNIT I FORCE ANALYSIS **12**

Applied and Constraint Forces - Free body diagrams - Static Equilibrium conditions - two, three and four force members - Static force analysis in simple mechanisms – Dynamic force analysis - Inertia force and Inertia torque - D.Alemberts principle Dynamic Analysis in Reciprocating Engines Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels - Engine shaking Forces

UNIT II BALANCING **12**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine Balancing Multi-cylinder Engines Balancing of reciprocating parts Concepts of direct and reverse crank mechanism

UNIT III GYROSCOPIC AND GOVERNING MECHNIS **12**

Gyroscopic principle - gyroscopic couple Effect of gyroscopic couple and centrifugal couple on four wheeled vehicle - Gyroscopic forces and Torques – Gyroscopic stabilization - Gyroscopic effects in, ships and airplanes. Governors - Types - Centrifugal governors- Classification of governors- sensitivity of various types of governor- controlling force of governor

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UNIT IV VEHICLE PERFORMANCE 12

Power requirement for propulsion, Air, Rolling and Gradient Resistances- Road performance curve for maximum acceleration – Determination of Centre of gravity – Drawbar pull, maximum speed and gradability, Maximum tractive effort calculation - handling and ride characteristics on different road surfaces

UNIT V VEHICLE STABILITY 12

Calculation of equivalent weight- distribution of weight- stability of a vehicle on a slope - reactions for different drive - dynamics of a vehicle running on a banked track - stability vehicle cornering

Course Outcomes

At the end of the course students will be able to:

CO1. Determine the static and dynamic forces acting in reciprocating engines
CO2. Calculate the balancing forces of rotating and reciprocating masses
CO3. Analyze the effects of gyroscopic and fuel governing mechanisms in automobile
CO4. Calculate the tractive characteristics for different type of drives (front, rear and four wheel drives) and tracks (banked, curved and grade)
CO5. Calculate the braking characteristics for different type of drives (front, rear and four wheel drives) and tracks (banked, curved and grade)

TEXT BOOKS

1. Shigley J.E. and Uicker J J., "Theory of Machines and Mechanisms". McGraw Hill. Inc., 2002.
2. N.K. Giri "Automobile Mechanics" Khanna Publishers, 2015.

REFERENCES

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Rattan SS, "Theory of Machines", Tata McGraw Hill Publishing company Ltd. New Delhi, 1994
3. Hans B Packeja, "Tyre and Vehicle Dynamics", 2nd Edition, SAE International, 2005

LABORATORY EXPERIMENTS: (Hours: 15)

1. Balancing of rotating masses
2. Balancing of reciprocating masses
3. Gyroscope - Determination of gyroscopic couple
4. Governors - Determination of sensitivity

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Course Code: 140AU0504	Course Title : AUTOMOTIVE TRANSMISSION	
Core / Elective: Core	L: T : P: C	3 : 0 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Engineering Mechanics
- IC Engines
- Automotive Chassis

Course Objectives

The course is intended to:

1. Illustrate the construction and working principle of various types of friction clutches
2. Classify the types of gearboxes used in manual gear boxes
3. Illustrate the construction and working principle of drive line components in ON road vehicles
4. Explain the construction and working principle of Hydrodynamic transmission system and Continuously Variable Transmission
5. Explain the construction and working principle of Hydro static and Electric Transmission systems

Course Content **Hours**

UNIT I CLUTCH **9**

Role of Clutch-positive and gradually engaged types - types of clutches- single plate clutch-coil spring type and diaphragm spring type -multiple plate clutch-centrifugal clutch. Clutch operating mechanisms- Hydraulic - Va cuum - Electromagnetic clutch.

UNIT II GEAR BOX **9**

Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes. Transfer case, overdrives.

UNIT III DRIVE LINE **9**

Propeller shaft, Slip Joint, universal joints- trunnion type, ring type, flexible disc type. Effect of driving thrust and torque reactions - Hotchkiss drive, torque tube drive and radius rods. Final Drive and Differential: Need of Final Drive- types of final drive- Single reduction and double reduction final drives. Need of Differential- Types of Differential, Differential Lock, Limited slip differential and Interaxle differential.

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UNIT IV AUTOMATIC TRANSMISSION 9

Automatic Transmission – Merits and demerits. Fluid coupling – principles - Performance characteristics – advantages – limitations. Torque converter - principles - Performance characteristics – advantages – limitations. Epicyclic Gear Box- Wilson Epicyclic Gear box. Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT

UNIT V HYDROSTATIC AND ELECTRIC DRIVE 9

Hydrostatic drive -Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Construction and working of typical Janny hydrostatic drive. Electric drive-types - Principle of modified Ward Leonard Control system-Advantages & limitations.

Course Outcomes

At the end of the course students will be able to:

CO1. Illustrate the construction and working principle of various types of friction clutches
CO2. Classify the types of gearboxes used in manual gear boxes
CO3. Illustrate the construction and working principle of drive line components In ON road vehicles
CO4. Explain the construction and working principle of Hydrodynamic transmission system and Continuously Variable Transmission
CO5. Explain the construction and working principle of Hydro static and Electric Transmission systems

TEXT BOOKS

1. Heinz Heisler, "Advanced Vehicle Technology". Butterworth Heinemann Publishers,2002.
2. N K Giri " Automobile Mechanics" Khanna Publications,2015

REFERENCES

1. Crouse W H, "Automotive Transmissions and Power Trains", McGraw Hill Book Co., 5th edition, 1976
2. Fenton J, "Hand book of Automotive Power Trains and Chassis Design", Progressive publisher, 1998
3. Garrett T K, Newton K. and Steeds W. "Motor Vehicle", Butter Worths & Co. Publishers Ltd., New Delhi, 2001.

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Course Code: 140AU0505	**Course Title :** AUTOMOTIVE ELECTRICAL AND ELECTRONICS - II	
Core / Elective: Core	**L: T : P: C**	2 : 0 : 2 : 3
Type : Theory & Practical	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics – I

Course Objectives

The course is intended to:

1. Explain the need of electronics in Automobile
2. Explain the working principles of various sensors used in automobile
3. Explain the working principles of various actuators used in automobile
4. Diagnosis the fault in the car wiring system
5. Explain the maintenance procedure for electrical systems.

Course Content **Hours**

UNIT I INTRODUCTION **6**

speed characteristics- load characteristics- usage of alternate fuels- global scenario- effect of emission on environment- effect of fuel economy over global market- global trends in drivability assistance- safety aspects required and its impact on environment- emission norms of global standards- emission norms of Indian government- advantage of electronic systems over mechanical systems.- needs of electronics in automobile to follow legislation and norms

UNIT II SENSORS **6**

HALL, Inductive, Resistance temperature detector (RTDS), Negative Temperature co efficient (NTC), Positive Temperature co efficient (PTC) sensors, Seebeck and Peltier effect - Applications, Manifold Absolute Pressure (MAP),Mass Air flow (MAF), Potentiometer, Chemical sensors, knock and Acceleration sensors

UNIT III ACTUATORS **6**

Solenoid - working principle, latching relay, bipolar and unipolar latching relay, linear unipolar relay, linear bipolar relay, piezoelectric injector, solenoid injector. Magneto Rheological fluids and applications.

UNIT IV WIRING HARNESS AND INDICATORS **6**

Car wiring layout, faults in the car electrical system, odometer, Speedometer, Fuel level indicator, Engine speed indicator, Coolant temperature indicator, Tire pressure indicator, Turn signal indicator.

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UNIT V ELECTRICAL SYSTEM MAINTENANCE 6

Testing methods for checking electrical components, checking battery, starter motor, charging systems, Ignitions system, lighting systems, Fault diagnosis and maintenance of modern electronic controls.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the need of electronics in Automobile
CO2. Explain the working principles of various sensors used in automobile
CO3. Explain the working principles of various actuators used in automobile
CO4. Diagnosis the fault in the car wiring system
CO5. Explain the maintenance procedure for electrical systems.

TEXT BOOKS

1. Kholi,P.L., "Automotive Electrical Equipment", Tata McGraw-Hill Co. Ltd., New Delhi,1975.
2. Crouse,W.H., "Automobile Electrical Equipment", McGraw Hill Book Co. Inc., New York,1980.

REFERENCES

1. Spreadbury,F.G., "Electrical Ignition Equipment", Constable & Co. Ltd., London,1962.
2. Automotive Hand Book, fifth edition, Robert Bosch, Bently Publishers, 2003.

LABORATORY EXPERIMENTS: (Hours 30)

1. Diagnose the fault in the given battery
2. Diagnose the fault in the car electrical system
3. Diagnose the fault in the ignition system
4. Conduct no load test on given starter motor
5. Conduct the load test on given Alternator.
6. Study of logic gates and half adder
7. Find RMS value of rectifiers and with and without filters

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Course Code: 140AU0507	**Course Title :** HEAT POWER LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0: 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics
- Fluid Mechanics & Machinery

Course Objectives

The course is intended to:

1. Conduct test and determine heat transfer parameters of simple objects

LIST OF EXPERIMENTS

HEAT TRANSFER

1. Thermal conductivity measurement using guarded plate method.
2. Thermal conductivity measurement of pipe insulation using lagged pipe approach.
3. Heat transfer through composite wall
4. Thermal conductivity of insulating powder in a concentric sphere
5. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
6. Determination of heat transfer coefficient under forced convection inside tube.
7. Heat transfer from pin-fin (Natural and Forced convection mode)
8. Determination of Stefan Boltzman constant.
9. Determination of emissivity of grey surface.
10. Effectiveness of parallel/counter flow heat exchanger.
11. Performance test on Cooling tower.

REFRIGERATION & AIR-CONDITIONING

1. Study of Refrigeration & Air-conditioning systems
2. Determination of COP of Refrigeration system.
3. Determination of COP of Air-conditioning system.
4. Performance test on two stage reciprocating air compressor

Course Outcomes

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

CO1. Conduct test and determine heat transfer parameters of simple objects

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Course Code: 140AU0508	**Course Title :** COMPUTER AIDED MACHINE DRAWING LABORATORY (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0: 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Graphics
- Engineering Metrology & Measurements

Course Objectives
The course is intended to:

1.Develop part models of machine components

2.Prepare assembly drawings of machine components

Course Content

1. Exercise on Knuckle joint
2. Exercise on Flange coupling
3. Exercise on Plummer Block
4. Exercise on Screw Jack
5. Exercise on Piston and Connecting rod
6. Preparation of Knuckle joint assembly drawing
7. Preparation of Flange coupling assembly drawing
8. Preparation of Plummer block assembly drawing
9. Preparation of Screw Jack assembly drawing
10. Preparation of Piston and Connecting rod assembly drawing

REFERENCES

1. Gopalakrishna, K. R., "Machine Drawing", 20th Edition Subhas publishing House,2007.

2. Cecil Jensen, Jay D. Helsel, Dennis R. Short , "Engineering Drawing & Design", 7th edition McGraw-Hill Higher Education. 2007.

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

CO1.Develop part models of machine components

CO2.Prepare assembly drawings of machine components

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Course Code: 140AU0509	**Course Title :** TEAMNESS AND INTERPERSONAL SKILLS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 2 : 1
Type : Practical	Total Contact hours:	30 Hours

Course Objectives

The course is intended to:

1. Be aware of attitudinal, behavioural and emotional aspects of self
2. Prefer to learn continuously about self and be in harmony with self
3. Understand others' preferences, values, roles & contexts and be in harmony with others
4. Identify barriers to harmonious relationships and derive ways to handle them
5. Work collaboratively as a team to deliver expected outcomes

Course Content

UNIT I HARMONY WITH SELF

Importance of learning about self continuously; Approaches to learn about self: introspection, being open to feedback, critical incidences as opportunities; Understanding life stages and challenges associated with them; Healthy ways of handling self in response to life's challenges;

Instruments/inventories to understand self and others: A) Know your temperament, B) Mayer Briggs Type Indicator, C) Interpersonal Needs Inventory (tentative).

UNIT II HARMONY WITH OTHERS

Importance of living in harmony with others; What it takes to live in harmony with others; Understanding preferences, values, roles and contexts of others; Approaches to navigating through differences between self and others;

Barriers to harmonious relationships - Perceptions, Judgments, and Emotional instability; Ways to handle each of the barriers; Importance of reaching-out to others

UNIT III GROUP DYNAMICS AND CONFLICTS RESOLUTION

Group dynamics: overt and covert processes at micro and macro levels; Understanding the basis of conflicts; Understanding one's own conflict handling style; Methods to handling conflicts effectively.

UNIT IV WORKING IN TEAMS

Effectiveness in communication; Forming – storming – norming and performing model; Competition vs collaboration – impact of both on team tasks; TEAM Questionnaire – components of a healthy team and approaches to improving them.

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Mode of delivery:

1. A 2-day learning workshop

1. Activities (experiential learning)
2. Audio visuals (affective learning)
3. Case discussions (cognitive learning)
4. Instruments/questionnaires (reflective learning)

Guided by Learner's workbook.

2. Continuous learning guided by learning journal, and reviews by faculty

3. Half-day reinforcement session towards the end of the semester

Assessments and Evaluation:

Assessment	Details	Weightage	Administration	By Whom	When
Continuous Assessment					
Initial Knowledge Test	Multiple choice questions (20)	10%	Pen and paper	Internal team	Immediately after the initial workshop.
Review of student journal	Student held journal book.	50%	Student journals to be reviewed	Trained Internal faculty	Once in a week.
Semester End Examination:					
Final comprehensive Knowledge test	Multiple choice questions (40)	10%	Pen and paper	Internal team	End of semester after the reinforcement program.
Viva-Voce	Scenario based questions	30%		Internal team	

Continuous Assessment = 60%
Semester end examination = 40%
An overall mark of 50 is to be scored for a pass in the course

Course Outcomes

At the end of the course, students will

CO1. Be aware of attitudinal, behavioural and emotional aspects of self
CO2. Prefer to learn continuously about self and be in harmony with self
CO3. Understand others' preferences, values, roles & contexts and be in harmony with others
CO4. Identify barriers to harmonious relationships and derive ways to handle them
CO5. Work collaboratively as a team to deliver expected outcomes

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END OF SEMESTER V

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SEMESTER VI

Course Code: 140AU0601	**Course Title :** FINITE ELEMENT ANALYSIS (Common to Automobile and Mechanical)	
Core / Elective: Core	**L: T : P: C**	4 : 0 : 0 : 4
Type : Theory	Total Contact hours:	60 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics-I
- Numerical Methods
- Strength of Materials
- Heat and Mass Transfer

Course Objectives

The course is intended to:

1. Convert physical problems into mathematical model using finite element procedure
2. Solve the one dimensional structural problems
3. Solve the vector variable problems using 2D CST element
4. Solve the scalar variable problems using 1D and 2D elements
5. Solve the vector variable problems using 2D Quadrilateral element

Course Content **Hours**

UNIT I FINITE ELEMENT FORMULATION 12

Finite element methods - general applicability of the methods, general finite element procedure, discretization of the domain, degree of freedom, basic element shapes and nodes, numbering of element and nodes, displacement models, local, global coordinates, Spring element - derivation of element stiffness matrices, global stiffness matrix and force vector using minimum potential energy principle, incorporation of boundary conditions, solution of numerical problems.

UNIT II ONE DIMENSIONAL VECTOR VARIABLE PROBLEMS 12

Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Plane Trusses - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition- problems, beam element – finite element formulation – Load vector –boundary condition- problems.

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UNIT III TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS USING CONSTANT STRAIN TRIANGLES 12

Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems, Axisymmetric solids subjected to Axisymmetric loading - axis symmetric formulation - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems.

UNIT IV HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1 D & 2D 12

Scalar variable problems- steady state heat transfer- 1D,2Dconduction & convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.

UNIT V TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING QUADRILATERAL ELEMENTS 12

Iso parametric elements – the four node quadrilateral- derivation of shape function, element stiffness matrix, element force vector- global stiffness matrix and force vector- Boundary condition-problems

Course Outcomes

At the end of the course students will be able to:

CO1. Convert physical problems into mathematical model using finite element procedure
CO2. Solve the one dimensional structural problems
CO3. Solve the vector variable problems using 2D CST element
CO4. Solve the scalar variable problems using 1D and 2D elements
CO5. Solve the vector variable problems using 2D Quadrilateral element

TEXT BOOKS

1. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions 2011.
2. Logan D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002

REFERENCES

1. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions(Engineering Mechanics Series), 2005.
3. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

WEB REFERENCES

- http://nptel.ac.in/courses/112104115/4
- http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf
- http://nptel.ac.in/courses/112104116/
-

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Course Code: 140AU0602	Course Title : DESIGN OF IC ENGINE COMPONENTS	
Core / Elective: Core	L: T : P: C	4 : 0 : 0 : 4
Type :Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- IC Engines
- Engineering Thermodynamics
- Strength of Materials

Course Objectives:

The course is intended to:

1. Explain the general design characteristics in IC Engine Design
2. Calculate the dimensions of cylinder block and mountings based on vehicle performance
3. Calculate the design parameters of piston system and valves
4. Compute the design parameters of connecting rod and crankshaft
5. Compute the design parameters of flywheel
6. Compute the fuel system design parameters based on engine performance requirement

Course Content **Hours**

UNIT I INTRODUCTION **12**

Principles of similitude – advantages – systems engineering – material properties – material selection – reliability engineering – robust engineering – cost engineering.

Vehicle performance requirements – Design of cylinder wall-liner – cylinder head – calculations – engine mountings and types.

UNIT II DESIGN OF PISTON COMPONENTS AND VALVES **12**

Piston components– choice of material – gas force calculation – piston, piston pin, and piston rings design calculation – piston slap – piston failures. Valve train components – valves – types – materials – design calculation.

UNIT III DESIGN OF CONNECTING ROD AND CRANKSHAFT **12**

Connecting rod – material – determining minimum length – small end design – shank design – design of big end cap bolts. Crankshaft – IC engines balancing – firing order – significance – material– design of crankshaft under bending and twisting.

UNIT IV DESIGN OF FLYWHEELS **12**

Mass of a flywheel – coefficient of speed fluctuation – engine flywheel – stresses on the rim – Design of hubs and arms of the flywheel – turning moment diagram.

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UNIT V DESIGN OF FUEL SYSTEM **12**

SI engine – carburettor – venture main jet – compensating jet – calculations. CI engine – fuel injection pump – theoretical fuel delivery – plunger diameter – complete plunger stroke – plunger active stroke – injector – fuel discharge time – mean velocity of fuel discharge – nozzle hole diameter.

Note: (Use of P S G Design Data Book is permitted in the examination)

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the general design characteristics in IC Engine Design
CO2. Calculate the dimensions of cylinder block and mountings based on vehicle performance
CO3. Calculate the design parameters of piston system and valves
CO4. Compute the design parameters of connecting rod and crankshaft
CO5. Compute the design parameters of flywheel
CO6. Compute the fuel system design parameters based on engine performance requirement

TEXT BOOKS

1. V. B. Bhandari," Design of Machine Elements", Tata McGraw-Hill Education, 2010.
2. Khurmi. R.S. & Gupta. J.K., "A textbook of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.

REFERENCES

1. Richard van Basshuysen, "Internal Combustion Engine Handbook", SAE International, 2004.
2. Kolchin and Demidov,"Design of automotive engines", Mir Publishers Moscow, 1984.

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Course Code: 140AU0603	Course Title : VEHICLE DYNAMICS	
Core / Elective: Core	L: T : P: C	4 : 0 : 0 : 4
Type :Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis
- Mechanics of Road Vehicles

Course Objectives

The course is intended to:

1. Explain the fundamentals of vibration
2. Analyse the effect of vibrating elements (Spring, Mass & Damper) on vibrating systems
3. Infer the tyre characteristics on vehicle ride behaviour
4. Analyze the vehicle handling characteristics based on lateral dynamics
5. udge the conflicting goals in the setup of vehicle suspension on stability

Course Content **Hours**

UNIT I CONCEPTS OF VIBRATION **9**

Fundamentals of vibration-importance and sources- vibration terminologies- simple harmonic motion-vibration analysis procedure -parts of vibrating system – vehicle models- methods of vibration analysis- equilibrium method, energy method, Rayleigh method-types of vibration-free and forced vibration, linear and nonlinear vibration, damped and undamped vibration, deterministic and random vibration, torsional vibration

UNIT II SINGLE AND MULTI DEGREE OF FREEDOM **15**

Free undamped vibration: differential equation- spring mass system, torsional vibrating system-equivalent stiffness of spring combinations- frequency response of spring mass system. Free damped vibration: differential equation – under damping, critical damping and over damping-frequency response of spring, mass and damper system-types of damping. Forced vibration: frequency response with external excitation – absolute motion-transmissibility- vibration isolation

Two degree of freedom-vibration response for undamped system-magnification factor-pitch and bounce frequencies of automobile vehicle – influence coefficient-orthogonality principle-matrix iteration method-holzer method

UNIT III TYRE DYNAMICS **12**

Tyre terminology- tyre and vehicle axis system-rolling resistance of tyre- force generation mechanism- tractive properties-cornering properties- camber thrust- aligning moment cornering behavior characteristics-ride properties

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UNIT IV VERTICAL DYNAMICS 12

Forces- side force, lift force, drag force- moments- yaw, roll, pitch and bounce – anti squat and anti dive geometry- roll center analysis- active suspension system – ride control, height control – body roll stability analysis- load transfer- lateral and longitudinal- "g" force for different riding conditions

UNIT V LATERAL DYNAMICS 12

Steering geometry-steering handling characteristics- under steer, over steer, neutral steer- steady state response – yaw velocity response, lateral acceleration response, curvature response – testing of handling characterizes- constant radius test, constant speed test, constant steering angle test- direction stability- influences on cornering-suspension effects and tractive effects

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the fundamentals of vibration
CO2. Analyse the effect of vibrating elements (Spring, Mass & Damper) on vibrating systems
CO3. Infer the tyre characteristics on vehicle ride behaviour
CO4. Analyze the vehicle handling characteristics based on lateral dynamics
CO5. Judge the conflicting goals in the setup of vehicle suspension on stability

TEXT BOOKS

1. Thomas D.Gillespie, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers Inc, 1992.
2. N.K.Giri "Automobile Mechanics" Khanna Publications 2015.

REFERENCES

1. G. NakhaieJazar, Vehicle Dynamics: Theory and Application, 1st Edition, Springer, 2008
2. Hans B Packeja, Tyre and Vehicle Dynamics, 2nd Edition, SAE International, 2005
3. J.Y. Wong, Theory of Ground Vehicle, 3rd Edition, Wiley-Interscience, 2001.

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Course Code: 140AU0604	Course Title : AUTOMOTIVE EMBEDDED SYSTEMS	
Core / Elective: Core	L: T : P: C	3 : 0 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics II

Course Objectives

The course is intended to:

1. Execute simple program using microcontroller
2. Interface the peripherals with 8051 microcontroller
3. Choose an appropriate protocol for Electronic communication system
4. Explain power train management system
5. Explain the working principle chassis electronics

Course Content **Hours**

UNIT I INTRODUCTION **9**

Architecture of Microcontroller- Memory organization in microcontroller, Arithmetical and logical instruction- programs using arithmetical and logical instruction- simple programs using microcontroller- programs using branching instructions- addressing modes, branching instruction

UNIT II PERIPHERAL INTERFACING **9**

Analog to Digital converter (ADC) - Interface ADC - Digital to Analog converter (DAC)- Interface DAC- stepper motor- Interface stepper

UNIT III COMMUNICATION PROTOCOL **9**

Control networking- protocol- choosing protocol- Serial peripheral Interface (SPI) - Controller Area Network (CAN) - Local Interconnect Network (LIN) - FlexRay - Media Oriented Systems Transport (MOST)

UNIT IV ENGINE AND TRANSMISSION MANAGEMENT SYSTEM **9**

SI Engine management system, CI Engine management system including emission control, Transmission management system

UNIT V CHASSIS ELECTRONICS **9**

Tyre Slip- sensors in ABS- ABS- TCS- ESP- EBD. body electronics system such as wiper-door control- infotainment system- Navigation system.

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Course Outcomes

At the end of the course students will be able to:

CO1. Execute simple program using microcontroller
CO2. Interface the peripherals with 8051 microcontroller
CO3. Choose an appropriate protocol for Electronic communication system
CO4. Explain power train management system
CO5. Explain the working principle chassis electronics

TEXT BOOKS

1. Frank Vahid and Tony Givargis, "Embedded system design A unified Hardware/software Introduction", Wiley India pvt. Ltd., 2012
2. Muhammad Ali Mazidi, Janice GillispieMazidi and RolinD.Mckinlay, " The 8051 Microcontroller and Embedded system using Assembly and C" 2nd Edition, Pearson education, 2009.

REFERENCES

1. David E.Simon, "An Embedded software premier", Pearson education, 2010.
2. "Automotive Handbook" 7th edition, Bosch, 2011.

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Course Code: 140AU0605	Course Title : ENVIRONMENTAL STUDIES	
Core / Elective: Core	L: T : P: C	3 : 0 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Pre-requisites: None

Course Objectives

The course is intended to:

1. Describe the multidisciplinary nature of environmental studies
2. Explain the importance of ecosystem and biodiversity
3. Identify the causes and propose suitable methods of control for various types of environmetnal pollution
4. Describe the importance of environmental protection in social and global context
5. Explain the relationship between environment and human beings

Course Content **Hours**

UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 9

Definition, scope and imporatnce; Need for public awareness; Natural resources and associated problems - Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources; Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concept of an ecosystem;Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem;Ecological succession;Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function ofthe following ecosystem - Forest, Grassland,Desert, Aquatic; Biodiversity and its conservation: Introduction; Biogeographical classification oflndia; Value of biodiversity; Biodiversity at global, national and local levels; India as a mega diversity nation; Threats to biodiversity;Endangered and endemic species of india; Conservation of biodiversity : In-situ and Ex-situ conservation.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition;Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster management : floods, earthquake, cyclone and landslides

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Environmental ethics : issues and possible solutions; Climate change, global warming, acid rain, ozone layer depletion,

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nuclear accidentsand holocaust. Wasteland reclamation ; Consumerism and waste products; Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations; Population explosion - Family Welfare Programme; Environment and human health; Human Rights; Value Education; HiV/AiDS; Women and Child Welfare; Role of information Technology in Environment and human health; Case studies; Field work – Visit to a local area to document environmental assets – river/forest/grassland/hill/mountain; Visit to a local polluted site – Urban/ Rural/ Industrial/ Agriculture; Study of simple ecosystems – pond, river, hill, slopes, etc.

Course Outcomes

At the end of the course students will be able to:

CO1. Describe the multidisciplinary nature of environmental studies
CO2. Explain the importance of ecosystem and biodiversity
CO3. Identify the causes and propose suitable methods of control for various types of environmetnal pollution
CO4. Describe the importance of environmental protection in social and global context
CO5. Explain the relationship between environment and human beings

TEXTBOOKS:

1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.
2. Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3rd edition, 2014.

REFERENCES:

1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2. Cunningham, W.P.Cooper., T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.
3. Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2005.

WEB REFERENCES:

- http://nptel.ac.in/courses/122102006
- www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

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Course Code: 140AU0607	Course Title : SIMULATION AND ANALYSIS LABORATORY	
Core / Elective: Core	L: T : P: C	0: 0 : 4 : 2
Type :Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Strength of materials

Course Objectives

The course is intended to:

1. Simulate simple mechanisms and systems using C / MAT Lab
2. Perform stress, thermal and heat transfer analysis on simple structural members for stress using analysis software.

LIST OF EXPERIMENTS

Simulation

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of free vibration characteristics of spring, mass and damper system
3. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
4. Simulation of cam and follower mechanism using C / MAT Lab.

Analysis (Simple Treatment Only)

1. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
2. Stress analysis of a plate with a circular hole.
3. Stress analysis of rectangular L bracket
4. Stress analysis of an Axi-symmetric component
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams(Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

Course Outcomes

At the end of the course students will be able to:

CO1. Simulate simple mechanisms and systems using C / MAT Lab

CO2. Perform stress, thermal and heat transfer analysis on simple structural members for stress using analysis software.

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Course Code: 140AU0608	**Course Title :** AUTOMOTIVE EMBEDDED SYSTEMS LABORATORY	
Core / Elective: Core	**L: T : P: C**	0: 0 : 4 : 2
Type : Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics I

Course Objectives

The course is intended to:

1. Write and execute simple programs using Microcontroller for Automotive application
2. Interface peripherals with Microcontroller for Automotive application

LIST OF EXPERIMENTS:

1. Assembly language programming for Addition and Subtraction
2. Assembly language programming for Logical operation
3. Assembly language programming for Multiplication and Division
4. Data conversion using Microcontroller
5. Interfacing of Stepper Motor
6. Generate pulse width modulated signal for automobile Head light application
7. Interfacing of ADC with Manifold absolute pressure (MAP) sensor
8. Interfacing of Hall sensor to find speed of wheel
9. Interrupt programming using microcontroller
10. Study of IDE

Course Outcomes

At the end of the course students will be able to:

CO1. Write and execute simple programs using Microcontroller for Automotive application

CO2. Interface peripherals with Microcontroller for Automotive application

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Course Code: 140AU0609	**Course Title :** CAMPUS TO CORPORATE (Common to all branches of B.E/B.Tech)	
Core / Elective: General	**L: T : P: C**	0: 0 : 2 : 1
Type : Theory	Total Contact hours:	30 Hours

Course Objectives

The course is intended to:

1. Display gratitude and social responsibility
2. Understand various business environments – industry & function wise
3. Explain the transition from a campus mindset to corporate mindset
4. Be prepared to adapt to the future work culture
5. Choose to be presentable and agile

Course content

UNIT I GRATITUDE AND SOCIAL RESPONSIBILITY

Importance of gratitude; Finding opportunities to give back to society; Responsible behaviour in public places; Volunteerism during calamities; Social relevancy during engineering design and manufacturing – how social issues could be tackled by engineering solutions;

UNIT II THE WORLD OF BUSINESS (GET TO THE SPECIFICS OF BEHAVIOURAL RESPONSES TO CERTAIN SPECIFIC CONTEXTS)

World of business - Perceptions vs reality; Various business types - B2B, B2C, & other business models; Various industry verticals – fundamentals, dynamics & nuances; Nature of work as per various functions – Sales & Marketing, Service, Research & Development, Production etc; Self-reflective questionnaire to identify the fitment to a particular field/function;

UNIT III TRANSITION FROM A CAMPUS MIND-SET TO CORPORATE MIND-SET

ROCK as an acronym (Responsibility, Ownership, Contribution, Knowledgeable (continuous learning)); Responsibility – ways in which responsibility should be demonstrated; Ownership – owning one's career, owning mistakes, desisting from complaining; Contribution – focus on creating value, giving more than receiving (salary & perks); Knowledgeable(continuous learning) – learning just begins after campus, aspects of learning mind-set, various opportunities to learn and how they can be utilised at work;

UNIT IV PREPAREDNESS TO ADAPT TO WORK CULTURE

Skills to get through selection process – Interview conversations, resume writing, group discussion & presentation; Handling Cultural differences; Handling Gender dynamics; Alignment to Ethics and values; Alignment to work processes & code of conduct; Handling multiple (often conflicting) demands; Handling peer influence; Conducting sensitively with subordinates, peers & boss; Managing personal finance; Maintaining work-life balance – work & social life, hobbies etc;

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UNIT V PRESENTABLE AND AGILE

Dressing & grooming – Reasons for good dressing & grooming; Professional etiquette – what is etiquette, professional etiquette vs social etiquette, Aspects of professional etiquette; Wellness – Healthy eating habits, Importance of sleep, Importance of fitness; Importance of cleanliness of surroundings – desk, work area, place of stay (5S);

Mode of delivery:

1. A 2-day learning workshop guided by Learner's workbook.
2. Continuous learning guided by learning journal, and reviews by faculty

Assessments and Evaluation:

Assessment	Details	Weigh tage	Administrati on	By Whom	When
Workbook record assessment	Assess the necessary elements to be entered in the workbook	20%	Individual workbooks reviewed by the faculty		Immediately after the learning workshop
Initial Knowledge Test and Scenario based knowledge test	Multiple choice questions (20)	25%	Pen and paper,	Internal team	Immediately after the learning workshop
Review of student journal	Student held journal for the whole semester	30%	Individual journals reviewed by the faculty	Trained faculty members	Once in a week.
Final Knowledge test and Scenario based knowledge test	Multiple choice questions (40)	10%		Internal team	End of semester
Review of student journal by external expert		15%	Student journal comprehensiv e review	Trained faculty members	End of semester

Course Outcomes

At the end of the learning program, learners will

1. Display gratitude and social responsibility
2. Understand various business environments – industry & function wise
3. Explain the transition from a campus mindset to corporate mindset
4. Be prepared to adapt to the future work culture
5. Choose to be presentable and agile

END OF THE SEMESTER VI

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SEMESTER VII

Course Code: 140AU0701	Course Title : DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS	
Core / Elective: Core	L: T : P: C	4:0 :0 : 4
Type :Theory	Total Contact hours:	60 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis
- Mechanics of Road Vehicles

Course Objectives

The course is intended to:

1. Design vehicle frames and steering system components.
2. Calculate the design parameters of axles and shafts.
3. Choose the appropriate clutch system for power transmission.
4. Design the gear box for vehicles.
5. Design the braking system for vehicles.

Course Content **Hours**

UNIT I VEHICLE FRAME AND STEERING COMPONENTS 12

Loads acting on frames, chassis operating conditions, Determination of CG, Design of frame for passenger and commercial vehicle - Condition for true rolling, calculation of Ackermann linkage geometry, steering box design.

UNIT II AXLES AND SHAFTS 12

Analysis of loads, moments and stresses at different sections of front axle, Design of front axle. Determination of bearing loads at Kingpin bearings, Design of propeller shaft- design details of final drive gearing, full-floating, semi-floating, three quarter floating rear axle and housings. Torsion bar.

UNIT III CLUTCHES 12

Types of friction clutches, Torque capacity of clutch, Design of single plate, multi-plate clutch, cone clutch and centrifugal clutch, Design of clutch components.

UNIT IV GEAR BOXES 12

Review of Gear terminology- Design of spur and helical gears - layout of gearboxes. Design of four speed and five speed gearboxes.

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UNIT V BRAKES **12**

Brakes function, weight transfer during braking, stopping distance, brake torque analysis of Internal expanding shoe brake. Calculation of mean lining pressure and heat generation during braking, design of disc brake, mechanics of hydraulic braking system and parking brake.

Course Outcomes

At the end of the course students will be able to:

CO1. Design vehicle frames and steering system components.
CO2. Calculate the design parameters of axles and shafts.
CO3. Choose the appropriate clutch system for power transmission.
CO4. Design the gear box for vehicles.
CO5. Design the braking system for vehicles.

TEXT BOOKS:

1. Giri, N.K., "Automobile Mechanics", Khanna publishers, New Delhi, 2007.
2. Khurmi. R.S. & Gupta. J.K., "A textbook of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.

REFERENCES:

1. Heldt, P.M., "Automotive Chassis", Chilton Book Co., 2012.
2. Dean Averns, "Automobile Chassis Design", Illife Book Co., 2009.
3. Shigley J.E and Mischke C.R, "Mechanical Engineering Design" 9th Edition, Tata McGraw-Hill,2011.
4. Lukin P, Gasparyants G, Rodionov V, "Automobile Chassis Design and Calculations", MIR Publishers, Moscow 1989.

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Course Code: 140AU0702	Course Title : AUTOMOTIVE POLLUTION CONTROL	
Core / Elective: Core	L: T : P: C	3 : 0 : 0 : 3
Type :Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- IC engines
- Automotive Fuels and Lubricants

Course Objectives

The course is intended to:

1. Apply the standards for emission control
2. Analyse the emissions in SI engines
3. Analyse the emissions in CI engines
4. Apply various emission control techniques
5. Demonstrate emission measurements and tests

Course Content **Hours**

UNIT I INTRODUCTION **6**

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards.

UNIT II EMISSIONS IN SI ENGINES **10**

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

UNIT III EMISSIONS IN CI ENGINES **10**

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 EMISSION CONTROL TECHNIQUES **10**

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.

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UNIT V EMISSION MEASUREMENTS AND TESTS 9

NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph Smoke meters. Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle –SHED test.

Course Outcomes

At the end of the course students will be able to:

CO1. Apply the standards for emission control
CO2. Analyse the emissions in SI engines
CO3. Analyse the emissions in CI engines
CO4. Apply various emission control techniques
CO5. Demonstrate emission measurements and tests

TEXT BOOKS:

1. Heywood,J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 2011.
2. B.P.Pundir, " IC Engines Combustion and Emissions", Narosa Publishers, 2010

REFERENCES:

1. Ramalingam. K.K., "Internal Combustion Engines", Scitech Publications, Chennai, 2003.
2. Ganesan,V., "Internal Combustion Engines", Tata McGraw Hill Co., 2008.

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Course Code: 140AU0707	Course Title : VEHICLE MAINTENANCE LABORATORY	
Core / Elective: Core	L: T : P: C	0 : 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Automotive Chassis
- IC Engines
- Automotive Transmission
- Automotive Electrical and Electronics

Course Objectives:
The course is intended to:

1. Recognize and Overhaul the faults in the vehicle systems

List of Experiments

1. Study and preparation of different statements/records required for the repair and maintenance works.
2. Minor and major tune up of gasoline and diesel engines.
3. Calibration of Fuel injection pump.
4. Fault diagnosis and service of steering system
5. Fault diagnosis and service of transmission system.
6. Fault diagnosis and service of suspension system.
7. Fault diagnosis and service of braking system.
8. Fault diagnosis and service of Electrical systems (battery, starting system, charging system)
9. Study and checking of wheel alignment - testing of camber, caster
10. Practice the following:
    - Adjustment of pedal play in clutch, brake and steering wheel play.
    - Air bleeding from hydraulic brakes, air bleeding of diesel fuel system.
    - Wheel bearings tightening and adjustment.
    - Adjustment of head lights beam.
    - Removal and fitting of tire and tube.

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

CO1. Recognize and Overhaul the faults in the vehicle systems

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Course Code: 140AU0708	**Course Title :** MODELLING AND ANALYSIS OF AUTOMOTIVE SUBSYSTEMS LABORATORY	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 4 : 2
Type : Practical	Total Contact hours:	60 Hours

Prerequisites:
The student should have undergone the course(s):

- Automotive Chassis
- Automotive Transmission
- Computer Aided Machine Drawing Laboratory
- Simulation and Analysis Laboratory

Course Objectives:

The course is intended to:

1. Develop part models of automotive subsystems.
2. Analyse part models of automotive subsystems

List of Experiments

1. Modelling and Analysis of Integral frame
2. Modelling and Analysis of Axle shaft for Commercial vehicles.
3. Modelling and Analysis of Single plate clutch
4. Modelling and Analysis of Transfer case
5. Modelling and Analysis of brake components

Course Outcomes:

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

CO1. Develop part models of automotive subsystems.
CO2. Analyse part models of automotive subsystems

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END OF SEMESTER VII

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SEMESTER VIII

Course Code: 140AU0809	**Course Title : PROJECT WORK**	
Core / Elective: Core	**L: T : P: C**	0 : 0 : 20 :10
Type : Practical	Total Contact hours:	300 Hours

Course Objectives:

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The students in a group of 2 to 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report.

Course Outcomes:

At the end of the course students will be able to:

CO1: Take up any challenging practical problems and find solution by formulating proper methodology.

CO2: Work collaboratively on a team to successfully complete a design project

CO3: Effectively communicate the results of projects in a written and oral format

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END OF SEMESTER VIII

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ELECTIVES

DESIGN STREAM

Course Code: 140AU9111	Course Title: IC ENGINES FOR SPECIAL APPLICATIONS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- IC Engines

Course Objectives:
The course is intended to:

1. Describe the working of marine engines
2. Explain the mechanics and maintenance procedure of marine engines
3. Explain the requirements of IC engines for agricultural applications
4. Explain the requirements of IC engines for Electrical Generators
5. Explain the requirements of IC engines for defence and other generators

Course Content **Hours**

UNIT–I MARINE ENGINEFUNDAMENTALS 9

Engine Operation; Operating Cycles; Performance factors; Supercharging and Scavenging Systems for two stroke and four stroke cycle engines, Submarine Engine Systems, inline and V-type engine-Fuels and Lubricants, Engine Pollution and Control.

UNIT–II MARINE ENGINE MECHANICS AND MAINTENANCE 9

Dynamics of crank gear, Engine Vibration, Design, Engine Systems, Speed governors and Accessory equipment–lubrication problems- additional cooling requirements-bolt tightening and gasket problems-engine design and manufacturing corrosive environment.

UNIT – III IC ENGINES FOR AGRICULTURAL APPLICATIONS 9

Introduction- Requirements- SI engine – two and four stroke-rich burn and lean burn-fuel type-natural gas-LPG/ Propane-petrol-emission requirements- static –movable- Diesel engine- two stroke –constant speed –variable speed- alternate fuels

UNIT – IV IC ENGINES FOR ELECTRICAL GENERATORS 9

Introduction-stationery- trailer mounted- fuels used- bifuel capability-noise reduction and emission –Railway diesel generator-power torque requirements.

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UNIT–V IC ENGINES FOR DEFENCE AND MISCELLANEOUS GENERATORS 9

Engine requirement for tanks and armoured vehicles- multifuel capability-altitude effect on engine performance- Power and speed requirements of lawn mower engines- starting methods-air filter maintenance and throttle control

Course Outcomes:

At the end of the course students will be able to:

CO1. Describe the working of marine engines
CO2. Explain the mechanics and maintenance procedure of marine engines
CO3. Explain the requirements of IC engines for agricultural applications
CO4. Explain the requirements of IC engines for Electrical Generators
CO5. Explain the requirements of IC engines for defence and other generators

TEXT BOOKS

1. John Lamb, "The Running and Maintenance of the Marine Diesel Engine", Charles Griffin and Company Ltd., U.K.,(Sixth Edition), 1976.
2. N. Petrovsky, "Marine Internal Combustion Engines", MIR Publishers, Mascow, 1974.

REFERENCES

1. Doug Woodyard (Editor), "Pounder's Marine Diesel Engines", Butterworth-Heinemann, UK (Seventh Edition), 1998.
2. George H.Clark, "Industrial and Marine Fuels" Butterworth-and Company, (Publishers) Ltd. U.K., 1998.
3. Nigel Calder, "Marine Diesel Engines: Maintenance, Troubleshooting, and Repair", McGraw Hill Professional, 2006.

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Course Code: 140AU9112	Course Title: AUTOMOTIVE AERODYNAMICS (Common to Automobile and Mechanical)	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Fluid Mechanics and Machinery
- Mechanics of Road Vehicle
- vehicle dynamics

Course Objectives:
The course is intended to:

1. Describe the Potential of vehicle aerodynamics
2. Calculate the drag coefficient of cars
3. Explain the shape optimization of cabs
4. Calculate forces and moments due to side winds
5. Demonstrate the use of wind tunnel for automotive aerodynamics

Course Content **Hours**

UNIT I INTRODUCTION 9

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT II AERODYNAMIC DRAG OF CABS 9

Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CABS 9

Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT IV VEHICLE HANDLING 9

The origin of force and moments on a vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

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UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.

Course Outcomes:

At the end of the course students will be able to:

CO1. Describe the Potential of vehicle aerodynamics
CO2. Calculate the drag coefficient of cars
CO3. Explain the shape optimization of cabs
CO4. Calculate forces and moments due to side winds
CO5. Demonstrate the use of wind tunnel for automotive aerodynamics

TEXTBOOK

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 1997.

REFERENCES

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Vehicle Aerodynamics, SP-1145, SAE, 1996.

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Course Code: 140AU9113	**Course Title: : NOISE, VIBRATION AND HARSHNESS** (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Vehicle Dynamics
- Mechanics of Road Vehicle
- Automotive Electrical and Electronics – II

Course Objectives:

The course is intended to:

1. Describe the sources of noise and vibration
2. Explain the effects of NVH on people
3. Explain the effects of noise and vibration on external environment
4. Explain the effects of noise and vibration on internal environment
5. Explain the measurement methods of noise and vibration

Course Content **Hours**

UNIT I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION 8

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE 7

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

UNIT III TRANSPORTATION NOISE AND VIBRATION 10

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.

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UNIT IV INTERIOR TRANSPORTATION NOISE AND VIBRATION 10

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

UNIT V NOISE AND VIBRATION TRANSDUCERS 10

General Introduction to Noise and Vibration Transducers, 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, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

Course Outcomes:

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

CO 1. Describe the sources of noise and vibration
CO 2. Explain the effects of NVH on people
CO 3. Explain the effects of noise and vibration on external environment
CO 4. Explain the effects of noise and vibration on internal environment
CO 5. Explain the measurement methods of noise and vibration

TEXT BOOKS

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

REFERENCES

1. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987
2. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989
3. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook" , McGraw-Hill,
   New Delhi, 2010
4. Colin H Hansen "Understanding Active Noise Cancellation" , Spon Press , London 2003
5. McConnell K, "Vibration Testing Theory and Practice", John Wiley, 1995.
6. Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier Butterworth-Heinemann, Burlington, 2004

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Course Code: 140AU9114	**Course Title: : VEHICLE SAFETY AND COMFORT SYSTEMS**	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Automotive chassis
- Automotive Electrical and Electronics – II

Course Objectives:
The course is intended to:

1. Explain the engineering principles that are necessary for the design of an automobile for the safety and comfort of the occupants and other road users.
2. Explain the role and use of safety systems in vehicle engineering.
3. Explain crashworthiness and failure analysis of a vehicle.
4. Explain the role and use of comfort systems in vehicle engineering.
5. Explain the importance of ergonomics and NVH in vehicle comfort system.

Course Content **Hours**

UNIT I INTRODUCTION TO SAFETY SYSTEMS 9

What is automotive safety; history, Role of material science in design for vehicle safety, Material selection for design for safety, Automotive structure and safety, Safety aspects of design for BIW,

UNIT II CONSTRUCTION AND OPERATION OF SAFETY SYSTEMS 9

Construction and operation of safety systems such as: airbags, safety cage, roof crush, crumple zones, seat belts, bumper, bonnet and impact bars.

UNIT III CRASHWORTHINESS AND FAILURE ANALYSIS 9

Crashworthiness legislation, Crash analysis; front crash, rear crash and side crash, The role of HMI Systems in safety aspects of automotive systems, CAE/FEA in analysis of vehicle structure, Fatigue failure analysis for vehicle structure, The role of different vehicle systems in safety aspects

UNIT IV INTRODUCTION TO COMFORT SYSTEMS 9

Embedded Systems (automotive electronics), Interior cabin comfort systems, including seating, lighting, thermal comfort

UNIT V VEHICLE ERGONOMICS AND NVH 9

Vehicle ergonomics and human factors, Human Machine Interface (HMI), automotive sound quality and NVH, Perceived quality, smart driving technologies

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Course Outcomes:

At the end of the course students will be able to:

CO 1. Explain the engineering principles that are necessary for the design of an automobile for the safety and comfort of the occupants and other road users.

CO 2. Explain the role and use of safety systems in vehicle engineering.

CO 3. Explain crashworthiness and failure analysis of a vehicle.

CO 4. Explain the role and use of comfort systems in vehicle engineering.

CO 5. Explain the importance of ergonomics and NVH in vehicle comfort system.

TEXT BOOKS

1. George A. Peters, Barbara J. Peters, "Automotive Vehicle Safety", Taylor & Francis, 2002
2. Jack Erjavec, "Automotive Technology: A Systems Approach", Volume 2, Delmar Cengage Learning, 1992

REFERENCES

1. Ulrich W. Seiffert, Mark Gonter , "Integrated Automotive Safety Handbook", SAE International,2013
2. Robert Bosch "Safety, Comfort and Convenience Systems" 3rd Edition, Wiley- Blackwell 2006.

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Course Code: 140AU9115	**Course Title: :** SUPERCHARGING AND SCAVENGING	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- IC Engines
- Design of IC Engine Components

Course Objectives:
The course is intended to:

1. Describe the effect of supercharging on I.C engine performance and emissions
2. Describe the effect of turbocharging on I.C engine performance and emissions
3. Describe scavenging process
4. Design Intake and Exhaust Systems for two stroke engines
5. Describe the experimental techniques for evaluating scavenging

Course Content **Hours**

UNIT – I SUPERCHARGING **8**

Definition and Engine modification required - effects on Engine performance - Thermodynamics Mechanical Supercharging. Types of compressors – Positive displacement blowers – Centrifugal compressors – Performance characteristic curves – Suitability for engine application – Matching of supercharger compressor and Engine.

UNIT – II TURBOCHARGING **8**

Turbocharging – Turbocharging methods - Thermodynamics – Engine exhaust manifolds arrangements. – Waste gate, Variable nozzle turbochargers, Variable Geometry Turbocharging – Surging - Matching of compressor, Turbine and Engine.

UNIT – III SCAVENGING OF TWO STROKE ENGINES **12**

Features of two stroke cycle engines – Classification of scavenging systems - Charging Processes in two stroke cycle engine – Terminologies – Sankey diagram – Relation between scavenging terms – scavenging modeling – Perfect displacement, Perfect mixing – scavenging models. Mixture control through Reed valve induction.

UNIT – IV PORTS AND MUFFLER DESIGN **8**

Porting – Port flow characteristics-Design considerations – Design of Intake and Exhaust Systems – Tuning- Kadenacy system.

UNIT – V EXPERIMENTAL METHODS AND RECENT TRENDS **9**

Experimental techniques for evaluating scavenging – Firing engine tests – Non firing engine tests - Development in two stroke engines for improving scavenging. Direct injection two stroke concepts.

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Course Outcomes:

At the end of the course students will be able to:

CO1. Describe the effect of supercharging on I.C engine performance and emissions
CO2. Describe the effect of turbocharging on I.C engine performance and emissions
CO3. Describe scavenging process
CO4. Design Intake and Exhaust Systems for two stroke engines
CO5. Describe the experimental techniques for evaluating scavenging

TEXT BOOKS

1. R.S. Benson and N.D. White house, Internal Combustion engines, First edition, Pergamon press, 1979.
2. John B.Heywood, Two Stroke Cycle Engine, SAE Publications, 1997.

REFERENCES

1. G P Blair, Two stroke Cycle Engines Design and Simulation, SAE Publications, 1997.
2. Schweitzer, P.H., Scavenging of Two Stroke Cycle Diesel Engine, MacMillan Co.,
3. Heinz Heisler, Advanced Engine Techology, Butterworth Heinmann Publishers, 2002.
4. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1980.Richard Stone, Internal Combustion Engines, SAE, 1992.
5. Vincent,E.T., Supercharging the I.C.Engines, McGraw-Hill.

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Course Code: 140AU9116	**Course Title: :** GAS DYNAMICS AND JET PROPULSION (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Thermodynamics
- Fluid Mechanics & Machinery
- Heat and Mass Transfer

Course Objectives:
The course is intended to:

1. Explain the basics and energy equations for compressible flow
2. Calculate the isentropic fluid flow properties with variable duct area
3. Evaluate fluid flow properties with normal shock wave in one dimensional flow
4. Identify fluid flow in constant area duct with heat transfer and friction
5. Describe the various types of Aircraft and Rocket Propulsion engines

Course Content **Hours**

UNIT I BASICS OF COMPRESSIBLE FLOW 9

Basics-compressible flow, flow process and non-flow process, Mach number, Energy Equations-Energy Equation for Flow and Non- Flow process, adiabatic energy equation, stagnation states, various region of flow, Mach waves and Mach cone, reference velocities, Bernoulli equation.

UNIT II ISENTROPIC FLOWS 9

Isentropic and adiabatic processes-Mach number variation in Nozzle and diffuser-stagnation and critical states-area ratio as function of Mach number-impulse function-mass flow rate in terms of pressure ratio, area ratio, Mach number-flow through nozzles and diffusers.

UNIT III NORMAL SHOCK 9

Development of shock wave-Prandtl Mayer relation-variation of flow parameters across the normal shock-impossibility of shock wave in subsonic flow-Mach number of supersonic flow-supersonic wind tunnels- Introduction to oblique shock.

UNIT IV FLOW THROUGH DUCTS 9

Rayleigh flow-Rayleigh curve, Rayleigh flow equations, variable flow properties, maximum heat transfer
Fanno flow -Fanno curve, Fanno flow equations, variable flow properties, variation of Mach number with duct length.

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UNIT V AIR CRAFT AND SPACE PROPULSIONS 9

Aircraft Propulsion- types-construction and working-ramjet engine, turbojet engine, turbofan engine, turbo propeller engine, Rocket Propulsion –types-construction and working-liquid propellant engine, solid propellant engine, hybrid propellant engine, nuclear propellant engine.

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the basics and energy equations for compressible flow
CO2. Calculate the isentropic fluid flow properties with variable duct area
CO3. Evaluate fluid flow properties with normal shock wave in one dimensional flow
CO4. Identify fluid flow in constant area duct with heat transfer and friction
CO5. Describe the various types of Aircraft and Rocket Propulsion engines

TEXT BOOKS

1. S.M. Yahya, Fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 2010.
2. V. Babu, Fundamentals of a Propulsion, Ane's Books Pvt. Ltd., 2009

REFERENCES

1. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Pearson India, 2001.
2. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2012.
3. Robert D. Zucker, Oscar Biblarz, Fundamentals of Gas Dynamics, John Wiley and Sons,2002.

WEB REFERENCES

- http://nptel.ac.in/courses/112106166/

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Course Code: 140AU9117	Course Title: COMPUTATIONAL FLUID DYNAMICS (Common to Automobile and Mechanical	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Fluid Mechanics & Machinery
- Heat and Mass Transfer

Course Objectives:

The course is intended to:

1. Explain the governing equations, classification of partial differential equation, initial and boundary conditions.
2. Discretize governing equations using finite difference method.
3. Discretize governing equations using finite volume method.
4. Solve incompressible viscous flow problems using MAC and SIMPLE algorithms.
5. Discuss basics of turbulence, its modeling and boundary conditions in real life problems.

Course Content **Hours**

UNIT I GOVERNING EQUATIONS 9

Introduction to fluid mechanics – Reynolds Transport Theorem- Continuity Equation – Momentum Equation - Energy Equation – Classification of PDE's – Initial and Boundary conditions.

UNIT II FINITE DIFFERENCE METHOD 9

Taylors Series – Forward, Backward and Central differencing schemes – FDM Formulation – Explicit scheme – FTCS and Dufort-Frankel method – Implicit scheme- Laasonen and Crank Nicolson method –1D Heat conduction –Problems - Errors (Qualitative).

UNIT III FINITE VOLUME METHOD 9

Introduction – 1D Steady state diffusion – 2D Steady state diffusion - 1D Steady state convection-diffusion - Central differencing schemes –UPWIND Scheme – Problems

UNIT IV VISCOUS FLOW 9

Incompressible flow using MAC and Simple algorithm - Stream function and Vorticity formulation for viscous incompressible flow. Two dimensional incompressible viscous flow.

UNIT V TURBULENCE AND ITS MODELLING 9

Introduction to turbulence- Turbulence models- One equation model - Mixing length model – Two equation model – K-Ɛ Model – Implementation of boundary condition in practical applications.

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Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the governing equations, classification of partial differential equation, initial and boundary conditions.
CO2. Discretize governing equations using finite difference method.
CO3. Discretize governing equations using finite volume method.
CO4. Solve incompressible viscous flow problems using MAC and SIMPLE algorithms.
CO5. Discuss basics of turbulence, its modeling and boundary conditions in real life problems.

TEXT BOOKS

1. Anderson D.A., Tannehil J.C, Pletcher R.H, Computational Fluid Mechanics & Heat Transfer, Hemisphere Publishing Corporation, New York, 2004.
2. Versteeg H.K, Malalasekara W, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Second Edition, Pearson Publishers, 2007.

REFERENCES

1. Klaus A. Hofmann, Steve T. Chiang, Computational Fluid Dynamics, Fourth Edition, Engineering Education System, 2000.
2. John D. Anderson, Computational Fluid Dynamics: The Basics with Applications, First Edition, McGraw-Hill Education, 2012
3. Murlidhar.K., Sunderrajan.T, Computational Fluid Mechanics and Heat Transfer, Narosa Publishing House, 2008.

WEB REFERENCES

- http://nptel.ac.in/courses/112105045/
- http://www.cfd-online.com/

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Course Code: 140AU9118	**Course Title: DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT** (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II
- Design of Machine Elements

Course Objectives:
The course is intended to:

1. Apply design Guidelines / Tolerance for DFM & DFA
2. Apply DFMA Concept for from design.
3. Design Features to facilitate machining.
4. Redesign of casting for economy
5. Design engineering products to meet environmental objectives / standards

Course Content **Hours**

UNIT I INTRODUCTION **9**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks, GD & T

UNIT II FACTORS INFLUENCING FORM DESIGN **9**

Working principle, Material, Manufacture, Design- Possible solutions – Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION **9**

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification byamalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION **9**

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

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UNIT V DESIGN FOR ENVIRONMENT AND DFMA TOOLS 9

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application Design for energy efficiency – Design to regulations and standards. AT&T life cycle assessment methods

Course Outcomes:

At the end of the course students will be able to:

CO1. Apply design Guidelines / Tolerance for DFM & DFA
CO2. Apply DFMA Concept for from design.
CO3. Design Features to facilitate machining.
CO4. Redesign of casting for economy
CO5. Design engineering products to meet environmental objectives / standards.

TEXT BOOKS

1. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight Product Design for Manufacture and Assembly, Third Edition, CRC Press, 2010
2. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004

REFERENCES

1. Harry Peck , "Designing for Manufacture", Pitman Publishing, 1973
2. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995
3. Fixel, J. Design for the Environment McGraw hill., 1996
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996
5. Poke-Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.

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Course Code: 140AU9119	**Course Title: PRODUCT DESIGN AND DEVELOPMENT** (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II
- Design of Machine Elements

Course Objectives:
The course is intended to:

1. Understand the process to plan and develop products.
2. List the process of collecting information and develop product specifications.
3. Discuss the concept generation, selection and testing processes.
4. Explain the concepts of industrial design and design for manufacture.
5. Describe the basics of prototyping, economic analysis and project planning

Course Content **Hours**

UNIT I INTRODUCTION **9**

Product Development process – Product development organizations, Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs, voice of customer

UNIT II PRODUCT SPECIFICATIONS **9**

Establishing the product specifications, – Target specifications – Refining specification Concept generation-Clarify the problem – Search internally – Search externally – Explore systematically.

UNIT III COMPONENT CONCEPT SELECTION **9**

Concept selection- Screening – scoring, Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

UNIT IV INDUSTRIAL DESIGN **9**

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design, design for manufacturing- cost considerations, Impact of DFM decisions on other factors.

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UNIT V PROTOTYPING & COST ANALYSIS 9

Principles of prototyping – Planning for prototypes, economics of product development projects, Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

Course Outcomes:

At the end of the course students will be able to:

CO1. Understand the process to plan and develop products.
CO2. List the process of collecting information and develop product specifications.
CO3. Discuss the concept generation, selection and testing processes.
CO4. Explain the concepts of industrial design and design for manufacture.
CO5. Describe the basics of prototyping, economic analysis and project planning

TEXT BOOKS

1. Karal, T.Ulrich steven D.Eppinger, Product Design and Development, McGraw Hill, International Editions, 2003.
2. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004

REFERENCES

1. S.Rosenthal, Effective Product Design and Development, Irwin, 1992.
2. Charles Gevirtz Developing New products with TQM, McGraw Hill International Editions, 1994.
3. Dieter.G.E., "Engineering Design," McGraw Hill Company International Edition
4. Ullman D.G., "The Mechanical Design Process", McGraw Hill Company International Edition

WEB REFERENCES

- http://users.encs.concordia.ca/~andrea/inse6411/Lecture2.pdf.
- http://www.me.umn.edu/courses/me4054/lecnotes/archive.html

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Course Code: 140AU9120	Course Title: FAILURE ANALYSIS AND DESIGN (Common to Automobile and Mechanical)	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Strength of Materials
- Design of Machine Elements

Course Objectives:

The course is intended to:

CO1. Explain the concepts of reliability
CO2. Explain the mechanics of fracture
CO3. Explain the characteristics of fatigue failure and fatigue testing methods
CO4. Explain the characteristics of Wear and corrosion failure
CO5. Explain the characteristics of creep failure

Course Content **Hours**

UNIT I RELIABILITY 9

Reliability concept and hazard function, life prediction, condition monitoring, application of Poisson, exponential and Weibull distribution for reliability - bath tub curve - parallel and series system - mean time between failures and life testing. Introduction to FMEA

UNIT II INTRODUCTION TO SOLID MECHANICS AND FRACTURE FAILURE 9

STRESSES IN A BODY: Two dimensional and three dimensional state of stress, Mohr's circle in two and three dimensions, hydrostatic stress, Von-mises, maximum shear stress (Tresca), octahedral shear stress, torsional stresses for large plastic strain. FRACTURE :Types of fracture, Griffith crack theory, stress analysis of cracks, metallographic aspects of fracture. Brittle, ductile fractures, notch effects, fracture curve, R curve, fracture under combined stresses, probabilistic aspects of fracture mechanics, toughness of materials.

UNIT III FATIGUE AND FATIGUE TESTING 9

FATIGUE: Statistical nature of fatigue, S-N curve, LCF, HCF, strain life equations, structural feature of fatigue, fatigue crack propagation, effect of stress concentration, size, surface properties, metallurgical variables on fatigue, case studies, designing against fatigue, detail design, improvements after failure and service, fatigue of bolts, welded and adhesive joints. FATIGUE TESTS: Purpose, specimen, fatigue test procedures, evaluation of fatigue test results, crack growth measurement

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UNIT IV WEAR AND CORROSION FAILURE 9

WEAR FAILURES: Type of wear, role of friction in wear, lubricated and non-lubricated wear, analysing wear failures, wear tests SOAP, ferrography. CORROSION FAILURES: Factors influencing corrosion failures, analysis of corrosion failures, overview of various types of corrosion, stress corrosion cracking - sources, characteristics of stress corrosion cracking, procedure of analysing stress corrosion cracking, various types of hydrogen damage failures, corrective and preventive action

UNIT V CREEP FAILURE 9

ELEVATED TEMPERATURE FAILURES: Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure, elevated temperature effects on certain gas turbine components and petroleum refinery components, tests for analysis of failure at elevated temperatures.

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the concepts of reliability
CO2. Explain the mechanics of fracture
CO3. Explain the characteristics of fatigue failure and fatigue testing methods
CO4. Explain the characteristics of Wear and corrosion failure
CO5. Explain the characteristics of creep failure

TEXT BOOKS

1. Richard W Hertzberg, "Deformation and Fracture Mechanism of Engineering Materials", John Wiley & Sons, Inc., 1995.
2. Jaap Schijve, "Fatigue of Structures and Materials", Kluwer Academic Publishers, 2001.

REFERENCES

3. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, USA, Vol. 10, 10th Edition, 1995.
4. George E Dieter, "Mechanical Metallurgy", McGraw Hill Book Company, 1988.
5. John M. Barsom, Stanley Theodore Rolfe "Fracture and Fatigue Control in Structures: Applications of Fracture Mechanics " ASTM International, 1999
6. Prasanta sahoo" Engineering Tribology" PHI Learning pvt. Ltd, 2005

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Course Code: 140AU9121	**Course Title: MECHANICAL SYSTEM DESIGN** (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Mathematics-I
- Numerical Methods

Course Objectives:
The course is intended to:

1. Explain the engineering process and system approach to formulate a problem.
2. Explain the system theories and system modeling concepts.
3. Apply the mathematical formulation in system design and optimization concepts.
4. Apply the decision analysis principles and system simulation concepts.
5. Apply the financial analysis to evaluate the system performance.

Course Content **Hours**

UNIT I SYSTEM APPROACH AND PROBLEM FORMULATION 9

Engineering processes- Role of an Engineer in Mechanical system Design, Engineering Problem solving. System approach-Application of system concepts, Characteristics of systems, elements of systems, Types of systems. Problem formulation-Problems and forming models, nature of engineering problems, problem characteristics, problem environment, problem statement and techniques involved in defining a problem, a case study.

UNIT II SYSTEM THEORIES AND SYSTEM MODELING 9

System Theories-Black box approach, state theory approach, component integrated approach, decision theory approach. System Modeling-Need of modeling, modeling process, principles, modeling types-static physical model, dynamic physical model, static mathematical model, dynamic mathematical model, a case study on system modeling.

UNIT III MATHEMATICAL FORMULATION IN MECHANICAL DESIGN 9

Mathematical Formulation in System Design-Linear Programming Problem- Graphical method, Simplex method, Network Flow analysis- critical path method, and probability of completion time. Optimization Concepts-optimization in engineering applications, ingredients and classifications, statement of optimization, design vector, constraints, objective function, Optimization concept in single variable optimization and multi variable optimization problem.

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UNIT IV DECISION ANALYSIS AND SYSTEM SIMULATION 9

Decision analysis-Elements of decision problem, decision making under certainty, decision making under uncertainty, decision models- quantitative methods, decision tree. System Simulation concepts- types of simulation models, simulation programs and languages, Monte Carlo simulation , waiting line simulation.

UNIT V SYSTEM EVALUATION 9

System evaluation-Request for proposals, Evaluation factors, stage of evaluation, Needs and benefits, Feasibility assessment, planning horizon. Financial analysis of system performance-Average rate of return method, Payback period, Balance sheet- profit and loss statement, a case study.

Course Outcomes:

At the end of the course students will be able to:

CO1 Explain the engineering process and system approach to formulate a problem.
CO2 Explain the system theories and system modeling concepts.
CO3 Apply the mathematical formulation in system design and optimization concepts.
CO4 Apply the decision analysis principles and system simulation concepts.
CO5 Apply the financial analysis to evaluate the system performance.

TEXT BOOKS

1. R.C Mishra and Simant, "Mechanical System Design" -PHI learning New Delhi, 2009.
2. K.U. Siddiqui and Manoj kumar singh, "Mechanical system Design"-New Age international Publishers, 2010.

REFERENCES

1. S.S.Rao "Engineering Optimization-Theory and Practice"- New Age international Publishers, 1996.
2. S.Kalavathy "Operations Research"-Vikas Publishing,2012
3. Ramachandran Aryasry & VV.Ramana Murthy, "Engg Economics & Financial Accounting",Tata McGraw-Hill Company, NewDelhi, 2004.

WEB REFERENCES

- http://content.asce.org/files/pdf/team2010-2Mechanical_systems_designpresentation.pdf
- http://www.engr.mun.ca/~yuri/Courses/MechanicalSystems/Design.pdf
- http://www.coursera.org

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Course Code: 140AU9122	Course Title: ADVANCED THEORY OF IC ENGINES	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- IC Engines

Course Objectives

The course is intended to:

1. Explain the combustion process of fuels
2. Analyse various engine cycles
3. Model the combustion process of IC engines
4. Compare the performance characteristics of non-conventional IC engines
5. Solve diffusion mass transfer
6. Analyse combustion process in IC engines

Course Content **Hours**

UNIT I COMBUSTION OF FUELS 9

Chemical Composition and molecular structureand hydrocarbon fuels, Combustion stoichiometry of hydro carbon fuels- Chemical Energy and heat of reaction calculations - Chemicalequilibrium and adibatic flame temperature calculation. Theory of SI and CI Engine combustion - Flame velocity and area of flame front. Fuel spray characterstics - Droplet size , Depthof penetrationand atomization.

UNIT II ENGINE CYCLE ANALYSIS 9

Ideal air, Fuel air cycle and actual Cycle analysis. Progressive combustion analysis in SI engines, Parametric Studies on work output, Efficiency and other engine performance.

UNIT III COMBUSTION MODELLING 9

Basic Concepts of Engine simulation- Governing Equations , Classifications of Engine models- Thermodynamic models for intake and exhaust flow process- Quasi steady flow-Filling and Emptying- Gas dynamic models. Thermodynamic based in cylinder models for SI engine and CI Engines

UNIT IV 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 rotafrycombustion engine. Dual fuel engine concept for multi fuel usage in CI Engine Performance studeis on dual fuel engines. Free piston Engine. Stratified charge and lean burn Engines. Locomotive and marine Engines.

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UNIT V COMBUSTION ANALYSIS IN IC ENGINES 9

Photo graphic studies of Combustion processes- Analysis of Pressure crank angle diagrams in SI and CI Engines. Knock studyfor pressure crank angle histories. Apparent heat release rate and Wiebe's Law analysis for combustion. Calculation of Ignition Delay and combustion duration- Hot wire and laser doppler anemometry and velocimetryfor flow and combustion analysis in IC Engines.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the combustion process of fuels
CO2. Analyse various engine cycles
CO3. Model the combustion process of IC engines
CO4. Compare the performance characteristics of non-conventional IC engines
CO5. Solve diffusion mass transfer
CO6. Analyse combustion process in IC engines

TEXT BOOKS

1. Ganeshan V., "Internal Combustion Engines, Tata McGraw Hill Publishing Co., 1994.
2. Ganeshan V., "Computer simulation of Spark ignition engine process", Universities Press (I) Ltd, Hyderabad,1996.

REFERENCES

1. Ramalingam K K" Internal Combustion Engine", Scitech Publications, chennai,2003
2. Ganeshan V "Compute Simulationof Compression Igniton Engine Process" Universities press (India) Ltd., Hyderabad,1996.
3. John B, Heywood, " Internal combustion Engine fundaments", Mc Graw Hill Publishing Co., New york,1990.

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Course Code: 140AU9123	Course Title: ADVANCED VEHICLE SYSTEMS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics II
- Automotive Embedded Systems

Course Objectives

The course is intended to:

1. Explain the operation of DTS ignition, VVT, Camless, GDI and CRDI engines
2. Explain the working of various vehicle safety systems
3. Explain the working of vehicle security and comfort system
4. Explain the operation of vehicle information and communication systems
5. Explain the working of various intelligent transportation systems

Course Content **Hours**

UNIT-1 POWERTRAIN 9

Modern Engine Technologies Like Digital Twin Spark ignition (DTS-I) , Digital Twin Spark Fuel Injection (DTS-Fi), Digital Twin Spark swirl induction (DTS-Si), Variable Valve Timing (VVT), Camless Engine, Gasoline Direct Injection (GDI) and Common Rail Direct Injection (CRDI)

UNIT II VEHICLE SAFETY 9

Antilock braking systems- Traction control system- Electrohydraulic brakes- Occupant safety systems- Air bags, Seatbelt tightening system, Collision warning systems, Child Lock- Power Windows- PowerSun roof-Seat and steering column- Bio metric Systems- Driver Assistance systems- Adaptive cruise control

UNIT III VEHICLE SECURITY AND COMFORT SYSTEM 9

Vision Enhancement, Road recognition system, AntiTheft Technologies, Smart card system, Number plate coding, Locking system - Central locking system- acoustic signalling devices Active suspension system,requirement and characterstics, different types, vehicle handling and ride characterstics of road vehicle, Pitch, Yaw, Bounce Control, Climate Control Management system

UNIT IV VEHICLE INFORMATION AND COMMUNICATION 9

Instrumentation- Vehicle information system- Trip Recorders- Parking systems- Analog and digital signal transmission - Automotive sound systems- Mobile and data radio - Mobile information services- Navigationsystems-Traffic Telematics- Multimedia Systems. OBD- I Engine diagnostic system- OBD-II Engine control systems-SAE DTC standards- Scan Tools- Strategy based diagnosis- Engine and vehicle Performance problems.

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UNIT V INTELLIGENT TRANSPORTATION SYSTEM 9

Traffic routing system- Automated highway systems - Lane warning system - Driver Information System- Driver assistance systems- Driver Conditioning warning - Route Guidance and navigation systems- Hybrid/ Electric and future cars.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the operation of DTS ignition, VVT, Camless, GDI and CRDI engines
CO2. Explain the working of various vehicle safety systems
CO3. Explain the working of vehicle security and comfort system
CO4. Explain the operation of vehicle information and communication systems
CO5. Explain the working of various intelligent transportation systems

TEXT BOOKS

1. Nadovich, C., " Synthetic instruments concepts and Applications". Elsevier, 2005
2. Bitter, R., Mohiuddin T and Nawricki M., " Labview Advanced Programming Techniques",CRC Press, 2 nd Edition,2007

REFERENCE

1. Robert N Brandy, " Automotive Electronics and Computer systems", Prentice Hall,2001

BoS Chairman

Course Code: 140AU9124	Course Title: ELECTRIC, HYBRID AND FUEL CELL VEHICLES	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Engineering Thermodynamics

Course Objectives

The course is intended to:

1. Explain the construction and working of power sources used for electric vehicles
2. Explain the performance characteristics and drives of electric vehicles
3. Explain the architecture of various hybrid vehicle designs
4. Explain the operating principle of fuel cells
5. Compare braking performance of EV, HEV and FCV

Course Content **Hours**

UNIT I ENERGY SOURCES **9**

Peaking Power Sources and Energy Storages-Electrochemical Batteries-Electrochemical Reactions, Thermodynamic Voltage, Specific Energy, Specific Power and Energy Efficiency. Battery Technologies –Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydride (NiMH) Battery, Li-Ion Battery, Zinc-Air Battery

UNIT II ELECTRIC VEHICLES **11**

Configurations of EVs-Performance of EVs-Traction Motor Characteristics, Tractive Effort and Transmission Requirement and Vehicle Performance. Electric Propulsion Systems - DC Motor Drives-Induction Motor Drives- Induction Motor Drives- SRM Drives, Voltage-Balance Equation, Torque-Speed Characteristics

UNIT III HYBRID VEHICLES **9**

Concept of Hybrid Electric Drive Trains-Architectures of Hybrid Electric Drive Trains-Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains. Fuel Cell Hybrid Electric Drive Train Design

UNIT IV FUEL CELLS **8**

Operating Principles of Fuel Cells -Fuel Cell Technologies-Proton Exchange Membrane Fuel Cells, Alkaline Fuel Cells, Phosphoric Acid Fuel Cells, Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells, Direct Methanol Fuel Cells. Fuel Supply and reforming techniques.

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UNIT V REGENERATIVE BRAKING 8

Braking energy consumption - Brake System of EV, HEV, and FCV - Control strategy for braking performance. Parallel Hybrid Braking System - Fully Controllable Hybrid Brake System.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the construction and working of power sources used for electric vehicles
CO2. Explain the performance characteristics and drives of electric vehicles
CO3. Explain the architecture of various hybrid vehicle designs
CO4. Explain the operating principle of fuel cells
CO5. Compare braking performance of EV, HEV and FCV

TEXT BOOKS

1. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid and Fuel CellVehicles: Fundamentals, Theory and Design", CRS Press, 2004.
2. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", utterworth- Heinemann, 2001

REFERENCES

1. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002
2. James Larminie and John Loury, "Electric Vehicle Technology-Explained", John Wiley &Sons Ltd.,2003.
3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", Second Edition, CRC Press, 2011

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Course Code: 140AU9125	Course Title: OFF ROAD VEHICLES	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Chassis
- Automotive Transmission

Course Objectives

The course is intended to:

1. Explain the construction and layout of earth moving equipments
2. Explain the construction and layout of constructional equipments
3. Explain the construction and layout of farm equipments
4. Explain the construction and layout of industrial vehicles
5. Explain the construction and layout of military and combat vehicles

Course Content **Hours**

UNIT I EARTH MOVING EQUIPMENTS **9**

Construction Layout, Capacity and applications of earth movers like dumpers, Front End loaders, Bull Dozers, Backhoe Loaders, Scrappers, Bucket Conveyors Etc., Selection Criteria of prime mover for dumper and front end loaders based on vehicle performance characteristics

UNITII CONSTRUCTIONAL EQUIPMENTS **9**

Layout of constructional equipments, Excavators, Jip Cranes, Hoist motor graders, Mixing machine, Concrete ready mixers, Drillers, Ramming machines for constructions of bridges and working principles, Power generators

UNIT III FARM EQUIPMENTS **9**

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

UNIT IV INDUSTRIAL APPLICATIONS **9**

Constructional Features, Capacity and stability of Jib Cranes, Vibratory compactors, Fork Lifts. Towing Vehicles, Case Studies

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UNIT V MILITARY AND COMBAT VEHICLES 9

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.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the construction and layout of earth moving equipments
CO2. Explain the construction and layout of constructional equipments
CO3. Explain the construction and layout of farm equipments
CO4. Explain the construction and layout of industrial vehicles
CO5. Explain the construction and layout of military and combat vehicles

TEXT BOOKS

1. Abrosimov.K, Bran Berg A and Katayer K., "Road making machinery", MIR Publishers, Moscow, 1971.
2. Wong J T .,"Theory of ground Vehicles"., John wiley & sons,Newyok,1987

REFERENCES

1. Bart H vanderveen, Tanks and transport vehicles, Fresderic warne and CO ltd., London
2. Kolchin A and Demidov V "Design of Automotive Engines for Tractor", MIR Publishers, 1972.

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Course Code: 140AU9126	Course Title: VEHICLE CONTROL SYSTEMS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics II
- Automotive Embedded Systems

Course Objectives

The course is intended to:

1. Explain the basic concepts of vehicle control systems
2. Develop empirical models from vehicle systems data
3. Explain the hardware components of vehicle control systems
4. Explain the working of various controllers for vehicle control systems
5. Explain the working of various engine control systems
6. Explain the working of vehicle drive line, braking and suspension control systems

Course Content **Hours**

UNIT 1 INTRODUCTION TO VEHICLE CONTROL SYSTEM 9

Steps in vehicle control system design- Influence of vehicle system design on vehicle control examples with respect to vehicle sub system - Degree of freedom for vehicle control - Calculation of the control degree of freedom - Effect of feedback on control degree of freedom - Selection of controlled, manipulated, Measured disturbance - classification of the variables in various automotive systems like engines, suspension, braking, air conditioning- General types of vehicle controller configurations-Feedback, inferential, Feed-Forward, Ratio control

UNIT II DYNAMIC BEHAVIOUR AND HARDWARE OF VEHICLE CONTROL SYSTEMS 9

Transfer function and state-space models - Dynamic behaviour of first order and second order vehicle systems- standard vehicle system inputs - dynamic responses characteristics of more complicated vehicle system- Development of empirical models from vehicle system data Hardware elements like vehicle plant, Measuring instruments, transducers, transmission lines, controller, final control elements, recording elements- use of digital computers in vehicle control

UNIT III FEEDBACK AND ADVANCED CONTROLLERS FOR VEHICLE CONTROL SYSTEM 9

Introduction- Basic control modes- Proportional control- Integral control- Reset windup - Derivative control - Various forms of PID Control - Enhancement of PID Controllers - On-Off Controllers- Typical responses of feedback control systems- Digital version of PID controllers

Feed - Forward control - Cascade control - Design Considerations for cascade control. Time delay compensation, Inferential Control - Nonlinear control-Adaptive control

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UNIT IV ENGINE CONTROL SYSTEMS 9

Fuel Control- Ignition Control- Lambada control- Idle Speed control - Knock Control- Adaptive Knock control- Combustion torque estimation

UNIT V VEHICLE DRIVE LINE, BRAKING AND SUSPENSION CONTROL SYSTEM 9

Driveline Modelling - Modelling for neutral gear -driveline control- drive line speed control- Drive line control for gear shifting- Active suspension control
Antilock braking control- Traction control-Electronic stability program control

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the basic concepts of vehicle control systems
CO2. Develop empirical models from vehicle systems data
CO3. Explain the hardware components of vehicle control systems
CO4. Explain the working of various controllers for vehicle control systems
CO5. Explain the working of various engine control systems
CO6. Explain the working of vehicle drive line, braking and suspension control systems

TEXT BOOKS

1. Uwe Kiencke and Lars Nielson, Automotive Control Systems, SAE Publications,2006
2. Bosch Automotive Handbook, Sixth Edition, 2004

REFERENCES

1. Katsuhiko Ogata, System dynamics, Prentice Hall International, Inc. Third Edition,1998
2. Benjamin C.Kuo and Farid Golnaraghi, Automatic Control Systems, John Wiley & Sons, Eighth Edition,2003
3. Richard C.Kuo and Farid Golnaraghi, Automatic Control System, John Wiley & Sons, Eighth Edition, 2003

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Course Code: 140AU9127	Course Title: HYDRAULIC AND PNEUMATIC SYSTEMS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Fluid Mechanics and Machinery
- Kinematics of Machines

Course Objectives
The course is intended to:

1. Explain the fluid power systems with advantages and applications.
2. Explain construction and working of hydraulic system components.
3. Design hydraulic circuit to perform the desired function.
4. Explain construction and working of pneumatic system components
5. Design pneumatic circuit to perform the desired function.

Course Content **Hours**

UNITI FLUID POWER SYSTEM AND FUNDAMENTALS 9

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components - Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system -Properties of hydraulic fluids - Types of fluids.

UNITII HYDRAULIC SYSTEM AND COMPONENTS 9

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Hydraulic symbols - Hydraulic circuits for linear actuators - Hydraulic circuits using different actuating devices - Speed control circuits - Sequencing circuit - Synchronizing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Milling operation, Grinding Machine - Hydraulic braking in Automobile.

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UNIT IV PNEUMATIC SYSTEM AND COMPONENTS 9

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator, air lubricator - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valve – Flow control valve - Pneumatic symbols

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Pneumatic circuits for single acting cylinder, Double acting cylinder - Pneumatic circuits using manual, mechanical, electrical actuating devices - Cascade method for sequencing: two and three Cylinders - Step counter method- Hydro-Pneumatic circuit - Material handling system circuit - Multiple operation Machining.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the fluid power systems with advantages and applications.

CO2. Explain construction and working of hydraulic system components.

CO3. Design hydraulic circuit to perform the desired function.

CO4. Explain construction and working of pneumatic system components

CO5. Design of pneumatic circuit to perform the desired function.

TEXT BOOKS

1. Esposito Anthony, "Fluid Power with Applications", Pearson Education Inc., New York, 2008.
2. Majumdar, S.R., "Oil Hydraulic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006.

REFERENCES

1. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.
2. Andrew Parr, "Hydraulics and Pneumatics, A technician's and engineer's guide", Third Edition, Butterworth-Heinemann, 2011.
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006

WEB REFERENCES

- http://www.nptel.ac.in/courses/112106175/
- http://nptel.ac.in/courses/112105046/
- http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2_Hydraulics_control_in_machine_tools.pdf
- http://maysaaiat.weebly.com/uploads/5/8/8/3/5883161/atm1122_hydraulics_module_1.pdf

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Course Code: 140AU9154	Course Title: OPTIMIZATION TECHNIQUES	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Strength of Materials
- Design of Machine Elements

Course Outcomes

The course is intended to:

1. Apply the principles of constrained optimization techniques in solving problems.
2. Apply the principles of unconstrained optimization techniques in solving problems.
3. Apply the dynamic programming concepts in solving the multi objective and multi stage problems.
4. Solve the optimization problems using unconventional optimization techniques.
5. Solve simple design problems using optimization techniques.

Course Content **Hours**

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES 9

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods. **(Condense)**

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES 9

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming, Introduction to Design of experiments and analysis of variance.

UNIT III DYNAMIC PROGRAMMING 9

Multi stage optimization – dynamic programming; stochastic programming; Multi objective Optimization.

UNIT IV UNCONVENTIONAL OPTIMIZATION TECHNIQUES 9

Genetic algorithms, Simulated Annealing and Ant Colony techniques; Neural network & Fuzzy logic principles in optimization

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UNIT V DESIGN APPLICATIONS 9

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

Course Outcomes

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

CO1. Apply the principles of constrained optimization techniques in solving problems.
CO2. Apply the principles of unconstrained optimization techniques in solving problems.
CO3. Apply the dynamic programming concepts in solving the multi objective and multi stage problems.
CO4. Solve the optimization problems using unconventional optimization techniques.
CO5. Solve simple design problems using optimization techniques.

TEXT BOOK:

1. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India Pvt. Ltd. 2006
2. Saravanan.R, "Manufacturing optimization through intelligent techniques",Taylor and Francis Publications,CRC Press,2006.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", McGraw Hill Professional, 1996
4. K. Krishnaiah, P. Shahabudeen "Applied Design Of Experiments And Taguchi Methods" PHI Learning Pvt. Ltd, 2012
5. R. Pannerselvam "Design and Analysis of Experiments "PHI Learning Pvt, 2012

REFERENCES:

1. SingaresuS.Rao, "Engineering Optimization – Theory & Practice", New Age International (P) Limited, New Delhi, 2000.
2. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Mathematical_optimization
2. https://mech.iitm.ac.in/nspch52.pdf

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Course Code: 140AU9155	Course Title: PRODUCT INNOVATION THROUGH TRIZ	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s): Nil

Course Objectives

The course is intended to:

1. Explain the fundamentals of product innovation
2. Explain the basic concepts of TRIZ
3. Solve inventive or non-routine technical problems within the framework of TRIZ
4. Apply ARIZ algorithm for inventive problem solving
5. Apply the evolution patterns for system development

Course Content **Hours**

UNIT I INTRODUCTION TO TRIZ 9

Introduction to Product Innovation – Relationship between Invention and Innovation – Theories of Innovation, TRIZ – Theory to resolve Inventive Problems, Historical Development – Essence of TRIZ. Techniques for Breaking Psychological Inertia.

UNIT II CONCEPT OF TRIZ 9

Ideal final Result – Problem formulation and Functional analysis – Ideality – Contradiction; Physical and Technical – Resolving Contradiction – 39 Contradicting Parameters – Contradiction Matrix – Use of S Curve and Technology Evolution Trends, Quality Function Deployment.

UNIT III INVENTIVE PRINCIPLES AND STANDARD SOLUTIONS 9

Definition of 40 Inventive Principles – Definition of 76 Standard Solutions – Improving the System with no brittle change (13) – Improving the system by changing the system (23) – System Transitions (6) – Detection and Measurement (17) – strategies for simplification and improvement – Case Studies.

UNIT IV ARIZ ALGORITHM 9

ARIZ – The Algorithm for Inventive Problem Solving – ARIZ frame work; Restructuring of the original problem – Removing the Physical Contradiction – Analyzing the Solution – Macro flow Chart of ARIZ– Case Studies

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UNIT V EVOLUTION PATTERNS FOR SYSTEM DEVELOPMENT 9

Introduction-Uneven Evolution of Systems, Transition to Macro level, Transition to Micro level, Increase of interactions, Expansion and Convolution, Benefits from understanding the patterns of evolution, Application of Evolution Patterns.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the fundamentals of product innovation
CO2. Explain the basic concepts of TRIZ
CO3. Solve inventive or non-routine technical problems within the framework of TRIZ
CO4. Apply ARIZ algorithm for inventive problem solving
CO5. Apply the evolution patterns for system development

TEXT BOOKS

1. Michael A Orloff, Inventive thinking through TRIZ, Springer, 2012.
2. Kalevi Rantanen and Ellen Domb, Simplified TRIZ-New Problem Solving Applications for Engineers and Manufacturing Professionals, Auerbach Publications 2008.

REFERENCES

1. Semyon D and Savransky, Engineering of Creativity - Introduction to TRIZ Methodology of Inventive Problem Solving, CRC Press LLC, 2000.
2. Genrich Altshuller, TRIZ Keys to Technical Innovation, Technical Innovation Center, 2002.

WEB REFERENCES

- www.triz-journal.com.

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Course Code: 140AU9156	Course Title: : C - PROGRAMMING	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s): Nil

Course Objectives

The course is intended to:

1 Write and draw a flowchart for given problems.

2 Recognize and build program using appropriate programming paradigms.

3 Implement modular programs using functions and files.

4 Apply pointers for effective memory usability.

5 Articulate the necessity of structures and unions.

Course Content **Hours**

UNIT I INTRODUCTION **9**

Basics of computers- Algorithm – Flow Chart-Introduction of C program-Identifier-Keywords -Data Types-Variables and Constants-Operators and Expressions – Managing Input and Output operations.

UNIT II CONTROL STATEMENTS AND ARRAYS **9**

Decision Making and Branching-Looping statements-Nested looping- Arrays-Declaration-Initialization – One dimensional and two dimensional arrays-Advantages and Limitations of Arrays.

UNIT III STRINGS AND FUNCTIONS **9**

String-Character Arrays-String operations--Arrays of Strings.Function –Built in function-User defined function-– Declaration of function – Definition of function-Pass by value – Pass by reference– Recursion.

UNIT IV POINTERS AND FILES **9**

Pointers - Operations on Pointers– Arithmetic & Relational operations on pointers- Void Pointer- Null Pointer – Relationship between Pointers and Arrays - Array of Pointers-Applications of Pointers- Files-File Operations.

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UNIT V STRUCTURES AND UNIONS 9

Structure definition – Structure declaration – Operations on Structures–Pointer to Structures-Array of structures– Nested Structures-functions and structures-Union - Practical applications of Unions and structures.

Course Outcomes

At the end of the course students will be able to:

CO1 Write and draw a flowchart for given problems.

CO2 Recognize and build program using appropriate programming paradigms.

CO3 Implement modular programs using functions and files.

CO4 Apply pointers for effective memory usability.

CO5 Articulate the necessity of structures and unions.

TEXT BOOKS

1. Anita Goel, Ajay Mittal, "Computer Fundamentals and programming in C" , First Edition, Pearson Education, 2013.
2. PradipDey, ManasGhosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.

REFERENCES

1. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
2. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

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MANUFACTURING STREAM

Course Code: 140AU9128	**Course Title:** COMPUTER INTEGRATED MANUFACTURING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing process I
- Manufacturing process II

Course Objectives

The course is intended to:

1. Explain NC, DNC and CNC used in CIM.
2. Apply the features of CAD System in design and modeling.
3. Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.
4. Describe Group Technology and Classification of Coding system.
5. Explain Artificial Intelligent system, Expert system and FMS.

Course Content **Hours**

UNIT I INTRODUCTION TO CIM 9

Automated Manufacturing system – Needs, Types. CIM - CIM wheel - Components, Evolution, needs, Benefits. NC system - Components, NC motion control system, application, advantages and disadvantages. Computer Numerical control System – Components, functions, advantages. Direct Numerical Control System – Components, functions, advantages.

UNIT II COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate. - typical CAD command structure - Types CAD modeling - wire frame modeling, surface modeling and solid modeling.

UNIT III MATERIAL HANDLING AND STORAGE SYSTEMS 9

Materials handling and Storage Systems - Automated storage and retrieval systems, carousel storage systems - Interfacing of Handling and Storage with Manufacturing system. AGVs - types, advantages and application. Robot – Basic concepts, applications.

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UNIT IV GROUP TECHNOLOGY 9

GroupTechnology - RoleofG.TinCAD/CAM Integration, partfamilies, part Classificationandcoding–DCLASSandMICLASSandOPITZcodingsystems - facility designusingG.T, benefitsofG.T - Cellular Manufacturing.

UNIT V ARTIFICIAL INTELLIGENT SYSTEM, EXPERT SYSTEM AND FMS 9

Artificial Intelligence System, Basic concepts of Artificial intelligence, Intelligent systems and expert systems. Flexible manufacturing systems – Configurations, workstations, planning, applications and benefits – Automated inspection and testing - Machine vision.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain NC, DNC and CNC used in CIM.
CO2. Apply the features of CAD System in design and modeling.
CO3. Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.
CO4. Describe Group Technology and Classification of Coding system.
CO5. Explain Artificial Intelligent system, Expert system and FMS.

TEXT BOOKS

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2001.
2. Mikell. P. Groover and Emory Zimmers Jr.,"CAD/CAM", Prentice hall of India Pvt. Ltd., 1998.

REFERENCES

1. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. Ltd., 2005.

WEB REFERENCES

- https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
- https://en.wikipedia.org/wiki/Computer-aided_manufacturing
- https://en.wikipedia.org/wiki/Integrated_Computer-Aided_Manufacturing
- http://www.simflow.net/publications/books/cimie-part1.pdf
- https://prezi.com/tnl5tme5rwr6/computer-integrated-manufacturing-cim

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Course Code: 140AU9129	**Course Title: NON-DESTRUCTIVE TESTING METHODS** (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Engineering Metrology and Measurements.

Course Objectives

The course is intended to:

1. Explain Visual Inspection and Eddy Current Testing Method.
2. Apply the Magnetic Particle Testing Method to identify the defects in ferrous metals.
3. Use Liquid Penetrant Testing Method to identify the defects in different components.
4. Apply the Ultrasonic Testing Method to identify the defects in different components.
5. Describe Radiographic Testing Method

Course Content **Hours**

UNIT I VISUAL INSPECTION AND EDDY CURRENT TESTING METHOD 9

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory-Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexi scope, Telescope and Hollography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAGNETIC PARTICLE TESTING METHOD 9

Basic Principle of magnetic particle testing(MPT)-induced magnetic fields-circular and longitudinal fields-Hysteresis curve-magnetic flux strips and coils-residual fields and demagnetization-MPT techniques-magnetization using a permanent magnet, magnetization using a Electro magnet, contact current flow method, wet and dry particle inspection methods, remote magnetic particle inspection, probe power inspection, light weight UV lamps inspection, semi automatic inspection, applications and limitations of MPT.

UNIT III LIQUID PENETRANT TESTING METHOD 9

Physical properties of liquid penetrant-penetrant testing materials-penetrants, cleaners, emulsifiers developers, lint free cloth-Basic Principle, applications and limitations of liquid penetrant testing(LPT)-different LPT methods-Post-Emulsification Fluorescent penetrant process, Reverse Fluorescent Dye penetrant process, Visible Dye penetrant process, Water-Emulsification visible Dye penetrant process, solvent clean visible Dye penetrant process.

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UNIT IV ULTRASONIC TESTING METHOD 9

Basic properties of sound beam-sound waves-velocity of ultrasonic waves, Acoustic Impedance behavior of ultrasonic waves-ultrasonic transducers-characteristics of ultrasonic beam, Flaw sensitivity, Beam divergence, Attenuation-Principle of ultrasonic testing methods, applications and limitations-Ultrasonic testing method-normal incident pulse echo inspection method, normal incident through transmission testing method, angle beam pulse echo inspection method.

UNIT V RADIOGRAPHIC TESTING METHOD 9

Basic Principle of Radiography-Electromagnetic radiation sources-X ray source, Gamma ray source-properties of X and Gamma rays-Radiographic Imaging-Geometrical factors-radiographic film-film density-Radiographic sensitivity- Penetrometer-Radiographic Inspection Techniques-single wall single image technique, wall penetration technique, Latitude technique-Applications and Limitations of Radiographic Inspection Techniques.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain Visual Inspection and Eddy Current Testing Method.
CO2. Apply the Magnetic Particle Testing Method to identify the defects in ferrous metals.
CO3.Use Liquid Penetrant Testing Method to identify the defects in different components.
CO4. Apply the Ultrasonic Testing Method to identify the defects in different components.
CO5. Describe Radiographic Testing Method

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu,"Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw-HillEducation Private Limited, 2003.

REFERENCES

1. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
2. American Metals Society, "Non-Destructive Examination and Quality Control", Metals Hand Book, Vol.17, 9th Edition, Metals Park, 1989.
3. Paul Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition,New Jersey,2005.

WEB REFERENCES

- https://www.nde-ed.org/index_flash.htm
- http:// http://117.55.241.6/library/E-Books/NDT%20Notes.pdf
- http:// www.slideshare.net/ndtindia123/introduction-uses-of-non-destructive-testing-24377016
- http:// www.eis.hu.edu.jo/ACUploads/10526/Ultrasonic%20Testing.pdf
- http://www.hse.gov.uk/comah/sragtech/ndt2.pdf

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Course Code: 140AU9130	**Course Title:** COMPOSITE MATERIALS (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Materials Science
- Strength of Materials
- Metallurgical Engineering.

Course Objectives

The course is intended to:

1. Classify different types of Matrix and Reinforcements
2. Explain different types Fibres and Matrices
3. Explain different types of methods to fabricate composites
4. Explain the mechanics of Fibre reinforced composites
5. Explain the load bearing behavior of Composite structures.

Course Content **Hours**

UNIT I INTRODUCTION **9**

Definition – Classification of Composite materials based on structure – based on matrix. Advantages of composites – application of composites – functional requirements of reinforcement and matrix. Reinforcement types – Fibres – continuous, particulate and whisker reinforcements – Properties -Applications – Comparison of fibre strengths –. Matrix materials – Properties. Wettability fibre with matrix – Effect of surface roughness – Interfacial bonding

UNIT IIREINFORCEMENTS AND MATRICES **9**

Different types of fibers - Manufacturing, properties and applications of glass fibers, carbon fibers, Kevlar fibers. Thermoset and thermoplastic matrices - properties of polyester, epoxy and nylon matrices, polypropylene and PEEK matrices.

UNIT III MANUFACTURING OF COMPOSITES **9**

Polymer matrix composites: Preparation of Moulding compounds and pre-pregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding.

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UNIT IV MECHANICS OF COMPOSITES 9

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young's modulus-transverse Young's modulus – major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina – laminates – lamination theory, Inter laminar stresses.

UNIT V COMPOSITE STRUCTURES 9

Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites. Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted

Course Outcomes

At the end of the course students will be able to:

CO1. Classify different types of Matrix and Reinforcements
CO2. Explain different types Fibres and Matrices
CO3. Explain different types of methods to fabricate composites
CO4. Explain the mechanics of Fibre reinforced composites
CO5. Explain the load bearing behavior of Composite structures.

TEXT BOOKS

1. Krishnan K.Chawla, "Composite Materials Science and Engineering", Springer.
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design",Maneel Dekker Inc, 1993.

REFERENCES

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites",John Wiley and Sons, New York, 1990.
2. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994,Second Edition

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- http://nptel.ac.in/courses/101104010/
- http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Composite%20Materials/New_index1.html

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Course Code: 140AU9131	**Course Title:** LEAN MANUFACTURING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s): Nil

Course Objectives

The course is intended to:

1 Explain the need for Lean Manufacturing.
2 Describe the tools and methodologies of Lean Manufacturing.
3 Describe the value stream management in Lean Manufacturing.
4 Explain the implementation of Lean Manufacturing in manufacturing and service industries.
5 Calculate the various lean metrics.

Course Content **Hours**

UNIT I INTRODUCTION TO LEAN MANUFACTURING 7

Manufacturing systems-Types-Ford Production System, Lean Manufacturing Paradigm-History of Lean Manufacturing-Traditional Vs Lean Manufacturing, TQM vs. Lean, Toyota Production System. Lean Principles-Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri-Types of wastes, Lean objectives-Need for lean manufacturing.

UNIT II LEAN TOOLS AND METHODOLOGIES 9

Problem solving tools-Cause and Effect Diagram, Pareto analysis, FMEA, Work cell and equipment management tools- Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow , Genchi Genbutsu, Milk run , Visual workplace, Quality at the source Methodologies-Pillars of Lean Manufacturing-Just in Time, Jidoka, 5S, TPM, Six sigma, DFMA, Kaizen.

UNIT III VALUE STREAM MANAGEMENT 10

Value stream Mapping-Value stream icons-Road map-Current State, Future State-Demand stage-Market Dynamics, Customer Demand; PQ Analysis; PR Analysis; Takt Time; Pitch; Finished Goods Stock, Cycle Stock Buffer Stock; Safety Stock-Flow Stage-Continuous flow, work cells, Line balancing, Standardized work, Quick change over, Autonomous maintenance, In process Super markets, Kanban systems, FIFO Lanes, Production Scheduling, Leveling Stage-Paced Withdrawal, Heijunka(Load Leveling), Heijunka Box, The Runner-a Case Study.

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UNIT IV LEAN IMPLEMENTATION **10**

Training Stage-Management Commitment, Identify the value stream manager/Champion and core Implementation team Members, Training of team members, Planning stage-Customer Focus, Go to the floor, Hosin Planning, Brain storming, Prepare Tree Diagram, Select the cross functional team, Prepare project plan, Improvement stage-Production and Productivity-Operator, Process, Machinery and Equipment, Work place Organization, Inventory management, Planning and Procurement of Materials, A case study on Lean implementation in manufacturing and service industries.

UNIT V LEAN METRICS **9**

Lean Metrics-the fundamentals, steps in identifying Lean Metrics, WIP inventory, Total Product cycle time, Total value stream lead time, On time delivery, Defective PPM, Uptime, OEE, Throughput rate, Through put yield, Utilization rate, Lean Manufacturing assessment-Radar Chart- a case study.

Course Outcomes

At the end of the course students will be able to:

CO1 Explain the need for Lean Manufacturing.
CO2 Describe the tools and methodologies of Lean Manufacturing.
CO3 Describe the value stream management in Lean Manufacturing.
CO4 Explain the implementation of Lean Manufacturing in manufacturing and service industries.
CO5 Calculate the various lean metrics.

TEXT BOOKS

1. Don Tapping, Tom Luyster, and Tom Shuker, Value stream Management Eight steps to planning, Mapping and sustaining Lean Improvements,2002, Productivity Press,New York.
2. N.Gopalakrishnan, Simplified Lean Manufacture Elements, Rules, Tools and Implementation, 2010, PHI Learning, New Delhi.

REFERENCES

1. James P. Womack, Daniel T Jones, Daniel Ross The Machine That Change the world,2007, Free Press trade paperback edition, U.S.A.
2. Ronald G. Askin & Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems,2003, John Wiley & Sons.
3. Rother M. and Shook J, 'Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, 1999, Brookline, MA.

WEB REFERENCES

- https:// www.learning –to-see.co.uk.
- https://www.lean.org.
- https://www.lean production.com.

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Course Code: 140AU9132	**Course Title:** UNCONVENTIONAL MACHINING PROCESSES (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II

Course Objectives

The course is intended to:

1. Classify Unconventional Machining Processes.
2. Compare various Mechanical energy based unconventional machining processes
3. Compare various Electrical energy based unconventional machining processes
4. Compare various Chemical & Electro chemical energy based unconventional Machining process
5. Compare various Thermal energy based unconventional machining processes

Course Content **Hours**

UNIT I INTRODUCTION 9

Need for unconventional machining process-Advantages of UCM - Disadvantages of UCM - Comparison of conventional and unconventional machining processes - Process parameters - Processes based on type of energy required to shape the material- Processes based on mechanism of material removal- Processes based on transfer media- Processes based on source of energy

UNIT II MECHANICAL ENERGY BASED UCM PROCESSES 9

Principle of Mechanical energy based UCM Processes - Mechanical energy based unconventional machining processes: Ultrasonic machining process, Abrasive Jet machining process, Water Jet Machining process - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Mechanical energy based unconventional machining processes

UNIT III ELECTRICAL ENERGY BASED UCM PROCESSES 9

Principle of Electrical energy based UCM Processes - Electrical energy based unconventional machining processes: Electric Discharge machining - Principle, Layout of EDM process, Functions and types of dielectric fluid, Properties of different tool materials, Working of R-C (Relaxation) circuit, R-C-L circuit, rotary pulse generator circuit, controlled pulse generator circuit, Process parameters in EDM Process, Mechanism of metal removal, Applications, Advantages and Disadvantages. Wire cut EDM (WCEDM) process: Layout, Construction and working of various elements, Applications, Advantages and Disadvantages. Drilling and Die sinking by EDM process. Comparison of Electrical energy based unconventional machining processes

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UNIT IV CHEMICAL & ELECTRO CHEMICAL ENERGY BASED UCM PROCESSES 9

Principle of Chemical & Electro chemical energy based UCM Processes - Chemical & Electro chemical energy based unconventional machining processes: Chemical machining, Electro chemical machining, Electro chemical grinding, Electro chemical honing processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Chemical & Electro chemical energy based unconventional machining processes

UNIT V THERMAL ENERGY BASED UCM PROCESSES 9

Principle of Thermal energy based UCM Processes - Thermal energy based unconventional machining processes: Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Thermal energy based unconventional machining processes.

Course Outcomes

At the end of the course students will be able to:

CO1. Classify Unconventional Machining Processes.
CO2. Compare various Mechanical energy based unconventional machining processes
CO3. Compare various Electrical energy based unconventional machining processes
CO4. Compare various Chemical & Electro chemical energy based unconventional Machining process
CO5. Compare various Thermal energy based unconventional machining processes

TEXT BOOKS

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. 2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (2007).

REFERENCES

1. Benedict.G.F."Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987).
2. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.
3. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008.

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- https://en.wikipedia.org/wiki/Laser_beam_machining
- https://en.wikipedia.org/wiki/Electrical_discharge_machining
- http://mechteacher.com/manufacturing-technology/
- http://www.engineershandbook.com/MfgMethods/nontraditionalmachining

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Course Code: 140AU9133	**Course Title:** INDUSTRIAL ROBOTICS AND AUTOMATION (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Kinematics of Machines
- Manufacturing Process I
- Manufacturing Process II

Course Objectives:

The course is intended to:

1: Explain the fundamentals of robot.
2: Describe the working of various robot drive systems and end effectors
3: Discuss the working principle of various sensors.
4: Explain the concepts of robot kinematics and robot programming.
5: Understand the implementation of robotics in industries.

Course Content **Hours**

UNIT I FUNDAMENTALS OF ROBOT **7**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS **10**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III SENSORS AND MACHINE VISION **10**

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors,Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection Feature Extraction and Object Recognition - Algorithms. Applications – Inspection, Identification Visual Serving and Navigation.

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UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8

Industrial applications like pick & place, welding, painting, inspection, etc. ; RGV, AGV; Implementation of Robots in Industries, Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Course Outcomes:

At the end of the course students will be able to:

CO 1: Explain the fundamentals of robot.
CO 2: Describe the working of various robot drive systems and end effectors
CO 3: Discuss the working principle of various sensors.
CO 4: Explain the concepts of robot kinematics and robot programming.
CO 5: Understand the implementation of robotics in industries.

TEXT BOOK

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001.

REFERENCES

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
3. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995
4. S.R.Deb and Shanka Deb "Robotics Technology and Flexible Automation", TATA Mc Graw Hill, 2009.
5. Richard D.Klafter "Robotic Engineering an integrated approach", Prentice Hall,1989.

WEB REFERENCES

- http://www.cdeep.iitb.ac.in/nptel/Mechanical/Robotics%20Course/TOC.htm
- http://nptel.ac.in/video.php?subjectId=112101099

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Course Code: 140AU9134	Course Title: RAPID PROTOTYPING AND TOOLING (Common to Automobile and Mechanical)	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II

Course Objectives

The course is intended to:

1. Explain the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.
2. Explain various liquid based and solid based rapid prototyping systems.
3. Explain data preparation for rapid prototyping technologies.
4. Explain Three Dimensional Printing process.
5. Explain the classification of Rapid tooling and case studies on applications in industries

Course Content **Hours**

UNIT I INTRODUCTION **6**

Introduction: Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **10**

Classification of RP systems, Fusion Deposition Modeling – Principle – process parameters – Applications. Laminated Object Manufacturing – Principle – process parameters – Applications, Stereo lithography systems – Principle – process parameters –process details – Applications.- Selective laser sintering (SLS) - Direct Metal Laser Sintering (DMLS) system – Direct Metal Deposition- Principle –process parameters –Applications-Solid ground curing.

UNIT III DATA PREPARATION FOR RAPID PROTOTYPING TECHNOLOGIES **10**

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: 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 and contour data organization, direct and adaptive slicing, Tool path generation.

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UNIT IV THREE DIMENSIONAL PRINTING 10

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): Introduction, basic process, shape decomposition, mold, SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing

UNIT V RAPID TOOLING 9

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.

CO2. Explain various liquid based and solid based rapid prototyping systems.

CO3. Explain data preparation for rapid prototyping technologies.

CO4. Explain Three Dimensional Printing process.

CO5. Explain the classification of Rapid tooling and case studies on applications in industries

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. Pham,D.T. & Dimov.S.S., "Rapid manufacturing", Springer-Verlag, 2001. Terry wohlers, "Wohlers Report 2000", Wohlers Associates, 2000.

REFERENCES

1. Andreas Gebhardt, Hanser "Rapid prototyping", Gardener Publications, 2003
2. LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals of Streolithography", Society of Manufacturing Engineering Dearborn, 1992.
4. Ali K. Kamrani, Emad Abouel Nasr, "Rapid Prototyping and Tooling, Industrial Design Centre, IIT, 1983.
5. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

WEB REFERENCES

- https://www.nde-ed.org/index_flash.htm

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Course Code: 140AU9135	**Course Title:** PLANT LAYOUT AND MATERIAL HANDLING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II

Course Objectives

The course is intended to:

1: Understand the concept of plant layout and required equipments for plant operations

2: Explain the techniques for developing various types of layouts and layout planning procedure

3: Identify the suitable environment for industrial buildings and utilities

4: Understand the benefit of an efficient material handling system

5: Understand difficulties in material handling system on process layout

Course Content **Hours**

UNIT I PLANT LOCATION AND PHYSICAL FACILITIES 9

Factors to be considered – Influence of location on plant layout, selection of plant site,consideration in facilities planning and layout – Equipment required for plant operation,Capacity, Serviceability and flexibility and analysis in selection of equipments, space and man power requirements

UNIT II PLANT LAYOUT 9

Need for layout, types of layout, factors influencing product, process, fixed and combination layout, tool and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure – visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines

UNIT III INDUSTRIAL BUILDINGS AND UTILITIES 9

Centralized electrical, pneumatic, water line systems. Types of buildings, lighting, heating, air-conditioning and ventilation utilities – planning and maintenance, waste handling, statutory requirements, packing and storage of materials: Importance of packaging, layout for packaging – packaging machinery – wrapping and packing of materials, cushion materials.

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UNIT IV MATERIAL HANDLING 9

Importance and Scopes – Principles of material handling – engineering and economic factors - planning, relationship to plant layout – types and selection of material handling systems, factors influencing their choice – concept of containerization and palletization.

UNIT V ANALYSIS OF MATERIAL HANDLING 9

Factors involved – motion analysis, flow analysis, graphical analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys – Designing of material handling systems – System equation - Planning chart, Unit load design – principle - efficiency of containers, pallet sizes.

Course Outcomes

At the end of the course students will be able to:

CO1: Understand the concept of plant layout and required equipments for plant operations
CO2: Explain the techniques for developing various types of layouts and layout planning procedure
CO3: Identify the suitable environment for industrial buildings and utilities
CO4: Understand the benefit of an efficient material handling system
CO5: Understand difficulties in material handling system on process layout

TEXT BOOKS

1. G.K Agrawal, "Plant Layout and Material Handling", Jain Publishing, 2012
2. Khanna, O. P., "Industrial Engineering and Management", Dhanpatrai and Sons, 2003.

REFERENCES

1. James A. Tompkins , John A. White, Yavuz A. Bozer and J. M. A. Tanchoco "Facilities Planning", 3rd edition , John Wiley & Sons, 2003.
2. Fred E Meyers, "Plant Layout and Material Handling", 2nd edition, Prentice Hall, 1999.

WEB REFERENCES

- https://en.wikipedia.org/wiki/Plant_layout_study
- https://en.wikipedia.org/wiki/Material_handling
- http://nptel.ac.in/courses/Webcourse-contents/IIT Delhi/project%20and%20production%20management/mod7/mod73.htm

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Course Code: 140AU9136	**Course Title:** MICRO MANUFACTURING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II
- Material Science

Course Objectives:

The course is intended to:

1. To understand the properties, design and behaviour of various micro materials.
2. To analyze the microscopic and macroscopic properties of micro materials.
3. To understands the concept of various micro fabrication processes.
4. To impart the principles of different micro machining process.
5. To understands the principles and applications of Micro Electro Mechanical Fabrication Systems.

Course Content **Hours**

UNIT I INTRODUCTION **9**

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feedback systems

UNIT II MICROMECHANICS **9**

Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials.

UNIT III MICRO-FABRICATION **8**

Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining-Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer-devices.

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UNIT IV MECHANICAL MICROMACHINING 10

Theory of micromachining-Chip formation-size effect in micromachining-micro-turning, micro-milling, micro-drilling- Micromachining tool design-Precision Grinding-Partial ductile mode grinding-Ultra precision grinding- Binder less wheel – Free form optics

UNIT V MICRO ELECTRO MECHANICAL SYSTEM FABRICATION 9

Introduction – advance in Micro electronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

Course Outcomes:

At the end of the course students will be able to:

CO1. To understand the properties, design and behaviour of various micro materials.

CO2. To analyze the microscopic and macroscopic properties of micro materials.

CO3.To understand the concept of various micro fabrication process.

CO4. To impart the principles of different micro machining process.

CO5.To understand the principles and applications of Micro Electro Mechanical Fabrication Systems.

TEXT BOOKS

1. Sámi Franssila, "Introduction to Micro Fabrication", John Wiley and sons Ltd., UK, 2004, ISBN: 978-0-470-85106-7.
2. Madore J, "fundamental of Micro fabrication", CRC Press, 2002.

REFERENCES

1. Mark J. Jackson, "Micro fabrication and Nanomanufacturing", CRC Press, 2006.
2. Peter Van Zant, "Microchip fabrication", McGraw Hill, 2004.
3. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC Press, 2006.

WEB REFERENCES

- https://en.wikipedia.org/wiki/Microfabrication
- http://www.micromanufacturing.net/didactico/Desarollo/microforming/1-introduction

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Dr. MCET, Pollachi - 642 003.

Course Code: 140AU9137	**Course Title:** PROCESS PLANNING AND COST ESTIMATION (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Process I
- Manufacturing Process II

Course Objectives:

The course is intended to:

1. Explain the basic concepts of process planning.
2. Evaluate the various approaches of manual and computer aided process planning and costing.
3. Explain the different components involved in direct and indirect costs.
4. Analyze the cost calculation methods of different manufacturing process.
5. Describe the concept of Break Even Analysis & Cost Management.

Course Content **Hours**

UNIT I PROCESS PLANNING, DESIGN AND CONCEPTS OF PROCESS PLAN **9**

Introduction- Place of process planning-economics- Process & Production Planning, Process Planning & Concurrent Engineering-Types of production- standardization- Production design & selection. Selection of processes, tools, cutting parameters & machine tools- Jigs and Fixtures - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs- Process capability, Process Charts

UNIT II MANUAL AND COMPUTER AIDED PROCESS PLANNING ESTIMATING AND COSTING **9**

Retrieval type/variant approach, group technology – generative approach, logics decision tress and tables, axiomatic approach – AI expert systems – feature recognition – applications Concepts, differences, different costing methods – classification of costs – cost grid-problems.

UNIT III DIRECT AND INDIRECT COST COMPONENTS **8**

Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – Direct Labour, Direct Material Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems.

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UNIT IV COST CALCULATIONS **10**

Machined components–welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. OPTIMUM MACHINING CONDITIONS: Taylor's equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis

UNIT V BREAK EVEN ANALYSIS & COST MANAGEMENT **9**

Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications. Linear, multi product break-even analysis Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications.

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the basic concepts of process planning.
CO2. Evaluate the various approaches of manual and computer aided process planning and costing.
CO3. Explain the different components involved in direct and indirect costs .
CO4. Analyze the cost calculation methods of different manufacturing process.
CO5. Describe the concept of Break Even Analysis & Cost Management.

TEXT BOOKS

1. Kannappan D, "Mechanical Estimating and Costing", Tata McGraw Hill, New Delhi, 2003.
2. Banga T R and Sharma S C, "Mechanical Estimating and Costing", Khanna Publishers, New Delhi, 2002.
3. Kesavan R "Process Planning and Cost Estimation", New Age International Pvt. Ltd., Chennai, 2005.

REFERENCES

1. Russell R.S and Tailor B.W, "Operations Management", PHI, 4th Edition, 2003.
2. Chitale A.V and Gupta R.C, "Product Design and Manufacturing", PHI, 2nd Edition, 2002.

WEB REFERENCES

- https://en.wikipedia.org/wiki/Planning
- http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20ManufacturingII/Module%20G/Module%20G(5)/p3.htm
- https://en.wikipedia.org/wiki/Cost_estimate

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Course Code: 140AU9138	**Course Title:** RELIABILITY AND MAINTENANCE ENGINEERING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Engineering Practices Laboratory
- Materials Science
- Manufacturing Process I
- Manufacturing Process II

Course Objectives
The course is intended to:

1. Distinguish between reliability and quality, availability and maintainability
2. Apply Redundancy Techniques To Improve Higher Reliability Of System.
3. Evaluate system reliability from reliability of sub systems.
4. Explain the principles, functions and practices adopted in industry for the Successful management of maintenance activities.
5. Conduct hazard and safety analysis for material handling equipments

Course Content **Hours**

UNIT I BASIC CONCEPTS OF RELIABILITY MAINTENANCE AND AVAILABILITY 9

Reliabilty –Definition, Reliability vs quality, Failure and failure modes,Bath tub curve,causes of failures and unreliability. Maintainability, Availability- Concepts, Definition. System down time, uptime – MTBF,MTTR,MTBM. Types of availability- Inherent availability, Achieved availability and Operation availability. Reliability and Maintanability trade off.

UNIT II DESIGN FOR RELIABILITY 9

Reliability analysis, Mathematical models and numerical evaluation. Designing for higher reliability. Redundancy Techniques, Application. Various forms of redundancy.

UNIT III SYSTEM RELIABILITY 9

Determination of system reliability from subsystems. Series configuration, Parallel configuration, Mixed configuration, R out of N structure. Component redundancy vs Unit redundancy, Stand by redundancy, Mixed redundancy- Simple problems to calculate system reliability. Reliability cost trade off.

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UNIT IV MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – comparative merits of each category – preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication – TPM.

UNIT V SAFETY AND OTHER ASPECTS OF MAINTENANCE 9

Repair methods for material handling equipment – Equipment records – Job order systems – use of computer in maintenance.

Course Outcomes

At the end of the course students will be able to:

CO1. Distinguish between reliability and quality, availability and maintainability
CO2. Apply Redundancy Techniques To Improve Higher Reliability Of System.
CO3. Evaluate system reliability from reliability of sub systems.
CO4. Explain the principles, functions and practices adopted in industry for the Successful management of maintenance activities.
CO5. Conduct hazard and safety analysis for material handling equipments

TEXT BOOKS

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

REFERENCES

1. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
2. Mishra R.C. and Pathak K. "Maintenance Engineering and Management" Prentice Hall of India Pvt. Ltd. 2007. 3 Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
3. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988

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- http://www.nios.ac.in/media/documents/VocInsServices/m1-4f.pdf
- http://discovery.bits-pilani.ac.in/dlpd/courses/coursecontent/courseMaterial/mgtszc211.pdf
- http://faculty.mercer.edu/jackson_r/Ownership/chap02.pdf

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Course Code: 140AU9139	Course Title: PRODUCTION PLANNING AND CONTROL (Common to Automobile and Mechanical)	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Processes - I
- Manufacturing Processes - II
- Engineering economics and cost analysis.

Course Objectives

The course is intended to:

1. Outline the fundamentals of production planning control.
2. Apply work measurement techniques and method-study for productivity improvement.
3. Infer steps in product planning using product information.
4. Solve Problems related to production scheduling.
5. Discuss the effect of demand on inventories and recent trends in production process control

Course Content **Hours**

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration- Standardization, Simplification & specialization-Break even analysis-Economics of a new design.

UNIT II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing - Pre requisite information needed for process planning - Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

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UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling- Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control- Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems- elements of Just in time systems Fundamentals of MRP II and ERP.

Course Outcomes

At the end of the course students will be able to:

CO1. Outline the fundamentals of production planning control.

CO2. Apply work measurement techniques and method-study for productivity improvement.

CO3. Infer steps in product planning using product information.

CO4.Solve Problems related to production scheduling.

CO5. Discuss the effect of demand on inventories and recent trends in production process control

TEXT BOOKS

1. Martand Telsang, "Industrial Engineering and Production Management", First Edition, S. Chand and Company, 2000.
2. James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International Edition1992.

REFERENCES

1. Andrew Sloss, Dominic Symes& Chris Wright, "ARM system Developer's guide", Elsevier.2005.1. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
2. Elwood S.Buffa, and RakeshK.Sarin, "Modern Production / b Operations Management", 8th Ed.John Wiley and Sons, 2000.
3. KanishkaBedi, " Production and Operations management", 2nd Edition, Oxford university press.2007.

WEB REFERENCES

- http://www.managementstudyguide.com/production-planning-and-control.htm
- http://www.tandfonline.com/toc/tppc20/current
- http://infocenter.arm.com/help/index.jsp
- http://www.yourarticlelibrary.com/production-management/elements-of-production-planning-and-control-in-an-organization/26170/

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Course Code: 140AU9140	Course Title: TOTAL PRODUCTIVE MAINTENANCE (Common to Automobile and Mechanical)	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Manufacturing Processes I
- Manufacturing Processes II

Course Objectives

The course is intended to:

1. Describe modern maintenance concepts and practices
2. Apply analytical tools in maintenance management
3. Apply Reliability Centered Maintenance for industrial systems
4. Illustrate TPM and global trends in maintenance management
5. Demonstrate use of simple instruments used for condition monitoring in maintenance

Course Content **Hours**

UNIT I MODERN MAINTENANCE CONCEPTS AND PRACTICES 9

Maintenance definition –Maintenance management – Maintenance Concepts: Objectives, Organization and Functions of Maintenance, Maintenance strategies, Types of Maintenance – Maintenance systems – (Planned, Unplanned / Breakdown, Corrective, Opportunistic, Routine, Preventive, Predictive, Condition based maintenance systems),Maintenance planning and scheduling, Maintenance Logistics, Human factors in Maintenance and Staffing methods, Maintenance manuals, Maintenance costs

UNIT II ANALYTICAL TOOLS IN MAINTENANCE MANAGEMENT 9

Failure Data Analysis, MTBF,MTTF, Useful life-Survival curves, Repair time, Breakdown time distributions- Poisson's, Normal, Exponential, Availability, Reliability, Maintainability, Maintainability prediction – System effectiveness- Overhaul / Repair / Replace maintenance policy, Queuing applications, simulation, spare parts management, Replacement Decisions: Optimal interval between preventive replacements, Overall Equipment Effectiveness

UNIT III RELIABILITY CENTERED MAINTENANCE 9

Reliability Centered Maintenance (RCM), Objectives and function, Steps in RCM implementation, steps in RCM analysis, System selection, Tero technology – RCM effectiveness indicators, RCM tasks Proactive Maintenance, Reliability models - System reliability- Series, Parallel and mixed configuration, System reliability determination; Reliability improvement, Scheduled restoration and scheduled discard, The P-F interval and P-F curves, linear as nonlinear PF curves , Default actions, RCM Decision diagrams.

UNIT IV TPM AND GLOBAL TRENDS 9

Concept of TPM, Characteristics of TPM, Zero breakdown concepts, Zero Defects and TPM, FMECA – Maintainability prediction– Design for maintainability, Maximizing equipment effectiveness, Autonomous maintenance program, Five pillars of TPM, TPM Small group activities. Implementing TPM.Philosophy / Indications of TPM. TPM Development - Preparation phase, Master Plan, Initiatives, Promotion, Planning, Organization, Awareness,

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Training, Establishment of basic policies and goals, TPM organization, Implementation phase; Consolidation phase. Measuring TPM effectiveness: Measuring TPM effectiveness Indicators, Plant effectiveness and Measuring; TPM Benefits and Global trends

UNIT V CONDITION MONITORING IN MAINTENANCE 9

Condition Based Maintenance: Machine signatures, Signature Analysis-MMIS Expert systems, Temperature noise, vibration and wear particle analysis, on line and off line techniques. Online Monitoring Condition Monitoring Techniques, Vibration Monitoring and Signature Analysis. Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control, Case Studies in Maintenance, Measurement and benchmarking of performance, MIS for maintenance.

Course Outcomes

At the end of the course students will be able to:

CO1. Describe modern maintenance concepts and practices

CO2. Apply analytical tools in maintenance management

CO3. Apply Reliability Centered Maintenance for industrial systems

CO4. Illustrate TPM and global trends in maintenance management

CO5. Demonstrate use of simple instruments used for condition monitoring in maintenance

TEXT BOOKS

1. Seiichi Nakajima, Introduction to TPM, Productivity Press, Chennai, 1992.
2. Gopalakrishnan, P. and Banerji, A.K., Maintenance and Spare Parts Management, Prentice – Hall of India Pvt. Ltd., 1991.

REFERENCES

1. Goto, F., "Equipment planning for TPM Maintenance Prevention Design",ProductivityPress, 1992.
2. Shirose, K., "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.
3. David J. Sumanth, 'Total Productivity Management (TPmgt) : A Systematic and Quantitative
   Approach to Compete in Quality, Price and Time', Productivity Press, 1997

WEB REFERENCES

- http://www.plant-maintenance.com/articles/tpm_intro.pdf
- http:// www.ame.org/sites/default/files/TPM-introduction-AME.pdf
- http://www.ijettjournal.org/volume-4/issue-5/IJETT-V4I5P85.pdf
- http:// www.rsareliability.com/TPM%20Materials.pdf
- http://www.smrp.org/files/public/smrpchapter-ginder.pdf

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Course Code: 140AU9157	**Course Title:** ENGINEERING ECONOMICS AND COST ANALYSIS (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics-I

Course Objectives

The course is intended to:

1. Categorize different cost and calculate the breakeven point for a given business situation
2. Apply different interest formulae and their application in decision making process.
3. Evaluate present value, future value and annual worth analysis on one or more economic alternatives.
4. Determine the economic value of an asset and develop a better replacement policy for given equipment.
5. Evaluate the depreciation of equipment per period.

Course Content **Hours**

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods with problems.

UNIT III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

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UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Straight line method of depreciation, declining balance method of depreciation- Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation- Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case study

Course Outcomes

At the end of the course students will be able to:

CO1. Categorize different cost and calculate the breakeven point for a given business situation

CO2. Apply different interest formulae and their application in decision making process.

CO3. Evaluate present value, future value and annual worth analysis on one or more economic alternatives.

CO4. Determine the economic value of an asset and develop a better replacement policy for given equipment.

CO5. Evaluate the depreciation of equipment per period.

Text Book

1. PanneerselvamR, "Engineering Economics", Prentice Hall of India Ltd, NewDelhi, 2014
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.

References

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2010.
3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1990.

Web References

- https://en.wikipedia.org/wiki/Engineering_economics
- https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

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SERVICES STREAM

Course Code: 140AU9141	**Course Title:** VEHICLE BODY ENGINEERING	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- Automotive Chassis

Course Objectives
The course is intended to:

1. Illustrate the various types of car body and ergonomic design aspects.
2. Classify the different constructions of bus body based on size and shape of body.
3. Classify the type of commercial vehicles based on body structure.
4. Describe the aerodynamic effect of forces on vehicle body.
5. Describe the various materials used for body construction and body repairing methods.

Course Content **Hours**

UNIT – I CAR BODY **9**

Car body terminology- Types of car: sedan limousine, convertible, hatch back car, station wagon, racing car- Visibility regulations- Tests for visibility, Methods to improve visibility, Safety regulations, Factors considering the safety design- Crumple zone- Safety features in car.

UNIT – II BUS BODY **9**

Bus body terminology- Types of bus based on size: minibus, town, mofussil, luxury bus- Types of bus based on shape: single deck, double deck, articulated bus- body on frame construction-integral type of construction- double skin bus body construction- Bus body layout: entrance and exit location, engine location, bus floor height- bus body building process.

UNIT – III COMMERCIAL VEHICLE BODY **9**

Types of LCV: pickup van, auto rickshaw cargo truck- Types of MCV: dropside, box van- Types of HCV: flat platform, tipper, tanker, draw bar trailer- Design factors of driver cab and seat- Types of driver cab: normal control, forward control, semi forward control

UNIT – IV VEHICLE AERODYNAMICS **9**

Objective of aerodynamics- Types of aerodynamic forces and moments- Effect of forces and moments on vehicle body- Types of aerodynamic drag- drag reduction methods- closed circuit wind tunnel test- flow visualization methods

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UNIT – V BODY MATERIALS, RECONSTRUCTION AND TRIMS 9

Types and properties of body materials: steel sheet, timber, polymers, FRP- body collision reconstruction- panel replacement reconstruction-types of paints-body painting process- anti corrosion coating methods- body trims

Course Outcomes

At the end of the course students will be able to:

CO1. Illustrate the various types of car body and ergonomic design aspects.
CO2. Classify the different constructions of bus body based on size and shape of body.
CO3. Classify the type of commercial vehicles based on body structure.
CO4. Describe the aerodynamic effect of forces on vehicle body.
CO5. Describe the various materials used for body construction and body repairing methods.

TEXT BOOKS

1. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London., London.
2. James E Dufly, Body Repair Technology for 4-Wheelers, Cengage learning, 2009.

REFERENCES

1. Powloski J. Vehicle Body Engineering, Business Books Ltd., 1998.
2. Giles, G J., Body construction and design, Illiffe Books Butterworth & Co.,1991.
3. Dieler Anselm., The Passenger car body, SAE International, 2000.

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Course Code: 140AU9142	**Course Title:** TRANSPORT MANAGEMENT (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Course Objectives

The course is intended to:

1. Explain the legislative laws governing the use of motor vehicle
2. Explain the types of vehicle insurance and the importance of road safety
3. Explain the operation of passenger transport system
4. Explain the operation of goods transport system
5. Describe taxation and traffic management

Course Content **Hours**

UNITI MOTOR VEHICLE ACT **9**

Motor Vehicle Act: Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Offences, penalties & procedures, Different types of forms. Government administration structure, Personnel, Authorities & duties, Rules regarding construction of motor vehicles.

UNITII INSURANCE AND ROAD SAFETY **9**

Insurance types & significance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & Run case, Duty of driver in case of accident, Surveyor & Surveyor's report

UNIT III PASSENGER TRANSPORT OPERATION **9**

Structure of passenger transport organizations, typical depot layouts, requirements, Fleet maintenance - Scheduling operation & control. Propaganda, passenger amenities, Parcel traffic. Theory of fares, Basic principles of fare charging , Needs, straight and tapered scales, Differential rates for different types of services, Depreciation & debt charges, operation cost, Economics & records.

UNIT IV GOODS TRANSPORT OPERATION **9**

Structure of goods transport organizations, Typical depot layouts, requirements ,scheduling of goods transport, materials Handling equipments in the goods transport operation, , storage & transportation of petroleum products

UNITV TAXATION AND TRAFFIC MANAGEMENT **9**

Objectives, Structure & methods of laving taxation, One-time tax, Tax Exemption & tax renewal, Global positioning system- Traffic navigation, advanced traffic control devices.

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Course Outcomes

At the end of the course students will be able to:

CO1. Explain the legislative laws governing the use of motor vehicle
CO2. Explain the types of vehicle insurance and the importance of road safety
CO3. Explain the operation of passenger transport system
CO4. Explain the operation of goods transport system
CO5. Describe taxation and traffic management

TEXT BOOKS

1. Motor Vehicle Act - Govt. of IndiaPublications.
2. Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of StateRoad Transport Undertakings, NewDelhi.

REFERENCES

1. P.G.Patankar, "Road Passenger Transport in India", CIRT,Pune.
2. Transport Development in India", S. Chand & Co. Pvt. Ltd., NewDelhi.

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Course Code: 140AU9143	Course Title: AUTOMOTIVE INSTRUMENTATION AND CONTROL	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Automotive Electrical and Electronics - II
- Automotive Chassis

Course Objectives

The course is intended to:

1. Explain the working of various measuring instruments used in automobiles.
2. Describe the working of engine system analyzer
3. Explain wheel alignment, wheel balancing and wind tunnel testing
4. Explain NVH measurement and chassis dynamometers
5. Explain the basics of control systems in automotive application

Course Content **Hours**

UNIT I INTRODUCTION **10**

Transducers, types, thermistor, LVDT, inductive pickup, capacitance, strain gauges, semiconductors, photocells, piezoelectric accelerometer, proximity sensors, micro switches, encoders, piezo-electric pressure sensors, instruments, ammeter, voltmeter, odometer, speedometer, fuel level indicator, pressure gauge, vacuum gauge, analog and digital, calibration, cathode ray oscilloscope, study of microprocessors 8085, micro controller, PLC.

UNITII ENGINE SYSTEM ANALYZER **10**

Introduction, exhaust gas analyzer, emission norm standards, flasher instrumentations, accelerometer, real time DAQ , fuel injection calibration, calibration rig ignition timer calibration, stroboscope, smoke meter, macro inspection of interior parts using fiber optics.

UNIT III CHASSIS INSTRUMENTATION **8**

Introduction Wheel alignment gauges, laser alignment, measurement different wheel parameters system wheel balancing, calibrations, wind tunnel testing and drag estimation and profile optimization

UNIT IV NVH, DYNAMOMETERS AND GAUGES **8**

Sound level meters, acoustic measurement, FFT analyzer, anechoic chamber, varechoic chamber, sound level measurements, NVH standards. Torque measuring instruments, Study of different dynamometers, chassis dynamometer for two and four wheelers

UNITV CONTROL SYSTEMS FUNDAMENTALS **9**

Basics of controls systems –different types , PID controller, sliding mode control- design and analysis, automotive applications of control systems

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Course Outcomes

At the end of the course students will be able to:

CO1. Explain the working of various measuring instruments used in automobiles.
CO2. Describe the working of engine system analyzer
CO3. Explain wheel alignment, wheel balancing and wind tunnel testing
CO4. Explain NVH measurement and chassis dynamometers
CO5. Explain the basics of control systems in automotive application

TEXT BOOKS

1. Beckwith T G and Buck N L "Mechanical Measurements " Wesley publishing company limited, USA,1995.
2. UWE Kiencke , Lars Nielsen: Automotive control systems Springer-Springer-Verlag

REFERENCES

1. Peter Elgan "Sensors for Measurements and control", 2nd edition, Pearson Education Limited, England,2001.
2. Longman TecQuipmentmanual. Patent No. 20070261482, In-cylinder pressure detection device and method for internal combustion engine.
3. Holman "Experimental methods for engineers"- McGraw hill publishing company,1994.
4. Ernest O Doebelin "Measurement systems – Application and Design "McGraw hill publishing company, 1990.

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Course Code: 140AU9144	**Course Title:** ALTERNATIVE FUELS AND ENERGY SYSTEMS (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s):

- IC Engines
- Automotive fuels and lubricants

Course Objectives
The course is intended to:

1. Describe the different types of alternate energy sources and fuels
2. Explain the performance and emission characteristics of IC engines with alcoholic fuels
3. Explain the Performance and emission characteristics of LPG, LPG in SI and CI Engines
4. Explain the Performance and emission characteristics of vegetable oils in IC engines
5. Explain the layout and working of electric, hybrid, fuel cell and solar cars

Course Content **Hours**

UNIT I INTRODUCTION **9**

Alternate Energy Sources

Introduction to alternate energy sources, Man and energy, energy forms, Need for alternate sources of energy, availability, Merits and demerits. Scope of alternate energy sources in India, Energy management, Global Energy Issues, National & State Level Energy Issues.

Alternate Fuels

Need for alternate fuel, Availability and properties of alternate fuels, General use of alcohols LPG, hydrogen, ammonia, CNG and LNG, vegetable oils, biogas, EV, hybrid vehicles, Fuel cells and solar cells ,Merits and demerits of alternate fuels.

UNIT II ALCOHOLS **9**

Properties as engine fuels, alcohols and gasoline blends, Performance in SI engine using methanol blends, Performance in SI engine using gasoline blends, Combustion characteristics in CI engine, Emission characteristics, DME, DEE properties, Performance analysis of DME, DEE, Performance in SI engine, Performance in CI engine.

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UNIT III NATURAL GAS, LPG, HYDROGENANDBIOGAS 9

Availability of CNG, properties, Modification required to be done in engines for CNG Performance and emission characteristics of CNG, Performance and emission characteristics of LPG, LPG in SI and CI engines, Hydrogen storage and handling, Performance and safety aspects. Biogas, Properties, production methods, Performance and emission characteristics

UNIT IV VEGETABLEOILS 9

Various vegetable oils for engines, Esterification process in vegetable oils, Performance of engines using vegetable oils, Performance and emission characteristics of a engine using vegetable oils, Bio-diesel and its characteristics

UNIT V ELECTRIC, HYBRID, FUEL CELL AND SOLARCARS 9

Layout of electric vehicles, Advantages and limitations of electric vehicles, Specifications and system components, Electronic control system, High energy and power density batteries, Hybrid vehicles, Fuel cell vehicles, Solar powered vehicles.

Course Outcomes

At the end of the course students will be able to:

CO1. Describe the different types of alternate energy sources and fuels
CO2. Explain the performance and emission characteristics of IC engines with alcoholic fuels
CO3. Explain the Performance and emission characteristics of LPG, LPG in SI and CI Engines
CO4. Explain the Performance and emission characteristics of vegetable oils in IC engines
CO5. Explain the layout and working of electric, hybrid, fuel cell and solar cars

TEXT BOOKS

1. Richard.L.Bechtold," Alternative Fuels Guide Book ", SAE, 1 9 9 7 .
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.

REFERENCES

1. Nagpal, "Power Plant Engineering ", Khanna Publishers, 1 9 9 1 .
2. Maheswar Dayal, "Energy today & tomorrow ", I & B Horishr India, 1982.
3. "alcohols and motor fuels progess in technology ", Series No.19, SAE Publication
4. " The properties and performance of modern alternate fuels " - SAE PaperNo.841210.
5. Keith owen and Trever Coley, "Automotive Fucls Reference Book", SAE 1995.

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Course Code: 140AU9145	Course Title: MARKETING MANAGEMENT	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:
The student should have undergone the course(s): Nil

Course Objectives
The course is intended to:

1. Describe key marketing theories, concepts and techniques for analyzing a variety of marketing situations
2. Explain the dynamic nature of the environment and appreciate the implications to formulate marketing strategy
3. Demonstrate the ability to carry out a marketing research to understand the buyer behavior strategies
4. Develop and implement a marketing plan
5. Compare recent trends in marketing

Course Content **Hours**

UNIT-I MARKETING CONCEPTS **9**

Marketing – An Overview: Introduction, Definition of Market, Types of Markets, Meaning and Definition of Marketing, Origin of Marketing, Scope of Marketing, Importance of Marketing, Functions of Marketing, Difference between Marketing and Selling

Marketing Concepts: Introduction, Exchange concept, Production concept, Product concept, Sales/selling concept, Modern marketing concept, Societal marketing concept, Impact of marketing concepts and its applicability

UNIT-II MARKETING ENVIRONMENT AND STRATEGY **9**

Marketing Environment: Introduction, Need and Importance of Environmental Analysis, Methods of Analysis – SWOT, PEST, Internal Environment of the Organization, External Environment

Marketing Mix: Introduction, Evolution of the "Marketing mix", Components of a traditional marketing mix, Additional components in the mix, Importance of marketing mix in marketing decisions

Marketing Planning and Strategies: Introduction, Management Processes in Marketing, Types of Marketing Plan, Competitive Marketing Strategies, Interactions between Marketing Mix and Marketing Environment, Control Mechanisms in Marketing

UNIT-III MARKETING RESEARCH **9**

Product Related Decisions: Introduction, Features of a Product and its Classifications, Product Plan and New Product Development, Product Mix and its Elements, Decisions related to Product Mix, Product Life Cycle

Market Segmentation: Introduction, Definition of market segmentation, Need for market segmentation, Criteria for effective segmentation, Bases for market segmentation, Benefits of market segmentation

Consumer Behavior: Introduction, Important definitions, Evolution of the study of consumer behavior, Determinants of consumer behavior, Types of buying decisions, Stages of the buying process, Importance of consumer behavior study

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UNIT- IV MARKETING PLAN 9

introduction to Branding: Introduction, Definition of a Brand, Development of a Brand, Types of Brands, Importance of Brands and Branding, Merits and Demerits of Branding

Pricing Decisions: Introduction, Price and its Determinants, Objectives of Pricing Decisions, Factors Affecting Pricing Decisions, Pricing Policies and Strategies, Pricing Methods

Distribution Strategy: Introduction, Meaning, Need for and Importance of Distribution Channel, Factors Influencing Channel Decisions, Types of Channels, Direct Channel, Indirect Channel, Functions of Channel Members

Promotion Mix: Introduction, Promotion mix and its components, Advertising, Sales Promotion, Personal selling, direct marketing, Public Relations and publicity, Online marketing, Developing an integrated promotion mix

Promotion Mix Decisions: Introduction: Advertising decisions, Sales promotion decisions, Personal selling decisions, Public Relations and Publicity decisions

UNIT-V RECENT TRENDS IN MARKETING 9

Services Marketing: Introduction, Definition of services, Characteristics of services, Distinction between goods and services, marketing mix for services, Types of services, Strategies for Services Marketing

Recent Trends in Marketing: Introduction, E-commerce, E-marketing, E-Retailing, Relationship marketing, Mobile marketing, Green marketing.

Course Outcomes

At the end of the course students will be able to:

CO1. Describe key marketing theories, concepts and techniques for analyzing a variety of marketing situations

CO2. Explain the dynamic nature of the environment and appreciate the implications to formulate marketing strategy

CO3. Demonstrate the ability to carry out a marketing research to understand the buyer behavior strategies

CO4. Develop and implement a marketing plan

CO5. Compare recent trends in marketing

TEXT BOOK

1. Philip Kotler,Kevin Keller, Abraham Koshy and Mithileshwar Jha, "Marketing Management" , Pearson – 2008

REFERENCE

1. William J.Stanton "Fundamentals of Marketing", McGraw-Hill; Australian Ed edition 1985

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Course Code: 140AU9146	**Course Title:** REFRIGERATION AND AIR CONDITIONING (Common to Automobile and Mechanical)	
Core / Elective: Elective	**L: T : P: C**	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Thermodynamics

Course Objectives

The course is intended to:

1. Evaluate the performance of refrigeration cycles and selection of refrigerants for specific applications
2. Explain the various components of Vapour compression refrigeration systems
3. Calculate the heating and cooling loads in an air conditioning system
4. Discuss the various applications of refrigeration and air conditioning systems
5. Describe the basic installation and servicing methods used in refrigeration and air conditioning systems

Course Content **Hours**

UNIT I REFRIGERATION **9**

Thermodynamic principles of refrigeration – Types of Refrigeration Systems – Vapour compression refrigeration cycle, use of Ts and P-H diagrams, Performance calculation – Refrigerants: Primary& secondary refrigerants, Nomenclature of Refrigerants, properties and selection – Environment friendly alternatives.

UNIT II COMPONENTS OF REFRIGERATION SYSTEM **9**

Refrigerant Compressors- Different Types, Performance, Capacity Control – Evaporators, Evaporators Circuitry, Different Types and application – Condensers- Types-air cooled-water cooled - evaporative condensers- Optimum Cooling Water Rate and Velocity – Expansion Devices.

UNIT III AIR CONDITIONING SYSTEM AND ITS COMPONENTS **9**

Characteristics of Human comfort condition – Different types of Air Conditioner , Construction Details of Room Air Conditioner , Window Type, Package Type, Split Type Central Units – Automotive Heater –Air conditioning Equipments , air filters , humidifiers & dehumidifiers, fans & blowers , control system – Thermal insulation and Ventilation in air conditioning system – Types of load - Cooling Load Calculations, Air Distribution Patterns.

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UNIT IV APPLICATION OF REFRIGERATION AND AIR CONDITIONING SYSTEMS 9

General layout, Working Principle, Advantages & Disadvantages - Food Preservation, Food Storage & Distribution - Beverage Coolers, LNG – Ice Manufacturing – Solar Air Conditioning, Solar dehumidifier – Automobile air conditioning, Refrigerated trucks, Aircraft air conditioning, Railway Refrigerator Cars, Marine Air conditioning

UNIT V INSTALLATION AND SERVICING 9

Duct installation - Charging of refrigerant - Servicing of central, packaged, split air-conditioning, – Safety procedures, Leak detection procedures- safety controls, trouble shooting. – Basic Elements of Control systems - temperature control, Bimetal thermostat, Electric resistance thermostat, Electronic thermostat- Humidity control elements- Automatic Dew point recorder - Energy conservation methods.

Course Outcomes

At the end of the course students will be able to:

CO1. Evaluate the performance of refrigeration cycles and selection of refrigerants for specific applications
CO2. Explain the various components of Vapour compression refrigeration systems
CO3. Calculate the heating and cooling loads in an air conditioning system
CO4. Discuss the various applications of refrigeration and air conditioning systems
CO5. Describe the basic installation and servicing methods used in refrigeration and air conditioning systems

TEXT BOOKS

1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 2004
2. Arora. C.P., "Refrigeration and Air conditioning", 2nd edition. Tata McGraw-Hill, 2000.

REFERENCES

1. Dossat, R.J. "Principles of Refrigeration", Prentice-Hall, 1997.
2. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", McGraw Hill Education (Asia) 2nd Edition 2001
3. ASHRAE 2012 Hand book (Fundamentals & Equipments)

WEB REFERENCES

- http://nptel.ac.in/courses/112105128/
- https://www.ashrae.org/

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Course Code: 140AU9147	Course Title: VEHICLE MAINTENANCE	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- IC Engines
- Automotive Chassis
- Automotive Transmission

Course Objectives

The course is intended to:

1. Explain the maintenance practices, safety and toolsused in workshop
2. Explain the engine and engine subsystem maintenance procedure
3. Explain the transmission and driveline maintenance procedure
4. Explain the steering, brake, suspension and wheel maintenance maintenance procedure
5. Explain the electrical and air conditioning maintenance procedure

Course Content **Hours**

UNIT I MAINTENANCE WORKSHOP PRACTICES SAFETY AND TOOLS 9

Maintenance- Need, Importance, Primary and secondary functions, Policies,- Classifications of maintenance work - Vehicle Insurance - basic Problem Diagnosis. Automotive Service procedures- Work shop operations - Workshopmanual- Vehicle identification.Safety- Personnel, Machines, and equipment, vehicles, fire safety- Firstaid. Basic tools - Special service tools- Mesuring instruments- Conditionchecking of seals, gaskets and sealants. Scheduldedmaintenance services- service intervals - towing and recovering.

UNIT II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 9

General Engine service- Dismantling of Engine components- Engine repair - Working on the underside, front,top, ancillaries- serviceof basic engine parts, cooling and lubricating system, Fuel system, Intake and exhaust system, Electrical system- Electronic fuel injection and engine management service - Fault diagnosis -servicing emission controls

UNITIII TRANSMISSION AND DRIVELINE MAINTENANCE 9

Clutch- general checks, adjustment and service -Dismantling, Identifying, Checking and reassembling of transmission, transaxle- road testing -removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joint - Rear axle service points - Removing axle shaft and bearings- servicing differential assemblies- fault diagnosis

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UNIT IV STEERING BRAKE SUSPENSION WHEEL MAINTENANCE 9

Inspection, maintenance and service of hydraulic brake, drum brake,disc brake, parkingbrake, bleeding of brakes.

Inspection, Maintenance and service of Mc Pherson strut, coilspring, leaf spring, shock absorber,Dismantling and assembly procedures.

Wheel alignment and balance, Removingand fitting of tyres,tyre wear and tyre rotation.

Inspection,Maintennace and service of steering linkage, steering linkage, steering column, rack and pinion steering, recirculating ball steering service- worm type steering, power steering system

UNIT V ELECTRICAL AND AIR CONDITIONING MAINTENANCE 9

Maintenance of batteries, starting system, charging system and body electrical- Fault Diagnosis using scan tools. Maintenance of Air conditioning parts like compressor, condensor, expansion valve, evaporato- replacement of hoses- leak detection - AC Charging - Fault Diagnosis. Vehicle Body repair like panel beating, tinkering,soldering,polishing, painting.

Course Outcomes

At the end of the course students will be able to:

CO1. Explain the maintenance practices, safety and toolsused in workshop
CO2. Explain the engine and engine subsystem maintenance procedure
CO3. Explain the transmission and driveline maintenance procedure
CO4. Explain the steering, brake, suspension and wheel maintenance maintenance procedure
CO5. Explain the electrical and air conditioning maintenance procedure

TEXT BOOKS:

1. Ed May, Autmobile Mechanics Volume one, Mc Graw Hill Publications, 2003
2. Crouse W H, "Automotive Transmissions and Power Trains", McGraw Hill Book Co.,5th edition, 1976

REFERENCE

1. Bosch automotive handbook , Sixth Edition,2004.

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OPEN ELECTIVES

Course Code:141OE0901	Course Title:GREEN VEHICLE TECHNOLOGY	
Core / Elective: Open Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s): Nil

Course Objectives

The course is indented to:

1. Explain the effects of pollution, emission standards and test cycles
2. Describe electronic gasoline control system
3. Explain electronic diesel control system
4. Explain architecture of electric vehicles and hybrid vehicles
5. Explain energy consumption in subsystems

Course Content **Hours**

UNIT I INTRODUCTION 9

Automotive pollutants – sources, pollutant formation – effects of pollution on environment and human health – regulated and unregulated emissions, Smog - Automotive Emission Standards – BS standards. Test cycles- FTP, ESC.

UNIT II ELECTRONIC GASOLINE CONTROL 9

Typical Gasoline Direct Injection Engine Management System - Electric Fuel Pump, Piezo-Injector, Pencil Coil, Electronic Throttle Control - Sensors used - Evaporative Emission Control: Canister Purge valve - Monitoring performance of a catalytic convertor

UNIT III ELECTRONIC DIESEL CONTROL 9

Particulate Matter and Nitrous Oxide Reduction - Construction of a typical Diesel Particulate Filter (DPF) and Selective Catalytic Reduction (SCR) - Urea Injection – EGR- Typical reactions in a DPF and SCR - Sensors used - Urea Dosing systems

UNIT IV ELECTRIC VEHICLES AND HYBRID VEHICLES 9

Electric vehicle: layout - performance– traction motor characteristics - transmission requirements - advantage and limitations – specifications - control system - safety and challenges in electric vehicles.

Electric Hybrid Vehicle: Concepts of hybrid electric drive train – types - architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles

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UNIT V ENERGY CONSUMPTION IN SUBSYSTEMS 9

Engine cooling fan. air conditioning and brake compressors. hydraulic power consumption - ABS energy consumption - battery-operated vehicles energy consumption - energy management system of Electric Vehicles

Course Outcome

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

CO1: Explain the BS emission standards of automotive pollutants and their effects on environment & human.
CO2: Describe the electronic gasoline control system to control emission to meet the BS emission standards in SI engines
CO3: Explain the electronic diesel control system to control emission to meet the BS emission standards in CI engines
CO4: Illustrate the challenges in Electric Vehicles and Hybrid Vehicles
CO5: Explain the breakup of energy consumption in subsystems of Electric Vehicles

TEXT BOOKS:

1. B.P.Pundir, "IC Engines Combustion and Emissions", Narosa Publishers, 2010.

2. Iqbal Husain,"Electric and Hybrid Vehicles: Design Fundamentals", Second Edition, CRC Press, 2011.

REFERENCES

1. Diesel Engine Management Systems and Components, Bosch, Springer 2014
2. Gasoline Engine Management Systems and Components Bosch, Springer 2014
3. Hybrid Vehicles and the Future of Personal Transportation , CRC Press 2009

Web References

1. NPTEL Lectures Introduction to Hybrid and Electric Vehicles. http://nptel.ac.in/courses/108103009/

2. NPTEL Lectures Engine Combustion http://nptel.ac.in/courses/112104033/

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Course Code: 141OE0902	Course Title: OPERATIONS RESEARCH	
Core / Elective: Open Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics I
- Engineering Mathematics II

Course Objectives

The course is intended to:

1. Solve linear programming problems
2. Select the optimal solution for transportation and assignment problems
3. Calculate EOQ and EBQ for manufacturing and purchase models
4. Select critical paths using CPM and PERT
5. Select the replacement policy and shortest queuing time

Course Content **Hours**

UNIT I LINEAR PROGRAMMING **9**

Introduction - Formulation of linear programming models – Assumptions-Graphical solution procedure – solving LPP using simplex algorithm – Degeneracy, Revised Simplex Method Duality theory - Interpretation of dual variables- Primal Dual Relationships – Role of duality in sensitivity analysis - Dual simplex method.

UNIT II TRANSPORTATION & ASSIGNMENT MODELS **9**

Transportation problems, transportation simplex method– Assignment problems, Hungarian method- LP formulation of transportation and Assignment networks- Traveling sales man problem

UNIT III INVENTORY MODELS **9**

Purchase model with no shortages – manufacturing model with no shortage – Purchase model with shortage – Manufacturing model with shortages –model with price breaks.

UNIT IV NETWORK MODELS **9**

Maximal flow problem – Shortest route problem – Minimal spanning tree problem - Project networks, CPM, PERT, Crashing of networks, L P model for crashing – project costing and control.

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UNIT V QUEUING AND REPLACEMENT MODELS 9

Queuing theory terminology – Single server, multi server, Limited queue capacity – applications – Markov chains. Replacement models – Money value, present worth factor and discount rate.

Course Outcomes

At the end of the course students will be able to:

CO1: Solve linear programming problems with simplex and graphical methods after formulation and assumption of required parameters.
CO2: Select the optimal solution for transportation and assignment problems, based on cost, using Northwest, Least Cost, Vogals Approximation and Hungarian methods.
CO3: Calculate EOQ and EBQ for manufacturing and purchase models operating with or without shortage.
CO4: Select critical paths using CPM and PERT in projects based on minimum duration of activities.
CO5: Select the replacement policy and shortest queuing time based on economic cost for various replacement and queuing models. them in domain specific situations

TEXT BOOKS:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2011.
2. R.Panneerselvam, "Operations Research", PHI, 2006

REFERENCES

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley,2002
2. Hamdy A Taha, "Operations Research – An Introduction", Prentice Hall India,2003
3. Ronald L Rardin, "Optimization in Operations Research", Pearson, 2003

Web References

- http://nptel.ac.in/courses/112106134/1
- http://www.mit.edu/~orc/

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Course Code: 141OE0903	Course Title: TWO AND THREE WHEELERS	
Core / Elective: Open Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s): Nil

Course Objectives

The course is intended to:

1. Classify two and three wheelers and explain its construction.
2. Select power plant for two wheelers & three wheelers.
3. Explain the construction and working of transmission and steering systems.
4. Explain the construction and working of braking and suspension system.
5. Explain the need for maintenance of two and three wheelers.

Course Content **Hours**

UNIT I INTRODUCTION **9**

Classification of two wheelers and three wheelers and their applications, Types of two wheeler frame: construction and materials, Types of three wheeler bodies, Aerodynamic and ergonomics considerations, side car

UNIT II THE POWER UNIT **9**

Power plant for two wheeler & three wheeler, Twin spark technology, Electronic Fuel Injection, Electronic Ignition System, Lubrication system, Starting system

UNIT III TRANSMISSION AND STEERING SYSTEM **9**

Requirements of clutch, Types of clutches used in two & three wheelers, Need of primary reduction, Gear box and gear shift mechanism, Continuous Variable Transmission, Final drive & differential in three wheeler,

Steering geometry, steering column construction, Panel meters and controls on handle bar.

UNIT IV BRAKING AND SUSPENSION SYSTEM **9**

Requirements of braking system, Disc and drum brakes, Braking mechanism: Mechanical and hydraulic, Anti-lock Braking System

Suspension requirements, Trailing & leading link, Swinging arm, Springs & Shock Absorbers, Nitrox suspension

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UNIT V TROUBLESHOOTING AND MAINTENANCE 9

Troubleshooting. Preventive & break down maintenance of two and three wheelers. Factors affecting fuel economy and emission.

Course Outcomes

At the end of the course students will be able to:

CO1: Explain the construction of frame of two wheelers and the body of three wheelers.

CO2: Select power plant for two wheelers & three wheelers for the given application/requirement.

CO3: Explain the construction and working of transmission and steering systems of two wheelers and three wheelers.

CO4: Explain the construction and working of braking and suspension system of two wheelers and three wheelers.

CO5: Explain the need for maintenance of two and three wheelers.

TEXT BOOKS:

1. Tony Foale,"Motor cycle handling and chassis design", 2nd edition, 2006.
2: Gaetano Cocco ,"Motorcycle Design and Technology Handbook", Motor Books International, 2004

REFERENCES:

1. Irving.P.E., "Motor Cycle Engineering", Temple Press Book, London, 1992.
2. The Cycle Motor Manual - Temple Press Limited, London – 1990
3. Encyclopedia of Motorcycling - 20 volume Marshall, Cavensih, UK - 1989

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