

Automobile Engineering

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SPPU
CREDIT SYSTEM SYLLABUS
B.E. (MECH) SEM - I
ELECTIVE-II



- SIMPLIFIED APPROACH
- CHAPTERWISE SOLVED SPPU QUESTIONS
DEC. 2005 TO DEC. 2018
- SOLVED SPPU QUESTION PAPERS
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As per Revised Syllabus of
SAVITRIBAI PHULE PUNE UNIVERSITY

Automobile Engineering

B.E. (Mechanical) Semester - I [Elective-II]

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Automobile Engineering

B.E. (Mechanical) Semester - I [Elective-II]

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PREFACE

The importance of **Automobile Engineering** is well known in various engineering fields. Overwhelming response to my books on various subjects inspired me to write this book. The book is structured to cover the key aspects of the subject **Automobile Engineering**.

The book uses plain, lucid language to explain fundamentals of this subject. The book provides logical method of explaining various complicated concepts and stepwise methods to explain the important topics. Each chapter is well supported with necessary illustrations, practical examples and solved problems. All chapters in this book are arranged in a proper sequence that permits each topic to build upon earlier studies. All care has been taken to make students comfortable in understanding the basic concepts of this subject.

Representative questions have been added at the end of each chapter to help the students in picking important points from that chapter.

The book not only covers the entire scope of the subject but explains the philosophy of the subject. This makes the understanding of this subject more clear and makes it more interesting. The book will be very useful not only to the students but also to the subject teachers. The students have to omit nothing and possibly have to cover nothing more.

I wish to express my profound thanks to all those who helped in making this book a reality. Much needed moral support and encouragement is provided on numerous occasions by my whole family. I wish to thank the **Publisher** and the entire team of **Technical Publications** who have taken immense pain to get this book in time with quality printing.

Any suggestion for the improvement of the book will be acknowledged and well appreciated.

Author
Anup Goel

Dedicated to Family, Friends and my Dear Students.

SYLLABUS

Automobile Engineering - (402045A)

Unit 1 : Introduction and Drive Train

Introduction : Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames : Types of chassis layout with reference to power plant locations and drive, various types of frames, constructional details.

Drive Train : Types of transmission system, necessity and selection of clutch, necessity of gear box and different types, fluid flywheel, torque convertor, continuous variable transmission, overdrive, propeller shaft, final drive and differential. (Chapters - 1 and 2)

Unit 2 : Axles, Wheels and Tyres, Steering System

Axles : Purpose, requirement and types of front and rear axle, loads acting on rear axles.

Wheels and tyres : Wheel construction, alloy wheel, wheel balancing, type of tyres, tyre construction, tyre materials, factors affecting tyre life.

Steering system : Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristics, steering linkages and gearbox, power steering, collapsible steering, reversibility of steering, four wheel steering, wheel alignment. (Chapters - 3 and 4)

Unit 3 : Suspension and Brake System

Suspension : Types of suspension linkages, types of suspension springs - leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self levelling suspension (active suspension), shock absorbers (hydraulic and air).

Brake systems : Drum, disc, mechanical, hydraulic, air brakes, vacuum, power assisted brakes, hand brake, ABS, EBD. (Chapters - 5 and 6)

Unit 4 : Vehicle Performance and Safety

Vehicle performance : Parameters, vehicle resistances, traction and tractive effort, power requirement for propulsion, road performance curves (numericals), stability of vehicles, vehicle testing on chassis dynamometer.

Vehicle safety : Types of active and passive safety, vehicle interior and ergonomics, NVH in automobiles. (Chapter - 7)

Unit 5 : Electrical System and Vehicle Maintenance

Batteries : Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods, introduction to lithium batteries.

Electrical system and accessories : Insulated and earth return systems, positive and negative earth systems, electrical fuel pump, speedometer, fuel, oil and temperature gauges, horn, wiper system, automotive sensors and actuators, electronic control unit/module.

Maintenance : Types of vehicle maintenance, servicing/overhauling of clutch, gear box, propeller shaft, differential, axles, steering system, suspension system, break system, electrical system. (Chapters - 8, 9 and 10)

Unit 6 : Electric and Hybrid Electric Vehicles

Introduction : Concept and environmental importance of EVs, HEVs and solar vehicles.

Electric vehicles : Layout, construction and working.

Hybrid electric vehicles : Types, layout, hybridization factor, plug in hybrid electric vehicles, fuel efficiency analysis.

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UNIT - 1

1

Introduction to Automobile Engineering

Syllabus

Introduction : Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames : Types of chassis layout with reference to power plant locations and drive, various types of frames, constructional details.

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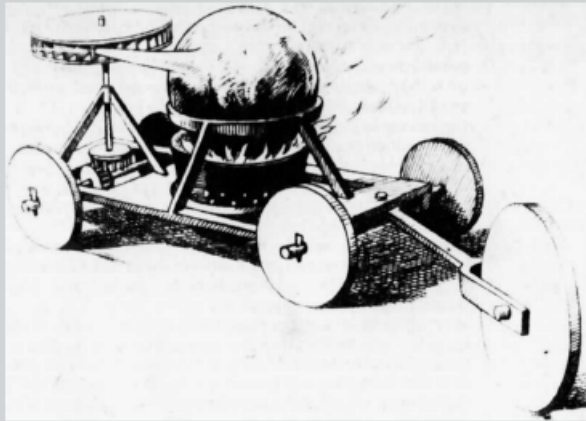
1.1 Definition of Automobile

- An *automobile*, autocar or motor car is a self propelled wheeled motor vehicle used for transporting passengers and goods on ground.
- Automobiles are designed to run primarily on roads unlike other self propelled vehicles used for air transport (aeroplane, helicopter) and water transport (ship, motor boat).

1.2 Automobile History and Development

- The automobile wasn't just invented.
- It is not the product of any single man or group rather it is the culmination of a worldwide series of experiments and developments.
- Today's automobile represents over 100,000 patents.
- The history of the automobile can be traced to prehistoric times for, fundamentally, it depends on the use of the wheel, fire, and manufactured materials.
- The history and development of automobile is summarized in Table 1.1.

Table 1.1 Automobile history and development

Time period	Engine type	Highlights
1672	Steam engine	<ul style="list-style-type: none"> • Ferdinand Verbiest, a member of a Jesuit mission in China, built the first steam-powered vehicle around 1672 as a toy for the Chinese Emperor. • It was a 65 cm model that could not carry a driver but it was, quite possibly, the first working steam-powered vehicle.  <p>Fig. 1.1 The steam car designed by Verbiest</p>
1769	Steam engine	<ul style="list-style-type: none"> • Nicolas-Joseph Cugnot build and demonstrated the first self-propelled mechanical vehicle. • It was an experimental steam-powered tricycle based artillery tractor. • It attained a speed of 2.5 miles per hour only for a period of 15 minutes. • Captain Nicolas Cugnot, a Frenchman is considered to be the father of "The Automobile".

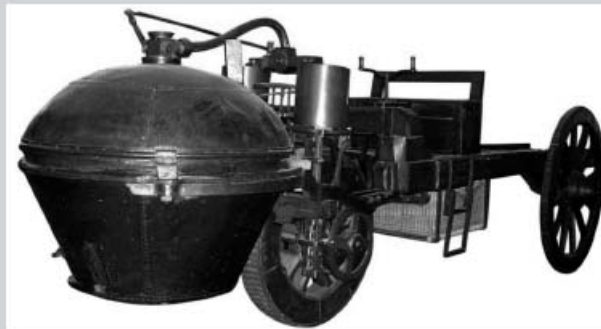


Fig. 1.2 (a) Cugnot's three-wheeled fardier à vapeur (steam dray)

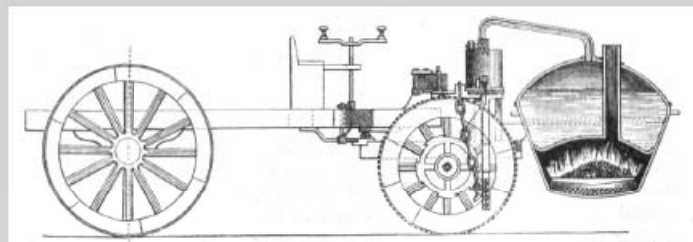


Fig. 1.2 (b) Cugnot's three-wheeled vehicle's cut-away drawing

1802	Steam engine	<ul style="list-style-type: none"> • Richard Trevitluek of England build the first practical steam engine based automobile using crankshaft for the first time.
1863	I.C. engine (gas fuel)	<ul style="list-style-type: none"> • Belgium inventor Etienne Lenoir was the first who gave us the first practical example of internal combustion engine. • It was a single cylinder engine working on lighting gas and the vehicle ran for 6 miles. <div> </div> <p>Fig. 1.3 The Lenoir gas engine with crankshaft</p>
1876	I.C. engine (gas fuel)	<ul style="list-style-type: none"> • Otto and Langen in Germany also invented and designed an internal combustion engine. • The engine was designed to work on coal gas and based on four-stroke cycle, known as 'Otto cycle'.
1880	I.C. engine (gas fuel)	<ul style="list-style-type: none"> • Dugald Clerk invented an engine based on two-stroke cycle.

<p>1885</p>	<p>I.C. engine (liquid fuel similar to gasoline i.e. petrol)</p>	<ul style="list-style-type: none"> • The actual development of modern automobile started from 1885. • Gottlieb Daimler in Germany patented an internal combustion engine and installed it on a bicycle. • This bicycle ran on liquid fuel similar to gasoline. • The first vehicle of this type was the three-wheeled car built in 1885 by the engineer Karl Benz in Germany. • It was the first high speed light construction gas engine capable of running at 800-1000 r.p.m. • This was the greatest achievement in the development history of automobiles. <div> </div> <div> <p>Fig. 1.4 The Reitwagen (riding car), the world's first internal combustion motorcycle</p> </div>
<p>1886</p>	<p>I.C. engine (liquid fuel similar to gasoline i.e. petrol)</p>	<ul style="list-style-type: none"> • Karl Benz of Germany also built a three wheeled carriage. • It was an internal combustion engine working on Otto cycle. <div> </div> <div> <p>Fig. 1.5 Karl Benz's patented tricycle</p> </div>
<p>1892</p>	<p>I.C. engine (liquid fuel i.e. diesel)</p>	<ul style="list-style-type: none"> • Ackroyd-Stuart, an Englishman and Rudolf Diesel, a German developed the diesel engine and got the patent approved in 1893.
<p>1892</p>	<p>I.C. engine (gasoline fuel i.e. petrol)</p>	<ul style="list-style-type: none"> • Charles E. Duryea and Grank Duryea (both brothers) produced the first gasoline (petrol) automobile in Massachutes, America.

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