



**Bansilal Ramnath Agarwal Charitable Trust's**

# **Vishwakarma Institute of Technology**

*(An Autonomous Institute affiliated to Savitribai Phule Pune University formerly University of Pune)*

## **Structure & Syllabus of Honors in Automobile Engineering Pattern 'H 15 Revised' Effective from Academic Year 2016-17**

**Prepared by: - Board of Studies in Mechanical Engineering**

**Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune**

**Signed by**

**Chairman – BOS**

**Chairman – Academic Board**

<b>Mechanical Engineering Department</b>							
<b>H 15 Rev Structure for Honors in Automobile Engineering (4 Semesters)</b>							
NO.	Subject Code	Subject Name	Teaching Scheme (Hrs/week)			Credits	Year and Semester
			Lect.	Tut.	Pract.		
T <sub>1</sub>	ME38111	Automobile Systems	2	0	0	2	T.Y. B.Tech- I
T <sub>2</sub>	ME38112	Automobile Design	2	0	0	2	T.Y. B.Tech- II
T <sub>3</sub>	ME48113	Automotive Electronics and Controls	2	0	0	2	Final Year B.Tech.-I
T <sub>4</sub>	ME48114	Vehicle Dynamics	2	0	0	2	Final Year B.Tech.-II
<b>Practical/Experimental Courses</b>							
	ME38311	Automobile Engineering Laboratory	0	0	2	1	T.Y. B.Tech- II
	ME48312	Advanced Automobile Engineering Laboratory	0	0	2	1	Final Year B.Tech.-I
		<b>Total</b>	<b>8</b>	<b>0</b>	<b>4</b>	<b>10</b>	

**Note- H 15 Rev Structure which is effective from academic year 2016-17 for Honors in Automobile Engineering is also applicable for the students who have registered for H 15 Structure in the academic year 2015-16.**

**ME 38111 :: AUTOMOBILE SYSTEMS****Credits: 2****Teaching Scheme: 2 Hours / Week****Unit I : Basic Concepts and Clutches**

- (A) Engine components, basic engine nomenclature, engine classification, working of four stroke & two stroke engines, Vehicle specifications, classification, layout, applications, Purpose of clutch, classification, single plate clutch, multiple plate clutch, centrifugal clutch, cone clutch, diaphragm spring clutch, vacuum operated clutch, clutch plate, lining material.
- (B) Preventive maintenance, trouble shooting and diagnosis of clutches.  
Automotive Electricals - Battery, Ignition system.

(6 Hrs.)

**Unit II : Gearbox**

- (A) Function, various resistances, tractive effort, performance curves, sliding mesh gearbox, constant mesh gearbox and synchromesh gearbox, epicyclic gearbox, torque convertor, automatic transmission, overdrive.
- (B) Preventive maintenance, trouble shooting and diagnosis of gearbox.  
Automotive Electricals - Starting system

(6 Hrs.)

**Unit III: Steering System**

- (A) Purpose, requirement, steering mechanisms, wheel alignment and wheel balancing, centre point steering, cornering force, slip angle, scrub radius, steering characteristic, steering gearboxes, power steering.
- (B) Preventive maintenance, trouble shooting and diagnosis of steering system.  
Wheels and Tyres.

(6 Hrs.)

**Unit IV: Propeller Shaft, Universal joints, Differential and Rear Axle**

- (A) Propeller shaft, universal joints, final drive, differential and their types, rear axle arrangements, two speed rear axle, single, double and triple reduction rear axles. driving thrust, torque reaction, Hotchkiss drive, Torque tube drive.
- (B) Preventive maintenance, trouble shooting and diagnosis of propeller shaft, Universal joints, differential and rear axle. Automotive Electricals - Charging system.

(6 Hrs.)

**Unit V: Suspension System and Braking System****(A) Suspension System**

Object, various types of springs, shock absorbers, sprung weight and unsprung weight, basic suspension movements, conventional suspension system,

independent suspension systems, air suspension, hydrolastic suspension, hydro-gas suspension, interconnected suspension, self leveling suspension.

#### Braking System

Purpose, stopping distance and time, braking force, brake efficiency, classification, mechanical, hydraulic, air brakes, antiskid braking system.

(B) Preventive maintenance, trouble shooting and diagnosis of suspension system and braking system. Automotive Electricals - Dashboard instruments.

(4 Hrs.)

#### Text Books:

1. K. Newton, W. Steeds & T.K. Garrett, 'The Motor vehicle', 'BUTTERWORTHS' London.
2. Singh Kripal, 'Automobile Engineering', Vol. I and Vol. II, Standard Publishers Distributors.
3. R.K. Rajput, A Textbook of Automobile Engineering, Laxmi Publications Ltd.

#### Reference Books

1. Narang G.B.S., 'Automobile Engineering', S.Chand and Company (Pvt.) Ltd.
2. Harbans Singh Reyat, 'The Automobile' S.Chand and Company (Pvt.) Ltd.
3. William H. Crouse and Donald L. Anglin, 'Automotive Mechanics', Tata McGraw Hill Publishing Company.
4. Joseph Heitner, 'Automotive Mechanics', C.B.S. Publisher and Distributors.
5. A.W. Judge, 'Automotive systems', Vol. 1 to 8.
6. AA Book of Car.

#### Course Outcomes:

The student will be able to-

1. Describe construction, working and other details of Internal Combustion Engines, Clutches, Battery and Ignition system
2. Demonstrate knowledge about construction, working and other details of different Gearboxes and Starting system
3. Understand and explain about construction, working and other details of Steering system, Wheels and Tyres
4. Demonstrate knowledge about construction, working, and other details of Propeller Shaft, Universal joints, Differential, Rear Axle and Charging system
5. Describe construction, working and other details of Suspension System, Braking System and Dashboard instruments

**ME38112 :: AUTOMOBILE DESIGN****Credits : 02****Teaching scheme :- Theory : 2 Hrs /Week****Unit 1: Design Considerations, Vehicle Body and Chassis Design****(A) Vehicle Body & Chassis Design**

Vehicle body structures, Body engineering. Overall structural design, Aerodynamic considerations in styling and shaping of body, Design for crashworthiness / safety.

**(B) Introduction and Design Considerations**

Design Process - Requirements, Definition, Conceptual Design, Embodiment Design, Detail Design. Basic rules, principles and guidelines. Various design considerations in vehicle design.

(6 hrs.)

**Unit 2: Design of Engine Components and systems**

**(A) Engine Components :** Design of Cylinder block and Head, Piston, pin, crown, rings, Valve gear mechanism. Material Selection.

**(B) Engine Systems :** Design and calculation of Major Engine systems – Cooling system, Lubricating system

(6 hrs.)

**Unit 3 : Design of Engine Components and systems**

**(A) Engine Components:** Connecting rod, Crankshaft, Camshaft, Material Selection.

**(B) Engine Systems:** Design and calculation of Major Engine systems –Air/fuel intake system, Exhaust system,

(6 hrs.)

**Unit 4 : Drive train Design**

(A) Design of clutch, drive-shaft, gears, gearbox, selection of proper gear ratios, differential.

(B) Belts, couplings / joints, bearings.

(6 hrs.)

**Unit 5 : Chassis System (Steering, Suspension & Brake) Design :**

(A) Design considerations in steering, suspension, brake systems and their components.

(B) Design / selection considerations of Wheels/Rims, Tyres, and other related components.

(4 hrs.)

**Text Books :**

1. Design of Machine Elements : Prof. V. B. Bhandari
2. Machine design : Dr. P. C. Sharma & Dr. D. K. Agarwal
3. Automobile Design : R. B. Gupta
4. Machine Design : R. S. Khurmi & J. K. Gupta

**Reference Books :**

1. The Automotive Chassis, Vol. 1 : Components Design : By Giancarlo Genta, et al : Springer Publ. : 2011
2. The Automotive Chassis, Vol. 2 : System Design : By Giancarlo Genta, et al : Springer Publ. : 2011
3. The Automotive Body, Vol. 1-Components Design : By Lorenzo Morello, et al : Springer Publ. : 2011
4. The Automotive Body, Volume 2 : System Design : By Lorenzo Morello, et al : Springer Publ. : 2011
5. Automotive Engineering : Powertrain, Chassis System and Vehicle Body : Edited by David A. Crolla : Butterworth-Heinemann - 2009.
6. Bosch Automotive Handbook – Robert Bosch GmbH – 2002
7. The Automotive Chassis – Engineering Principles : J. Reimpell, H. Stoll, et al – SAE
8. An Introduction to Modern Vehicle Design : Ed. Julian Happian-Smith, Butterworth – 2002

**Course Outcomes:**

The student will be able to -

1. Demonstrate knowledge about design considerations, design process in vehicle design
2. Design of Cylinder, Piston, Valve gear mechanism, Cooling system and lubrication system
3. Design of Connecting rod, Crankshaft, Camshaft, Air/Fuel intake system and Exhaust system
4. Design Drive train components
5. Understand design considerations of automobile systems such as steering, suspension and brake systems and components like Wheels/Rims and Tyres

**ME 48113 :: AUTOMOTIVE ELECTRONICS AND CONTROLS****Credits : 02****Teaching scheme :- Theory : 2 Hrs /Week****Unit I (6 Hrs)**  
**Switches and Relays**

**A. Switches:** Construction, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Emergency switch, Micro-switches, Review of process switches, starter switches, Horn Switches, Dipper Switches, Pull and Push Switches, Flush Switches, Toggle Switches, Limit Switches, Ignition Key, Non-contact Switches.

**Relays:** Construction, working, specifications, selection criteria and applications of Electro-mechanical relay, Reed relay, hermetically sealed relay, Solid-state relays. Wiring diagrams related to switches and relays.

**B.** Specifications of switches and relays used in automobiles.

**Unit II (6hrs)****Sensors and Transducers**

**A.** Basic sensor arrangement, Introduction to automotive sensors and instrumentation, Market perspective for sensors and instrumentation techniques, Sensor electronics and techniques, Overview of sensor measurements, Sensor classification

Types of sensors such as- Fuel metering/ vehicle speed sensors and destination sensors, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, speedometer, fuel, oil and temperature gauges.

Pressure, position, flow, temperature, humidity, speed, acceleration, torque, distance and level sensors

**B.** Oxygen sensors, crank angle position sensors, Altitude sensor

**UNIT –III (6 hrs)****Sensors and Transducers**

**A.** Electronic Dash board instruments. Sensor for Fuel Level in Tank, Engine Cooling Water Temperature Sensors Design, Engine Oil Pressure Sensor Design, Speed Sensor, Vehicle Speed Sensor Design, Air Pressure Sensors, Engine Oil Temperature Sensor, odometer, Oil Pressure Warning System, Engine Overheat Warning System, Air Pressure Warning System, Speed Warning System. Door Lock Indicators, Gear Neutral Indicator.

**B.** Pollution measuring sensors, Gas analyzer, FID, Measurement of NO<sub>x</sub>, smoke, etc.

**Unit IV (6 Hrs)**  
**Actuators**

**A.** Solenoid, stepper motor, relays, Horn, wiper system, flasher, electric fuel pump, Trafficator, clutch

hydraulic actuation system, Brake Actuation Warning System. Trafficators, Flash System, Car Fan, Windshield Wiper, Window Washer, Starting Systems – Charging Systems – Ignition Systems Principles of actuation and control, DC motors, stepper motors, Relays and solenoids, Hydraulic and pneumatic, climate control and electronic displays.

B. Vehicles lighting Circuits Signaling Circuit, electric windows systems, seat belt tensioners

### **Unit V**

**(4 Hrs)**

#### **Control Systems**

A. Automatic Cabin climate control, Automatic Cruise Control, Air Bag Control, ABS Control, Automatic Transmission Control, Electronic steering Control, Automatic gear control, Electric Power Steering, Electronic Distributor-less ignition control, Exhaust Gas Recirculation Control, Electronic Fuel Control

B. Electronic Clutch Control, Electronic Damping Control, Traction Control, Automotive central locking and anti-theft system control

#### **Text Books**

1. William B. Riddens, “Understanding Automotive Electronics”, 5th Edition, Butterworth Hennimann Woburn, 1998.
2. Jiri Marek, Hans Peter trah, 'Sensors Applications, Sensors for Automotive Technology', 1<sup>st</sup> Edition (Wiley -VCH)
3. U.Kiencke, and L. Nielson, “Automotive Control Systems”, Springer Verlag Berlin, 2000  
Judge.A.W, ‘Modern Electric Equipments for Automobiles’, Chapman and Hall, London.

#### **Reference Books**

1. Sonde.B.S., ‘Transducers and Display System’, Tata McGraw Hill Publishing Co. Ltd. New Delhi
2. W.F. Walter, ‘Electronic Measurements’, Macmillan Press Ltd., London.
3. E.Dushin, ‘Basic Metrology and Electrical Measurements’, MIR Publishers, Moscow, 1989.

#### **Course Outcomes:**

The student will be able to -

1. Demonstrate knowledge about fundamentals, construction and other details of switches and relays
2. Demonstrate knowledge about sensors and transducers
3. Demonstrate knowledge about electronic dash board instruments and other details
4. Demonstrate knowledge about actuators
5. Understand and explain the control systems using sensing and actuation devices.



**ME48114:: VEHICLE DYNAMICS****Credits: 02****Teaching Scheme: 2 Hours / Week****Unit I (5 Hrs)****Mechanics of Pneumatic tyres****A:** Tyre forces and moments, rolling resistance, tractive properties, cornering properties**B:** Tyre construction**Unit II (5 Hrs)****Performance characteristics of road vehicles****A:** Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration**B:** braking performance, Brake proportioning, braking efficiency**Unit III (5Hrs)****Ride Characteristics****A:** Excitation sources, human response, vehicle ride models**B:** Vehicle response**Unit IV (5 Hrs)****Handling characteristics****A:** Steady state cornering, suspension effects on cornering, Understeer effects, Experimental measurement of understeer gradient, testing of handling characteristics**B:** Directional stability of single track vehicles, 3-wheelers & 4-wheelers**Unit V (4 Hrs)****Suspensions and Steering system****A:** Roll centre analysis, Leaf Spring suspension. Steering geometry, steering forces and moments, axles, independent suspensions, suspension geometry**B:** Quarter car and half car modeling with ADAMS software,**Text Books**

1. Gillespie T, D. ,Fundamentals of Vehicle Dynamics , Society of Automotive Engineers

2. Giles J. G., Steering , Suspension and tyres , ILIFFE Books Ltd.

3. Ellis J. R., Vehicle handling dynamics, Mechanical Engineering Publications Ltd.  
London

### **Reference Books**

1. John Dixon, Suspension Geometry and Computation, John Wiley & Sons Ltd
2. Prof. Dipl.-Ing. JornsensReimpell, Dipl.-Ing. Helmut Stoll, Prof. Dr.-Ing. Jurgen W. Betzler, The Automotive Chassis: Engineering Principles, Society of Automotive Engineers, Inc.
3. A.Crolla, Automotive Engineering Powertrain, Chassis System and Vehicle Body, Elsevier Publications

### **Course Outcomes:**

The student will be able to-

1. Understand characteristics of the components related to the vehicle handling.
2. Understand vehicle performance criteria and able to solve simple problems on the same.
3. Understand vehicle models and analyse dynamic response of the vehicle.
4. Understand handling characteristics of the vehicles and able to perform mathematical analysis.
5. Understand basic characteristics of different components and assemblies responsible for vehicle handling.

## **ME 38311 :: AUTOMOBILE ENGINEERING LABORATORY**

**Credits : 01**

**Teaching scheme :- 2 Hrs /Week**

### **List of Experiments:**

1. Freehand sketching / CAD Modeling of prototypes of structural components of a car.
2. Design of exterior body by using a CAD / graphics software.
3. Study of design evolution of a mass produced car platform.
4. Study of new trends in the design of electric or hybrid vehicles.
5. Wheel alignment and balancing.
6. Mechatronic system used in a vehicle. (E.g. Power window mechanism, Power steering, ABS, etc.).
7. Engine pollution measurement and its analysis.
8. Programming & simulation for variable load performance of diesel engine.
9. Programming & simulation for Morse Test on multi-cylinder petrol engine.
10. Report on visit to automobile manufacturing industry/service station.

### **Text Books:**

1. K.Newton, W.Steeds & T.K.Garrett, 'The Motor vehicle', 'BUTTERWORTHS' London.
2. Singh Kripal, 'Automobile Engineering', Vol.I and Vol. II, Standard Publishers Distributors.
3. R.K. Rajput, A Textbook of Automobile Engineering,Laxmi Publications (Pvt.) Ltd.

### **Reference Books**

1. Narang G.B.S., 'Automobile Engineering', S.Chand and Company (Pvt.) Ltd.
2. Harbans Singh Reyat, 'The Automobile' S.Chand and Company (Pvt.) Ltd.
3. William H. Crouse and Donald L.Anglin, 'Automotive Mechanics', Tata McGraw Hill Publishing Company.
4. Joseph Heitner, 'Automotive Mechanics', C.B.S. Publisher and Distributors.
5. A.W.Judge, 'Automotive systems', Vol. 1 to 8.
6. AA Book of Car.

### **Course Outcomes :**

The student will be able to -

1. Demonstrate knowledge about CAD Modeling, exterior body design and other design considerations
2. Understand about automobile systems
3. Perform engine testing and do programming and simulation and do engine pollution measurement and its analysis

## **ME 48312 :: ADVANCED AUTOMOBILE ENGINEERING LABORATORY**

**Credits : 01**

**Teaching scheme :- 2 Hrs /Week**

### **List of Experiments:**

1. Advanced safety measures and comforts adopted in automotive vehicles.
2. Engine management system
3. Variable valve timing (VVT) and Variable valve lift engine control (VTEC) mechanism.
4. Alternative Fuels.
5. Automatic transmission.
6. Advanced braking systems.
7. Advanced suspension systems.
8. Electronic power steering. .
9. Vehicle reliability and testing.
10. Simulation of vehicle drive system.

### **Text Books:**

1. K.Newton, W.Steeds & T.K.Garrett, 'The Motor vehicle', 'BUTTERWORTHS' London.
2. A.W.Judge, 'Automotive systems', Vol. 1 to 8.
3. R.K. Rajput, A Textbook of Automobile Engineering,Laxmi Publications (Pvt.) Ltd.

### **Reference Books:**

1. William H. Crouse and Donald L.Anglin, 'Automotive Mechanics', Tata McGraw Hill Publishing Company.
2. Joseph Heitner, 'Automotive Mechanics', C.B.S. Publisher and Distributors.
3. A.W.Judge, 'Automotive systems', Vol. 1 to 8.
4. AA Book of Car.

### **Course Outcomes:**

The student will be able to -

1. Demonstrate knowledge about safety measures and comforts and latest trends in I.C. engine
2. Understand and explain various advanced systems used in automobiles.
3. Demonstrate knowledge about vehicle testing and Simulation of vehicle drive system