NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF AUTOMOBILE ENGINEERING

M.E. AUTOMOBILE ENGINEERING

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation : 2021

Curriculum and Syllabi

M.E Programme

DEPARTMENT OF AUTOMOBILE ENGINEERING

M.E. AUTOMOBILE ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Mechanical Engineering
Department of Automobile Engineering

Vision of the Department

Our vision is to serve the society for providing education skills suitable to the development approaching generation. We strive a deep sense of promise to bring the opportunity for student, providing quality education and teaching methodology for the development of overall individuality to meet all requirements for the challenging global expectation.

Mission of the Department

M1: To provide quality education and to prepare nationally and internationally competitive students for a successful career in safety, occupational health, environmental management and fire protection using global standards.
M2: To impart high-quality professional training and to prepare graduates to achieve sound knowledge in safety.
M3: To nurture leading-edge research in the fast-changing field of safety engineering and make students to be successful professionals, committed to lifelong learning.
M4: Encourage students to upgrade the latest technology in the field of fire and safety and to improve the safety standards to large extent and make positive contributions towards society by creating a safe atmosphere.

Description of the programme

With Industry tuned Outcome Based Curriculum, Well qualified and Experienced Faculty Members and Excellent Infrastructure towards Academic and Field Training Automobile Engineering Program specialize engineers in, alternative fuels, chassis, electronics, emissions, ergonomics, manufacturing, materials, motorsport, power train, rapid prototyping, vehicle and pedestrian safety etc to meet all requirements for the challenging global expectation.

Programme Educational OBJECTIVESs - PEO	
PEO-01	To provide a robust foundation in basic science and general engineering principles, equipping students with the essential scientific and engineering knowledge needed to effectively formulate, analyze, evaluate, and solve complex engineering problems
PEO-02	To demonstrate professional and innovative skills in the design, implementation, and evaluation of safety systems and components that effectively address the needs of society and diverse industries.
PEO-03	To provide comprehensive guidelines for effective communication, professionalism, and ethical behavior, while delivering high-quality training in teamwork to tackle technical challenges, ultimately enhancing practices in safety engineering and management.
PEO-04	To foster continuous learning through advanced studies, professional development opportunities, self-directed learning, and value-added courses, facilitating adaptation to evolving safety technologies in both local and global contexts.
PEO-05	To impart knowledge of contemporary engineering tools that effectively address real-time challenges in the automotive sector

Programme Outcome - PO	
PO-1	Apply knowledge of mathematics, science, and engineering fundamentals and specialized engineering knowledge to solve the problems related to safety engineering.
PO-2	Identify, formulate and analyze the complex safety problems using the principles of mathematics, natural sciences, and engineering concepts.
PO-3	Design and conduct experiments, analyze and interpret data through appropriate methods in order to provide a valid conclusion.
P0-4	Design solutions for complex safety problems and design system components or processes to meet the desired needs in public health, safety and environmental consideration.
PO-5	Gain and use knowledge on contemporary issues and apply appropriate techniques, skills and engineering tools necessary for implementation in real-time safety issues.
PO-6	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings
PO-7	Communicate effectively to the engineering community and with the society through effective reports, documents, presentations, symbols, guidelines, and drawings
PO-8	Assess the societal needs in the field of occupational health and safety and to bring effective solutions through professional engineering practice.
	Understand the impact of professional engineering solutions in the context of

PO-9	social, cultural and environmental responsibilities and the need for sustained development
PO-10	To provide excellent guidelines to exhibit ethical behaviour and to enrol as a professional in a competitive engineering society
PO-11	Demonstrate the knowledge and understanding of the safety engineering and management principles and apply these to manage and execute projects, safety audits in the multidisciplinary environment.
PO-12	Recognize the need for, and have the preparation ability to effectively engage in the fast-changing field of safety engineering and make students to be successful safety professionals, committed to lifelong learning.

Mapping of Graduate Attributes and Programme Outcome

GAs / PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PO-1	**H**	**A**	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not
PO-2	**A**	**H**	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not
PO-3	Not	Not	**H**	**A**	Not	Not	Not	Not	Not	Not	Not	Not
P0-4	Not	Not	**A**	**H**	Not	Not	Not	Not	**A**	Not	Not	Not
PO-5	**A**	Not	Not	Not	**H**	Not	Not	Not	Not	Not	Not	Not
PO-6	Not	Not	Not	Not	Not	**H**	Not	Not	Not	Not	Not	Not
PO-7	Not	Not	Not	Not	Not	Not	**H**	Not	Not	Not	Not	Not
PO-8	Not	Not	Not	Not	Not	Not	Not	**H**	Not	Not	Not	Not
PO-9	Not	Not	Not	Not	Not	Not	Not	Not	**H**	Not	Not	Not
PO-10	Not	Not	Not	Not	Not	Not	Not	**A**	Not	**H**	Not	Not
PO-11	Not	Not	Not	Not	Not	**A**	Not	Not	Not	Not	**H**	Not
PO-12	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not	**H**

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational OBJECTIVES (PEOs) and Programme Outcomes (POs)

PEO PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05
PO-1	H	A	Not	Not	Not
PO-2	H	H	Not	Not	Not
PO-3	Not	H	Not	Not	Not
P0-4	Not	H	Not	Not	A
PO-5	Not	A	Not	Not	H
PO-6	Not	Not	Not	H	Not
PO-7	Not	Not	H	Not	Not
PO-8	Not	A	H	Not	Not
PO-9	Not	H	Not	A	Not
PO-10	Not	Not	H	Not	Not
PO-11	Not	A	H	Not	Not
PO-12	Not	Not	Not	H	A

H- Highly Associated A- Associated Not – Not Associated

Duration of the programme : Two Years /Four Semesters

Total credits : 77

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3503	Applied Mathematics	3	1	0	4
2.	AM3501	Automotive Engines and Subsystems	3	0	0	3
3.	AM3502	Automotive Chassis	3	0	0	3
4.	AM3503	Vehicle Body Engineering	3	0	0	3
5.	EEXX1	Elective I	3	0	0	3
6.	EEXX1	Elective II	3	0	0	3
PRACTICAL						
7.	AM3571	Automotive Engine and Vehicle Components Laboratory	0	0	4	2
TOTAL			18	1	4	21

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	AM3504	Engine Management System	3	0	0	3
2.	AM3505	Electric and Hybrid Vehicles	3	0	0	3
3.	AM3506	Engine and vehicle components design	3	0	0	3
4.	AM3507	Automotive Safety	3	0	0	3
5.	EEXX3	Elective III	3	0	0	3
6.	EEXX4	Elective IV	3	0	0	3
PRACTICAL						
7.	AM3572	Modeling and Simulation of Auto Components Laboratory	0	0	4	2
TOTAL			18	1	4	21

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	AM3508	Chassis Management System	3	0	0	3
2.	EXX5	Elective 5	3	0	0	3
3.	EXX6	Elective 6	3	0	0	3
PRACTICAL						
4.	AM35P1	Industry Internship Training	0	0	4	2
5.	AM35P2	Project work – Phase I	0	0	18	6
TOTAL			9	0	22	17

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
PRACTICAL						
1.	AM35P5	Project Work – Phase II	0	0	36	18

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3503	Applied Mathematics	3	1	0	4
2.	AM3501	Automotive Engines and Sub Systems	3	0	0	3
3.	AM3502	Automotive Chassis	3	0	0	3
4.	AM3503	Vehicle Body Engineering	3	0	0	3
5.	EEXX1	Elective I	3	0	0	3
6.	EEXX1	Elective II	3	0	0	3
PRACTICAL						
7.	AM3571	Automotive Engine and Vehicle Components Laboratory	0	0	4	2
TOTAL			18	1	4	21

MA3503	APPLIED MATHEMATICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

To impart the basic knowledge about Matrices, Transforms, Conformal Mappings and Numerical problems so that those concepts could be adopted in their concerned branch.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Generalized Eigen vectors&– Least square approximations	U,R
CO-02	Students will gain adequate knowledge about Functional dependent on first and higher order derivatives	U
CO-03	Students will gain knowledge about. Discrete Event Simulation	R,U
CO-04	Students will gain knowledge about Transformation of boundaries in parametric form	U
CO-05	Students will gain knowledge about various first and second order ordinary and partial differential equations	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: ADVANCED MATRIX THEORY **9**

Generalized Eigen vectors – Jordan canonical form — Matrix norms – Singular value decomposition – Pseudo inverse – Least square approximations – QR decomposition.

Unit II: CALCULUS OF VARIATIONS **9**

Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables —Isoperimetric Problems.

Unit III: SIMULATION **9**

Discrete Event Simulation – Stochastic Simulation - Monte Carlo Simulation – Generation of Random Numbers using Congruent method – Applications to Queuing systems.

Unit IV: CONFORMAL MAPPING **9**

Schwarz – Christoffel Transformation – Transformation of boundaries in parametric form – Physical applications – Application to fluid flow and heat flow.

UnitV: FIRST AND SECOND ORDER ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9**

Solution of first order differential equations -Single step Methods: Taylor's Series, Fourth order Runge-Kutta method. Finite difference solution of one dimensional heat equation: Bender Schmidt Method– One dimensional wave equation and two dimensional Poisson equations.

L: 45 + T: 15, TOTAL: 60 Hours

REFERENCES:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw–Hill, New York , 1989.
2. Spiegel, M.R.," Theory and Problems of complex variables with an introduction to conformal mapping and its applications. Schaum's outline series" McGraw-Hill Book Co,1964.
3. Gupta, A.S., "Calculus of Variations with Applications", Prentice-Hall of India, New Delhi, 1997.

4. Dr.Venkataraman, M.K., " Higher Mathematics for Engineering and Science", National Publishing Company, 1992.
5. Jain M.K., Iyengar. S.R.K and Jain. R.K, "Numerical method for scientific and Engineering Computations", New Age International(P) Ltd., Publishers, 2003.
6. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition, Khanna Publishers, Delhi 2007.
7. Taha, H.A. "Operations Research: An Introduction", Ninth Edition, Pearson Education
Edition, Asia, New Delhi, 2002.
8. J.K Sharma "Operations Research" Macmillan, 2003

AM3501	AUTOMOTIVE ENGINES AND SUBSYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main objectives of this course are to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about basics of engine theory.	U,R
CO-02	Students will gain adequate knowledge about fuel supply and ignition systems.	U
CO-03	Students will gain knowledge about cooling and lubrication system.	R,U
CO-04	Students will gain knowledge about air motion, combustion and different types of combustion chambers.	U
CO-05	Students will gain knowledge about various new engine technologies.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: ENGINE BASIC THEORY **9**

Engine types – Otto, diesel, dual operating cycles - Engine design and operating parameters – Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine -performance and pollution aspects.

Unit II: FUEL SUPPLY AND IGNITION SYSTEMS **9**

Theory of carburetion and carburetors — Design aspects — Diesel fuel injection - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems, advance mechanisms.

Unit III: COOLING AND LUBRICATING SYSTEMS **9**

Air cooling and water cooling – thermo syphon cooling, forced cooling systems. Fins and radiator -design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petro oil lubrication system, forced feed lubrication system.

Unit IV: AIR MOTION, COMBUSTION AND COMBUSTION CHAMBER **9**

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion — combustion in SI and CI engines. Cylinder pressure data and heat release analysis. Optimized design of combustion chambers. Supercharger and Turbochargers.

Unit V: NEW ENGINE TECHNOLOGY **9**

Lean Burn engine – Different approaches to lean burn – LHR engine – Surface ignition concept –catalytic ignition – homogenous charge compression ignition – variable valve timing – Multi Port Injection System - Gasoline Direct Injection – Common Rail Direct Injection – Recent Trends.

TOTAL: 45 Hours

TEXTBOOK

1. J.B.Heywood, ‘Internal combustion engine Fundamentals’, McGraw Hill Book Co, 1989.
2. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.

REFERENCES:

1. Edward F.Obert, ‘Internal combustion engines and air pollution’ Harber and Row Publishers, 1973.
2. M.Khovakh, ’Motor Vehicle Engines’, Mir Publishers, Mascow,1976
3. W.H.Crouse and A.L.Anglin, ‘Automotive Emission control’, McGraw Hill Book Co, 1995.
4. G.S.Springer and A.J.Patterson, ’Engine emissions and pollutant formation’, plenum press,Newyork, 1985.
5. M. L. Mathur, R. P. Sharma, "Internal combustion engines", Dhanpat Rai Publication, 2005
6. William Crouse, Donald Anglin, "AUTOMOTIVE MECHANICS", Tata McGraw Hill Book Co, 2006

AM3502	AUTOMOTIVE CHASSIS	L	T	P	C

		3	**0**	**0**	**3**

OBJECTIVES:

All automobiles have important driveline and structural components. This subject deals with the functions and constructional details of all the chassis components.

Course Outcome - COs		**Cognitive Skill**
CO-01	Students will gain knowledge about the location of power plants in vehicles and its body and frame construction	U, R
CO-02	Understand the basics of wheel geometry, steering systems and front axle and analysis the steering problems	U, An
CO-03	Understand the basics of various drive line in automobiles and rear axle and the modification in same to achieve better performance	U, A
CO-04	Students will gain knowledge about the suspension system and to design a shock absorbers to reduce shocks	E
CO-05	Students will gain knowledge about different types of brakes used in the automobiles	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	L	N	N	M	L	N	N	N	N	L
CO-02	L	S	L	L	L	L	S	N	N	M
CO-03	M	M	M	N	L	N	L	N	M	L
CO-04	S	L	L	L	L	L	L	N	N	L
CO-05	S	M	M	N	N	M	N	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Types of chassis layout with reference to power plant locations and drives, vehicle frames, various types of frames, constructional details, materials, testing of vehicle frames, Unitized frame body construction.

Unit II: FRONT AXLE AND STEERING SYSTEM **9**

Types of front axles, construction details, materials, 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, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering, steering of crawler tractors.

Unit III: DRIVE LINE **9**

Effect of driving thrust and torque reactions, Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential Unit, non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, fully floating, three quarter floating and semi floating rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles.

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, rubber suspension, pneumatic suspension, shock absorbers.

Unit V: BRAKING SYSTEM **9**

Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, material, hydraulic system, vacuum assisted system, air brake system, antilock braking, retarded engine brakes, eddy retarders.

TOTAL: 45 Hours

TEXT BOOKS

1. Heldt.P.M.- “Automotive Chassis”- Chilton Co., New York- 1990
2. K.K.Ramalingam - “Automobile Engineering” – Scitech Publication, Chennai - 2001.

REFERENCES

1. Steed W - “Mechanics of Road Vehicles”- Illiffe Books Ltd., London- 1960
2. Newton Steeds and Garrot- “Motor Vehicles”- Butterworths, London- 2000.
3. Judge A.W- “Mechanism of the Car”- Chapman and Halls Ltd., London- 1986
4. Giles.J.G- “Steering, Suspension and tyres”- Iiiffe Book Co., London- 1988.
5. Crouse W.H- “Automotive Chassis and Body”- McGraw-Hill, New York- 1971.

AM3503	AUTOMOTIVE CHASSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

This subject deals with the Aerodynamics and safety aspects of vehicles as well as Design of body, forces in roll over, head on impact, plastic collapse and analysis.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Types of cars and busses as well as special vehicles.	U,R
CO-02	Students will gain adequate knowledge about seating dimensions, interior ergonomics as well as ergonomics system design,	U
CO-03	Students will gain knowledge about Vehicle drag and types, effects of forces and various body optimization techniques for minimum drag,	R,U
CO-04	Students will gain knowledge about safety and fatigue aspects.	U
CO-05	Students will gain knowledge about various Structural design for production.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	L	N	N	M	L	N	N	N	N	L
CO-02	L	S	L	L	L	L	S	N	N	M
CO-03	M	M	M	N	L	N	L	N	M	L
CO-04	S	L	L	L	L	L	L	N	N	L
CO-05	S	M	M	N	N	M	N	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: SPECIAL VEHICLES **9**

Types of cars and busses – special utility vehicles - vehicle body technology, trends, special goods vehicle, special haulage vehicles cab body., Buses and coaches PSV (passenger specialty vehicle) structural design, low floor and arctic buses, Three wheelers, developing country vehicles, light weight trailers.

Unit II: ERGONOMICS **9**

Introduction, seating dimensions, interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments,

electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout.

Unit III: AERODYNAMICS **9**

Vehicle drag and types, effects of forces (lift, drag) and moments (pitch, roll and yaw) , side wind effects on forces and moments, various body optimization techniques for minimum drag,

Unit IV: VEHICLE BODY ANALYSIS **9**

Introduction, criteria for vehicle body design, design based on deflection criteria, sheet metal representation, curved panels, equation for flexure, torsion, twist and differential bending, beam idealization and flexural axis, instability of thin walled structures.

Unit V: SAFETY AND FATIGUE ASPECTS **9**

Design of body, forces in roll over, head on impact, plastic collapse and analysis, fatigue and vibration, test on box sections, structural vibration. Idealization for analysis, Unit load method and structural deflection, observed deflections of a car, torsional stiffness car body idealization, symmetric bending and torsion loading, closed integral car structure, bus body idealization for analysis, bus body in torsion.

Structural design for production: Gravimetric analysis, design for press working, design for spot welding, adhesives and sealants, goods vehicle structure design, chassis frame configuration, structural properties of chassis frame members.

Total 45 Hours

TEXT BOOKS:

1. Jnusz Pawlowski, "Vehicle Body Engineering", Business books limited, 1989.
2. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.

REFERENCES:

1. John Fenton, "Hand book of automotive power train and chassis design", SAE, 1998.
2. Ian Andrew Norman, "Heavy Duty Vehicle systems", third edition, Delmar-Thomson Learning ltd.
3. Patent No. 20070292625, automotive part print design process.
4. Patent No. 20080010875, Display apparatus to be mounted on an automotive vehicle.
5. Patent No. 20080018151, Seat configuration system for an automotive interior.
6. Patent No. 20070267876, On demand morph able automotive body moldings and surfaces.

AM3571	AUTOMOTIVE ENGINE AND VEHICLE COMPONENTS LABORATORY	L	T	P	C
		0	1	2	2

1. Dismantling of 4 cylinder petrol engine.
2. Assembling of 4 cylinder petrol engine.
3. Dismantling and Assembling of 4 cylinder Engine Head
4. Dismantling, inspection and assembling of any one type steering gear box
5. Dismantling, inspection and assembling of mechanical braking system
6. Dismantling and assembling of Suspension system.
7. Dismantling, inspection and assembling of Clutch assembly.
8. Dismantling, inspection and assembling of Gear box.
9. Dismantling, inspection and assembling of Front Axle.

10. Dismantling, inspection and assembling of Rear Axle.
11. Dismantling, inspection and assembling Differential Unit.
12. Study of vehicle cooling and lubrication system.

TOTAL: 45 Hours

LIST OF EQUIPMENTS

(For a batch of 18 students)

1. Four cylinder petrol engine	-1No.
2. Cylinder Head 4 cylinder Engine	-2 No.
3. Front axle	-1 No.
4. Rear axle	-1No.
5. Steering gear box (Rack and pinion)	-1No.
6. Mechanical brake system	-1No.
7. Leaf spring, coil spring, torsion bar	-1No.each
8. Clutch assembly	- 1No
9. Gear box (light duty, heavy duty)	-1No.each
10. Differential Unit	-1No.
11. Water pump, thermostat, radiator, temperature gauge	-1No.each
12. Lob. oil pump, Pressure relief valve, filter, oil pressure gauge	-1No.each

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C

THEORY						
1.	AM3504	Engine Management System	3	0	0	3
2.	AM3505	Electric and Hybrid Vehicles	3	0	0	3
3.	AM3506	Engine and vehicle components design	3	0	0	3
4.	AM3507	Automotive Safety	3	0	0	3
5.	EEXX3	Elective III	3	0	0	3
6.	EEXX4	Elective IV	3	0	0	3
PRACTICAL						
7.	AM3572	Modeling and Simulation of Auto Components Laboratory	0	0	4	2
TOTAL			18	1	4	21

AM3504	**ENGINE MANAGEMENT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:
To explain the principle of engines electronic management system and different sensors used in the systems.

Course Outcome - COs		**Cognitive Skill**
CO-01	Students will gain knowledge about Components for electronic engine management system.	U,R
CO-02	Students will gain adequate knowledge about sensors and actuators.	U
CO-03	Students will gain knowledge about Layout and working of SI engine management systems	R,U
CO-04	Students will gain knowledge about Fuel injection system parameters affecting combustion and various type of injection system.	U
CO-05	Students will gain knowledge about various digital engine control system.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L

CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.

Unit II: SENSORS AND ACTUATORS 9

Inductive, Hall Effect, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine speed sensor, exhaust oxygen level (two step, linear lambda and wideband), knock, manifold temperature and pressure sensors. Solenoid, relay(four and five pin), stepper motor.

Unit III: SI ENGINE MANAGEMENT 9

Layout and working of SI engine management systems. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless (BREAKERLESS) electronic ignition system, Electronic spark timing control.

Unit IV: CI ENGINEMANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronically controlled Unit Injection system. Common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

Unit V: DIGITAL ENGINE CONTROL SYSTEM 9

Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop and closed loop control – Integrated engine control system, Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments –Onboard diagnosis system.

TOTAL: 45 Hours

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE 2003

REFERENCES:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004.
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004.

AM3505	ELECTRIC AND HYBRID VEHICLES	L	T	P	C

		3	**0**	**0**	**3**

OBJECTIVES:
To explain about Layout as well as performance of electric vehicles, electric propulsion systems and electric propulsion systems.

Course Outcome - COs		**Cognitive Skill**
CO-01	Students will gain knowledge about Layout as well as performance of electric vehicles.	U,R
CO-02	Students will gain adequate knowledge about concepts of hybrid electric drive train	U
CO-03	Students will gain knowledge about electric propulsion systems.	R,U
CO-04	Students will gain knowledge about various types of batteries motor controllers and control systems.	U
CO-05	Students will gain knowledge about various types of batteries and solar powered car.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: ELECTRIC VEHICLES **9**

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system, components, electronic control system.

Unit II: HYBRID VEHICLES **9**

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design efficiency and cost comparison.

Unit III: ELECTRIC PROPULSION SYSTEMS **9**

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking, efficiency and cost comparison.

Unit IV: MOTOR CONTROLLERS AND CONTROL SYSTEMS **9**

Control system principles, speed and torque control – DC motors and AC motors, DC generators, AC generators, voltage and frequency regulations, efficiency and cost comparison.

Unit V: ENERGY STORAGES **9**

Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra-capacitors. Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars- photovoltaic cells, tracking, efficiency and cost comparison.

TOTAL: 45 Hours

REFERENCES:

1. MehrdadEhsani, YiminGao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles:Fundamentals, Theory and Design", CRS Press, 2004.
2. James Larminie and John Loury, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2003.
3. SandeepDhameja, "Electric Vehicle Battery Systems", Butterworth –Heinemann, 2002.
4. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.
5. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth-Heinemann, 2001.

AM3506	ENGINE AND VEHICLE COMPONENTS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

Students will gain adequate knowledge about spur, helical, straight, spiral bevel gears and herringbone gears.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about design of engine components.	U,R
CO-02	Students will gain adequate knowledge about spur, helical, straight, spiral bevel gears and herringbone gears.	U
CO-03	Students will gain knowledge about Different layouts with reference to power plant, location and drive.	R,U
CO-04	Students will gain knowledge about Steering gear boxes, steering angle and steering ratio.	U
CO-05	Students will gain knowledge about various Tyre requirements as well as selection of tyres.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: DESIGN OF ENGINE COMPONENTS 9

Calculation of gas forces, variation of gas forces, Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, materials , piston failures, lubrication of piston assembly, 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, , material for crankshaft, design of crankshaft, balancing weight calculations.

Unit II: DESIGN OF VALVES, FLYWHEEL, CLUTCHES AND GEARS 9

Design of valves, valve springs, tappet. Cam design, cam profile generation, cam shaft design, rocker and rocker shaft design considerations, materials Design aspects of intake and exhaust manifolds, inlet and Exhaust valves, valve springs, tappets, valve train. Materials and design of flywheel. Design of single and multi-plate clutches, materials. Design of spur, helical, straight, spiral bevel gears and herringbone gears, Gear box design.

Unit III: DESIGN OF FRAMES 9

Different layouts with reference to power plant, location and drive. Engineering materials and their physical properties applied to design, selection of materials, factor of safety, Types of frames, various forces acting on frames, different sections, materials, crash safety, Operating condition on frames.

Unit-IV: DESIGN OF STEERING SYSTEM 9

Functions, requirements, conditions for true rolling – Ackerman and Davis mechanisms, roll centre and roll axis. Steering geometry – camber, castor, king pin inclination, toe-in, toe out, steering angle and steering ratio. Steering gear boxes- recirculation ball, worm and worm wheel, rack and pinion. Steering linkages, steering kinematics.

Unit V: DESIGN OF SUSPENSION,BRAKING SYSTEM AND TYRES 9

Types of suspension, factors affecting ride quality, suspension springs. Shock absorbers, different suspension systems, suspension spring design, Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and

pneumatic, disc and drum brakes. Tyre requirements, selection of tyres, wheels and mountings – lateral force and friction co-efficient ,torque steer efect

TOTAL: 45 Hours

TEXT BOOKS:

1. Reimpell J, Stoll H, Betzler J W, "The Automotive Chassis", SAE International, Second Edition, 2001.
2. Julian Happian-Smith, "An Introduction to Modern Vehicle Design", Butterworth Heinemann Publishers, 2002.

REFERENCES:

1. Rudolf Limpert, "Brake Design and Safety", SAE International, Second Edition, 1999.
2. John Fenton, "Handbook of Automotive Power trains and Chassis Design", Professional Engineering Publishing, 1998.
3. Donald Bastow, Geofry Howard and John P.Whitehead "Car Suspension and Handling", 4th edition, SAE2004.
4. Giri N K, "Automobile Mechanics", Khanna Publishers, 2006.
5. Lukin R, Gasparyants G, Rodionov V, "Automobile Chassis Design and Calculations", MIR Publishers, Moscow, 1989.

AM3504	AUTOMOTIVE SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end, the student will have good exposure to automotive safety aspects including safety equipment.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Design of the body for safety and energy equation	U,R
CO-02	Students will gain adequate knowledge about safety concepts like Active safety, driving safety, conditional safety.	U
CO-03	Students will gain knowledge about Seat belt, regulations, automatic seat belt tightened system	R,U
CO-04	Students will gain knowledge about Collision warning system and object detection system with braking system interactions.	U
CO-05	Students will gain knowledge about various comfort and convenience system	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L

CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Unit II: SAFETY CONCEPTS **9**

Active safety: driving safety, conditional safety, perceptibility safety, operating safety-passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

Unit III: SAFETY EQUIPMENTS **9**

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tilt able steering wheel, air bags, electronic system for activating air bags, bumper design for **safety.**

Unit IV: COLLISION WARNING AND AVOIDANCE **9**

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

Unit V: COMFORT AND CONVENIENCE SYSTEM **9**

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

TOTAL: 45 Hours

TEXT BOOK

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.

REFERENCES

1. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.
2. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.

AM3572	**MODELING AND SIMULATION OF AUTO COMPONENTS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Outcome - COs		
CO-01	Able to understand 3D modeling and simulation of the	A

	manufacture of cylinder head, cylinder and piston.	
CO-02	Able to understand 3D modeling and simulation of the manufacture of piston pin, piston rings and connecting rod.	A
CO-03	Able to understand 3D modeling and simulation of the manufacture of Crankshaft, Inlet and Exhaust Valves, Cam andCam Shaft.	A
CO-04	Able to understand 3D modeling and simulation of the manufacture of Steering System and Brake System.	A
CO-05	Able to understand 3D modeling and simulation of the manufacture of Suspension System and Chassis Frame	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Introduction to File Import, Export – DXF, IGES, STL, STEP3 D Modeling and Simulation of Manufacture of the following parts :

1. Cylinder Head.
2. Cylinder.
3. Piston.
4. Piston Pin and Piston Rings.
5. Connecting Rod.
6. Crankshaft
7. Inlet and Exhaust Valves
8. Cam and Cam Shaft.
9. Steering System
10. Brake System
11. Suspension System
12. Chassis Frame

LIST OF EQUIPMENTS

(for a batch of 30 students)

1. Computer system - 30 Nos.
2. Software like Pro-E , Master CAM - 15 licenses

TOTAL: 45 Hours

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	AM3508	Chassis Management System	3	0	0	3

2.	EXX3	Elective 3	3	0	0	3
3.	EXX4	Elective 4	3	0	0	3
PRACTICAL						
4.	AM35P1	Industry Internship Training	0	0	4	2
5.	AM35P2	Project work – Phase I	0	0	18	6
TOTAL			**9**	**0**	**22**	**17**

AM3508	**CHASSIS MANAGEMENT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:
To explain the principle of chassis management system and different sensors used in the Systems.

Course Outcome - COs		**Cognitive Skill**
CO-01	Students will gain knowledge about various components of chassis management system.	U,R
CO-02	Students will gain adequate knowledge about driveline control system.	U
CO-03	Students will gain knowledge about Airbags, seat belt tightening system, collision warning systems.	R,U
CO-04	Students will gain knowledge about Active suspension systems, requirement and characteristics of various systems.	U
CO-05	Students will gain knowledge about various intelligent transportation system	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L

CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Components of chassis management system – role of various sensors and actuators Pertaining to chassis system – construction – working principle of wheel speed sensor, Steering position, tyre pressure, brake pressure, steering torque, fuel level, Gyro sensor.

Unit II: DRIVELINE CONTROL SYSTEM **9**

Speed control – cylinder cutoff technology, Gear shifting control – Traction / braking control, brake-by-wire – Adaptive cruise control, and throttle by wire. Steering – power steering, collapsible and tilt able steering column – steer by wire.

Unit III: SAFETY AND SECURITY SYSTEM **9**

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock Braking systems, Vision enhancement, road recognition system, Anti theft technologies, Smart card system, number plate coding, central locking system.

Unit IV: COMFORT SYSTEM **9**

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power Windows, thermal management system, adaptive noise control.

Unit V INTELLIGENT TRANSPORTATION SYSTEM **9**

Traffic routing system - Automated highway systems - Lane warning system – Drive Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems – vision Enhancement system - In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

TOTAL: 45Hours

REFERENCES

1.Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
2.Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, NewDelhi, 2002.
3.LjuboVlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”,

AM35A1	**IC ENGINE PROCESS MODELING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The main objectives of this course are to impart knowledge in computer simulation of IC engine process. The detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine will be taught to the students. The simulation of two stroke SI engine will also be introduced tote students. At the end of the course the students will have command over simulation of IC engine process.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about computer simulation and Classification of engine models.	U,R
CO-02	Students will gain adequate knowledge about Reactive processes, Heat of reaction, measurement of URP, measurement of HRP.	U
CO-03	Students will gain knowledge about computer simulation of SI engine with fuel air cycle	R,U
CO-04	Students will gain knowledge about brake power, brake thermal efficiency as well as effect of speed on performance.	U
CO-05	Students will gain knowledge about various computer simulation of ci engine	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models– Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylinder models. Step by step approach in SI engine simulation.

Unit II: COMBUSTION AND STOICHIOMETERY **9**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction -Combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. Conversion of volumetric analysis to mass analysis. Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.

Unit III: COMPUTER SIMULATION OF SI ENGINE WITH FUEL AIR CYCLE **9**

SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation,

work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Wiebe's law combustion analysis.

Unit IV: COMPUTER SIMULATION OF SI ENGINE WITH GAS EXCHANGE PROCESS **9**

Introduction, gas exchange process, Heat transfer process, friction calculations, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance.

Unit V COMPUTER SIMULATION OF CI ENGINE **9**

Zero, one and multi zone models for diesel engine combustion. DoubleWiebe'sLaw analysis for diesel combustion. Heat release model and different heat transfer models. Equilibrium calculations. Parametric studies on simulated engine performance.

TOTAL: 45 Hours

TEXTBOOK:

1. Ganesan.V. "Computer Simulation of spark ignition engine process", Universities Press (I) Ltd,Hyderbad, 1996.

REFERENCES

1. John. B. Heywood, 'Internal Combustion Engines'", Tata McGraw Hill Co., Newyork, 1988.
2. Benson.R.S., Whitehouse.N.D., "Internal Combustion Engines", Pergamon Press, oxford, 1979
3. Ramoss.A.L., "Modelling of Internal Combustion Engines Processes", McGraw Hill Publishing Co.,1992
4. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, NewYork, 1986.

AM35A2	TWO AND THREE WHEELERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Classifications and design considerations of two and three wheelers.	U,R
CO-02	Students will gain adequate knowledge about Design criteria for 2 stoke and 4 stoke engines	U
CO-03	Students will gain knowledge about. Gears for two and three wheelers and Design of clutch system.	R,U
CO-04	Students will gain knowledge about Types of frames and tyres	U

CO-05	Students will gain knowledge about various. Three wheelers	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Classifications- design considerations –weight and dimension limitations –requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

Unit II: POWER UNIT IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS **9**

2 stoke and 4 stoke engines. Design criteria for engines – design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburetor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical systems.

Unit III: CLUTCHES AND TRANSMISSION **9**

Types of clutches. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

Unit IV: FRAMES, SUSPENSION, WHEELS AND TYRES **9**

Types of frames. Wheel frames- construction design of frames for fatigue strength, torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

Unit V: THREE WHEELERS **9**

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission, wheel types, wheel mountings attachment, tyre types. Brake systems.

TOTAL: 45 Hours

TEXTBOOK:

1. Irving P.E., “Motor Cycle Engineering”, Temple Press Book, London, 1964.
2. Marshal Cavandedish, ‘Encyclopedia of Motor cycling’, New York, 1989
3. Srinivasan.S., ‘Motor cycle, Scooter, Mopeds’, New century book house, 1988.

REFERENCES:

1. M.M.Griffin., 'Motor cycles from inside and outside', Prentice Hall Inc, New Jersey, 1978.
2. Johns.B.A., 'Motorcycles', Good Heartwill, 1984.
3. 'Cycle Motor Manual', Templeton Press Ltd., London, 1992.
4. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.

AM35A3	THEORY OF FUELS AND LUBRICANTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To understand the properties of fuels and lubricants for the design and operation of the I.C engines

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about manufacture of finished automotive lubricants and fuels.	U,R
CO-02	Students will gain adequate knowledge about various theory of lubrication.	U
CO-03	Students will gain knowledge about Specific requirements for automotive lubricants and the classification of lubricating oils.	R,U
CO-04	Students will gain knowledge about Thermo-chemistry of fuels and their properties.	U
CO-05	Students will gain knowledge about various additives for lubricants and fuels	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: MANUFACTURE OF FUELS AND LUBRICANTS **9**

Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil basestocks, manufacture of finished automotive lubricants.

Unit II: THEORY OF LUBRICATION: 9

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

Unit III: PROPERTIES AND TESTING OF LUBRICANTS 9

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

Unit IV: PROPERTIES AND TESTING OF FUELS 9

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

Unit V: ADDITIVES FOR LUBRICANTS AND FUELS 9

Additive - mechanism, requirements of additive, petrol fuel additives, diesel fuel additives – Additive sand additive mechanism, for lubricants. Introduction to Nano fluids.

TOTAL: 45 Hours

TEXT BOOKS:

1. Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi,2003.
2. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication,2003.
3. Obert.E.F “Internal Combustion Engineering and Air Pollution”, International book Co., 1988.

REFERENCES

1. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.
2. Francis, W – Fuels and Fuel Technology, Vol. I & II
3. Hobson, G.D. &Pohl.W- Modern Petroleum Technology
4. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
5. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

AM35A4	SPECIAL TYPE OF VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main objectives of this course areto introduce the concept and principle of operation of special vehicles such as Bulldozers, Ditchers, Bucket excavators, farm equipments, military vehicles etc. At the end of the course, the students can have a better understanding of the application of the special types of vehicles in the excavation of earth.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Construction details of earth moving equipment's	U,R
CO-02	Students will gain adequate knowledge about power train concepts	U
CO-03	Students will gain knowledge about vehicle Braking system and actuation.	R,U
CO-04	Students will gain knowledge about special purpose vehicles for industrial applications	U
CO-05	Students will gain knowledge about various features and constructional details farm as well as military equipments.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: EARTH MOVING AND CONSTRUCTIONAL EQUIPMENTS 9

Construction details, capacity and applications of earthmovers for dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrappers, motor graders etc. criteria for selection of prime mover for dumpers and front end loaders based on vehicle performance characteristics.

Unit II: POWER TRAIN CONCEPTS: 9

Engine – converter match curves. Epicyclical type transmissions. Selection criteria for universal joints. Constructional details of steerable and drive axles of dumper.

Unit III: VEHICLE SYSTEMS AND FEATURES : 9

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects of dumper body, loader bucket and water tank of sprinkler. Articulated vehicles, double decker. Firefighting equipment.

Unit IV: SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 9

Constructional features, capacity and stability of jib cranes. Vibratory compactors. Stackers, bore well machines, concrete mixtures.

Unit V: FARM EQUIPMENTS, 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. Harvesting vehicles.

TOTAL: 45 Hours

REFERENCES

1. Pipenger, 'Industrial Hydralics', Mcgraw Hill, Tokoyo, 1979.
2. A. Astakhov, 'Truck cranes', MIR Publishers, Moscow, 1971.
3. Bart H Vanderveen, 'Tanks and Transport Vehicles', Frederic Warne and co. Ltd., London, 1974.
4. K. Abrosimov, A. Bromberg and F. Katayer, 'Road making machineries', MIR Publisher, Moscow,1975.
5. SAE Handbook – Vol III, 1995.

AM35A5	INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

Study of the theory, construction and operation of different measurement technology, instruments transducers and their application in automotive industry.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Static and Dynamic Measurement systems	U,R
CO-02	Students will gain adequate knowledge about Transducers and amplifiers for Automotive Applications	U
CO-03	Students will gain knowledge about Instrumentation for Measuring Weight, Force, torque, pressure, power, temperature.	R,U
CO-04	Students will gain knowledge about various Instrumentation for performance testing of engine.	U
CO-05	Students will gain knowledge about vehicle experimental techniques.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L

CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: MEASUREMENT SYSTEMS **9**

Static and Dynamic Measurement systems-importance of measurement system – methods of measurement -applications - characteristics of measuring system-static and dynamic characteristics of measuring system – Analysis of experimental detail, Error analysis-types of errors-limiting errors.

Unit II: TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES **9**

Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile –filters -types – Data Acquisition system - analog and digital type DAS-Indicators, Printers and display device –Signal Analyzing with example of automobile applications.

Unit III: MECHANICAL MEASUREMENT **9**

Instrumentation for Measuring Weight, Force, torque , pressure, power, temperature, fluid flow and special methods , vibration piezo electric effect, rotational speed .Measuring Velocity, acceleration and angular motion with respect to automobile applications.

Unit IV: ENGINE EXPERIMENTAL TECHNIQUES **9**

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

Unit V: VEHICLE EXPERIMENTAL TECHNIQUES **9**

Laboratory tests- test tracks - Endurance Tests- crash tests- wind tunnel tests- Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

TOTAL: 45 Hours

TEXTBOOK:

1. J.G. Giles, ‘Engine and Vehicle Testing’, Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, ‘Mechanical Measurements’, Oxford and IBH Publishing House, NewDelhi, 1995

REFERENCES

1. A.W. Judge, ‘Engineering Precision Measurement’, Chapman and Hall Ltd, Essex Street
   W.C.,1951,
2. D.Patambis, ‘Principle of Industrial Instrumentation’, Tata McGraw Hill Publishing Co, New Delhi,1990.

3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill PublishingCo., Ltd., 1990

AM35A6	HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:
The objectives of this course are to introduce the essential principles of hydraulic and pneumatic system and related automobile applications

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about the Comparison between pneumatic and hydraulic system	U,R
CO-02	Students will gain adequate knowledge about Basic requirement As well Elements of pneumatics.	U
CO-03	Students will gain knowledge about hydraulic systems	R,U
CO-04	Students will gain knowledge about servo and plc systems	U
CO-05	Students will gain knowledge about various aspects of Design and analysis of a hydraulic / Pneumatic system.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I:INTRODUCTION **9**

Properties - hydraulic fluids and air, Hydraulic fluids, types, factors affecting oil performance, selection, power Unit. Selection of pipe / tubing, couplings. Packing and seals, packing standards. Comparison between pneumatic and hydraulic system. Symbols of pneumatic and hydraulic elements.

Unit II: PNEUMATIC SYSTEMS **9**

Basic requirement. Elements of pneumatics, constructional details of air compressors, types, specifications, air generation and distribution. Air motors, control valves, actuators and mountings, filter, lubricator, regulator. General approach of system design, travel step

diagram. Types - sequence control, cascade, step counter method. K.V.Mapping for minimization of logic equation. Simple circuits.

Unit III: HYDRAULIC SYSTEMS **9**

Cylinder, Pumps and motors - types, characteristics. Construction details. Valves for control of direction, flow and pressure – types and construction details. Power pack– elements and design. Pipes- material, pipe fittings. Seals and packing. Maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes.

Unit IV: SERVO AND PLC SYSTEMS **9**

Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming.

Unit V: AUTOMOTIVE APPLICATIONS **9**

Hydraulic tipping mechanism, power steering, fort lift hydraulic gear, hydro-pneumatic suspension, air brake. Maintenance and trouble shooting. Design and analysis of a hydraulic / Pneumatic system. Case Study

TOTAL :45 Hours

REFERENCES:

1.Andrew Parr, "Hydraulic and Pneumatics", Jaico publishing house, 1999.
2.AnthonyEspisito, " Fluid Power with Application", Pearson Education (Singapore) Pte.Ltd, Delhi, India, Fifth Edition, First Indian Reprint, 2003
3.Festo KG, "Pneumatic Tips", Festo, Germany, 1987.
4.Majumdar, S.R., "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw- Hill Publishing Company Ltd., New Delhi, Fourth Reprint, 2003.
5.PeterRohner, "Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples", The Macmillan Press Ltd., UK, 1979.
6.Pippenger, J.J, "Industrial Hydraulic & Pneumatics", McGraw Hill, 2002.
7.WernerDeppert and Kurt Stoll, "Pneumatic Controls : An introduction to principles", Vogel-Druck Wurzburg, Germany, 1975.

AM35A7	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to introduce basic concepts of fluid flow-derivation of the governing equations related automobile applications

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Basic concepts of fluid flow-derivation of the governing equations.	U,R
CO-02	Students will gain adequate knowledge about Finite difference method as well as Properties of numerical solution methods.	U
CO-03	Students will gain knowledge about grid generation	R,U
CO-04	Students will gain knowledge about various Computational fluid dynamics (CFD).	U

CO-05	Students will gain knowledge about turbulence modeling and Practical problem solving method using CFD packages.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types.

Unit II: DISCRETISATION **9**

Finite difference method - forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods.

Unit III: INTRODUCTION TO GRID GENERATION: **9**

Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements, adaptive grids.

Unit I V: CFD TECHNIQUES **9**

Lax - Wend off technique – Mac Cormack's technique, relaxation technique. Artificial viscosity, AD technique, Pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting.

Unit V: TURBULENCE MODELING: **9**

Turbulence energy equation- one-equation model, the k-_ model, the k- _ model.

TOTAL 45 Hours

REFERENCES:

1. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
2. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
3. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method',Longman, 1995.
4. John D Anderson, " Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, , New York, 1995.
5. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc., 1993.

AM35A8	DESIGN OF BRAKES, STEERING AND RUNNING GEARS	L	T	P	C
		3	0	0	3

OBJECTIVES:
The objectives of this course are to introduce basic concepts design of steering system as well as braking system related to automobiles

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about mechanical, hydraulic and pneumatic, disc and drum brakes.	U,R
CO-02	Students will gain adequate knowledge about various mechanisms of driving systems.	U
CO-03	Students will gain knowledge about Types of frames as well as various forces acting on frames.	R,U
CO-04	Students will gain knowledge about various types of suspension systems.	U
CO-05	Students will gain knowledge about various wheels and tyres requirement.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: DESIGN OF BRAKING SYSTEM **9**

Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design and analysis of brake shoes and friction pads.

Unit II: DESIGN OF STEERING SYSTEM **9**

Functions, requirements, conditions for true rolling – Ackerman and Davis mechanisms, roll centre and roll axis. Steering geometry – camber, castor, king pin inclination, toe-in, toe out, steering angle and steering ratio. Steering gear boxes – re-circulating ball, worm and worm wheel, rack and pinion. Steering linkages, steering kinematics.

Unit III: DESIGN OF RUNNING GEARS **9**

Types of frames, various forces acting on frames, different sections, materials, crash safety. Purpose of axle settings, wheel base and track. Front axle - functions, forces acting, cross sections. Rear axles –functions, forces acting, different types and design, simple design calculations.

Unit IV: SUSPENSION SYSTEM: **9**

Types of suspension, factors affecting ride quality, suspension springs. Shock absorbers, different suspension systems, suspension spring design, gyroscopic effects.

Unit V: SELECTION OF WHEELS AND TYRES: **9**

Tyre requirements, selection of tyres, wheels and mountings – lateral force and friction co-efficient, self aligning torque and caster offset, overturning moment, torque steer effects.

TOTAL 45Hours

REFERENCES:

1. Giri N K, "Automobile Mechanics", Khanna Publishers, 2006.
2. Donald Bastow, Geoffry Howard and John P.Whitehead "Car Suspension and Handling", 4th edition, SAE2004.
3. Julian Happian-Smith, "An Introduction to Modern Vehicle Design", Butterworth Heinemann Publishers, 2002.
4. Reimpell J, Stoll H, Betzler J W, "The Automotive Chassis", SAE International, Second Edition, 2001.
5. Rudolf Limpert, "Brake Design and Safety", SAE International, Second Edition, 1999.
6. John Fenton, "Handbook of Automotive Power trains and Chassis Design", Professional Engineering Publishing, 1998.
7. Lukin R, Gasparyants G, Rodionov V, "Automobile Chassis Design and Calculations", MIR Publishers, Moscow, 1989.

AM35A9	NOISE, VIBRATION AND HARSHNESS CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to study about Emission formation in SI and CI engines as well as their controlling techniques.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Emission formation in SI and CI engines.	U,R
CO-02	Students will gain adequate knowledge about emission control techniques	U
CO-03	Students will gain knowledge about instrumentation for emission measurement	R,U
CO-04	Students will gain knowledge about Identification of noise sources and there control methods	U
CO-05	Students will gain knowledge about vibration measurement and	R,U

	control	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: EMISSIONS FROM SI AND CI ENGINES: 9

Emission formation in SI and CI engines – effect of pollution on human health. Emission norms - EURO & Bharath norms, emission regulations and emission test cycles. - causes for the increase in emissions in engines, engine modifications to reduce emissions, role of engine fuel in engine emission, effect of fuel properties and additives on emissions, use of alternate fuels.

Unit II:EMISSION CONTROL TECHNIQUES 9

Crank case emission control, fuel evaporation & control, EGR, intake temp control, air injected exhaust, thermal reactors, catalytic converters – types, tuning of mechanical systems - A/F ratio control.

Unit III: INSTRUMENTATION FOR EMISSION MEASUREMENT 9

NDIR analyzer, flame ionization detectors, chemiliumines cent analyzer, smoke meters, gas chromatograph.

Unit IV: NOISE AND NOISE CONTROL: 9

Sound wave and its propagation, sound measurement, subjective response and ratings. Reverberation time and absorption of sound. Identification of noise sources, quantification, noise measuring instruments, control of air borne noise - use of noise absorber, barrier, different materials, criteria for the selection of materials, control of structure borne noise - treatments for vibration damping materials for hood liner and head liner, evaluation of natural frequencies of critical members, resonance, ill effects of resonance. sound isolation- machine enclosures, silencers and mufflers.

Unit V: VIBRATION MEASUREMENT AND CONTROL: 9

Measurement of vibration, FFT analyzer. Methods of vibration control -excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials- viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitative treatment only), unturned viscous damper, vibration isolation.

TOTAL: 45 Hours

REFERENCES:

1. John Fenton, “Handbook of Automotive Power Train and Chassis Design”, SAE 1998.
2. Rao S S, "Mechanical Vibrations", Addison Wesley Longman, New Delhi, 1995.
3. Heinz Heisler, “Advanced Engine Technology”, SAE 1995.
4. “Automobiles and pollution” SAE Transaction, 1995.
5. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New York, 1990.
6. Springer and Patterson, “Engine Emission”, Plenum Press 1990.
7. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
8. Ashok Kumar Mallik, “Principles of Vibration control”, Affiliated East-West Press (P) Ltd., New Delhi, 1990.
9. Grover G K, "Mechanical Vibrations ", New Chand and Brothers, Roorkey, 1989.
10. Tse Morse and Hinkle, “Mechanical Vibration”, Prentice Hall of India Ltd., New Delhi,1987.

AM35B1	AUTOMOTIVE COMPONENT MANUFACTURING3	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to introduce the knowledge about Engine, transmission and body components related automobile applications

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Casting and machining of engine blocks	U,R
CO-02	Students will gain adequate knowledge about Manufacturing of friction plates using conventional blanking and fine blanking	U
CO-03	Students will gain knowledge about welding of body panels, resistance welding and other welding processes	R,U
CO-04	Students will gain knowledge about various surface coatings methods	U
CO-05	Students will gain knowledge about various electrical components automotive.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L

CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: ENGINE COMPONENTS: **9**

Casting of engine block - conventional and expendable pattern, machining of engine blocks in machining center. Preparation of casting for cylinder heads, forging of crank shaft, connecting rod and gudgeon pins, machining and heat treatment, casting of piston by gravity casting, squeeze casting, machining and finishing, upset forging of valves, heat treatment and surface improvement, cylinder liners and piston ring manufacturing. Engine bearing manufacturing

Unit II:TRANSMISSION COMPONENTS: **9**

Manufacturing of friction plates using conventional blanking and fine blanking. Casting of gear box casing, precision forging ofgears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing. Continuous casting of propeller shaft, extrusion of propeller shaft, extrusion dies, heat treatment and surface hardening of propeller shaft, composite propeller shaft manufacturing. Forging of rear axles, casting of rear axle casing, wheels, brake drum, tyre manufacturing.

Unit III: BODY COMPONENTS: **9**

Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance welding and other welding processes. Introduction, principle of injection moulding, injection moulding of instrument panel, moulding of bumpers, reinforced reaction injection moulding, tooling and tooling requirements, manufacture ofmetal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs.

Unit IV:SURFACE COATINGS: **9**

Chemical vapour deposition, physical vapour deposition, sol-gel processing, spraying, plating, painting, paint booth, electro plating of metals, metal coatings, case hardening, thermal spraying, vapour deposition, electro plating , electro-less plating, anodizing

.

Unit V:ELECTRICAL COMPONENTS: **9**

Starter motor, alternator, regulator, battery, lamps, control switches, electronic gauges, power windows, power steering, head light and other external lights, wind shield wipers, defroster, switches and switch pads, wiring harness.

TOTAL: 45 Hours

REFERENCES:

1. Philip F. Ostwald & Jairo Munuz, “Manufacturing Processes and Systems”, John Wiley & Sons, New York, 1998.
2. Degarmo E.P., “Materials and process in Manufacturing”, Macmillan Publishing Co., 1997.
3. Heldt P.M., “High Speed Combustion Engines”, Oxford IBH publishing Co., Calcutta, 1996.
4. Kalpakjian,“Manufacturing and Engineering and Technology”, Addison Wesloy, Publishing Company, 1995.
5. Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2003

AM35B2	AUTOMOTIVE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:
The objectives of this course are to introduce the essential principles and classification of ceramics and polymers.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about classification of ceramics and polymers.	U,R
CO-02	Students will gain adequate knowledge about Selection strategy, property limits of various materials	U
CO-03	Students will gain knowledge aboutTypes of cast irons, properties, structures, compositions and applications	R,U
CO-04	Students will gain knowledgeabout various body materials	U
CO-05	Students will gain knowledge about variousnon-metallic / electrical and magnetic materials	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: CLASSIFICATION **9**

Metals, ceramics, glasses, elastomers, polymers, composites, smart materials, members of each class, nano science materials, material properties viz mechanical, thermal, wear, corrosion oxidation.

Unit II: SELECTIONOF MATERIALS **9**

Selection strategy, property limits and material indices, function OBJECTIVESs and constraints, performance maximizing criteria. Modulus - density, strength – density, modulus – strength, specific stiffness and specific strength, fracture toughness, modulus fracture etc. Shape factors, elastic extrusion, elastic body and twisting, failure, bending and twisting, axial loading and column buckling, efficiency of standard sections, material limits for shape factors, microscopic shape and shape factors.

Unit III: FERROUSAND NON FERROUS ALLOYS **9**

Types of cast irons, properties, structures, compositions and applications, plain carbon steels, low alloy steels and effects of alloying elements, high alloy steels, stainless steel types, cast ability, formability, machinability, hardenability and weldability of the material, high temperature steels and super alloys. Alloys of copper, aluminium, nickel, magnesium, titanium, lead, tin, zinc - compositions, heat treatments, structures, properties, applications, castability, formability, machinability, hardenability and weldability.

Unit IV: BODY MATERIALS **9**

Steels – HSLA, aluminum alloys, magnesium alloys, plastics and ceramics, ULSAB, ULSAS, DP, IF,TRIP Steels. Types of composites, volume fraction - lamellar composites production and properties of whiskers of silicon carbide, graphite, fibers of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibers applications.

Unit V: NON-METALLIC / ELECTRICAL AND MAGNETICMATERIALS **9**

Ceramics, refractories, abrasives, enamels, cement – glasses, polymers: thermosetting and thermoplastics, types of polymerisation, elastomers, electrical conducting polymers.P and N type semiconductors, single crystals, soft and hard magnets superconductors, MEMS materials, nano science materials, smart materials, shape memory alloys.

TOTAL: 45 Hours

REFERENCES:

1. Michael F. Ashby, “Materials Selection in Mechanical Design”, Butterworth Heinemann, 2005.
2. Daniel Yesudian C., “Materials Science and Metallurgy”, Scitech Publications (India), 2004.
3. Polmear I.J., “Light Alloys”, Arnold Publishers, 1995.
4. Swarup D. and Saxena M.N., "Elements of Metallurgy", Rastogi Publishers, Meerut, 1994.
5. Srinivasan N.K. and Ramakrishnan S.S., "The Science of Engineering Materials", Oxford and IBH Pub. Co., New Delhi ,1993.
6. Van Vlack L.H., "Elements of Materials Science and Engineering", Addison Wesley, New York, 1991.
7. Guy A.G," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990.

AM35B3	COMBUSTION THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to make the students to know and understand the principle of engine combustion and to introduce the various heat transfer models and its measuring methods.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about Combustion kinetics.	U,R

CO-02	Students will gain adequate knowledge about Chemical thermodynamic model for Normal Combustion.	U
CO-03	Students will gain knowledge about flame speed correlations- quenching and flammability	R,U
CO-04	Students will gain knowledge about Engine Heat transfer and heat Balance rate.	U
CO-05	Students will gain knowledge about various instrumentation techniques in engines.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: THERMODYNAMICS OF COMBUSTION **9**

Premixed and diffusion combustion process in IC engines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and droplet combustion.

Unit II: CHEMICAL KINETICS OF COMBUSTION **9**

Combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion.

Unit III: FLAMES **9**

Laminar - premixed and diffusion flames – flame speed correlations- quenching, flammability, and ignition, flame stabilization, turbulent premixed, diffusion flames- Damkohler number.

Unit IV: HEAT TRANSFER IN IC ENGINES **9**

Engine Heat transfer and heat Balance. Measurement of Instantaneous heat transfer rate. Heat transfer modeling. Heat transfer coefficients, radiative heat transfer. Temperature measurement in Piston, Cylinder, Cylinder Head, Liner and valves.

Unit V: INSTRUMENTATION **9**

Pressure sensors, crank angle encoder. Hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines. In-cylinder pressure measurement and Rate of heat release calculation.

TOTAL: 45 Hours

REFERENCES

1. Spalding.D.B., "Some fundamentals of Combustion", Butterworth Science Publications, London,1985.
2. Irvin Glasman, "Combustion" Academic Press, London, 1987, ISBN 0-12-285851-4.
3. Taylor.E.F. "The Internal Combustion Engines ", International Text Book Co., Pennsylvania, 1982.
4. Ashley Campbel, "Thermodynamic analysis of combustion engine", John book company, Newyork,1979.
5. J.l.Ramos, "Modeling of Internal Combustion Engine", Mcgraw hill book company New york 1990
6. John. B. Heywood,' "Internal Combustion Engines", Tata McGraw Hill Co., Newyork, 1988.
7. Ganesan.V. "Computer Simulation of Spark Ignition Engine Process ", Wiley eastern India ltd,1996.

AM35B4	AUTOMATIC TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to make the students to know and understand the principle of components of automatic transmission as well as the comparison between conventional and centrifugal clutches.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about main components of automatic transmission	U,R
CO-02	Students will gain adequate knowledge about comparison between conventional and centrifugal clutches	U
CO-03	Students will gain knowledge about overdrive operations	R,U
CO-04	Students will gain knowledge about fluid coupling and torque converters	U
CO-05	Students will gain knowledge about various systems of hydrostatic drives, pump and motors.	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L

CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Principles of automatic transmission, advantages, limitations, main components of automatic transmission, hydraulic control system, pumps, automatic variable delivery pump.

Unit II: CENTRIFUGAL CLUTCHES AND FLUID COUPLING **9**

Principle of centrifugal clutches, comparison between conventional and centrifugal clutches, centrifugal clutches used in two wheelers, principles of fluid coupling, principles of energy transfer, working fluid, requirements, fluid coupling characteristics, fluid coupling with conventional gear boxes.

Unit III: OVERDRIVES **9**

Overdrives - overdrive operations, going into overdrive, coming out of overdrive, locking out the overdrive, advantages, WARNER automatic overdrives, speed sensitive clutch, locking arrangements for sun gear, Planetary gear train, typical gear ratios, drawbacks of over drives, reverse lock up, over drive lubrication.

Unit IV: HYDRODYNAMIC TORQUE CONVERTERS **9**

Introduction to torque converters, comparisons between fluid coupling and torque converters, performance characteristics, slip, principles of torque multiplication, 3 and 4 phase torque converters, typical hydrodynamic transmission.

Unit V: HYDROSTATIC DRIVES **9**

Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pump and constant displacement motor, variable displacement pump and constant displacement motor and variable displacement motor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor, advantages and limitations, typical hydrostatic drives, Janney hydrostatic drives, Nel Glasgow transmission-hydrostatic shunt drives.

TOTAL: 45 Hours

REFERENCES:

1. Jack Erjavec, “Automatic Transmissions”, Delmar Publishers,1st edition,2005.
2. Tom Birch and ChnckRockmood, “Automatic Transmissions and Transaxles”, Prentice Hall,1st edition,2002.
3. Mathias F Brejeha, “Automatic Transmission”, Prentice Hall,1998.
4. William Turney, “Automatic Transmissions and Transaxles”, Chek Chart Publishers,1997.
5. Tucker H F, “Automatic Transmission”, Van Nostrand Reinhold Company,1980.

AM35B5	**FINITE ELEMENT METHODS IN AUTOMOBILE ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The objectives of this course are to make the students to know and understand the principle of FEM and its application in automotive component design.

Course Outcome - COs		Cognitive Skill
CO-01	Students will gain knowledge about meaning and purpose of Engineering design analysis	U,R
CO-02	Students will gain adequate knowledge about Use of bar and beam elements in structural analysis	U
CO-03	Students will gain knowledge about Numerical integration schemes and Treatment of boundary condition	R,U
CO-04	Students will gain knowledge about structural and dynamic analysis	U
CO-05	Students will gain knowledge about various1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transient thermal analysis	R,U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO- F	PO-G	PO-H	PO- I	PO-J
CO-01	S	S	L	M	L	L	M	N	M	L
CO-02	S	S	L	M	L	L	M	N	M	L
CO-03	S	S	L	M	L	L	M	N	M	L
CO-04	S	S	L	M	L	L	M	N	M	L
CO-05	S	S	L	M	L	L	M	N	M	l

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: INTRODUCTION **9**

Engineering design analysis-meaning and purpose, steady state, propagation and transient problems. Concepts of FDM, FEM, FVM. Steps involved in FEM. Applicability of FEM to structural analysis, heat transfer and fluid flow problems. Advantages and limitations of FEM. Test for convergence. Element choice. Commercial finite element packages. Solution of Boundary value problem –Integral formulation for numerical solution - Variational methods - Minimum total potential energy formulation.

Unit II: 1D ELEMENTS **9**

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.

Unit III: 2D ELEMENTS **9**

Rectangular elements - Quadratic quadrilateral elements - Linear Triangular elements - 2D elements applications for plane stress, plane strain and axi-symmetric problems. Treatment of boundary condition. Mesh generation techniques. Numerical integration schemes. Iso Parametric elements. Introduction to 3D Elements.

Unit IV: STRUCTURAL AND DYNAMIC ANALYSIS **9**

1D & 2D problems in Solid mechanics. Dynamics problems representation in FE. Free vibration problem formulation. Torsion of non-circular shaft - ax symmetric problem. Case Studies like Structural analysis of Chassis Frame, Whirling speed of propeller shaft, contact analysis of gears ,modal analysis of suspension system, impact, crash worthiness etc.

Unit V: HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS **9**

1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transient thermal analysis. Case Studies like Heat transfer analysis of piston, fins.

TOTAL: 45 Hours

TEXT BOOK:

1. Segerlind,L.J., Applied Finite Element Analysis, Second Edition, John Wiley and Sons Inc., NewYork, 1984
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and applicationsof finite element analysis”, 4th edition, John Wiley & Sons, 2007.

REFERENCES

1. Krishnamurthy,C.S., Finite Element Analysis, Tata McGraw Hill, 1987.
2. Ramamurthi,V., Computer Aided Design in Mechanical Engineering, Tata McGraw Hill, 1987.
3 . Bathe,K.J. and Wilson,E.L., Numerical methods in finite element analysis, Prentice Hall of IndiaLtd., 1983.
4. J. N. Reddy, “Finite Element Methods”, 2nd Edition, 6th Reprint, Tata McGraw Hill, 2005.
5. Singiresu S. Rao, “The Finite Elements Methods in Engineering”, 4th Edition, USA2006