K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Master of Technology (Automobile Engineering)

M.Tech (AE)

Programme Code: 54

2018-20

Approved in the 17th Meeting of Academic Council Held on 29 June 2018

Member Secretary
Academic Council
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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About K. R. Mangalam University

The K.R. Mangalam Group has made a name for itself in the field of education. Over a period, various educational entities of the group have converged into fully functional corporate institutions. Resources at KRM have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly inter-disciplinary environment where they grow up with integrative skills through interaction with students from engineering, social sciences, management and other study streams.

The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education. With mushrooming of institutions of Higher Education in the National Capital Region, the university considered it very important that students take informed decisions and pursue career objectives in an institution where the concept of education has evolved as a natural process.

K. R. Mangalam University is established under the Haryana Private University Act 2006, received the approval of Haryana Legislature vide Amendment Act # 36 of 2013 and consent of the Hon'ble Governor of Haryana on 11th April 2013, which was published in the Gazette notification vide Leg. No.10/2013, dated 3rd May 2013.

KRM University is unique because of its:

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives:

To impart undergraduate, post graduate and doctoral education in identified areas of higher education.

i. To undertake research programs with industrial interface.

ii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programs with foreign, Indian Universities/Institutions and MNCs.
iii. To act as a nodal center for transfer of technology to the industry.
iv. To provide job oriented professional education to the Indian student community with particular focus on Haryana.

v.

About the School of Engineering & Technology (SOET)

School of Engineering and Technology (SOET), K.R. Mangalam University, is dedicated to fostering innovation, excellence, and advancement in engineering and technology. Empowering the new generation of change-makers by imparting exceptional understanding and intellect to facilitate the creation of highly sophisticated futuristic solutions. Our well-qualified academicians, accomplished researchers and industry insiders are focused on imparting their extensive knowledge and expertise to students through various lectures, workshops, industrial visits, projects, and competitions throughout the year ensuring that students receive a comprehensive education that blends theory with practical application.

These programs offered at SOET have the distinct objective of equipping the students with knowledge, skills and attitudes in engineering and technology, to make them capable of successfully meeting the present requirements and future challenges in the engineering profession. SOET brings together outstanding academics, industry professionals, and experienced researchers to deliver a unique hands-on and multi-disciplinary learning experience.

The curriculum of programs has been designed to cater to the ever changing needs and demands of the industry. The curriculum is regularly updated. The school has the best infrastructure including domain-specific labs. SOET aims to provide exposure to the principles and practices of Design / Developments and Projects in the area of engineering. SOET is offering Ph.D. programs also.

School Vision

To create, disseminate, and apply knowledge in science and technology to meet the higher education needs of India and the global society, To serve as an institutional model of excellence in scientific and technical education characterized by integration of teaching, research and innovation.

School Mission

M1: To create an environment where teaching and learning are prioritized, with all support activities being held accountable for their success.

M2: To strengthen the institution's position as the school of choice for students across the State & Nation.

M3: To promote creative, immersive, and lifelong learning skills while addressing societal concerns.

M4: To promote co- and extra-curricular activities for overall personality development of the students.

M5: To promote and undertake all-inclusive research and development activities.

M6: To instill in learners an entrepreneurial mindset and principles.

M7: Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.

M8: To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

The Programs offered by School

School offers undergraduate B. Tech Program, B.Sc. (Hons) Program, postgraduate M. Tech Program, and Doctoral Program. All these programs are designed to impart scientific knowledge to the students and provide theoretical and practical training in their respective fields.

M.Tech in Automobile Engineering

M.Tech in Automobile Engineering is a postgraduate program designed to provide advanced knowledge and skills in the field of automotive technology and engineering.

Eligibility Criteria: Candidates must have a B.E. / B. Tech degree in Mechanical Engineering with a minimum of 50% marks in aggregate. The reservation and relaxation for SC/ST/OBC/PWD and other categories shall be as per the rules of central/state government, whichever is applicable.

Course Outline: Chassis & Body Engineering, Advanced Manufacturing Technology, Automobile Air Conditioning, Advanced Automotive Transmission, Alternate Energy Sources for Automobiles.

Career Options: Automotive Engineer, Product Development Manager, Design Engineer, Corporate Sales Manager.

Program Duration: 2 Years

The maximum period for the completion of the M.Tech. (AE) Programme offered by the University shall be Two years.

Class Timings:

The classes will be held from Monday to Friday from 9.10 am to 4.00 pm.

Scheme of Studies and Syllabi

The scheme of studies and syllabi of M. Tech (AE) is given in the following pages. These are arranged as (a) common courses (b) degree-specific courses, in numeric order of the last three digits of the course code. The first line contains Course Code and Credits (C) of the course for each course. This is followed by detailed syllabi.

Two Years M. Tech (Automobile Engineering) Program at A Glance

Semester	1	2	3	4	Total

Courses	8	8	3	2	21
Credits	23	23	16	20	82

Scheme of Studies

Semester I

SN	Category		Course Code	Course Title	L	T	P	C
1	Major	CC	ETME701	Chassis & Body Engineering	4	-	-	4
2	Minor	CC	ETME703	Pneumatic & Hydraulic System	3	1	-	4
3	Minor	CC	ETME705	Automotive Engines & Emission	3	1	-	4
4	Major	CC	ETME707	Advanced Manufacturing Technology	4	-	-	4
5	DE	DE		Elective – I (Gas Dynamics-ETME709)	4		-	4
6	Major	SE	ETME751	Engine Testing and Pollution Measurement Lab	-	-	2	1
7	Major	SE	ETME753	Automotive System components Lab	-	-	2	1
8	SEC	SE	ETME755	Seminar – I	-	-	-	1
					20	**-**	**4**	**23**

Semester II

SN	Category		Course Code	Course Title	L	T	P	C
1	Major	CC	ETME702	Automobile Air Conditioning	4	-	-	4
2	Minor	CC	ETME704	Design of Experiments & Research methodology	3	1	-	4

3	Minor	CC	ETME706	Advanced Automotive Transmission	3	1	-	4
4	Major	CC	ETME708	Vehicle Safety & Maintenance	4	-	-	4
5	DE	DE		Elective II (Production of Automotive Component-ETME710)	4		-	4
6	Major	SE	ETME752	Automobile air conditioning Lab	-	-	2	1
7	Major	SE	ETME754	Automobile CAD Lab with simulation	-	-	2	1
8	SEC	SE	ETME756	Seminar – II	-	-	-	1
					20	**-**	**4**	**23**

Semester III

SN	**Category**		**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Major	CC	ETME801	Alternate Energy Sources for Automobiles	4	-	-	4
2	DE	DE		Elective – III (Electric and Hybrid Vehicles ETME809)	4	-	-	4
3	DSS	SE	ETME851	Dissertation Part-A	-	-	-	8
					8	**-**	**-**	**16**

SN	**Category**		**Course Code**	**Course Title**	**L**	**T**	**P**	**C**

Semester IV

1	DE	DE		Elective-IV (Two and Three wheeler Technology, ETME-806)	4	-	-	4
2	DSS	SE	ETME852	Dissertation Part-B	-	-	-	16
					4	**-**	**-**	**20**

Total Credits: 82

Detailed Syllabus

SEMESTER I

ETME 701	CHASSIS AND BODY ENGINEERING	L	T	P	C
		4	**-**	**-**	**4**

Objective: To make the students understand chassis, frames and material used for the same. Also understand need of propeller shaft, suspension and braking system.

UNIT I CHASSIS & BODY ENGG: Types, Technical details of commercial vehicles, types of chassis, lay out, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

UNIT II

DRIVE LINE STUDY: Effect of driving thrust and torque –reaction .Hotchkiss drives. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drive- different types. Two speed rear axle. Rear axle construction-full floating, three quarter floating and semi-floating arrangements. Differential-conventional type, Non-slip type, Differential locks and differential housing.

UNIT III

BRAKING SYSTEM

Type of brakes, Principles of shoe brakes. Constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Exhaust brakes, power and power assisted brakes. Testing of brakes.

UNIT IV SUSPENSION SYSTEMS

Types of suspension, Factors influencing ride comfort, Types of suspension springs- independent suspension- front and rear. Rubber, pneumatic, hydro- elastic suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, tubeless tyres and aspect ratio of tubed tyres.

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.

2. P.M.Heldt, "Automotive Chassis", Chilton Co., New York, 1982.

3. W.Steed, "Mechanics of Road Vehicles", Illiffe Books Ltd., London. 1992.

REFERENCES:

1. Harban Singh Rayat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.

2. G.J.Giles, "Steering Suspension and Tyres", Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.

4. G.B.S.Narang, "Automobile Engineering", Khanna Pub. New Delhi, 2005.
5. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.

ETME 703	PNEUMATIC & HYDRAULIC SYSTEMS	L	T	P	C
		4	-	-	4

OBJECTIVE: Students will able to understand Classification, application in various fluids of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, Types of hydraulic fluids and their properties, effect of temperature on fluids. Hydraulic system elements.

UNIT - I

Control of fluid power elements: Requirement of pressure control, direction control, flow control valves. Principle of pressure control valves: direction control valves, pilot operated, relief, pressure reducing, quick exhaust, sequence valves, flow control valves and their types, meter-in and meter-out circuit and flow through circuit.

Types of direction control valves – two way two position, four way two position, four way three position, open center,, close center, tandem center, manual operated, solenoid, pilot operated direction control valves, check valves.

UNIT II

Actuators – linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings. Calculation of piston velocity, thrust under static and dynamic operation and application, consideration of friction and inertia loads. Hydraulic servo-system for rotary and linear motion.

UNIT III

Pneumatic Systems: Application of pneumatics, physical principles, basic requirement of pneumatic system. Comparison with hydraulic systems. Elements of Pneumatics, Air compressors, Pneumatic control valves,

Pneumatic actuators - types and the mountings, Air motors – types, Pneumatic circuits – Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuits and their applications. Pneumatic servo-system for linear and rotary motion.

UNIT IV

Typical Automotive Applications: Hydraulic tipping mechanism, power steering, fork lift hydraulic gear, hydro-pneumatic suspension Maintenance and trouble shooting of hydraulic & pneumatic circuits.

Introduction to fluidics: study of simple logic gates, turbulence, amplifiers, pneumatic sensors and applications.

Text Books:

1. Basic fluid power- D.A. Pease-PHI
2. Industrial Hydraulic & pneumatics – J.J. Pippenger - McGraw Hill

Refrence Books:

1 Fluid with applications – A. Esposito- PHI
2 Oil Hydraulics – B Lal- Intl- Literature
3 Fluid power Design Hand book – Yeaple
4 Industrial Hydraulic Manual Vicker Sperry

ETME 705	AUTOMOTIVE ENGINES & EMISSION	L	T	P	C
		4	-	-	4

Objective: To impart the knowledge in I C engine cycles, working of valve timing diagram, cooling and Lubrication system. Also students will understand combustion chamber theory and pollution norms

UNIT I

Engine Basic Theory: Engine types and their operation, classification, Properties of I.C. engine, fuels, Actual cycle, air fuel cycle, combustion charts (Equilibrium), Two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram, supercharging, MPFI, VVT, cam less engine, Fuel Supply, Ignition,

Cooling and Lubrication Systems : Theory of carburetion and carburetors, mixture distribution, petrol injection, diesel fuel injection pumps, conventional and electronic ignition systems for SI engines, air cooling and water cooling, design aspects, forced feed lubrication system.

UNIT II

Air Motion Combustion and Combustion Chambers: Swirl and turbulence – swirl generation, combustion in SI & CI engines, flame travel and detonation, Ignition delay,. Knock in CI engines, combustion chamber design

Air Pollution due to Automobile Exhaust: Sources of Emission, Exhaust gas constituents & analysis, Ingredients responsible for air pollution, Smoke, odor, Smog formation.

UNIT III

Exhaust Emission Control: Basic method of emission control, catalytic converter, After burners, reactor manifold, air injection, crank case emission control, evaporative loss control, Exhaust gas recirculation, Fuel additives.

Pollution Norms: European pollution norms, Indian pollution norms as per Central Motor Vehicle Rules (C.M.V.R.). Instrumentation for Exhaust Emission Measurement: Measurement procedure, Sampling Methods, Orsat Apparatus, Infrared Gas analyzer, Flame Ionization Detector (FID), Smoke meters.

UNIT IV

Alternative Fuels: CNG, LPG, Bio-Diesel, Hydrogen, fuel cells, Eco-friendly vehicles, Electric & Solar operated vehicle Stratified Charged, Low heat rejection engine, Sankey plot, four / three valve engine, OHC engine, governing of automobile engine, New engine technology, Recent developments in I. C. engine.

Text Books :

1. Introduction to Internal Combustion Engines", Richard Stone, McMillan, London
2. Vehicle and Engine Technology – Hein Heister 3. Advance Vehicle Technology - Hein Heister
3. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
4. I. C. Engines – C. Fayette Taylor & Edward S. Taylor, International text book com.

Reference Books:

1. I.C. Engine by Maleev V. L., McGraw Hill Book, Co.
2. I. C. Engines – Ferguson
3. S. I. Engine – Fuel Injection Development - Charles A. Fisher, Chapman & Hall
4. Automotive Engines - Herbert E. Ellinger
5. Automobile Engg. Volume – I , American Technical Society, Chicago
6. Internal Combustion Engines Fundamentals – John B. Heyhood, McGraw Hill

ETME 707	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
		4	-	-	4

Objective: - To impart knowledge in Modern machining process like Ultrasonic, Water Jet and Electro-discharge machining. Also the function of CNC machine.

Unit-I

Modern Machining Process: Introduction and classification.Abrasive Jet Machining: Fundamental principles, process parameters, Metal removal rate, effect of parameters, application & limitations. Water Jet Machining: Construction. Ultrasonic Machining: Fundamental principles, process parameters, cutting tool design, tool feed mechanism, transducer, Design of velocity transformers, Mechanics of cutting, Effect of parameters, Economic considerations, application & limitations.

Unit-II.

Electrochemical Machining : Classification, fundamental principles, elements of process, Metal removal rate, electro-chemistry of process, Dynamics and hydrodynamics of process, optimization analysis, choice of electrolytes.Electrochemical Grinding: Fundamental principles, electro-chemical and process parameters, Application, advantages and disadvantages, Electrochemical deburring and honning.

Unit-III

Electrical Discharge Machining : Mechanisms of metal removal, Basic circuitry, Evaluation of metal removal rate, Machining accuracy, Surface finish, Analysis for optimization, tool material, dielectric fluid, application &

limitation. Plasma Arc Machining : Non-thermal generation of plasma, mechanics of metal removal, various parameters, accuracy and surface finish, applications.

Unit-IV

CNC Programming: Programming of CNC Lathe and Milling machine for common machining operations. Absolute and Incremental Programming. Canned cycles of CNC milling machine. Introduction to Computer Assisted Part Programming.

Text **Books**

1. Pandey P. C. & Shan H. S., Modern Machining Process, Tata McGraw Hill.
2. Dr. Bhattacharya Amitabh, The Institution of Engineers Publication, New Technology.
3. Groover, Production System & Computer Integrated Manufacturing, PHI

References:

1. Production Technology, HMT

ETME 751	ENGINE TESTING AND POLLUTION MEASUREMENT LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS

1. Performance study of petrol and diesel engines both at full load and part load conditions.
2. Morse test on petrol and diesel engines.
3. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines.
4. Heat balance test on an automotive engine.
5. Testing of 2 and 4 wheelers using chassis dynamometers.
6. Study of NDIR Gas Analyser and FID Study of ChemiluminescentNOx analyzer Measurement of HC, CO, CO2, O2 using exhaust gas analyzer Diesel smoke measurement.

ETME 753	AUTOMOBILE SYSTEM COMPONENT LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS:

1. To Study the chassis, body and Frame of the vehicle with actual model.

2. To Study the clutch of the vehicle by dismantling and assembling.

3. To Study the gear system of the vehicle by dismantling and assembling.

4. To Study the rear and front axle by dismantling and assembling.

5. To Study the steering system of the vehicle by dismantling and assembling with actual vehicle.

6. To study the engine of the vehicle by dismantling and assembling

ETME 709	GAS DYNAMICS	L	T	P	C
		4	-	-	4

Objective: - To know application of Euler's equation, vortex flow. Also significance of Viscous and compressible flow

Unit 1

Fundamental Equations of Steady Flow:Continuity equation, Equations of Motion, Euler's Equation, Bernoulli's equation, Energy, Stream Function and Velocity Potential,

Unit II

Potential Flow:Elementary potential flow, Source, Sink, Vortex and Doublet, Superposition of flow patterns. Flow over immersed bodies. Development of the aerofoil-lift and drag, Kutta- Joukowski Profile, pressure distribution over aerofoil blading.

Unit III

Viscous Flow:Incompressible Flow: Laminar Turbulent Flows: Navier's Strokes equation and exact solutions of steady flow problems. Flow through pipes, over flats plates. Laminar and turbulent boundary layers. Dimensional analysis.

Unit IV

Compressible Flow of Gases:Isentropic and adiabatic flow, Stagnation and critical properties Flow though ducts of constant area, Fanno line and Rayleigh line flows. Fundamental equations and variation in flow properties. Flow with normal shock waves governing equations, Prandtl Meyer and Rankine Hugoniot relations, Strength of a shock wave, Moving normal shock waves.

Text Books:

1. Fundamental of Compressible Flows -Yahya
2. Compressible Fluid Flow -Michel A.Saad,
3. Introduction of fluid mechanics - Donald

Reference Books:

1. Turbo Machines A.Valan Arasu
2. Applied Fluid Dynamics Handbook Robert D.Blevins
3. Int J.of Heat and Mass Transfer -Elsevier Pub

		L	T	P	C
ETME 711	**ADVANCED COMPUTER AIDED DESIGN**	**4**	**-**	**-**	**4**

OBJECTIVE: The student will learn Use of computers in design of components and assembly

UNIT I:

Introduction to computer aided design and computer graphics: The design process-Application of computers in design-typical CAD System-CAE-Benefits of CAD-Concept of CAD as drafting and designing facility-drawing features in CAD-Translation, rotation, scaling-Layering-CAD Hardware-Design workstation-Graphic Terminal-Operator input devices-Output devices-CPU. Creation of Graphic primitives-Output primitives (Points, Lines, Curves)- Windowing, view ports-Clipping transformation- Data exchange standards-Geometric modelling- Wireframe, Surface, Solid Modeling –Data Structures-Engineering Data Management System-Hierarchical, Network, Relational data structure.

UNIT III:

Visual realism: Fundamentals -rendering techniques-lines and shaded images, dynamics, stereopsis, Improved display, aliasing and ant-aliasing.

UNIT IV

Assembly of parts: Assembly of parts, tolerance analysis, mass property calculations, mechanisms simulation.

UNIT V

Solid modeling: Solid modeling- Rapid Prototyping -CSG and B-REP Techniques-Features of Solid Modeling Packages-Case Studies

Text Books:

1. William .M. Neumann and Robert .F. Sproul (1989) “Principle of Computer Graphics” , McGraw Hill Book Co. Singapore.
2. Donald Hearn and .M. Pauline Baker (1992) “Computer Graphics”, Prentice Hall, Inc.

References Books:

1. Mikell .P. Grooves and Emory .W. Zimmers Jr. “CAD/CAM Computer -- Aided Design and Manufacturing”, Prentice Hall, Inc.
2. Ibrahim Zeid “CAD/CAM -- Theory and Practice”, McGraw Hill, International Edition.

Objective:- The students should able to understand various mathematical methods used to analyze various automobile components. Also know various applications of FEM in automobile sectors.

Basic concepts of finite element method. Steps involved in FEM. Solution of Boundary value problem - Integral formulation for Basic Concepts

ETME 713	FINITE ELEMENT ANALYSIS IN DESIGN	L	T	P	C
		4	-	-	4

UNIT I

numerical solution - Variational method - Collocation method - Subdomain method - Galerkin method - Least square method - Minimum total potential energy formulation.

UNIT II 1d elements

Use of bar and beam elements in structural analysis. Bar Element – Stiffness matrix formulation by direct and polynomial methods. Boundary condition and assemblage concepts. Beam element characteristics matrix. Global, local, natural coordinates - Numerical Integration.

UNIT III 2d elements

Rectangular elements - Quadratic quadrilateral elements - Linear Triangular elements - 2D elements applications for plane stress, plane strain and axi-symmetric problems. Numerical integration schemes. Iso Parametric elements.

UNIT IV Application of FEM

1D & 2D problems in Solid mechanics, fluid mechanics and heat transfer by conduction and convection. Torsion of non circular shaft - axisymmetric problem - acoustic vibration. Dynamics problems representation in FE.

Text Books:

1 Finite element method: Chandrupatla & Belegundu

2 Finite element procedures: K.J.Bathe

Reference Books:

1 Computer Inegrated Manufacturing: Alavudeen, A, Venkateshwaran, N, PHI

2 CAD/CAM, Chris McMahon, Jimme Browne, Pearson Education, Asia

3 Matering CAD/CAM, Ibrahim Zeid, Tata McGrawHill.

ETME 715	ADVANCED MATERIALS AND SENSORS FOR AUTOMOBILE	L	T	P	C
		4	-	-	4

Objective: - At the end of the course students will understand various materials and their processes involved for making automobile components. Also know various safety sensors used in the vehicle.

UNIT I

Characteristics and fabrication of plastically deformed bodies-Theory of Plasticity-Load requirement to accomplish metal forming operations – Analysis of rolling, forging and extrusion processes.

UNIT II

Cold rolled steel- Properties, manufacturing methods and super plasticity –weldability- Hot rolled vs Cold rolled - Foam materials- Structure, Stability and Types – Manufacturing Methods – Applications- Materials for safety-bearing materials-coating techniques for wear- PVD and CVD techniques, Chemical and electrochemical techniques, Spraying, Roll to Roll spraying techniques, heat and environment.

UNIT III

Corrosion phenomenon with special reference to automobile bodies - advanced materials for automobile, Nanostructured steel for automotive body structures; Aluminium sheet for automotive applications; High-pressure die-cast (HPDC) aluminum alloys for automotive applications; Magnesium alloys for lightweight powertrains and automotive bodies; Polymer and composite moulding technologies for automotive applications.

UNIT IV

Necessity of Sensors in automobiles , sensors for antilock braking systems, seat belts,automaticlocks,gasguage, air bags, heater, temperature sensor, speedometer, oil guage etc.

Text Books:

1. Black, J.T., Ronald, A.K. Materials and Processes in Manufacturing, 10th Edition, John Wiley Publication, 2007.

Reference Books:

1. George S. Brady, Henry R. Clanser, Materials: Theory Properties and Uses,McGraw-Hill, 2006

ETME 717	ADVANCED THEORY OF VIBRATIONS	L	T	P	C
		4	-	-	4

Objective: The students will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I

Introduction and numerical methods: Single degree of freedom, two degree of freedom, free, forced and damped vibrations modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber. Two degree of freedom system. modal analysis. Approximate methods for determining fundamental frequency, Dunkerleys lower bound, Rayleighs upper bound, Holzer method for closed coupled system and branched system.

UNIT II

Control techniques: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT III

Automotive noise sources: Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV

Source of noise and control: Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TEXT BOOKS

1. Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education.
2. Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons.

ETME 719	MODERN AUTOMOBILE ACCESSORIES	L	T	P	C
		4	-	-	4

Objective: - Understand the use of Electronics in the Fuel delivery in SI & CI engines, Ignition (Closed loop) system, Catalytic convertor & Particulate traps. Know about the air conditioning & heating systems.

UNIT I Engine management systems:

Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed loop ignition system. Catalytic converters and particulate traps.

UNIT II Chassis:

Active suspension control, Pneumatic suspensions. Rheological Suspension, Electronic Braking System, Fail safe Braking System, ABS

UNIT III Heating and air conditioning:

Principles of vehicle air conditioning and heating. Vapor Absorption Air conditioning, vapor compression air conditioning CO, CO2 level monitoring inside the cabin

UNIT IV Comfort and convenience: Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering.

TEXT BOOKS

1. Tom Denton - "Automobile Electrical and Electronic Systems" - Edward Arnold, London.

2. Eric Chowanietz - 'Automotive Electronics' - SAE International USA .

REFERENCE

1. Bosch Automotive Hand Book - 5th Edition - SAE Publication, USA .

SEMESTER III

ETME 702	AUTOMOBILE AIR CONDITIONING	L	T	P	C
		4	-	-	4

Objective: - To Enable the student to understand the components of the automotive air-conditioning and their functions and the latest developments in this field. Also understands various components of automotive air conditioning system, Properties of the different refrigerant and service maintenance of air conditioning system.

UNIT I

Airconditioning fundamentals: Basic air conditioning system - Location of air conditioning components in a car, Schematic layout of a refrigeration system, Compressor components, Condenser and high pressure service ports, Thermostatic expansion valve, Expansion valve calibration, Controlling evaporator temperature, Evaporator pressure regulator, Evaporator temperature regulator.

UNIT II

Air conditioner - heating system: Automotive heaters, Manually controlled air conditioner, Heater system, Automatically controlled air conditioner and heater systems, Automatic temperature control, Air conditioning protection, Engine protection. HVAC. Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc.

UNIT III

Refrigerant: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil Simple problems - Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer

Depletion, Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system.

UNIT IV

Air routing and temperature control: Objectives, evaporator airflow through the re-circulating unit, Automatic temperature control, Duct system, Controlling flow, Vacuum reserve, testing the air control and handling systems. CO, CO2 monitoring inside the cabin.

TEXTBOOK:

1. Tom Birch, "Automotive Heating and Air Conditioning" Pearson Education Inc.

2. Boyce H. Dwiggins, Jack Erjavec., "Automotive Heating and Air-Conditioning", Delmer publisher.
2. William H Crouse and Donald L Anglin, "Automotive air conditioning", McGraw - Hill Inc.

REFERENCES:

1. Goings. L.F., "Automotive air conditioning", American Technical services.
2. Paul Weiser, "Automotive air conditioning", Reston Publishing Co Inc.

3. MacDonald, K.L., "Automotive air conditioning", Theodore Audel series.

4. James D. Halderman, "Automotive Heating, Ventilation, and Air Conditioning Systems", Pearson Education Inc.

5. SAE papers
6. Vehicle service manuals.

ETME 704	DESIGN OF EXPERIMENT AND RESEARCH	L	T	P	C
		4	-	-	4

Objective: - To know the students meaning of research, literature review, mathematical modeling and simulation and report writing

UNIT I

Research concepts: Meaning, objectives, motivation, type of research, approaches, research (descriptive research, conceptual, theoretical, applied and experimental, literature review, importance and methods, sources, quantification of cause-effect relations, discussions, wheel study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research.

UNIT II

Mathematical modeling and simulation: concept of modeling, classification of mathematical models, modeling with ordinary differential equations, difference equations, partial differential equations, graphs, simulation: concept, types (quantitative , experimental, computer, fuzzy theory, statistical) processes of formulation of model based on simulation.

UNIT III

Experimental modeling: Definition of experimental design, examples, single factor experiments blocking and Nuisance factors, guidelines for designing experiments.

6. General model of process: I/P factors/ variables, O/P parameters /variables controllable/uncontrollable variables, dependent/independent variables, experimental validity.

7. Process optimization and design experiments methods for study of response surface, first Order design, determining optimum combination of factors, method of steepest ascent, Taguchi approach to parameter design. Analysis of results (parametric and nonparametric, descriptive and inferential data) types of data, collection of data (normal distribution, calculation of co relation coefficient) data processing, analysis, error analysis.

UNIT IV

Report writing: types of report, layout of research report, interpretation of results, style manuals, layout and format, style of writing, typing, references, paginations, table, figures, conclusions, appendices, writing research paper for publication based on dissertation / research wor**k**.

TEXT BOOKS:

1. C. R. Kothari, “Research Methodology”, Willy Estern Ltd. ND.

2. Schank Fr, “Theories of Engineering Experiments”, Tata McGraw Hill.

3. Douglas Montgomary, “Design of Experiments”

REFERENCES:

1. "Introduction to SQC" John Willy & sons.

2. John W. Besr and James V. Kahn, "Research in Education", PHI publication.

3. S. S. Rao, "Optimization Theory & Applications", Wiley Estern Ltd. ND.

4. Willkinsion K.P. L., Bhandarkar, "Formulation of Hypothesis", Himalaya publishing,

ETME 704	ADVANCED AUTOMOTIVE TRANSMISSION	L	T	P	C
		4	-	-	4

Objective: - To impart knowledge about the critical importance of the transmission system in an automobile and to create awareness about the evolution, components involved and different types of transmission system widely used in automobiles.

UNIT I

TRANSMISSION SYSTEMS: Clutch, types of clutch, clutch design, Gear box, types of gear boxes, gear box design, overdrive gears, Fluid flywheel & torque converter, Epicyclic gear box, semi-automatic & automatic transmission Propeller shaft,

UNIT II

DESIGN OF TRANSMISSION SYSTEMS: propeller shaft, slip joint, universal joint, Final drive, differential, Dead & live axle, axle design, Constant velocity joints

UNIT III

BRAKING SYSTEM: types of brakes, brake-actuating mechanisms, factors affecting brake Performance, power & power assisted brakes, Brake system design, and recent developments in transmission & braking system

UNIT IV

STEERING SYSTEMS: Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering,

TEXTBOOK:

4. Heldt P.M, Torque Converters, Chilton Book Co.

5. K. Newton, W.Steeds and T.K.Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India.

REFERENCES

1. Heinz Heisler, “Advanced Vehicle Technology”, second edition, Butterworth – Heinemann, New York.
2. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi.

ETME 706	VEHICLE SAFETY & MAINTENANCE	L	T	P	C
		4	-	-	4

Objective: - At the end of the course, the students will be able to have a complete knowledge of the Vehicle safety with their operating procedure also know the maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail

UNIT I SAFETY CONCEPTS

Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT II SAFETY EQUIPMENTS

Seat belt, regulations, automatic seat belt tightened system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety, antiskid braking system, regenerative braking system, speed control devices.

UNIT III MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log

books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT IV ENGINE REPAIR AND OVERHAULING

Dismantling of engine and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Engine trouble shooting chart, Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

REFERENCES

4. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.

5. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago,

6. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984
7. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.

8. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork,
9. Vehicle servicing manuals.

		L	T	P	C
ETME 752	**AUTOMOBILE AIR CONDITIONING LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS:

1. To Study Vapor compression Refrigeration System
2. To learn various types of refrigerant used in Automobile A.C. system
3. Study of various tools and equipments used in Automobile refrigeration laboratory
4. To study important component of air conditioning system used in Automobile.
5. Study of a range of controls used in Air conditioning system
6. Write a troubleshoot chart for automobile air conditioning system.

		L	T	P	C
ETME 754	**AUTOMOBILE CAD LAB WITH SIMULATION**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS:

1. Introduction to Solid Modelling & Pro/E Package
2. Working with sketch mode of Pro/E
3. Introduction to MATLAB Programming
4. Assembly modelling in Pro/E
5. Generating, editing and modifying drawings in Pro/E
6. Make the simulation of following automobile components:

    1 Chassis
    2 Frame
    3 Piston
    4 Connecting rod.

		L	T	P	C
ETME 710	**PRODUCTION OF AUTOMOTIVE COMPONENT**	**4**	**-**	**-**	**4**

Objective: - To provide the students sound knowledge of powder metallurgy, extrusion process, forging process and casting process used for manufacturing of automotive component. Also know the process of powder injection molding

UNIT I
POWDER METALLURGY AND PROCESSING OF PLASTICS

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics.

UNIT II
FORGING AND EXTRUSION PROCESS

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, and transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, and piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels.

UNIT III
CASTING AND MACHINING

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburetor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT IV
RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS

Powder injection molding - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming –Squeeze Casting of pistons - aluminum composite brake rotors. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts.

TEXT BOOK

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.
2. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
3. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.

REFERENCES

1. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai,
2. Sabroff.A.M. & Others, "Forging Materials & Processes ", Reinhold Book Corporation, NY

3. Upton, "Pressure Die Casting ", Pergamon Press, 1985.
4. HMT handbook

		L	T	P	C
ETME 712	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS CONTROL**	**4**	**-**	**-**	**4**

Objective;-The course should enable the student to Understand construction and working of batteries and accessories, starting system and charging system. Also the student will have to know about all theoretical information and about electrical components used in a vehicle.

UNIT I :- FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS: Microprocessor and micro computer applications in automobiles – Components for engine management system – electronic management of chassis system, vehicle motion control, electronic panel meters. Introduction, basic sensor arrangement, types of sensors, oxygen sensor cranking sensor – position sensors – engine cooling water temperature sensors, engine oil pressure sensor, fuel metering, vehicle speed sensor & detonation sensor, stepper motors – relays.

UNIT II :- ELECTRONIC FUEL INJECTION & IGNITION SYSTEM: Introduction, feedback carburetor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

UNIT III :- AUTOMOTIVE ELECTRICAL: Batteries, starter motor & drive mechanism, d.c. generator & alternator, regulation for charging, lighting design, dash board instruments, horn, warning systems and safety devices.

UNIT IV :- COMFORT AND SAFETY : seats, mirrors and sun-roofs, central locking and electronic windows, cruise control, in-car multimedia, security, airbag and belt tensioners, other safety and comfort systems, advanced comfort and safety systems, New developments in comfort and safety

REFERENCES

1. Automobile Electrical & Electronic Equipments - Young, Griffitns - Butterworths, London
2. Understanding Automotive Electronics – Bechfold SAE 1998

3. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London

4. Automotive Computer & Control System – Tomwather J. R., Cland Hunter, Prentice Inc. NJ

5. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall Eaglewood, Cliffs, NJ
6. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical

7. Understanding Automotive Electronics – Wiliam B. Ribbens, Allied Publishers Pvt. Ltd., Chennai.
8. Automobile Electrical & Electronic Systems – Tom Denton, Allied Publishers Pvt. Ltd., Chennai.

ETME 714	AUTOMOBILE DESIGN	L	T	P	C
		4	-	-	4

Objective: - To make the students understand the design concept and principles of various vehicle system components. These concepts and principles are familiarized for design of components.

UNIT I:- DESIGN OF CYLINDER AND PISTON ASSEMBLY

Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

UNIT II: - DESIGN OF CONNECTING ROD, CRANKSHAFT

Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, connecting rod failures, balancing of I.C. Engines, significance of firing order, material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations.

UNIT III :- DESIGN OF BRAKES AND CLUTCHES:

Specifications for brakes and clutches, calculation of brake power requirements and power transmission requirements of clutches. Design aspects of drum and disk brakes, Principle of Anti-lock braking systems. Design of single and multi-plate clutches, Cone clutch and centrifugal clutch.

UNIT IV :- VEHICLE FRAME, SUSPENSION AND STEERING SYSTEMS

Study of loads, moments and stresses on frame members, computer aided design of frame for passenger and commercial vehicles, computer aided design of leaf springs, coil springs and torsion bar springs. Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

TEXT BOOKS

1. R.K. Jain, "Machine Design", Khanna Publishers, New Delhi, 1997.
2. "Design Data Book", PSG College of Technology, Coimbatore, 2000.
3. P.M.Heldt "High Speed Combustion Engines", Oxford-IBH Publishing Co., Calcutta, 1965.
4. Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2002

REFERENCES

1. A.Kolchin and V.Demidov, "Design of Automotive Engines", MIR Publishers, Moscow, 1984.
2. Sundararaja Murthy T.V "Machine Design", Khanna Publishers, New Delhi, 1991.
3. Steeds. W -"Mechanics of Road Vehicles"- Illiffe Books Ltd., London- 1990
4. Giles.K.G - Steering, Suspension and tyres"- Illiffe Books Ltd., London – 1988

		L	T	P	C
ETME 716	**AUTOMOTIVE POWER TRAINS**	**4**	**-**	**-**	**4**

Objective: The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students

UNIT I :- OVERVIEW OF VEHICLE POWER TRAINS SYSTEM: Outlines of Power Trains, Power train functions, Power train layout and components, Main and Auxiliary functions, Requirements profile, Interrelations: Direction of rotation, Transmission Ratio and Torque, Road Profiles, Load Profiles, Typical Vehicle uses and Driver types, Performance features of Vehicle Transmissions. Design trends in Transmission, Kinematical relations of power trains, Numerical problems.

UNIT II:- START-UP DEVICES: One -way clutch, Band clutch, Multi-disk clutch, Clutch Design and Analysis, **Hydrodynamic Clutches and Torque Converters:** Principles, Characteristic curves of Hydrodynamic Clutches, **Con**struction and operation of Torque Converter, Input/output characteristics, Design Considerations, Trilok Converter, Torque Converter test diagram, Interaction of engine and Trilok Converter, Numerical problems

UNIT III:- MANUAL TRANSMISSIONS: Manual Transmission Layouts and Components, Basic gear box construction, gear-sets with fixed axles, countershaft transmission and epicyclic gears, schemes for reverse gear. Transmission Power Flows, Numerical problems.

Gear shifting mechanisms, Layout and design of Synchronizers: Internal shifting mechanisms and External shifting mechanisms, Classification of shifting elements, synchronizer functional requirements, synchronizing process, design of synchronizers, alternative transmission synchronizers

UNIT IV :- DIFFERENTIAL AND FINAL DRIVES: Outline of differential theory-friction free differential, Differential with internal friction, Self locking differential, final drives: formats, performance limits, transmission ratios. Differential gears, differential locks and locking differentials, types of self locking differential, Numerical problems.

REFERENCES

1. **Automotive Transmissions: Fundamentals, Selection, Design and Application,** Gisbert Lechner, Harald Naunheimer, Springer-Verlag Berlin Heidelberg, New York, ISBN 3-540-65903.

2. **Design Practices: Passenger Car Automatic Transmissions,** Many authors, Third Edition, AE-18, SAE, Warrendale, 1994.

3. **Handbook of Automotive Powertrain and Chassis Design,** J. Fenton, Professional Engineering Publishing, London 1998.

4. **Gears andTransmissions, Vol. 4,** J.G. Giles, Automotive Technology series,Butterworth, London 1969.

ETME 718	AUTOMOTIVE AERODYNAMICS	L	T	P	C
		4	-	-	4

Objective: - The course should enable the students to fundamentals of fluid mechanics related to vehicles, aerodynamics drag of cars and knowledge of vehicle handling.

UNIT I:- INTRODUCTION & AERODYNAMIC DRAG OF VEHICLE

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine. LCV and HCV as a bluff body, flow field around Vehicle, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles

UNIT II:- SHAPE OPTIMIZATION OF CARS

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

UNIT III :-VEHICLE HANDLING

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

UNIT IV:- WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

TEXT BOOK

1. Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd., - 1997.

REFERENCES

1. A. Pope - "Wind Tunnel Testing"- John Wiley & Sons - 2nd Edition, New York - 1974.

2. Automotive Aerodynamic: Update SP-706 - SAE - 1987
3. Vehicle Aerodynamics - SP-1145 - SAE - 1996.

ETME 720	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		4	-	-	4

Objective:- To introduce numerical modeling and its role in the field of heat transfer and fluid flow. To enable the students to understand the various discretization methods and solving methodologies. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers

UNIT I:- GOVERNING EQUATIONS OF FLUID DYNAMICS: Introduction, models of the flow, substantial derivative of moving fluid element, divergence of the velocity, continuity equation, momentum equation, energy equation, physical boundary conditions Mathematical behavior of PDE,
The impact of CFD: Suitable forms of governing equations, hyperbolic, parabolic, elliptic equations, well posed problems

UNIT II :- CFD TECHNIQUE – Lax – Wendroff technique, MacCormackls techniques, relaxation technique, numerical dissipation and dispersion, Alternating direction-implicit technique, pressure correction technique, need for the staggered grid, pressure correction formula, boundary condition for pressure correction method, introduction to different plots of computer graphics.

UNIT III :- NUMERICAL SOLUTION: quasi one dimensional nozzle flow, subsonic, supersonic, isentropic flow and its CFD solution, shock capturing.
Fluid Mechanics problems in I.C. Engines: Flow through manifolds (single and multi cylinder engines), valves and ports, elements of air motion in engines viz. Swirl, squish, tumble and turbulence.

UNIT IV :- BASICS OF TURBULENT FLOW – turbulence modeling and characterization of turbulent mixing.
Outline of fluid dynamic models –applications of available commercial codes to engine processes with and without chemical reactions

REFERENCES

1. John D. Anderson, "Computational Fluid Dynamics: The Basics with application", McGraw Hill, New Delhi.

2. W. Kanzman, Fluids Mechanics

3. Streeter, “Fluid Mechanics”, Tata McGraw Hill, New Delhi

4. Computational Fluid Flow & Heat Transfer – K. Muralidhar, T. Sundarajan, Narosa Pub. House, New Delhi.

ETME 756	SEMINAR II	L	T	P	C
		-	-	-	1

Seminar should be based on the any topic relevant to Automobile Engineering but excluding second sem syllabus (Should be helpful for selecting a probable title of dissertation).

Each student has to prepare a write up of about 30 pages of “A4” size sheets and submit it in duplicate as the term work.The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally.

SEMESTER - III

ETME 801	Alternate Energy Sources for Automobiles	L	T	P	C
		4	-	-	4

Course Objective: To know the several of sources of alternate fuels for automotive Engines and study the performance of engine using different fuels.

UNIT I

Introduction

Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological up gradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, roadmap for alternative fuels.

UNIT II

Solar energy & Gaseous fuels: Solar energy geometry, Solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P.V.effect solar

cells and characteristics. Application of solar energy for automobiles. Introduction and principle of Fuel cell, Working Principle, types of Fuel Cells, Advantages of Fuel Cell.

Gaseous alternative fuels: Hydrogen, properties and production of hydrogen. Storage, Advantages and disadvantages of hydrogen. Hydrogen used in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Performance and Emission of from Hyderogen, LPG, CNG, Methanol and Ethanol and its blends as Fuel for SI and CI engine

UNIT III

Bio-Diesel: Straight vegetable oil, Biodiesel – Production of Bio-Diesel, Bio-Diesel as Fuel, Performance and emission of Bio-Diesel.

Biomass energy and Reformulated Conventional Fuel: Biogas or Biomethane. History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas.

UNIT IV

Reformulated conventional fuels: Introduction. Production of coal water slurry. Properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels, PMF, Ammonia, Liquid-Nitrogen.

Introduction to alternative power trains: Components of an EV,.EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of

EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology Applications of DFT. Dual fuel engine operation. Advantages and disadvantages of dual fuel technology.

TEXT BOOKS:

1. S.S.Thipse “Alternative Fuels”. JAICO Publishing House.
2. G.D.Rai “Non-Conventional Energy Sources” Khanna Publishing New Delhi.

REFERENCES BOOKS:

1. Alternative fuels for vehicle book by M.poulton
2. Alternative fuels guide book by R. Bechtold.SAE
3. Alternative energy sources by T.N Veziroglu, McgrawHill
4. A Primer on Hybrid Electric vehicles
5. Automotive Fuels Guide Book- Richard L.Bechtold, SAE Publications.

ETME 851	Dissertation Part-A	L	T	P	C
		-	-	-	8

Objective: To improve the professional competency and research aptitude by touching the specific areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry/field and current research.

The project work can be analysis and design projects of innovative nature or experimental investigation or numerical simulations or a combination of these. Appropriate software developments with sufficient literature contributions can also be taken up. Each student will be allotted with a faculty as guide. In specific cases student may consult with an external guide with the prior consents of internal guide and head of the department. In this semester, students are expected to finalize appropriate topic of research, complete the required literature survey and about 25% of the objectives of their intended research.

SEMESTER III -ELECTIVES

ETME 805	Automotive Maintenance & Management	L	T	P	C
		4	-	-	4

Course Objective: To understand the need of maintenance and factors affecting the system components. It also discusses process of maintenance of various components of the vehicle.

UNIT I

Maintenance records and schedule: Importance of maintenance with different types, maintenance records, factors considered for design & development of modern service garages / dealers shops, different garage layouts.

Engine Maintenance: Engine troubles, effects & remedies, different major & minor services for engine, inspection and checking of components visually and dimensionally, reconditioning methods of engine components, engine tune-up, special tools & advanced equipments

UNITII

Chassis Dive-line Maintenance: Maintenance, repair and servicing of clutches, Fluid flywheel, gear boxes, Automatic transmission, CVT unit, propeller shaft, differential unit, front axle and rear axle, suspension systems, servicing of brake systems- hydraulic, air systems, brake bleeding and brakes adjustments, maintenance and

servicing of steering system-Manual & Power Steering system, wheel balancing, wheel alignment, maintenance of tyres, tyre rotation, frame defects, chassis frame alignment.

UNIT III

Maintenance, servicing of auxiliaries: Cooling system service, anti corrosion additives, anti freezing solutions, dry & wet liners, Petrol fuel and diesel fuel system maintenance, MPFI maintenance, lubrication system services, Chassis lubrication, lubrication chart, maintenance and care of storage batteries, battery testing methods, maintenance of ignition systems, tyre service & reconditioning.

UNIT IV

Maintenance & repair of vehicle body: Passenger comfort parameters, body coach work, window rattling, noise & vibration, body repair tools & equipments, polishing and painting of new and old vehicle body.

TEXT BOOKS:

1. Vehicle Maintenance and Garage Practice by by Doshi J.A
2. Mechanics of Road Vehicles – W. Steed, Illefe Books Ltd. London

REFERENCE BOOKS:

1. Automotive Engineering: Powertrain, Chassis System and Vehicle Body, by David Crolla Professor, Publisher Butterworth-Heinemann

2. Advance Vehicle Technology - Hein Heister

ETME 807	AUTOMOTIVE AIR POLLUTION AND CONTROL	L	T	P	C
		4	-	-	4

Course Objective: The main objective of this course is to impart knowledge in automotive pollution control. The detailed concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students. The instruments for measurement of pollutants and emission standards will also be introduced to the students

UNIT I

Laws and Regulations: Historical background, regulatory test procedure (European cycles), Exhaust gas pollutants (European rail road limits), particulate pollutants, European statutory values, inspection of vehicle in circulation (influence of actual traffic conditions and influence of vehicle maintenance)

UNIT II

Source of emission from automobiles: Sources of Air Pollution, Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Automotive waste management, old vehicle disposal, Battery recycling, tyre recycling.

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

UNIT III

emission from autmotive engines s.i. engine emissions and its control:Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke — Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, CCS, Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

emission from c.i. engine and its control:
Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and
Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, Split injection, Add Blue, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR

UNIT IV

Influence of Fuel Properties on Emission and Effect of Air Pollution.
Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions, Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plants.

Test procedures and emission measurements:
Constant Volume Sampling I and 3 (CVS-1 &CVS3) Systems- Sampling Procedures — Chassis dyno - Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

TEXT BOOKS:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2. D.J.Patterson and N.A.Henin, ‘Emission from Combustion Engine and their control’, Anna Arbor Science Publication.

REFERENCE BOOKS:

1. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint.
2. Crouse and Anglin, ‘Automotive Emission Control’, McGraw Hill company., Newyork.
3. L.Lberanek, ‘Noise Reduction’, Mcgrawhill Company., Newyork.
4. C.Duerson, ‘Noise Abatment’, Butterworths ltd., London.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, ‘Road traffic noise’, Applied science publisher ltd., London,

ETME 809	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		4	-	-	4

Course Objective: This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.

UNIT I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT II

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT IV

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

TEXT BOOKS

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,

REFERENCES BOOKS

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley.

ETME 811	Vehicle Instrumentation & Testing	L	T	P	C
		4	-	-	4

Course Objective: Understand the importance of testing of vehicle components/systems as per standards. Apply the knowledge of error and uncertainty with regards to instruments and equipment used in engine/vehicle testing. Classify the dynamometers for testing the engines/vehicles. Identify the harmful pollutants and analyze the instruments used for measuring vehicle emissions. Identify the methods for quantifying aerodynamic drag of vehicles.

UNIT I

Introduction: Overview of the course-Need of vehicle testing (engine testing both for performance and emissions in specific)-Requirement of standard instrumentation and equipment, certification and national and international standards, Importance of expertise in testing, certification.

Measurement fundamentals: Definitions associated with measurements-Least count, resolution, Precision, Accuracy, Error / Uncertainty analysis- Data collection and handling Simple numerical problems.

UNIT II

Engine Testing: Definition and importance of engine in a vehicle- Road load equation-Testing under constant speed and variable speed condition. Classification of engine dynamo meters Characteristic curves of various types of dynamometers-Advantage and limitations of different types engine dynamometers-Discussion on typical engine performance characteristics.

Combustion analysis: Definition of Combustion, Combustion stoichiometry, SI engine combustion and CI engine combustion-Measurement of in-cylinder pressure, temperatures instrumentation

UNIT III

Fuel injection systems: Fuel injection for SI and CI engines, Types of different systems Electronic injection systems and Electronic Control Units-Testing of injection systems.

Vehicle Emissions: Types of emissions and pollutant formation mechanisms-Vehicle Driving Cycles, Emission measurement on engine and chassis dynamometer-Measurement of regulated and non-regulated pollutants-Description of emission measuring instrumentation-NDIR ,FID, Chemiluminescence Analyzer, Chromatograph, Smoke meters -Emission regulations and legislation- EURO and Bharat Stage norms

UNIT IV

Vehicle performance and testing techniques: Schematic layout of typical vehicle-Types of testing for both engine in specific, and whole vehicle body. Description of important components of Vehicle and Engine that require testing. Different types of engines for Vehicles- fossil fuel run engines, hybrid and electric vehicles -Testing procedure for electric vehicles- -Chassis and Rolling road dynamometers-Brief introduction to testing of tires, steering, brakes, wheel alignment-Introduction to on-board diagnostics.

Vehicle Drag & Aerodynamics of Vehicle: Introduction to drag and aerodynamics, Description drag-terms associated; streamlined and bluff bodies-Definition of Ahmed car-adverse effects of drag-Drag measuring techniques-drag reduction strategies.

Vehicle certification: Need for Vehicle certification and facilities required, Importance driving cycles-Indian Driving Cycle, MIDC-procedures, Introduction to other country driving cycle-Japan, EUDC.

TEXT BOOKS:

1. Heinz Heisler, Advance Vehicle Technology, Butterworth-Heinemann,
2. Tom Denton, Advanced Automotive Fault Diagnosis,Elsevier ButterworthHeinemann,

REFERENCE BOOKS:

1. Martyr and Plint, Engine testing-theory and Practice, Butterworth-Heinemann.
2. J.P. Holman, Experimental Methods for Engineers, Tata McGraw Hill Co.

ETME 813	Micro and Nano Manufacturing	L	T	P	C
		4	-	-	4

Course Objective: Subject is designed to understand the principles of various micro and nano manufacturing methods. This subject aims for the student to acquire knowledge of the fundamentals of micro and nanoproducts and of the manufacturing of such products and knowledge of micro and nano-materials processing methods and techniques.

UNIT I

Scope of Nano Technology: Nano technology Concepts and Applications, Micro- and Nanofabrication, Nano technology in India, Scope for Microfabrication, Rise Nano technology Fields, Commercialization Issues of Micro-Nano Technology

UNIT II

Micro-fabrication: Mechanical Micromachining, Physical Fabrication Methods, Lithography, Processing Setup, Nano Lithography & Manipulation, Precision Micro- and Nano grinding , Use of Spectrometers & Microscopes

UNIT III

Laser-Based Micro and Nanofabrication, Pulsed Water Drop Micromachining, Nano Materials, Synthesis of Nano materials, Bio Materials, Nano Composites, Development of Nano Particles

UNIT IV

Innovative Applications on Present Devices: Nano chips, Nanotubes and Nanowires, Integration of chips and microprocessors, Technology Support, Meeting Social Needs

Nano Design & CAD: Computer Aided Nano Design, VLSI product detailing Finite Element Analysis of Microstructures, 3-D Molecular Modelling

TEXT BOOKS:

1. Micro fabrication & Nano manufacturing by Mark J. Jackson
2. ASM handbook on machining.

REFERENCE BOOKS:

1. Springer's Hand book of Nano-technology - Bharat Bhusan (Ed.)
2. Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer.
3. Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, and John J. Moore, Introduction to Nano science and Nanotechnology, CRC Press, Boca Raton,

ETME 815	SPECIAL TYPES OF VEHICLES	L	T	P	C
		4	-	-	4

Course Objective: Subject is designed to know the modern time vehicles and their technologies.

UNIT I

Tractors and farm equipments: Classification and power required - Design consideration - Ride and stability characteristics power plants and transmission, Farm equipments.

UNIT II

Earth moving machines: Construction and operation aspects of Bull dozers, scrapers, Dumpers, Loaders, Mobile cranes, Road rollers, Elevators and Elevating graders.

UNIT III

Military and combat vehicles: Special requirements like power, fuel strength and impact resistance tanker, Gun carrier and transport vehicle.

UNIT IV

Classification and requirements of heavy vehicles: Power plants, chassis and transmission.

TEXT BOOKS:

1. Construction planning, Equipment and Methods – Robert L. Peurifoy, William B. Ledbrtter, Clifford J. Schexnayder - McGrawHill, Fifth

REFERENCE BOOKS:

1. Gurevich and E.Soreking, Tractors Mir Publishers, Moscow
2. V. Rodichev & G. Rodicheva, Tractors and automobiles, MIR Publishers, Moscow

SEMESTER – IV

ETME 852	Dissertation Part-B	L	T	P	C
		-	-	-	16

Objective: Master Research project phase II is a continuation of project phase I started in the third semester. Towards the end of the semester there would be a pre-submission presentation to the evaluation committee to assess the quality and quantum of the work done. This would be a prequalifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conference. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external.

SEMESTER IV-ELECTIVES

ETCE 804	ADVANCED AUTOMOTIVE	L	T	P	C

	TRANSMISSION	4	0	-	4

Course Objective: The main objective of this course is to impart knowledge in automotive transmission. The detailed concept, construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devisees and automatic transmission system will be taught to the students. The design of clutch and gearbox will also be introduce to the students. At the end of the course the students will have command over automotive transmission concepts and application.

UNIT I

Clutch: Requirements of Transmission system. Clutches – Functions, Principle of operation and types – single plate, multi plate, diaphragm and overrunning clutches.

Gear box: Purpose of gear box. Construction and working principle of sliding, constant and synchromesh gear boxes. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications.

UNIT II

Hydrodynamic transmission: Fluid coupling – principles - Performance characteristics – advantages – limitations – drag torque – reduction of drag torque. Torque converter - principles - Performance characteristics – advantages – limitations – multi and poly stage torque converters.

UNIT III

Automatic transmission: Introduction to epicycle gear trains - Ford – T model gear box, Wilson gear box- Cotal electric transmission. Chevrolet "Turboglide" transmission. – Hydraulic control systems of automatic transmission. Continuously Variable Transmission (CVT)- types and operations.

UNIT IV

Hydrostatic drive and electric drive: Hydrostatic drive – various types of hydrostatic transmission – principle - Advantages and limitations. Comparison of hydrostatic transmission with hydrodynamic transmission. Construction and working principle of Janny hydrostatic drive. Electric drive- Principle of Early and modified Ward Leonard control system – advantages and limitations.

TEXT BOOKS:

1. Heldt P.M, Torque Converters, Chilton Book Co.
2. T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited**,** London.

REFERENCE BOOKS:

1. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York.
2. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi.

3. James Larminie “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

ETME 806	TWO AND THREE-WHEELER TECHNOLOGY	L	T	P	C
		4	0	-	4

Course Objective: The course is designed to understand different types of two and three wheelers types, construction and working. Students will also be able to learn about different functions of two and three wheelers.

UNIT I

Introduction: Development and history of two & three wheeler vehicles. Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three wheeler vehicles (by applications – passengers & goods carriage, capacity etc.). Study of technical specification of Two & Three wheeler vehicles.

Power Plant : Selection criteria and Design considerations for two wheeler & three wheeler power plants (Engine). Systems requirements for Engine lubrication, cooling & starting (Kick starter mechanism, Moped cranking mechanism & Button Start mechanism). Recent developments in engine (2 stroke/4 stroke engines, Fuel used – Gasoline, CNG, Diesel AND high powered engine), Electric Vehicles. Valve timing and port timing diagram, scavenging, types of scavenging and relative merits and demerits with one another. Study of different Exhaust system layouts, it’s routing and elevation. Starting Mechanism / Procedure of three wheelers – Hand Lever & Rope drive types in particular, its construction and design criteria.

UNIT II

Chassis & Sub Systems: Main frame and its types, Diamond frame, Cradle frame, Back bone frame, Under bone frame. Study of Parking stand types and its design criteria. Chain and shaft drive, Clutch, purpose, types, single plate, multiple plates, centrifugal clutches working principle, merits and demerits, CVT-Continuously Variable Transmission, gear box, purpose, Sliding mesh gear box, constant mesh gear box – construction and working principle - gear controls & shifting mechanism.

Suspension & Steering Handle bar: Front suspension system – shock absorber construction and working principle. Rear suspension system – Mono type suspension. Steering Handle bar on two wheeler / three wheeler vehicles. Instrumentation & Controls: Two wheeler / three wheeler panel meters & controls. All types Switches, Indicators, warnings indicators / buzzers & actuating levers on steering handle bar. Starting / Ignition and steering lock key switch on Steering Handle Shaft.

UNIT III

Brakes and Wheels: Brake types – Drum brakes, Disc brakes – construction and working principle / purpose. Hand Brake and Paddle brake and its actuating mechanism. Design criteria actuating mechanism components

selection considerations. Brake circuit Layout for two wheeler and three wheeler vehicles. Wheels - Front and Rear – Wheel rim types – construction of spokes wheel - construction of cast wheel – construction of Alloy wheels. Tyre – functions – materials – types – construction of tube type tyre and tubeless tyres, it's advantages & comparison – methods vulcanizing of Tubes & Tyres for Tubeless tyres.

Road Performance: Handling characteristics, road holding & vehicle stability, riding characteristics. Driver & pillion seating arrangement, seat height adjustment, ergonomics, seating posture & comfort. Various Safety measures & arrangements. Special requirements for Racing bikes. Maximum speed, Turning Circle diameter, Brake performance.

UNIT IV

Two & three wheeler Maintenance: Importance of maintenance – general maintenance, scheduled maintenance, Servicing of two wheeler vehicles, periodic checkups. Comparative study of specifications & maintenance of different types of two Wheelers – Motor Cycles – Scooter - Moped – race vehicles. Trouble shooting causes and remedies. Comparative study of specifications & maintenance of different types of Three wheeler vehicles – auto rickshaw – pick up van – delivery van – trailer. Schedule of service by the different manufacturer. General maintenance servicing manuals – periodic checkups for three wheeler vehicle.

Electrical Systems & Instruments: Battery specifications, Charging system, Lighting (front & rear), Ignition key switch, Horn, Side Signaling, Instruments & Indicators.

Helmets: Types & purpose. Safety standards related to helmets.

TEXT BOOKS:

1. Newton Steed, "The Motor Vehicle", McGraw Hill Book Co. Ltd., New Delhi.

2. Siegfried Herrmann, "The Motor Vehicle", Asia Publishing House, Bombay.

REFERENCE BOOKS:

1. G.B.S. Narang, "Automobile Engineering", 5th Edition, Khanna Publishers, Delhi.

2. Service Manuals of Manufacturers of Indian Two & Three wheelers.

ETCE 808	ROBUST DESIGN	L	T	P	C
		4	0	-	4

Course Objective: Understand stages in engineering design and concept of robust design,

Develop quality loss functions and S/N ratios for S, N and L type objective functions and Identify control and noise factors for a given product or process.

UNIT I

Introduction: Taguchi's quality philosophy, causes of performance variation, concept of robust design, stages in product/process design, need for experimentation, QFD, process flow analysis, cause and effect diagram.

UNIT II

Design of Experiments: Principles of experimentation, Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA, Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data;

UNIT III

Parameter Design: Loss function, average quality loss, S/N ratios, objective functions, selection of control & noise factors and their levels, strategy for systematic sampling of noise, classification of control factors, inner-array and outer-array design, data analysis, selection of optimum levels/values for parameters.

UNIT IV

Tolerance Design: Experiments, selection of tolerances to be tightened, fixing the final tolerances.

TEXT BOOKS:

1. Taguchi G, Chowdhury S and Taguchi S, *Robust Engineering*, TMH.

REFERENCES BOOKS:

1. Ross PJ, *Taguchi Techniques for Quality Engineering*,TMH.

ETME 810	VEHICLE DYNAMICS	L	T	P	C
		4	0	-	4

Course Objective: To understand basics and Vehicle Dynamics and its influence on the vehicle handling characteristics.

UNIT I

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

Tyres: Tyre forces and moments, Tyre structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tyre. Performance of tyre on wet surface. Ride property of tyres. Magic formulae tyre model, Estimation of tyre road friction. Test on Various road surfaces. Tyre vibration..

UNIT II

Braking Performance: Basic equations, Braking forces, Brakes, Brake Proportioning, Antilock Brake system, Braking efficiency, Rear wheel lockup, Standards and Legislations, Numerical Examples.

Vertical Dynamics: Human response to vibration, Sources of Vibration. Design, analysis and computer simulation of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

UNIT III

Vehicle Aerodynamics: Aerodynamic, Aerodynamic forces lift and drag components, Pitching, yawing, rolling moments, and Total road loads, Numerical Examples.

Steady State Handling Characteristics of Road Vehicles:

Steering Geometry, Derivation of fundamental equation governing the steady-state handling behavior of a road vehicle, Neutral Steer, Understeer and Oversteer characteristics, characteristic and critical speeds, Neutral Steer Point, Static margin, Steady-State Response to Steering Input-Yaw Velocity Response, Lateral Acceleration Response, Sideslip Response and Curvature Response; Numerical Problems.

UNIT IV

Performance Characteristics of Off-Road Vehicles: Drawbar Performance - Drawbar Pull and Drawbar Power, Tractive Efficiency, Coefficient of Traction, Weight-to-Power Ratio for Off-Road Vehicles; Fuel Economy of Cross- country Operations Transport Productivity and Transport Efficiency, Mobility Map and Mobility Profile, Selection of Vehicle Configurations for Off-Road,Numerical Problems.

Suspension Mechanisms: Solid Axle Suspension, Independent Suspension, Roll Center and Roll Axis, Car Tire Relative Angles,Toe, Caster Angle, Camber, Trust Angle, Suspension Requirements and Coordinate Frames, Kinematics Requirements, Dynamic Requirements, Wheel, wheel body, and tyre Coordinate Frames, Caster Theory, Numerical examples.

TEXT BOOKS:

1. **"Vehicle Dynamics: Theory and Applications**"-Reza N. Jazar, Springer Verlag.
2. **"Theory of Ground Vehicles"-**J. Y. Wong, John Willey&Sons,NY.
3. **"Fundamentals of Vehicle Dynamics"-** T D Gillespie, SAE

4. John C. Dixon, **Tyres, Suspension, and Handling**, 2nd Edition, Society of Automotive Engineers Inc.

REFERENCE BOOKS:

1. **"Tyre and Vehicle Dynamics"-** Hans B.Pacejka, SAE

2. **"Motor Vehicle Dynamics: Modeling and Simulation"**-Giancarlo Genta, World Scientific Publishing Co.; Singapore.
3. **Aerodynamics of Road Vehicles,** Hucho W. H. SAE.
4. Thomas D. Gillespie, **Fundamentals of Vehicle Dynamics**, Society of Automotive Engineers Inc.
5. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer

ETME 812	AUTOMOTIVE SECURITY	L	T	P	C
		4	0	-	4

Course Objective: To understand basics and Vehicle Dynamics and its influence on the vehicle handling characteristics.

UNIT I

Introduction: Embedded IT Security in Automotive Application – An Emerging Area.

UNIT II

Security in the Automotive Domain: Aspects of Secure Vehicle Software Flashing, Secure Software Delivery and Installation in Embedded Systems, Anti-theft Protection: Electronic Immobilizers, A Review of the Digital Tachograph System, Secure In-Vehicle Communication

UNIT III

Embedded Security Technologies: Fundamentals of Symmetric Cryptography, Fundamentals of Asymmetric Cryptography, Security Aspects of Mobile Communication Systems, Embedded Cryptography: Side Channel Attacks, Embedded Security: Physical Protection against Tampering Attacks.

UNIT IV

Business Aspects of IT Systems in Cars: Automotive Digital Rights Management Systems, Security Risks and Business Opportunities in In-Car Entertainment, In-Vehicle M-Commerce: Business Models for Navigation Systems and Location-based Services

TEXT BOOKS:

1. **"Embedded Security in Cars**"- Kerstin Lemke · Christof Paar · Marko Wolf (Eds.)

REFERENCE BOOKS:

1. "**Automotive Electronics Handbook**"**,** Ronald K. Jurgen, McGraw Hill Publishing Co.
2. "**Automotive Electricity and Electronics**", Al Santini, Delmar Publishers.

ETCE 814	MANUFACTURING AND TESTING OF VEHICLE COMPONENT	L	T	P	C
		4	0	-	4

Course Objective: To impart knowledge on basic principle and production methods of automotive components and testing.

UNIT I

Casted engine components: Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

UNIT II

Forged engine components: Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

UNIT III

Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum. Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching. Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres. Heat treatment procedures.

UNIT IV

Testing of different components of vehicle: clutch, gear box, propeller shaft, differential, axels, wheels. Testing of vehicle systems: Test procedure of brake system, suspension system, steering system.

TEXT BOOKS:

1. Heldt.P.M, "**High speed combustion engines**", Oxford publishing Co., New York.

REFERENCE BOOKS:

1. Kirpal Singh, "**Automobile** Engineering", Vol. I & II, Standard Publishers, New Delhi.
2. Newton and steels, the motor vehicle, ELBS.

3. Automotive Mechanics – S.Shrinivasan - Tata McGraw Hill Second edition.