

**DEPARTMENT OF AUTOMOBILE ENGINEERING  
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING  
INDUS UNIVERSITY**

B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VIII)											
SEMESTER - II (w.e.f. Year 2021-2024)											
Sub. Code	Name of the subject	C R E D I T	Teaching Scheme (per week)				Evaluation Scheme				
							Theory		Practical		Total Marks
			CIE	End Sem	CIE	End Sem					
			Th	Th	Pr	Pr					
AU0022	Fundamentals of Automobile Engines	3	2	0	2	3	60	40	60	40	200
AU0223	Fundamentals of Automobile Systems	3	2	0	2	3	60	40	60	40	200

**DEPARTMENT OF AUTOMOBILE ENGINEERING**  
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B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem IV)												
SEMESTER - IV (w.e.f. Year 2021-2024)												
Sub. Code	Name of the subject	C R E D I T S	Teaching Scheme (per week)				Evaluation Scheme					
			Th	T ut	P r	Tot hr	Theory		Practical		Total Mark s	
							CI E	End Sem	CI E	End Sem		
Th	Th	Pr	Pr									
AU0406	Automobile Systems	4	3	0	2	5	60	40	60	40	200	
AU0411	Machine Design & Industrial Drafting	3	2	1	0	3	60	40	0	0	100	
AU0410	Engineering Thermodynamics	3	3	0	0	3	60	40	0	0	100	
	Department Elective - 1	3	2	0	2	4	60	40	60	40	200	
	Open Elective 4	3	3	0	0	3	60	40	0	0	100	
	Open Elective 5	3	3	0	0	3	60	40	0	0	100	
AU0431	Constitution of India	2	2	0	0	2	60	40	0	0	100	
BB0311	Management for Engineers	2	-	-	-	-	-	-	100	-	100	
	<b>TOTAL</b>	<b>23</b>	<b>18</b>	<b>1</b>	<b>4</b>	<b>23</b>	<b>420</b>	<b>280</b>	<b>280</b>	<b>120</b>	<b>1000</b>	

## Open Elective 4

<b>Subject Code</b>	<b>Department</b>	<b>Subject</b>
CE0419	CE/CS/IT	Cyber Security and Intellectual Property Rights
AU0421	Auto	Off Road Vehicles
MME0405	Meta	Metal Casting and Solidification
EC0421	EC	Signals & Systems
EL0422	EL	Solar and Wind Energy System
ME0434	Mech	Roadmap for Patent creation
CV0424	Cvl	Engineering Materials for Sustainability
	SH	Complex Analysis

## Open Elective 5

<b>Subject Code</b>	<b>Department</b>	<b>Subject</b>
CE0420	CE/CS/IT	Web Design
AU0422	Auto	Modern Vehicle Technology
MME0406	Meta	Recycling of Materials
EC0422	EC	Modern Communication Trends
EL0423	EL	Solid State Devices and Applications
ME0435	Mech	Energy Management
CV0425	Cvl	Metro Systems and Engineering
	SH	Discrete Mathematics

## Department Elective – 1

<b>Subject Code</b>	<b>Subject</b>
AU0407	Automobile Materials (D.E. - I)
AU0408	Automotive Infotronics & Autotronics (D.E. - I)
AU0409	Industrial Engineering (D.E. - I)

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B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VI)											
SEMESTER - VI (w.e.f. Year 2021-2024)											
Sub. Code	Name of the subject	C R E D I T S	Teaching Scheme (per week)				Evaluation Scheme				Total Marks
			Th	Tut	Pr	Total (hr)	Theory		Practical		
							CIE	End Sem	CIE	End Sem	
Th.	Th.	Pr.	Pr.								
AU0615	Vehicle Maintenance & Garage Practices	4	2	0	4	6	60	40	60	40	200
AU0624	Heat & Mass Transfer	4	2	1	2	5	60	40	60	40	200
AU0616	Internal Combustion Engine Technology	4	3	0	2	5	60	40	60	40	200
	Department Elective - 3	3	3	0	0	3	60	40	0	0	100
	Department Elective - 4	3	2	0	2	4	60	40	60	40	200
	Open Elective - 7	3	3	0	0	3	60	40	0	0	100
AU0632	Tires and Alignment Basics – MOOC (Optional)	3	-	-	-	-	Offered by <a href="http://www.class-central.com">www.class-central.com</a>				
AU0631	Aptitude Enhancement	2	2	0	0	2	60	40	0	0	100
	<b>TOTAL</b>	<b>26</b>	<b>17</b>	<b>1</b>	<b>10</b>	<b>28</b>	<b>420</b>	<b>280</b>	<b>300</b>	<b>200</b>	<b>1100</b>



## Open Elective 7

<b>Subject Code</b>	<b>Department</b>	<b>Subject</b>
CE0625	CE/CS/IT	Big Data & Business Analysis
AU0621	Auto	Intelligent Vehicle Technology
MME0611	Meta	Nano Technology
EC0623	EC	Digital Image Processing
EL0627	EL	Sensors and Actuators
ME0545	Mech	Non-Conventional Energy sources
CV0627	Cvl	Green Buildings
	SH	Graph Theory

## Department Elective – 3

<b>Subject Code</b>	<b>Subject</b>
AU0617	Quality & Reliability Engineering (DE-III)
AU0625	(DE-III)
AU0619	Production Technology (DE-III)

## Department Elective – 4

<b>Subject Code</b>	<b>Subject</b>
AU0620	Automotive Safety, Ergonomics & Auxiliary systems (DE-IV)
AU0622	Fuel Cells & Applications (DE-IV)
AU0623	Automotive Hydraulics & Pneumatics Systems (DE-IV)

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B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VIII)										
SEMESTER - VIII (w.e.f. Year 2021-2024)										
Name of the subject	C R E D I T	Teaching Scheme (per week)				Evaluation Scheme				Total Marks
						Theory		Practical		
		CIE	End Sem	CIE	End Sem					
		Th	Tut	Pr	Total (hr)	Th	Th	Pr	Pr	
Project	15	0	0	15	15	0	0	60	40	100

## **2<sup>nd</sup> Semester**



**DEPARTMENT OF AUTOMOBILE ENGINEERING  
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INDUS UNIVERSITY**

B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VIII)											
SEMESTER - II (w.e.f. Year 2021-2024)											
Sub. Code	Name of the subject	C R E D I T	Teaching Scheme (per week)				Evaluation Scheme				
							Theory		Practical		Total Marks
			CIE	End Sem	CIE	End Sem					
			Th	Th	Pr	Pr					
AU0022	Fundamentals of Automobile Engines	3	2	0	2	3	60	40	60	40	200
AU0223	Fundamentals of Automobile Systems	3	2	0	2	3	60	40	60	40	200

Subject: <b>Fundamental of Automobile Engines (OE-2)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0022			Semester: 1/2	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Understand the construction and working of types of I.C. engines.
2. Recognize the different components of I.C. engine and types of engine
3. Understand the different parts of I.C. engine
4. Recognize the importance of automobile engine materials

### CONTENTS

#### UNIT 1

[8 hours]

History, Introduction of I. C. Engine and Steam engine, Difference between I. C. Engine and steam engine, Construction and working of two stroke petrol and diesel engine, Construction and working of four stroke petrol and diesel engine

#### UNIT 2

[8 hours]

Introduction of types of engine- On the basis of fuel used, On the basis of cycle of operations, On the basis of No. of stroke per cycle, On the basis of ignition system, On the basis of number and arrangement of cylinders, On the basis of valve arrangement

#### UNIT 3

[8 hours]

Introduction to Thermodynamic Cycle, IC Engines working cycle – Otto cycle, Diesel cycle, dual cycle, Air Standard Efficiency of Otto, Diesel and Dual Cycle.

#### UNIT 4

[8 hours]

Introduction of I. C. engine components, Function and construction of Cylinder block, Cylinder head, Crankcase, Function and construction of Piston, Piston rings, Piston pin, Connecting rod, Crankshaft, Flywheel, Camshaft, valve and valve mechanism, Rocker arm

Function and construction of air filter, oil filter, spark plug, carburetor, Fuel injector, Introduction of engine materials

### **Course Outcome**

1. Be aware of the construction and working of types of I.C. engines.
2. Recognize the different components of I.C. engine and types of engine
3. Identify the different parts of I.C. engine
4. Recognize the importance of automobile engine materials

### **Text Books**

1. S Srinivasan, "Automotive Engines", Tata McGraw-Hill Education, Fifth Reprint, 2007
2. Domkundwar, "Internal Combustion Engines", DhanpatRai Publication, 2013

### **Reference Books**

1. James D Halderman, "Automotive Engines", Pearson, Edition 4, 2014
2. R.B. Gupta, "Automobile Engineering", SatyaParkashan, New Delhi, Edition 2, 2015

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcomes</b>
1.	To study about Construction and working of two stroke petrol and diesel engine	Basic knowledge and fundamentals of two stroke petrol and diesel engine
2.	To study about Construction and working of four stroke petrol and diesel engine	Basic knowledge and fundamentals of four stroke petrol and diesel engine
3.	To study about classification of I.C. engine	Basic knowledge and fundamentals of classification of I.C. engine
4.	To study about Function and construction of Cylinder block, Cylinder head, Crankcase	Basic knowledge of Cylinder block, Cylinder head, Crankcase
5.	To study about Function and construction of Piston, Piston rings, Piston pin, Connecting rod, Crankshaft, Flywheel, Camshaft	Basic knowledge of Piston, Piston rings, Piston pin, Connecting rod, Crankshaft, Flywheel, Camshaft
6.	To study about Function and construction of air filter, oil filter, spark plug	Basic knowledge and fundamentals of air filter, oil filter, spark plug
7.	To study about Function and construction of carburetor, Fuel injector	Basic knowledge and fundamentals of carburetor, Fuel injector
8.	To study about engine materials	Basic knowledge of engine materials

Subject: <b>Fundamental of Automobile System (OE-3)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0223			Semester: 2	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Recognize the importance of different types of fuel and cooling systems.
2. Understand the name of components and function of brake, steering and suspensions system
3. Understand different parts of electrical system
4. Recognize the importance of transmission system

### CONTENTS

#### UNIT 1

[8 hours]

Introduction of fuel system- classification of fuel feed system, classification of carburetor, classification of fuel injection system, Introduction of engine cooling system- Methods of cooling, Introduction of engine lubrication system- Properties of lubricants

#### UNIT 2

[8 hours]

Introduction of steering and front axle- Name of different components, function and requirement of steering system, Types of front axles, Introduction of suspension- Function, types and requirement of suspension system, Introduction of brakes - Function, types and requirement of brake

#### UNIT 3

[8 hours]

Introduction of electrical system- Name of different components, function and requirement of battery, charging system, Starting system, Ignition system

#### UNIT 4

[8 hours]

Introduction of transmission system, Introduction of clutch- Function, types and requirement of clutch , Introduction of transmission - Function, types and requirement of transmission, Introduction of differential and rear axle- Function, types and requirement of differential

### **Course Objectives**

1. Recognize the importance of different types of fuel and cooling systems.
2. Understand the name of components and function of brake, steering and suspensions system
3. Understand different parts of electrical system
4. Recognize the importance of transmission system

### **Text Books**

1. Kripal Singh, “Automobile Engineering”, Standard Publishers Distributors Delhi, Edition 13, 2012
2. Dr. K.M. Gupta, Automobile Engineering Vol-I & II, Edition 12, 2011

### **Reference Books**

Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, Edition 5, 2014

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcomes</b>
1.	To study about fuel supply system	Basic knowledge and fundamentals of fuel supply system
2.	To study about steering system	Basic knowledge and fundamentals of steering system
3.	To study about suspension system	Basic knowledge and fundamentals of suspension system
4.	To study about brakes	Basic knowledge of brakes
5.	To study about electrical system	Basic knowledge of electrical system
6.	To study about transmission system	Basic knowledge and fundamentals of transmission system
7.	To study about transmission	Basic knowledge and fundamentals of transmission
8.	To study about differential and rear axle	Basic knowledge of differential and rear axle

# **4<sup>TH</sup> SEMESTER**

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B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem III)												
SEMESTER - IV (w.e.f. Year 2021-2024)												
Sub. Code	Name of the subject	C R E D I T S	Teaching Scheme (per week)				Evaluation Scheme				Total Mar ks	
							Theory		Practical			
			CI E	En d Se m	CI E	En d Se m	Th	Th	Pr	Pr		
AU0406	Automobile Systems	4	3	0	2	5	60	40	60	40	200	
AU0411	Machine Design & Industrial Drafting	3	2	1	0	3	60	40	60	40	100	
AU0410	Engineering Thermodynamics	3	3	0	0	3	60	40	0	0	100	
	Department Elective - 1	3	2	0	2	4	60	40	60	40	200	
	Open Elective 4	3	3	0	0	3	60	40	0	0	100	
	Open Elective 5	3	3	0	0	3	60	40	0	0	100	
AU0431	Constitution of India	2	2	0	0	2	60	40	0	0	100	
BB0311	Management for Engineers	2	2	0	0	2	60	40	0	0	100	
	<b>TOTAL</b>	23	18	1	4	23	420	280	280	120	1000	

## Open Elective 4

<b>Subject Code</b>	<b>Department</b>	<b>Subject</b>
CE0419	CE/CS/IT	Cyber Security and Intellectual Property Rights
AU0421	Auto	Off Road Vehicles
MME0405	Meta	Metal Casting and Solidification
EC0421	EC	Signals & Systems
EL0422	EL	Solar and Wind Energy System
ME0434	Mech	Roadmap for Patent creation
CV0424	Cvl	Engineering Materials for Sustainability
	SH	Complex Analysis

## Open Elective 5

<b>Subject Code</b>	<b>Department</b>	<b>Subject</b>
CE0420	CE/CS/IT	Web Design
AU0422	Auto	Modern Vehicle Technology
MME0406	Meta	Recycling of Materials
EC0422	EC	Modern Communication Trends
EL0423	EL	Solid State Devices and Applications
ME0435	Mech	Energy Management
CV0425	Cvl	Metro Systems and Engineering
	SH	Discrete Mathematics

## Department Elective – 1

<b>Subject Code</b>	<b>Subject</b>
AU0407	Automobile Materials (D.E. - I)
AU0408	Automotive Infotronics & Autotronics (D.E. - I)
AU0409	Industrial Engineering (D.E. - I)



Subject: <b>Automobile Systems</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0406			Semester: <b>IV</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Develop an understanding on working of Automobile System.
2. Develop in-depth knowledge on various systems in Automobile System

## CONTENTS

### UNIT 1

[12 hours]

#### **CHASSIS & BODY**

Classification of vehicle, layout with reference to power plant, steering location and drive, chassis, construction and details (frames, sub-frames, defects in frame, frameless vehicles, vehicle dimensions), details of chassis & body materials, Integrated body construction, BIW type and corresponding design parameters, Vehicle interior system (dash board & seating system), Cosole design, Pillar trims (Type A, B, C), head roofs.

#### **TRANSMISSION & DRIVELINE**

Clutches, principle, types, Fluid coupling and torque convertors, problems on performance of automobile such as resistance to motion, tractive efforts, engine speed, power and acceleration requirements. Determination of gear box ratios for different vehicle applications, different types of gear boxes, Automatic transmission, Effect of driving thrust and torque-reaction, Hotchkiss drives, Torque tube drive, radius rods, Propeller shaft, Universal joints, Final drive- different types, two speed rear axle, Rear axle construction: full floating, three quarter floating and semi-floating arrangements, Differential: conventional type & Non-slip type, differential locks

### UNIT 2

[12 hours]

#### **FRONT AXLE & STEERING**

Front axle types, rigid axle and split axle, constructional details, materials, front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out, Wheel alignment and balancing, Condition for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkages layout for conventional and independent suspensions. Turning radius,

instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering.

### **UNIT 3**

**[12 hours]**

#### **BRAKING SYSTEM**

Type of brakes, Principles of shoe brakes. Constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Parking & Exhaust brakes, power & power assisted brakes, Antilock Braking System (ABS).

#### **SUSPENSION SYSTEM**

Types of suspension, factors influencing ride comfort, types of suspension springs (leaf & coil springs), independent suspension (front and rear). Rubber, pneumatic, hydro-elastic suspension, Shock absorbers, types of wheels, construction of wheel assembly, types of tyres and constructional details, Static and rolling properties of pneumatic tyres, tubeless tyres and aspect ratio of tubed tyres

### **UNIT 4**

**[10 hours]**

#### **WHEELS & TYRES**

Types of wheel rims, Tread patterns, Types of tyres, Cross ply, Radial & tubeless tyres, Specifications of tyres

#### **PERFORMANCE OF VEHICLE**

Vehicle motion, Resistances during motion, Power required for acceleration and constant velocity motions, Tractive efforts and draw bar pull, Power required and engine characteristics, Gear ratio requirement, Motion on gradient

#### **Course Outcomes**

After learning the course the students should be able to:

1. Understand the various vehicle classification and its layouts.
2. Understand the different types of suspension systems.
3. Understand the functions of different types of clutches and brakes.
4. Understand the types of gear boxes and transmission systems.
5. Understand the steering requirements and types of front axle.
6. Understand the performance of vehicle.
7. Understand the types of wheel rims and tires with their specifications.

#### **Text Books**

1. KripalSingh, "Automobile Engineering", Standard Publishers Distributors Delhi, Edition 13, 2012.
2. R.B. Gupta, "Automobile Engineering", SatyaParkashan, New Delhi, Edition 2, 2015.

### **Reference Books**

1. James D Halderman, "Automotive Engineering", Pearson, Edition 4, 2012.
2. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, Edition 5, 2014

### **Web Resources**

1. [http://web.iitd.ac.in/~achawla/public\\_html/736/1-Automobile\\_intro-v5\\_1.pdf](http://web.iitd.ac.in/~achawla/public_html/736/1-Automobile_intro-v5_1.pdf) - Introduction
2. <http://www.ignou.ac.in/upload/Unit-1-61.pdf> - vehicle classification and its layouts
3. <https://www.howacarworks.com/basics/how-a-car-clutch-works> - Clutch
4. [http://www.carbibles.com/brake\\_bible.html](http://www.carbibles.com/brake_bible.html) - Brakes
5. [http://www.carbibles.com/steering\\_bible.html](http://www.carbibles.com/steering_bible.html) - Steering
6. [http://www.carbibles.com/transmission\\_bible.html](http://www.carbibles.com/transmission_bible.html) - Transmission
7. [http://www.carbibles.com/suspension\\_bible.html](http://www.carbibles.com/suspension_bible.html) - Suspension

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcome</b>
1.	To study about vehicle layouts	Basic knowledge of different drive systems
2.	To study about different types of clutch	Knowledge of construction and working of clutch and its mechanism
3.	To study about the performance of vehicle	Knowledge of construction and working of rear axle, final drive and differential
4.	To study about the different types of gear boxes	Knowledge of vehicle performance on grades
5.	To study about rear axle, final drive and differential	Basic knowledge of construction and working of gearbox
6.	To study about Automatic Transmission system	Basic knowledge of construction and working of epicyclic gearbox
7.	To study about different types of tires and wheels.	Basic knowledge of construction and working of different types of tires and wheels
8.	To study of different types of automobile brakes.	Knowledge of Construction and working of hydraulic brakes
9.	To study of steering systems	Basic knowledge of construction and working of different types of steering mechanism and linkages.
10.	To study about different types of suspension system	Basic knowledge of construction and working of different suspensions used in automobile

Subject: Machine Design & Industrial Drafting								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0411			Semester: <b>IV</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	1	0	3	16/40	0	24/60	0	100

### Course Objectives

1. Student to be made aware of computer aided drafting of the component and system.
2. Basic knowledge of design techniques and fundamentals of design procedure

## CONTENTS

### UNIT 1

[8 hours]

#### **INTRODUCTION**

Design, Drafting, Difference between design and drafting, Machine Design, Basic procedure of Design, Standards in Design, Selection of Preferred sizes, Concepts of stresses and Strain, Theories of Failures: Distortion energy (von Mises), Maximum Shear stress, Maximum Principal stress, Selection and Use of theories of failures; Factor of safety, Crushing and Bearing stress.

Application Problems: Cotter and Knuckle Joints, Design of levers.

### UNIT 2

[8 hours]

#### **SCREWED THREADS & FASTENERS**

Introduction, Terminologies, All types of V & square threads, Conventional representation of threads, Multiple start thread, Right hand & left hand threads, Types of nut, bolt & washer, Forms of bolt, Set-screw, Drawing hexagonal nut and square nut, hexagonal headed bolt, square headed bolt and washer. Screw thread, Foundation of bolt, locking arrangement, stud, set screw, Spanner.

### UNIT 3

[11 hours]

#### **ELEMENTS OF PRODUCTION DRAWING**

Geometric tolerance, types of Geometric tolerance, terminology for Geometric tolerance, Representation of Geometric tolerance on drawing, Dimensional tolerance, Terminology of dimensional tolerance, selection of tolerance, representation of dimensional tolerance, Fits, Hole basis and shaft basis system, Representation of Holes, shafts and Fits, Surface roughness, Terminology of surface roughness, Representation of surface roughness on drawing, Conventional representation of machine parts.

## UNIT 4

[11 hours]

### **CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS & MATERIALS**

leaf spring, leaf spring with eyes, coil spring (tension and compression), disc spring, spiral spring, splined shaft, serrated shaft, square end of shaft, ball and roller bearing, spur gearing, bevel gearing, worm and worm wheel, straight knurling, diamond knurling, internal and external thread, method of designating and dimensioning metric thread & materials representation.

### **AUTOCAD**

Different softwares packages for drafting, Advantage & Application of CAD, Concept of CAD, 2D drafting using AutoCAD, AutoCAD basic commands & applications, 2D drafting of machine part.

### **Course Outcomes**

After learning the course the students should be able to:

1. Students will be able to analyse components subjected to various mechanical loads.
2. Students will be able to analyse beams and columns for stresses and deflection.
3. Students will be able to design and analyse shafts, keys and couplings.
4. Students will be able to select fasteners and design welded / riveted joints.
5. Students will be able to generate and interpret assembly and production drawings

### **Text Books**

1. P.C Sharma and D. K. Aggarwal “Machine Design”, S.K. Kataria& Sons, Edition 3, 2009.
2. V. B. Bhandari “Design of Machine Elements”, McGraw Hill Publication Publishing Co, Edition 2, 2011.

### **Reference Books**

1. William Orthein, “Machine Component Design (Vol. I & II)”, M/s. Jaico Publishing, 1998 - 99
2. N.D. Bhatt, “Machine Drawing”, Charator Publication, Edition 50, 2014.
3. P.S. Gill, “Machine Drawing”-S.K. Kataria& Sons, New Delhi, 2009
4. S. G. Kulkarni, “Machine Design” - Solved Problems”, McGraw Hill Publication Publishing Company Ltd., New Delhi, Edition 3, 2008.
5. Joseph Edward Shigley and Charles R. Mischke, “Mechanical Engineering Design”, McGraw Hill International, Edition 10, ISBN-13: 978-0073398204.

### **Web Resources**

<http://nptel.ac.in/courses/112105124/> - Syllabus of whole subject included

Subject: <b>Engineering Thermodynamics</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0410			Semester: <b>IV</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
3	0	0	3	16/40	-	24/60	-	100

### Course Objectives

1. To study various energy interactions notably heat and work transfer based on certain laws of nature which are never seen to be violated.
2. To develop the idea of thermodynamics and topics like first law of thermodynamics, second law of thermodynamics, concept of entropy, properties of pure substances, gas power cycles, vapour power cycles, refrigeration etc.
3. To evaluate the thermal performance of different heat engines and refrigeration cycles through the calculation of their thermal efficiency or coefficient of performance.

### CONTENTS

#### UNIT 1

[12 hours]

#### **CONCEPTS OF THERMODYNAMICS**

Microscopic & macroscopic point of view, thermodynamic system and control volume, thermodynamic properties, processes and cycles, Thermodynamic equilibrium, Quasi-static process.

#### UNIT 2

[12 hours]

#### **FIRST LAW OF THERMODYNAMICS**

First law for a closed system undergoing a cycle and change of state, Energy-A property of the system, Different forms of stored energy, Specific Heat at constant Volume and Pressure, Enthalpy, Energy of an Isolated system, Perpetual motion machine of the first kind-PMM1, Control Volume, Steady flow Process, Mass and Energy balance in a simple steady flow Process.

#### **IDEAL GAS MIXTURES**

Composition of a gas mixtures, P-v-T behavior of ideal gas mixtures, properties Of ideal gas mixtures, psychometrics of gas-vapor mixtures.

#### UNIT 3

[12 hours]

#### **SECOND LAW OF THERMODYNAMICS**

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their

Equivalence, PMM of Second kind, reversibility and irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

### **ENTROPY**

Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes, third law of thermodynamics

### **AVAILABILITY**

Available and unavailable energy, availability of a closed system, availability function of a closed system availability of steady flow system, availability function of open system, Energy of a heat input in a cycle, exergy destruction in heat transfer process, irreversibility.

## **UNIT 4**

**[10 hours]**

### **THERMODYNAMIC RELATIONSHIPS**

Maxwell's equations, T-ds equations, difference in heat capacities, coefficient of Volume expansion and isothermal compressibility, adiabatic compressibility, ratio of specific heat, energy equations, Joule-Kelvin effect, Clausius-Clapeyron equation.

### **VAPOUR POWER CYCLES**

Ideal Rankine cycle, Comparison of Carnot and Rankine Cycle, Effect of operating variable on Rankine Cycle, Reheating of Steam, Simple Steam Power Cycle, Carnot Vapour Power Cycle,.

### **AIR STANDARD CYCLES**

Concept of air standard cycles, Assumptions, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Comparison of Otto, Diesel and Dual cycles, Efficiency of air standard cycle, Mean Effective Pressure, Relative efficiency. Brayton cycle, effect of reheat, regeneration, intercooling and turbine and compressor efficiency on Brayton cycle. (No numerical, for reheat & regenerative).

### **Course Outcomes**

After learning the course the students should be able to

1. Understand basic terms used in thermodynamics.
2. Understand laws of thermodynamics and its applications.
3. Comprehend the concept and applications of energy, entropy and exergy.
4. Understand various gas and vapour power cycles.
5. Understand the properties of gas mixtures

### **Text Books**

P.K. Nag, "Engineering Thermodynamics" Tata McGraw-Hill, 5th edition, 2013.

### **Reference Books**

1. R.Yadav, “Fundamentals of Engineering Thermodynamics”, Central Publishing House, 3rd edition, 1996.
2. YunusCentel& Boles, “Thermodynamics – An Engineering Approach”, Tata McGraw-Hill, 3rd edition, 2013.
3. YVC Rao , “An introduction to Thermodynamics”, New Age publishers, 2nd edition, 1993.

### **Web Resources**

1. <http://nptel.ac.in/courses/112105123> - Whole syllabus included.
2. <https://www.youtube.com/watch?v=ub86Dhg67tM> – combustion of fuels
3. <https://www.youtube.com/watch?v=RzAPQPWOINI> – Properties of gases and mixtures

### **MOOC:-**

1. <https://www.coursera.org/learn/thermodynamics-intro>
2. [https://onlinecourses.nptel.ac.in/noc18\\_ae05/preview](https://onlinecourses.nptel.ac.in/noc18_ae05/preview)



Subject: <b>Automobile Materials (DE-I)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0407			Semester: <b>IV</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. To develop the knowledge of Automotive engineering materials and Selection
2. To develop the knowledge of materials and their applications in automotive
3. Applications in different sectors.
4. To introduce the concepts of heat treatment and surface modification techniques
5. To introduce knowledge in advanced metallic and non metallic materials

## CONTENTS

### UNIT 1

[8 hours]

#### **REVIEW OF MECHANICAL AND CHEMICAL BEHAVIOR OF MATERIALS**

Structure of crystalline solids, imperfections in solids, Plastic deformation Strengthening mechanisms Griffith's theory of failure modes –Damping properties of materials fracture toughness Initiation and propagation of fatigue cracks Creep mechanisms environmentally induced degradation and preventivesolutions

#### **ENGINEERING ALLOYS**

Cast iron, steels, alloy steels - significance of iron – iron carbide equilibrium diagram in design steels and cast irons, stainless steels –, types, specific applications, heat treatment, effect of alloying elements Aluminum, Magnesium and Ti wrought and cast alloys used in automotive applications –Types, specifications, heat treatment

### UNIT 2

[8 hours]

#### **AUTOMOTIVE COMPONENTS & MATERIAL SELECTION**

Organized process of Selection of Materials for different components. Materials for Power train components like cylinder block ,head& liner, piston &piston rings, gudgeon pin, connecting rod, bearings, crankshaft, flywheel, camshaft, valves, valves seats, springs, gear train, chain &belt drives. Materials for Automobile components like body –in –white, crash worthiness, suspension systems, cabin interiors. Functional requirements, manufacturing processes & failure modes for each.

#### **NON METALLIC MATERIALS**

Elastomers and Engineering Plastics, FRP Composite materials, ceramics, laminated & heat treated glass, adhesive bonding, An over view of Manufacturing processing, their characteristics features, types and applications

### **UNIT 3**

[8 hours]

#### **SURFACE MODIFICATION OF MATERIALS**

Mechanical surface treatment and coating -Case hardening and hard facing -thermal spraying – vapour deposition-iron implantation -Diffusion coating -Electroplating and Electro-less - Conversion coating -Ceramic and organic coatings – laser based surface modification Diamond coating.

#### **INTRODUCTION TO COMPOSITE MATERIALS**

Definitions: Composite material, Fiber, Matrix. Types of fibers and Raw Fiber Properties, Types of Matrix, Prepegs, Fillers and other Additives

### **UNIT 4**

[8 hours]

#### **MODERN MATERIALS AND ALLOYS**

Light weight materials & implications on vehicle design,, Micro alloyed, high strength low alloy steel – High strength Steels (HSS), Advanced High Strength Steels (AHSS), Ultra high strength Steels (UHSS), developments in Aluminum and Magnesium alloys, Advanced forming & joining processes like - Hydro forming, Warm forming, Laser welding techniques, Induction heating, etc; carbon fiber composites, Natural fibers, refractory metals, SMART Materials - shape memory alloys (SMA), Piezo-electric materials, MEMS, Metallic glass-Quasi crystal and Nano crystalline materials, metal foams.

#### **BASICS OF COMPOSITES**

Mechanical Behavior of Composite Materials. Lamina, Laminate: The basic building block of a composite material

#### **Course Outcomes**

After learning the course the students should be able to:

1. Understand the significance of replacing existing metal structures with composite materials wherever beneficial
2. Highlight the appropriate use of different material structures in the industry
3. Comprehend the complexity of design of different materials and structures
4. Mainly understand the mechanics of different materials

#### **Text Books**

Callister W.D. "Material Science and Engineering- An introduction", Wiley –Eastern Publications 3rd edition (2006)

#### **Reference Books**

1. Thomas H. Courtney, "Mechanical Behavior of Materials", McGraw Hill 2nd edition (2000)
2. Flinn R. A. and Trojan P. K., "Engineering Materials and their Applications", Jaico publications 3rd edition (1999)

### **Web Resources**

1. <http://nptel.ac.in/courses/101106038/mod01lec02.pdf>- composite materials
2. [https://nptel.ac.in/courses/112108150/pdf/PPTs/MTS\\_01\\_m.pdf](https://nptel.ac.in/courses/112108150/pdf/PPTs/MTS_01_m.pdf) - modern materials
3. [https://nptel.ac.in/courses/112101005/downloads/Module\\_2\\_Lecture\\_1\\_final.pdf](https://nptel.ac.in/courses/112101005/downloads/Module_2_Lecture_1_final.pdf) - non metallic materials

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcome</b>
1.	Study of optical microscope.	Understand the working of optical microscope
2.	Specimen preparation for metallography.	Understand the basic terminologies and applications
3.	Mounting of specimen.	Understand the basic concept hot mounting and cold mounting
4.	Structure of Pure metals	Study the basic structures of metals and their properties.
5.	Micro-structural observation of Cast Irons.	Study the microstructure of ferrous materials
6.	Annealing of Medium / High carbon steels.	Study effect of annealing on medium/ high carbon steel
7.	Normalizing of Medium / High carbon steels.	Study the effect of normalizing on medium/ high carbon steel
8.	Spheroidizing of High carbon steel.	Study effect of spheroidization of high carbon steel
9.	Hardening & tempering of medium/ high carbon steels.	Study effect of hardening & tempering on medium / high carbon steel.
10.	To examine the effect of quenching media on hardening of steel	Examine the effect of quenching media on hardening of steel

Subject: <b>Automotive Infotronics &amp; Autotronics (DE-I)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0408			Semester: <b>IV</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Understand the basics of Automotive Infotronics&Autotronics.
2. Know the working of sensors and actuators used in vehicle control.
3. Understand the working of electronic fuel supplyand the working electronic steering system.
4. Understand the computer based automotive instrumentation system.

### CONTENTS

#### UNIT 1

[8 hours]

#### **DRIVER ASSISTANCE SYSTEMS**

Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring.

#### **TELEMATICS**

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

#### UNIT 2

[8 hours]

#### **SAFETY SYSTEMS AND SECURITY SYSTEMS**

Airbags, seat belt tightening system, collision warning systems, child lock, anti - lock braking systems. anti - spin regulation, traction control systems. Anti theft technologies, smart card system, number plate coding.

#### UNIT 3

[8 hours]

#### **ADAPTIVE CONTROL SYSTEMS AND COMFORT SYSTEMS**

Adaptive cruise control, adaptive noise control, active roll control system, cylinder cut- off technology. Active suspension systems, requirement and characteristics, different types, power steering, collapsible and tilt able steering column, power windows.

## UNIT 4

[8 hours]

### **BASIC OF AUTOTRONICS**

Importance of Autotronics-definition of mechatronics- architecture of mechatronics –system-measurement, open loop and closed loop control system. - signal conditioning-interfacing-analog and digital signals- conversion of analog to digital conversion.-difference between conventional and mechatronics system. Fundamentals of Python- Introduction to Python, Running python program and writing python Codes.

### **SENSORS AND ACTUATORS**

Sensors –variable resistance sensor, pickup coil type sensor, Hall Effect switch, piezoelectric knock sensor, throttle position sensor, MAP sensor, MAF sensor and Actuators.

### **Course Outcomes**

After learning the course the students should be able to:

1. Understand about different vehicle assistance system
2. Understand about safety system about vehicle.
3. Understand about different Control Systems.
4. Overview of different sensors and actuators.

### **Text Books**

1. LjuboVlagic, Michel Parent and Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001.
2. Robert Bosch, “Automotive Hand Book”, 5th Edition, SAE, 2000.

### **Reference Books**

1. Bechhold, “Understanding Automotive Electronics”, SAE, 1998.
2. Ronald K Jurgen, “Navigation and Intelligent Transportation Systems – Progress in Technology”, Automotive Electronics Series, SAE, USA, 1998.
3. William B Riddens, “Understanding Automotive Electronics”, 5th edition, Butter worth Heinemann Woburn,1998.

### **Web Resources**

1. [https://www.youtube.com/watch?v=jt8EJnAT2\\_0](https://www.youtube.com/watch?v=jt8EJnAT2_0)- Lexus IS: Driver Support Systems
2. <https://www.mercedes-benz.com/en/mercedes-benz/innovation/mercedes-benz-intelligent-drive/>- Mercedes-Benz Intelligent Drive
3. [https://www.youtube.com/watch?v=9V\\_Mz7NDy3o](https://www.youtube.com/watch?v=9V_Mz7NDy3o)- Geographic Information Systems (GIS)
4. <https://www.youtube.com/watch?v=rYckJqp4XTc>- Collision warning systems at the test track
5. [https://www.youtube.com/watch?v=own\\_VaRZ9M8](https://www.youtube.com/watch?v=own_VaRZ9M8)- EN | Bosch Adaptive Cruise Control (ACC)
6. <https://www.youtube.com/watch?v=IQ1eKddstxM>- Electromagnetic Active Suspension System

7. <https://www.mathworks.com/videos/understanding-control-systems--part-4--simulating-disturbance-re-1480629735127.html>- Understanding Control Systems
8. <https://www.youtube.com/watch?v=3P3xxKS-l8E>- Knock Sensor using arduino and piezo element

**LIST OF EXPERIMENTS**

<b>No.</b>	<b>Title</b>	<b>Learning Outcome</b>
1	To study the basics of Infrotronics	Students will learn about Infrotronics.
2	To study the Driver Assistance Systems	Students will learn about driver support systems and Vehicle support
3	To study Telematics	Students will learn about Global positioning systems, geographical information systems and navigation systems.
4	To study Safety Systems	Students will learn about safety systems in Automobile.
5	To study Security Systems	Students will learn about security systems in Automobile.
6	To study Adaptive Control Systems	Students will learn about Adaptive cruise control, noise control, active roll control system, cylinder cut- off technology.
7	To study Comfort Systems	Students will learn about Active suspension systems, requirement and characteristics
8	To study the basics of Autotronics	Students will learn about Importance of Autotronics and mechatronics system.
9	To study about various Sensors	Students will learn about sensors used in automobile.
10	To study about various Actuators	Students will learn about actuators used in automobile.

Subject: <b>Industrial Engineering (DE-I)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0409			Semester: <b>IV</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Students learn to design and conduct experiments, as well as to analyze and interpret data
2. Students learn to function on multidisciplinary teams
3. Students learn to identify, formulate, and solve engineering problems

## CONTENTS

### UNIT 1

[8 hours]

#### **LOCATION SELECTION**

Nature of Location Decision, Importance of Plant Location, Dynamic Nature of Plant Location, Choice of site for selection, State regulations on location, Government policies on decentralization. Industrial Estates, Economic Survey of Site selection, SEZ, Comparison of location

#### **PLANT LAYOUT**

Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop, repair shop and services sectors.

### UNIT 2

[9 hours]

#### **PRODUCTION PLANNING AND CONTROL: INTRODUCTION**

Types of production systems and their characteristics functions and objectives of P.P.C., product design and development including standardization and simplification,

#### **SALES FORECASTING AND HUMAN RESAOURCES MANAGEMENT**

Concept, techniques, application, production planning and process planning, Sequencing, loading and scheduling, techniques and their selection, line of balance, assembly line balancing, dispatching, progress control, Wage sheet, HR laws, Designing of Human resources values.

## **INSPECTION AND STATISTICAL QUALITY CONTROL**

Inspection – functions, types, objectives and benefits, quality control – principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, ISO, and six sigmaSQC Concept, variable and attributes, normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability, Acceptance sampling, sampling plans, OC curves and AOQ curves

### **UNIT 3**

[8 hours]

#### **PRODUCTIVITY AND WORK STUDY**

Definition of productivity, application and advantages of productivity improvement tools, reasons for increase and decreases in productivity. Areas of application of work study in industry. Reaction of management and labour to work study. Method Study: Objectives and procedure for methods analysis, Recording techniques, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design.

#### **WORK MEASUREMENT**

Objectives, Work measurement techniques -time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, and standard time. introduction to ergonomics

### **UNIT 4**

[7 hours]

#### **JOB EVALUATION AND WAGE PLAN**

Objective, Methods of job evaluation, job evaluation procedure, merit rating (performance appraisal), method of merit rating, wage and wage incentive plans

#### **INDUSTRIAL LEGISLATION**

Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952

### **Course Outcomes**

After learning the course the students should be able to:

1. Demonstrate location decision and site selection
2. Use of plant layout knowledge for betterment of plant
3. Use of Production planning and control
4. Solve forecasting problem by applying different techniques
5. Understanding planning, scheduling and sequencing problems for shop floor
6. Demonstrate assembly line balancing and dispatching
7. Apply work study techniques and understands its importance for better productivity
8. Demonstrate wage and incentive plans



9. Acquire knowledge of industrial legislation
10. Apply statistical quality control techniques for inspection

**Text Books**

1. M. Mahajan “Industrial Engineering and Production Management “, Dhanpat Rai & Co., 2010
2. Martand Telsang “Industrial Engineering and Production Management” , S Chand & Company, 2016

**Reference Books**

1. J.L. Riggs ,”Production System, Planning, Analysis and Control” – By 3rd ed. Wiley, 2012
2. S K Sharma “Industrial Engineering and Organization Management” by, Savita Sharma, KATSON Books., 2014

**Web Resources**

1. [www.nptel.com/109870](http://www.nptel.com/109870) - Whole Syllabus
2. <http://www.economicdiscussion.net/engineering-economics/work-measurement-definition-objectives-and-techniques/21707> - work measurement
3. <https://www.slideshare.net/amirthakarathi/production-planning-control-15402497> - Production Planning & Control
4. [http://www.pondiuni.edu.in/storage/dde/downloads/hrmiv\\_cm.pdf](http://www.pondiuni.edu.in/storage/dde/downloads/hrmiv_cm.pdf) - job evaluation
5. <https://sol.du.ac.in/mod/book/view.php?id=794&chapterid=447> –wage plan

**LIST OF EXPERIMENTS**

No.	Title	Learning Outcome
1	To Study about Various Operation process chart (OPC)	Given real mechanical assembly having 6-8 components, prepare operation process chart. Students Understand and learn a. Sketch parts and assembly. b. Prepare OPC. c. Prepare process plans for all components.
2	To Study about various Flow diagram(FD)	Given real mechanical component having minimum 6-8 mechanical operations, prepare FD. Students Understand and learn a. Sketch component. b. Sketch institute workshop layout. c. Prepare FD.
3	To Study about Man and machine chart	Prepare man and machine chart for given situation. Students Understand and learn a. List objectives of preparing man and machine chart. b. Description of the situation c. Prepare the man and machine chart. d. Interpret the chart and suggest if any further improvements can be made with respect to enhance productivity.
4	To Study about Performance rating	Calculate co-efficient of co-relation for time study person using performance rating technique. Students Understand and learn a. performance rating. b. Description of the situation c. List the

		steps followed to perform the exercise. d. Observe and record the observations. e. Plot, interpret and calculate the co-efficient of correlation.
5	To Study about Time study	Calculate standard time for a given job using decimal minute stop watch techniques. Students Understand and learn. Sketch the part undertaken for time study. b. List elements to be considered. c. Observe and record elements time. d. List and justify allowances to be taken with values. e. Calculate standard time.
6	To Study about Frequency distribution curve	a. Take live problem (may be measured variable dimension, result analysis, etc. and summarize the data. b. Perform and prepare frequency table. c. Determine central tendency, spread or dispersion and range, mode, median and mean standard deviation and variance. d. Prepare frequency bar, frequency polygon and frequency curve. e. Plot the areas under normal curve. f. determine numbers/probabilities of acceptance/rejection using normal distribution table.
7	To Study about Control charts for variables	a. variable. b. For given live problem, determine subgroup size, measure the variable and record the observations. c. Perform necessary calculations and determine control limits. d. Plot X – R chart and interpret the same.
8	To Study about Control charts for attributes	a. attribute. b. Explain binomial and Poisson distributions. c. For given live problems (different for different charts), determine parameters, record the observations of attribute. d. Perform necessary calculations and determine control limits. e. Plot p and c charts and interpret the same.
9	To Study about Acceptance sampling	a. Show double sampling plan using block diagram. b. Prepare/operate double sampling plans on the basis of given lot size, AQL, inspection level and other input for a given problems. c. Record the observations and conclude the outcome.
10	Industrial Visit	Visit at least two related industries. Prepare the report as guidelines provided in notes.

Subject: Off Road Vehicles(OE-IV)								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0421			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	16/40	-	24/60	-	100

### Course Objectives

1. Classification and requirements of off road vehicles
2. Tractors, Earth moving machines, Scrapers and graders, Shovels and Ditchers.
3. Classification and requirements of Off road vehicles

## CONTENTS

### UNIT 1

[10 hours]

#### **INTRODUCTION TO OFF ROAD VEHICLES**

Land clearing machines Earth moving machines Scrapers and graders Shovels and ditchers' Power plants, chassis and transmission, multi-axle vehicles.

#### **STUDY OF WORKING PRINCIPLES & DESIGN CONSIDERATIONS**

Power system, transmission, final drive, lubrication, electrical, braking, steering, pneumatic & hydraulic control circuits.

### UNIT 2

[12 hours]

#### **CONSTRUCTIONAL WORKING FEATURES AND INSTRUMENTATION**

Transport equipment: Powered equipment, Tractors and Trolleys, Trailers, Platform lift trucks, Fork lift trucks, containers and Supports. Hauling equipment: Types of dump trucks, On-high way vehicles, off high way vehicles. Hoisting equipment: Jacks, truck mounted crane, Crawler crane, Outriggers.

### UNIT 3

[13 hours]

#### **TRACTORS**

Tractors and tractor units; Tractors in earth moving, applications of tractors, Rating of Tractors, Wheeled and Crawler tractor, Recent trends in tractor design, power shift transmission and final drive in caterpillar tractor. Motor grader, recent trends, control mechanism of a caterpillar motor grader.

## **EARTH MOVING MACHINES**

Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-Powered types - dump trucks and dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines.

### **UNIT 4**

**[12 hours]**

#### **SCARPER AND GRADERS**

Scrapers, elevating graders, self-powered scrapers and graders. Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines - ditchers - capacity of shovels. Land clearing machines: Bush cutter, stampers, tree dozer, rippers.

#### **SHOVELS AND DITCHERS**

Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.

#### **SPECIAL PURPOSE VEHICLES**

All terrain vehicles, Defence Vehicles, Special Purpose Electric Vehicles, Solar Vehicles and Hybrid Vehicles. Types, architecture and parameters of design considerations.

#### **Course Outcomes**

1. Students will be able to understand special type of vehicles based on the need and purpose.
2. Students will be able describe the working principles.
3. Students will be able to understand design considerations and features of special purpose vehicles.

#### **Text book**

Abrosimov. K. Bran Berg. A. and Katayer. K., “Road making Machinery”, MIR Publishers, Moscow, 1971.

#### **Reference Books**

1. Wang. J. T., “Theory of Grand vehicles”, John Wiley & Sons, New York, 1987.
2. Mahesh Varma, “Construction Equipment and its Planning and Applications, Metropolitan Books Co., Delhi, 2004.

#### **Web Resources**

1. <https://drive.google.com/drive/folders/0B5ghhqKc4g0dUkVqbG42cU8wYIU> - Whole Syllabus
2. [http://www.uotechnology.edu.iq/dep/building/LECTURE/structural%20engineering/third\\_class/Methods%20of%20Construction%20-%203rd%20Class/semester1/6-Excavating%20Equipment-Power%20Shovels.pdf](http://www.uotechnology.edu.iq/dep/building/LECTURE/structural%20engineering/third_class/Methods%20of%20Construction%20-%203rd%20Class/semester1/6-Excavating%20Equipment-Power%20Shovels.pdf)– Shovels
3. [http://www.bis.org.in/sf/med/me07\\_1237.pdf](http://www.bis.org.in/sf/med/me07_1237.pdf)- Earthmovers

Subject: Modern Vehicle Technology (O.E. – V)								
Program: B.Tech. Automobile Engineering				Subject Code: AU0422			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	16/40	-	24/60	-	100

### Course Objectives

1. To expose the fundamentals in various automotive body construction techniques.
2. To integrate the concepts of aerodynamics in body engineering for better style and low drag.

## CONTENTS

### UNIT 1

[10 hours]

#### **TRENDS IN AUTOMOTIVE PRIME MOVERS**

Hybrid Vehicles – Stratified charged / lean burn engines – Hydrogen Engines-battery vehicles – Electric propulsion with cables – Magnetic track vehicles.

### UNIT 2

[10 hours]

#### **SUSPENSION BRAKES AND SAFETY**

Air suspension-Closed loop suspension-antiskid braking system, Retarders, Regenerative braking safety cageair bags-crash resistance – passenger comfort.oise& Pollution: Reduction of noise – Internal & external pollution control through alternate fuels/ power plants-Catalytic converters and filters for particular emission.

### UNIT 3

[11 hours]

#### **VEHICLE OPERATION AND CONTROL**

Computer Control for pollution and noise control and for fuel economy-Transducers and operation of the vehicle like optimum speed and direction.

### UNIT 4

[12 hours]

#### **VEHICLE AUTOMATED TRACKS**

Preparation and maintenance of proper road network-National highway network with automated roads and vehicles-Satellite control of vehicle operation for safe and fast travel.

### **Course Outcomes**

After learning the course the students should be able to:

1. Understand and have knowledge about different aspects related to body and chassis.
2. Understand various safety provisions.
3. Understand different types of chassis and able to select the section of same.

### **Text books**

1. Heinz Heisler, “Advanced Vehicle Technology”, 2nd edition, Butterworth –Heinemann, 2002.
2. Wolf-Heinrich Hucho, “Aerodynamics of road vehicles”, 4th edition, 2000.

### **Reference Books**

John Fenton, “Vehicle Body layout and analysis”, Mechanical Engineering Publication Ltd., 1984

### **Web Resources**

1. [https://en.wikipedia.org/wiki/Commercial\\_vehicle](https://en.wikipedia.org/wiki/Commercial_vehicle) - Commercial vehicles
2. <http://www.techno-preneur.net/technology/project-profiles/mechanics/bus5.html> - Bus Body

Subject: Constitution of India								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0431			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	0	2	16/40	-	24/60	-	100

### Course Objectives

1. Students will Know the Fundamental rights
2. Students will be familiar with the concept of women empowerment
3. Students will be aware about the features of our constitution

## CONTENTS

### UNIT 1

[6 hours]

#### **Introduction**

Introduction to the Constitution of India, The Making of the Constitution and Sailable features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.

### UNIT 2

[8 hours]

#### **Directive Principles of State Policy & Relevance of Directive Principles**

State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.

### UNIT 3

[6 hours]

#### **State Executives**

State Executives – Governor Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th&91st Amendments.

### UNIT 4

[8 hours]

#### **Special Provision**

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Powers and functions of Municipalities, Panchayats and Co – Operative Societies.

### **Course Outcomes**

After learning the course the students should be able:

1. Understand the Fundamental Rights
2. Understand the various amendments introduced.

### **Text Books**

Constitution of India – Government of India.



Subject: <b>Management for Engineers</b>								
Program: <b>B.Tech in Automobile Engineering</b>				Subject Code: <b>BB0311</b>			Semester: <b>IV</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				<b>Total</b>
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	
2	0	0	2	16/40	-	24/60	-	100

### Course Objectives

1. Techniques relating to managing engineering activities, engineer's transition into management, engineering managerial functions, motivation of individual and group behavior.
2. Productivity assessment/improvement.
3. Managing the quality function and communications.

### CONTENTS

#### UNIT-I

[7 hours]

Meaning, importance, skills and roles of manager, different levels of management. Functions of management, planning: nature, importance, steps, Organising: Meaning, process, principles of organizing, staffing:-manpower planning, recruitment, selection, placement.

#### UNIT-II

[7 hours]

Leadership and Organizations Management, Strategic Planning, Budgeting, Project Planning - Risk Identification, Assessment and Response Planning

#### UNIT-III

[7 hours]

Management of Technology, Product Development and Innovation, Technical Entrepreneurship, Global Trade and International Operations, Operations Management

#### UNIT-IV

[7 hours]

Marketing Management:-the 4 p's of marketing, demand forecasting (concepts only), market segmentation. Financial management:-meaning, scope, functions, objectives, role of financial manager. Lean Systems, Intellectual Property, Legal Issues in Engineering Management, Principles of Ethics for Engineering Managers

### Course Outcomes

1. Able to know, comprehend, apply, analyze, synthesize and evaluate the basic principles of the fundamentals of managing technical organizations.
2. Prepare for further study in the area of engineering technology management.
3. Able to identify and apply appropriate management techniques for managing contemporary organizations.
4. Have an understanding of the skills, abilities, and tools needed to obtain a job on a management track in an organization of their choice.

### **Text Books**

1. Principles of Management by PC Tripathi & Reddy.
2. Management –I by Stephen P. Robbins& Stoner.
3. Management-II BY Kotler,Stoner

### **Reference Books**

1. L. M. Prasad; Principles of Management; Sultan Chand and Sons
2. Karminder Ghuman and K. Aswathapa; Management – Concept

# **6<sup>TH</sup> SEMESTER**

**DEPARTMENT OF AUTOMOBILE ENGINEERING  
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING  
INDUS UNIVERSITY**

B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VI)											
SEMESTER - VI (w.e.f. Year 2021-2024)											
Sub. Code	Name of the subject	C R E D I T S	Teaching Scheme (per week)				Evaluation Scheme				Total Marks
			Th	Tut	Pr	Total (hr)	Theory		Practical		
							CIE	End Sem	CIE	End Sem	
Th.	Th.	Pr.	Pr.								
AU0615	Vehicle Maintenance & Garage Practices	4	2	0	4	6	60	40	60	40	200
AU0624	Heat & Mass Transfer	4	2	1	2	5	60	40	60	40	200
AU0616	Internal Combustion Engine Technology	4	3	0	2	5	60	40	60	40	200
	Department Elective - 3	3	3	0	0	3	60	40	0	0	100
	Department Elective - 4	3	2	0	2	4	60	40	60	40	200
	Open Elective - 7	3	3	0	0	3	60	40	0	0	100
AU0632	Tires and Alignment Basics – MOOC (Optional)	3	-	-	-	-	Offered by <a href="http://www.class-central.com">www.class-central.com</a>				
AU0631	Aptitude Enhancement	2	2	0	0	2	60	40	0	0	100
	<b>TOTAL</b>	<b>26</b>	<b>17</b>	<b>1</b>	<b>10</b>	<b>28</b>	<b>420</b>	<b>280</b>	<b>300</b>	<b>200</b>	<b>1100</b>



## Open Elective 7

Subject Code	Department	Subject
CE0625	CE/CS/IT	Big Data & Business Analysis
AU0621	Auto	Intelligent Vehicle Technology
MME0611	Meta	Nano Technology
EC0623	EC	Digital Image Processing
EL0627	EL	Sensors and Actuators
ME0545	Mech	Non-Conventional Energy sources
CV0627	Cvl	Green Buildings
	SH	Graph Theory

## Department Elective – 3

Subject Code	Subject
AU0617	Quality & Reliability Engineering (DE-III)
AU0618	Nano technology (DE-III)
AU0619	Production Technology (DE-III)

## Department Elective – 4

Subject Code	Subject
AU0620	Automotive Safety, Ergonomics & Auxiliary systems (DE-IV)
AU0622	Fuel Cells & Applications (DE-IV)
AU0623	Automotive Hydraulics & Pneumatics Systems (DE-IV)

Subject: <b>Vehicle Maintenance &amp; Garage Practice</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0615			Semester: <b>VI</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
2	0	4	4	16/40	16/40	24/60	24/60	200

### Course Objectives

To have a complete understanding and hands-on experience of the vehicle maintenance procedures, which will help them to acquire skills in handling situations where the vehicle is likely to fail.

### CONTENTS

#### UNIT 1

[8 hours]

#### **VEHICULAR MAINTENANCE PRACTICES IMPORTANCE & TYPES OF MAINTENANCE SCHEDULES**

(Daily, weekly and monthly), Scheduled Maintenance Charts, Breakdown, Preventive, Predictive maintenance practices.

#### **SERVICE STATION OPERATIONS**

Service station, functions and operations, activities, depot and workshop layouts. Study of Workshop documents & records (job cards, bill, satisfaction voucher, history sheet, manufacturer's service coupon book, warranty policy etc.) Study of Workshop Manual, Parts Catalogue and Parts price list. Billing procedure. Customer complaint Handling & consumer cases in case of any dispute.

#### **TOOLS & EQUIPMENTS VARIOUS TOOLS AND EQUIPMENT**

Garage measuring instruments and testing, calibration, repair equipments: their function, usage and testing procedures.

#### UNIT 2

[8 hours]

#### **ENGINE MAINTENANCE**

Repairs & Overhauling Cylinder Block bore – measurement, Cylinder boring & honing, Cylinder liners fitting, Cylinder head - facing, valve seat lapping, Study Valve timing & Fuel injection pump timing procedure and timing gear train. Rocker arm gap adjustment / setting procedure, engine tune up.

## **MAINTENANCE OF FUEL SYSTEMS**

Cooling Systems & Lubrication System Petrol Engine - Carburetor- tuning and setting of MPFI engines, Diesel engine - Fuel injection pumps and fuel injector's calibration, Cleaning of water cooling system, water pump & radiator maintenance, maintenance of lubricating system

### **UNIT 3**

[8 hours]

## **CHASSIS MAINTENANCE REPAIRING OF GEAR BOX AND SHIFTING MECHANISM**

Final drive and differential maintenance, differential back lash adjustment, Wheels and tire maintenance, re-treading of tyres, wheel balancing, Steering system linkages, Wheel alignment: toe in, toe out, caster and camber. Hydraulic brakes circuit- brake adjustment, bleeding of brakes, Study of Air Brakes circuit & system components, Chassis greasing, wheel bearing greasing, Bearing Preload adjustment, Suspension system – lubrication, Adjustment of clutch pedal free play, repair/replacement of clutch parts, Repair & maintenance of Propeller shaft “U” joints and Centre bearing

### **UNIT 4**

[8 hours]

## **ELECTRICAL SYSTEM MAINTENANCE - SERVICING & REPAIR**

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

## **MISCELLANEOUS SYSTEMS**

Servicing & Repair Air Conditioning Systems, Body repairing and denting

### **Course Outcomes**

1. Learning of maintenance types/techniques.
2. Learning of different garage equipments and practices.
3. Learning of workshop documents and records.

### **Text Books**

1. Doshi, Panchal & Maniar, "Vehicle Maintenance & Garage Practices" PHI India, 2016
2. Crouse "Automotive mechanics", TMH Publications, 2013

### **Reference Books**

1. John Doke "Fleet Management", , McGraw-Hill Co., 1984
2. James D Halderman "Advanced Engine Performance Diagnosis", , PHI, 1998
3. Anil Chikara "Automobile Systems"-2012

### **Web Resources**

1. <https://www.youtube.com/watch?v=oE2ol2qyqnA> – Four post hoist demonstration
2. <https://www.youtube.com/watch?v=bRN9hJB8O-8> – Wheel balancing



3. <https://www.youtube.com/watch?v=MiyJwJvbFoQ> – Wheel Alignment
4. <https://www.youtube.com/watch?v=uz6l3cmXcy0> – Overhauling of Diesel Engines
5. <https://www.youtube.com/watch?v=FfTX88Sv4I8&list=PL6475B40A65E70AF6> – Engine overhauling sessions

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcomes</b>
1.	Study of modern workshop layout	Understanding of modern workshop layouts
2.	Study of different types of job cards & maintenance schedule chart.	Understand different types of job cards & maintenance schedule chart.
3.	Study of measuring, gauging & service equipment	Operate and understand the importance of measuring, gauging & service equipment
4.	Demonstration on tire inflator and hydraulic hoist.	Operate and understand the importance of on tire inflator and hydraulic hoist
5.	Demonstration on tire changer and car washer unit.	Demonstration on tire changer and car washer unit
6.	Performance on wheel balancer.	Understanding of Performance on wheel balancer
7.	Performance on wheel aligner.	Understanding of Performance on wheel alignment
8.	Cleaning and testing of petrol injector	Understanding of Cleaning and testing of petrol injector
9.	Cleaning and testing of different types of nozzles.	Understanding of Cleaning and testing of different types of nozzles
10.	Bleeding of hydraulic brakes	Understanding of Bleeding of hydraulic brakes
11.	Performing the tappet clearance and use of feeler gauge.	Understanding of Performing the tappet clearance and use of feeler gauge.
12.	Study of different workshop documents & records	Understanding of different workshop documents & records

Subject: Heat & Mass Transfer								
Program: B.Tech. Automobile Engineering				Subject Code: AU0624			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	1	2	4	16/40	16/40	24/60	24/60	200

### Course Objectives

1. To get the basic knowledge of heat transfer.
2. To understand the application of heat transfer in automobile.
3. To study designing of components for effective heat transfer, such as fins for cooling.

## CONTENTS

### UNIT 1

[6 hours]

#### **MASS TRANSFER**

Diffusion mass transfer, Fick's law of diffusion, steady state molecular diffusion, convective mass transfer, convective mass transfer correlation heat and mass transfer analogy

### UNIT 2

[9hours]

#### **THERMAL RADIATION-BASIC RELATIONS**

Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchoff, intensity of radiation and solid angle, Lambert's cosine law.

#### **RADIATION EXCHANGE BETWEEN SURFACES**

Radiation heat exchange between black bodies, radiation shield, electrical analogy.

### UNIT 3

[9hours]

#### **CONDUCTION – STEADY STATE**

Fourier's law of heat conduction, derivation of generalized equation in Cartesian coordinates and its reduction to specific cases, three dimensional heat conduction equations in cylindrical and spherical co-ordinates, One dimensional steady state conduction, heat conduction through plane and composite walls, hollow and composite cylinders, hollow and composite spheres, electrical analogy, overall heat transfer coefficient, Critical thickness of insulation, Types of fin, heat flow through rectangular fin.

## **CONDUCTION-UNSTEADY STATE (TRANSIENT)**

Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances, Biot number.

### **UNIT 4**

**[8hours]**

## **FORCED AND FREE CONVECTION**

Newton's law of cooling, Dimensional analysis applied to forced and free convection, empirical correlations for free and forced convection, Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer.

## **HEAT EXCHANGER**

Types, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, effectiveness and number of transfer unit for parallel and counter flow heat exchanger, introduction to heat pipe, compact heat exchangers. Design parameters for radiator & water pump design, hoses, Thermostat Valve, Radiators Cap, Radiator fan, Radiator Fan shroud, Surge Tank. Design parameters and Synchronization of vehicular Engine cooling system for dissipation of heat generated in Engine. Cooling system trouble diagnosis.

### **Course Outcomes**

After learning the course the students should be able to:

1. Understand basic concept of heat transfer
2. Able to do basic calculations involving heat transfer as is typical for a mechanical engineer. This includes conduction, convection and radiation heat transfer as well as heat exchanger design.
3. Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to conduction, convection and radiation heat transfer.

### **Text Books**

1. D.S. Kumar , "Heat and mass transfer", S.K.Kataria& Sons, 7th edition, 2008.
2. R.C. Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", New Age International, 4th Edition, 2010

### **Reference Books**

1. J.P. Holman, "Heat Transfer", Tata McGraw Hill, 9th Edition, 2004.
2. F.P. Incropera, D.P. Dewitt, T.L. Bergman, A.S. Lavine, KN Seetharamu and T.R. Seetharam, "Fundamentals of Heat and Mass Transfer", Wiley India, 1st Edition, 2013.
3. Cengel and Ghajar, "Heat and Mass Transfer: Fundamental and Applications", Mc-Graw hill education, 4th edition, 2011.
4. S. P.Sukhatme, "A text book on Heat Transfer", University press, 4th edition, 2005.
5. P. K. Nag, "Heat and Mass Transfer", Tata McGrawHill education, 3rd edition, 2007.

### **Web Resources**

1. [nptel.ac.in/courses/112101097/](http://nptel.ac.in/courses/112101097/) - whole syllabus included

2. [https://www.youtube.com/watch?v=9joLYfayee8&list=PLpU09Q\\_AvrWgEpejrBIcZPkSLlAPXcTTS](https://www.youtube.com/watch?v=9joLYfayee8&list=PLpU09Q_AvrWgEpejrBIcZPkSLlAPXcTTS) – Principle of Heat transfer and Heat transfer by conduction
3. <https://www.youtube.com/watch?v=sE8GA-HO2ks> – Heat Transfer with Change of Phase
4. <https://www.youtube.com/watch?v=lnFjt30goiY> - Heat Transfer by Convection
5. <https://www.youtube.com/watch?v=YEn-vX4duUc> - Heat Transfer by Radiation
6. <https://www.youtube.com/watch?v=GZbp6PJRM-w> – Design of Heat Exchangers

### **LIST OF EXPERIMENTS**

No.	Title	Learning Outcomes
1.	To study the fundamentals of heat transfer	Basics of heat transfer and modes of heat transfer: Conduction, Convection and radiation.
2.	Thermal conductivity of insulating powder	Determine thermal conductivity of insulating powder using sphere in sphere method.
3.	Heat transfer co-efficient for composite wall	Overall heat transfer coefficient for given composite wall with the help of composite wall apparatus.
4.	Temperature distribution and the effectiveness of the fin	Study temperature distribution and the effectiveness of the Pin fin.
5.	Heat transfer co-efficient by natural convection	To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.
6.	Heat transfer co-efficient in force convection	To determine convective heat transfer coefficient in forced convection.
7.	Determination of Stefan Boltzmann constant	To determine Stefan Boltzmann constant for the problem of radiation
8.	Emissivity measurement	To determine emissivity for the given surface.
9.	Study of heat exchangers	Study of heat exchangers like boilers, HVAC system, etc.
10.	Study of Automobile Engine cooling system	Study of various cooling system used in an automobile engine.

Subject: <b>Inrenal Combustion Engine Technology</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0616			Semester: <b>VI</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	4	16/40	16/40	24/60	24/60	200

### Course Objectives

The course focuses at imparting knowledge and process of combustion regarding automobile engines. Students examine the combustion process and characteristics of different types of internal combustion engines: spark ignition, diesel, stratified-charge, GDI and HCCI engines.

### CONTENTS

#### UNIT 1

[12 hours]

#### **OVERVIEW OF GASOLINE DIRECT INJECTION ENGINES**

Introduction, overview of direct injection gasoline engines, potential and technologies for high efficiency direct injection gasoline engine, high pressure fuel injection system, exhaust emissions and after treatment devices

#### UNIT 2

[12 hours]

#### **STRATIFIED CHARGE COMBUSTION IN DIRECT INJECTION GASOLINE ENGINES**

Introduction, thermodynamics and combustion process, production engines with stratified gasoline direct injection

#### UNIT 3

[12 hours]

#### **TURBOCHARGED DIRECT INJECTION SPARK IGNITION ENGINE**

Introduction, historical background: turbocharging for high specific output, problems and challenges associated with turbocharging spark ignition engines, advantages of combining direct injection and turbocharging in spark ignition engines, challenges of applying direct injection to a turbocharged spark ignition engine

#### UNIT 4

[12 hours]

#### **DIRECT INJECTION GASOLINE ENGINES WITH AUTO IGNITION COMBUSTION**

Introduction, principle of auto ignition combustion in the gasoline engines, approaches to auto ignition combustion operation in gasoline engines, operation and control of direct injection gasoline engines with auto ignition combustion.

## **HOMOGENOUS CHARGE COMPRESSION IGNITION (HCCI) ENGINES**

Introduction, HCCI combustion fundamentals, Gasoline HCCI engine, Diesel HCCI combustion engines, operational limits and emissions.

### **Course Outcomes**

After learning the course the students should be able to:

1. They will get knowledge latest technology of automobile engineering field
2. They got knowledge about future of I. C. engine.
3. Describe basic concepts of combustion process in SI, CI, HCCI, GDI engine.
4. Describe and analysis effect of super charging in petrol engine.
5. Describe and analysis effect of stratification in engine.

### **Text Books**

1. H Zhao, "Advanced Direct Injection Combustion Engine Technologies and Development", Elsevier, Vol.1
2. H Zhao, "HCCI And CAI Engines For The Automotive Industry", Elsevier, 2007
3. H.N. GUPTA, "Fundamentals of Internal Combustion Engines", PHI Learning Pvt. Ltd., 2nd ed., 2012

### **Reference Books**

1. V Ganesan, "Internal combustion engine", Tata McGraw-Hill Education, 2002
2. Dennis N Assanis, Fuquan Zhao, James A Eng, John E Dec, Paul M Najt, Thomas N Asmus, "Homogeneous Charge Compression Ignition (HCCI) Engines: Key Research and Development Issues Hardcover", SAE, 2003-1-1

### **Web Resources**

1. <https://cdn.intechopen.com/pdfs-wm/43660.pdf> - HCCI engines
2. [training.sae.org/seminars/c1009/](http://training.sae.org/seminars/c1009/) - GDI engines
3. <https://en.wikipedia.org/wiki/Supercharger> - Supercharger
4. <https://en.wikipedia.org/wiki/Turbocharger> - Turbo Charger
5. <https://www.youtube.com/watch?v=LjJSbHxIvnM> - Bosch gasoline direct injection
6. <https://www.youtube.com/watch?v=i534p49-HOI> - High Pressure Fuel Injection Pump
7. <https://www.youtube.com/watch?v=-bgBA0zvGKk> - Stratified Fuel injection Animation
8. [https://www.youtube.com/watch?v=d021ePu\\_3wo](https://www.youtube.com/watch?v=d021ePu_3wo) - FSI ( Fuel Stratified injection ) BOSCH
9. <https://www.youtube.com/watch?v=H6p0sVdMeeQ> - GDI vs PFI Fuel Injection

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcomes</b>
1.	Study of combustion process of diesel engine	Basic Knowledge and fundamentals of combustion process in diesel engine

2.	Study of combustion process of spark ignition engine	Basic knowledge and fundamental of combustion process in spark ignition engine
3.	Study of Stratified charge combustion in direct injection gasoline engines	Basic knowledge and fundamental of Stratified charge combustion in direct injection gasoline engines
4.	Study of direct injection gasoline engines with auto ignition combustion	Basic knowledge and fundamental of direct injection gasoline engines with auto ignition combustion
5.	Study of Turbocharged direct injection spark ignition engine	Basic knowledge and fundamental of Turbocharged direct injection spark ignition engine
6.	Study of Homogenous Charge Compression Ignition (HCCI) Engines	Basic knowledge and fundamental of Homogenous Charge Compression Ignition (HCCI) Engines.
7.	Fuel injections pump timing adjustment and testing	Basic knowledge and fundamental Fuel injections pump timing adjustment and testing.
8.	Engine analysis using engine diagnostic system for gasoline and diesel engine	Basic knowledge and fundamental of Engine Analyzer and tests performed on Engine Analyzer.
9.	Study of chemiluminescentNOx Analyzer	Basic knowledge and fundamental of Eddy Emissions in IC Engines.

Subject: <b>Quality and Reliability Engineering (DE-III)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0617			Semester: <b>VI</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
3	0	0	3	16/40	-	24/60	-	100

### Course Objectives

1. To present a problem oriented in depth knowledge of Quality and Reliability Engineering.
2. To address the underlying concepts, methods and application of Quality and Reliability Engineering.

## CONTENTS

### UNIT 1

[10 hours]

#### **INTRODUCTION**

Quality – Concept, Different Definitions and Dimensions, Inspection, Quality Control, Quality Assurance and Quality Management, Quality as Winning Strategy, Views of different Quality Gurus.

#### **TOTAL QUALITY MANAGEMENT (TQM)**

Introduction, Definitions and Principles of Operation, Tools and Techniques, such as, Quality Circles, 5 S Practice, Total Quality Control (TQC), Total Employee Involvement (TEI), Problem Solving Process, Quality Function Deployment (QFD), Failure Mode and Effect analysis (FMEA), Fault Tree Analysis (FTA), Kizen, Poka-Yoke, QC Tools, PDCA Cycle, Quality Improvement Tools, TQM Implementation and Limitations

### UNIT 2

[12 hours]

#### **INTRODUCTION TO DESIGN OF EXPERIMENTS**

Introduction, Methods, Taguchi approach, Achieving robust design, Steps in experimental design

#### **JUST –IN –TIME AND QUALITY MANAGEMENT**

Introduction to JIT production system, KANBAN system, JIT and Quality Production.

### UNIT 3

[12 hours]

#### **INTRODUCTION TO TOTAL PRODUCTIVE MAINTENANCE (TPM)**

Introduction, Content, Methods and Advantages



## **INTRODUCTION TO ISO 9000, ISO 14000 AND QS 9000**

Basic Concepts, Scope, Implementation, Benefits, Implantation Barriers

### **CONTEMPORARY TRENDS**

Concurrent Engineering, Lean Manufacturing, Agile Manufacturing, World Class Manufacturing, Cost of Quality (COQ) system, Bench Marking, Business Process Re-engineering, Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation of all as applicable.

### **UNIT 4**

**[10 hours]**

### **INTRODUCTION TO PROBABILITY THEORY**

Fundamental laws of probability, Random variables; Probability distribution function; Discrete and continuous distribution; Histogram and Normal distribution curve, Mean, variance and standard deviation of a distribution function. Random samples

### **RELIABILITY CONCEPTS**

Reliability engineering fundamentals; Failure data analysis; Failure rate; mortality curve; Concept of burn in period; Useful life and wear out phase of a system; Mean time to failure (MTTF); Mean time between failure, (MTBF) and mean time to repair (MTTR); Reliability in terms of Hazard rate and failure density, Conditional probability and multiplication rules

### **Course Outcomes**

After learning the course the students should be able to:

1. Understand the basic of TQM.
2. Understand the basic of Six Sigma.
3. Understand Various Reliability Concepts.

### **Text Books**

1. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jain and A K Chitale, Khanna Publishers
2. Statistical Quality Control by M. Mahajan, DhanpatRai& Co. (P) Ltd.
3. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India
4. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Educaiton
5. Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd.

### **Reference Books**

1. Reliability Engineering by Srinath L. S., Affiliated East West Press.
2. Total Quality Management by K C Arora, S K Kataria& Sons.
3. Statistical Quality Control by Eugene L. Grant and Richard S. Leavenworth, McGraw-Hill Publishing Company Ltd.
4. Total Quality Management: Poornima M. Charantimath, Pearson Education (Singapore) Pte.

Ltd.

5. Managing for Total Quality: N. Logothetis, Prentice Hall of India Pvt. Ltd.
6. Competitive Manufacturing Management: John M. Nicholas, Mcgraw Hill.
7. Managing Quality: Barrie G. Dole, Blackwell publishing.

**Web Resources**

<http://www.nptel.ac.in/courses/108103009/> - Whole Syllabus covered

Subject: Nano technology (DE-III)								
Program: B.Tech. Automobile Engineering				Subject Code: AU0618			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	16/40	0	24/60	0	100

### Course Objectives

To make students understand the use of concept of nanotechnology and nanoscience in the chemical industries and in consumer products. Nanotechnology will mean complete control of the structure of matter, building complex objects with molecular precision. In current scenario, engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger scale counterparts. So in order to move towards advanced materials and devices students should have the knowledge of nano science.

### CONTENTS

#### UNIT 1

[12 hours]

#### **NANOTECHNOLOGY**

Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nanodots, self-assembly, Dip pen nanolithography, Simple details of characterization tools- SEM, TEM, STM, AFM

#### UNIT 2

[12 hours]

#### **NANOMATERIALS**

What are Nanomaterials? Preparation of Nanomaterials-Plasma arcing, Chemical Vapor Deposition, Sol-gels techniques, Electrodeposition, Ball Milling, Natural Nanomaterials, Applications of Nanomaterials-Insulation materials, Machine tools, Phosphors, Batteries, High power magnets Medical implants

#### **NEW FORMS OF CARBON**

Carbon tubes-types of nanotubes, formation of nanotubes, Assemblies, purification of Carbon nanotubes, Properties of nanotubes, applications of nanotubes

### **UNIT 3**

[12 hours]

#### **OPTICS, PHOTONICS AND SOLAR ENERGY**

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, Solar cells, Nanoparticles and nanostructures; Optically useful nanostructured polymers, Photonic Crystals.

#### **NANOELECTRONICS**

Introduction, Tools of Micro- and Nanofabrication-optical and electron beam lithography, Molecular beam lithography, Quantum electronic devices, Molecular electronics, Simple ideas about quantum computers

### **UNIT 4**

[12 hours]

#### **APPLICATIONS**

MEMs, robots, Nanomachines, Nanodevices, New Computing System, Optic-electronic devices, Environmental applications, Nanomedicine, Biological Nano-Technological future.

#### **Course Outcomes**

After learning the course the students should be able:

1. Understand bulk and Nanostructured materials.
2. Understand synthesis of nanomaterial with different.
3. Understand the basic principal of various characterization technique.
4. Understand the use of nanoscience and nanotechnology for various applications.
5. Students can understand the difficulties in synthesizing Nano particles and can work in the field of commercialization of Nano materials.

#### **Text Books**

Mick Wilson, KamaliKannangra Geoff Smith, Michelle Simons and BurkhardRaguse Nanotechnology-Basic Science and Emerging Technologies, Overseas Press publication 2nd edition 2002

#### **Reference Books**

1. Mark Ratner and Daniel Ratner Nanotechnology-AGentle Introduction to the Next Big Idea, Prentice Hall publication 2nd edition 2003
2. RebeccalJohnson Nanotechnology Lerner Publications. 2nd edition 2005
3. Charles P. Poole Jr., Chapman Introduction to Nanotechnogy: Hall/CR publication 1st edition 2003
4. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press publication 1st edition 2001

### **Web Resources**

1. <http://nptel.ac.in/courses/118104008/> - Full syllabus
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-701-introduction-to-nanoelectronics-spring-2010/> - introduction to NanoElectronics
3. <https://ocw.mit.edu/courses/materials-science-and-engineering/> - Material Science & Engineering
4. <http://www.lib.uts.edu.au/guides/science/physics-nanotechnology/open-courses> - physics involved in nanotechnology

Subject: <b>Production Technology (DE–III)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0619			Semester: <b>VII</b>	
<b>Teaching Scheme</b>				<b>Examination Evaluation Scheme</b>				
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>University Theory Examination</b>	<b>University Practical Examination</b>	<b>Continuous Internal Evaluation (CIE)- Theory</b>	<b>Continuous Internal Evaluation (CIE)- Practical</b>	<b>Total</b>
3	0	0	3	16/40	0	24/60	0	100

### Course Objectives

1. Students will be able to apply basics of metal machining processes very well. They can have enough knowledge of different forces acting while cutting with tool life and wear. They can interpret and utilize the economics of machining.
2. Learning of the technology of Gear and threads manufacturing which is grassroots knowledge of any manufacturing industries. They are able understand the usefulness of Jig & Fixtures, Presses & Press work, Types of Dies and various forces acting during cutting. They also understand non conventional machining processes its importance, application advantages and economy aspect in production technology.

## CONTENTS

### UNIT 1

[12 hours]

#### **THEORY OF METAL CUTTING**

Principles of metal machining, cutting tools and tool materials, tool signature, mechanics of chip removal, cutting forces and parameters effecting it, cutting fluids, tool wear, tool life, economics of machining. Multi point cutting tools, temperature measurement at tool-work interface and its effects

### UNIT 2

[12 hours]

#### **GEAR AND THREADS MANUFACTURING**

Different types of Threads manufacturing methods, and tools involved, Different gear forming and generating methods with their special features, Gears finishing processes.

#### **JIGS & FIXTURES**

Definition, its usefulness in mass production, design principles, locating systems and types of locators & clamps, jig bushes, design of jigs and fixtures for various machining operations.

### UNIT 3

[12 hours]

#### **PRESSES AND PRESS WORK**

Classification Of Presses, Classification Of Dies, Cutting Actions In Dies, Clearance, Cutting Forces, Center Of Pressure Design Of Press Tools, Methods Of Mounting Of Punches, Scrap Reduction, Strip Layout.

### **CONTROLS IN MACHINE TOOLS**

Machine tool drives, Machine tool structures, Machine tool spindles, Special purpose machines, Capstan and turret lathes, single spindle and multi spindle automats, bar type and chucking type machines, Design of cam for single spindle automat Transfer Machines.

### **UNIT 4**

**[12 hours]**

### **NON-CONVENTIONAL MACHINING**

EDM, IBM, ECM, ECG, CM, AJM, wire cut EDM, USM, LBM process principle, process parameters and their applications

### **Course Outcomes**

1. Students will be able to apply basics of metal machining processes very well with the detailed signature of tools.
2. Students able to understand different forces acting while metal cutting and can draw Merchant circle diagram and also able to apply knowledge to economic metal cutting.
3. Students can able to grasp distinctive knowledge of gear forming and its generating methods.
4. Students are able to clutch its usefulness and design of such locating and fixing devices.
5. Learn in depth about press and press work
6. Gained elementary knowledge in Non-conventional machining and its application in industries.

### **Text Books**

1. Boothroyd Fundamentals of machining and machine tools, by -CRC publication 2nd edition 1990
2. M C Shaw Metal Cutting principles, by, Oxford University press 2nd edition 2004

### **Reference Books**

1. Donaldson Tool Design, Tata McGraw Hill Publication 4th edition 2012
2. Trent Metal cutting Principles McGraw Hill Publication. 4th edition 2000

### **Web Resources**

1. <http://nptel.ac.in/downloads/112105127/> - Metal Cutting
2. <http://nptel.ac.in/courses/112105126/33> - Gear and Threads Manufacturing
3. <http://nptel.ac.in/courses/112105126/34> - Jigs & Fixtures
4. <http://nptel.ac.in/courses/112107144/8> - Presses And Press Work  
<http://nptel.ac.in/courses/112104028/> - Non-Conventional Machining

Subject: <b>Automobile Safety, Ergonomics and Auxiliary Systems (DE-IV)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0620			Semester: <b>VI</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. To provide an understanding of automotive safety, comfort systems & its future prospects.
2. This Subject also focuses on the ergonomic and its related issues.

### CONTENTS

#### UNIT 1

[8 hours]

#### **DESIGN OF AUTOMOTIVE BODY AND SAFETY**

Introduction to automotive safety systems - Design of the body for safety – engine location - concept of crumple zone - safety sandwich construction – deformation behavior of vehicle body - speed and acceleration characteristics of passenger compartment on impact.

#### UNIT 2

[8 hours]

#### **SAFETY SYSTEMS**

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

#### UNIT 3

[8 hours]

#### **CRASH WORTHINESS**

Definition – Requirements – Tests – component, sled and full-scale barrier impacts-Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety

#### UNIT 4

[8 hours]

#### **COLLISION WARNING AND AVOIDANCE**

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

#### **COMFORT SYSTEMS**

NVH (noise, vibration and harshness) of chassis, engines and power train, ride quality and sound quality; heating, ventilation and air conditioning systems. Steering and mirror adjustment, central



locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system

**Course Outcomes**

After learning these subject students will able to:

1. Understand and analyze the safety systems requirements for automobiles
2. Understand and analyze the comfort system requirements for automobiles

**Text books**

Vivek D. “Ergonomics in the Automotive Design Process” Bhise publisher CRC press, Taylor and Francis group,-2005.

**Reference Books**

1. Ronald K Jurgen, “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., - 1999.
2. Bosch, “Automotive Handbook”, 5th edition - SAE Publication - 2000.
3. JullianHappian, “Smith An Introduction to Modern Vehicle Design”, SAE, 2002.
4. Johnson W and Mamalis A.G, “Crashworthiness of Vehicles”, MEP, London,-2005.
5. Richard Bishop, “Intelligent Vehicle Technology and Trends” – 2005.
6. George A. Peters, Barbara J. Peters, “Automotive Vehicle Safety” – 2002.

**Web Resources**

1. <http://drivingergonomics.lboro.ac.uk/downloads/vehicle%20ergonomics%20and%20best%20practice%20guide.pdf> - Ergonomics for vehicles
2. [https://onlinecourses.nptel.ac.in/noc17\\_me26/preview-](https://onlinecourses.nptel.ac.in/noc17_me26/preview-) Safety procedures for Automobiles

**LIST OF EXPERIMENTS**

No	Title	Learning Outcome
1.	Study of safety parameters in passenger vehicle.	Basic of safety standards
2.	Study of behavior of vehicle body during different operating conditions.	Vehicle testing methods
3.	Design and safety analysis of roll cage for off-road car.	Roll cage design basics and Testing for safety
4.	Design and safety analysis of roll cage for Formula Car.	F1 design constraints and testing of F1 chassis
5.	Ergonomics study of a car.	Basic of ergonomics related to Cars
6.	Ergonomics study of commercial vehicle.	Basics of ergonomics related to commercial vehicles
7.	Study of various advanced system designed developed to avoid collision.	Study of various advanced systems for collision protection

8.	Study of noise level of different vehicles.	Basics of noise testing
9.	Study of various crash tests to be carried out on a vehicle.	Different crash testing standards and results
10.	Case study on different vehicle models and comparison in terms of safety and ergonomics	Real time comparison of vehicles in terms of safety and ergonomics

Subject: <b>Fuel Cells &amp; Applications (DE-IV)</b>								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0622			Semester: <b>VI</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

Understand fundamental concept and working of various fuel cells, their relative advantages / disadvantages and hydrogen generation/storage technologies

## CONTENTS

### UNIT-1

[8 hours]

#### **HYDROGEN – FUNDAMENTALS**

Hydrogen as a source of energy, physical and chemical properties, salient characteristics, relevant issues and concerns

### UNIT-2

[8 hours]

#### **HYDROGEN STORAGE AND APPLICATIONS**

Production of hydrogen, steam reforming, water electrolysis, gasification and woody biomass conversion, biological hydrogen production, photo dissociation, direct thermal or catalytic splitting of water, hydrogen storage options, compressed gas, liquid hydrogen, hydride, chemical storage, safety and management of hydrogen, applications of hydrogen

### UNIT-3

[8 hours]

#### **FUEL CELLS- TYPES**

Brief history, principle, working, thermodynamics and kinetics of fuel cell process, types of fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, performance evaluation of fuel cell, comparison of battery Vs fuel cell

### UNIT-4

[8 hours]

#### **FUEL CELLS -APPLICATION AND ECONOMICS**

Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells

### **Course Outcomes**

After learning this subject, the student shall be able to

1. Understand different types of Fuel Cells
2. Design considerations of hybrid vehicles.
3. Challenges to design and develop Fuel Cell vehicle.

### **Text book**

Iqbal Hussein, “Electric & Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

### **Reference Books**

1. Viswanathan, B and M AuliceScibioh, “Fuel Cells – Principles and Applications”, Universities Press ,-2007.
2. Rebecca L. and Busby, “Hydrogen and Fuel Cells: A Comprehensive Guide”, Penn Well Corporation, Oklahoma,-2005.
3. Bent Sorensen (Sorensen), “Hydrogen and Fuel Cells: Emerging Technologies and Applications”, Elsevier Academic Press, UK,-2004.
4. Kordesch, K and G.Simader, “Fuel Cell and Their Applications”, Wiley-Vch, Germany,-2003.
5. Hart, A.B and G.J.Womack, “Fuel Cells: Theory and Application”, Prentice Hall, NewYork Ltd., London,-2001.
6. Jeremy Rifkin, “The Hydrogen Economy”, Penguin Group, USA,-2005.

### **Web Resources**

<http://www.nptel.ac.in/courses/103102015/2> - Full Syllabus

### **LIST OF EXPERIMENTS**

<b>No</b>	<b>Title</b>	<b>Learning Outcome</b>
1.	To Study about fundamental of hydrogen.	Understand the basic knowledge of hydrogen.
2.	To study about relevant issues of hydrogen as fuel.	Recognize important issues of hydrogen as fuel
3.	To study about production of hydrogen.	Understand the different process for production of hydrogen
4.	To study about types hydrogen storage system and applications.	Understand the types of storage system for hydrogen.
5.	To study about fundamental of fuel cell.	Emphasis the technology of fuel cell.
6.	To study about types of fuel cell.	Comprehend the types of fuel cell.
7.	To study about performance evaluation of fuel cell.	Understand process to evaluate the performance of fuel cell.
8.	To study about Fuel cell usage for large scale power generation.	Understand the processes for large scale power generation.

9.	To study about Fuel cell usage for Automobile industry.	Understand the processes for Automobile industry.
10.	To study about future trends of fuel cells	Enhance the fuel cell for future of Automotive industry.

Subject: Automotive Hydraulics & Pneumatics Systems								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0623			Semester: <b>VI</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	2	3	16/40	16/40	24/60	24/60	200

### Course Objectives

1. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.
2. Visualize how the hydraulic/pneumatic circuit will work to accomplish the function.

## CONTENTS

### UNIT 1

[8 hours]

#### **INTRODUCTION TO FLUID POWER**

Classification, application of various fluids in engineering, various Symbols used in hydraulic and pneumatic (ISO/JIC), transmission of power at static and dynamic states. Types of hydraulic fluids and their properties, effect of temperature on fluids.

#### **HYDRAULIC SYSTEM ELEMENTS: CONTROL OF FLUID POWER ELEMENTS**

Requirement of pressure control, direction control, flow control valves. Principles of pressure control valves, direction control valves, and pilot operated relief valve, pressure reducing valve, quick exhaust valve, sequence valves. Types of direction control valves – two way two position, four way two position, four way three position, open center, close center, tandem center, manual operated, solenoid, pilot operated direction control valves, check valves. Flow control valves: principle and their types, meter-in and meter-out circuit and flow through circuit. Actuators – linear and rotary, hydraulic motors, types of hydraulic cylinders

### UNIT 2

[8 hours]

#### **PNEUMATIC SYSTEMS**

Application of pneumatics, physical principles, basic requirement of pneumatic system. Comparison with hydraulic systems. Elements of Pneumatics, Air compressors, Pneumatic control valves, Pneumatic actuators – types and the mountings, Air motors – types

### **UNIT 3**

[8 hours]

#### **HYDRAULIC CIRCUIT AND WORKING**

Basic hydraulic circuit, impulse operation, speed control, Hydraulic motor circuit, sequencing of motion, time delay circuits and their applications, and other hydraulic circuits.

### **UNIT 4**

[8 hours]

#### **PNEUMATIC CIRCUITS AND WORKING**

Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuits and their applications, and other pneumatic circuits.

#### **Course Outcomes**

After learning the course, the students should be able to:

1. Identify and analyse the functional requirements of a power transmission system for a given application. (Application involving fluid power transmission)
2. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.
3. Visualize how the hydraulic/pneumatic circuit will work to accomplish the function.

#### **Text Books**

1. A. Esposito , “Fluid Power with applications” ,PHI, 3rd edition, 2010
2. R Srinivasan , “Hydraulic and Pneumatic Controls”, Tata McGraw Hill, 2nd edition, 2003.

#### **Reference Books**

1. Andrew Parr , “Hydraulic & pneumatics”, Jaico Publishing House, 4th edition, 2004.
2. D.A. Pease , “Basic fluid power”, PHI, 2nd edition, 2005.
3. S R Majumdar , “Basic Pneumatic Systems, Principle and Maintenance” , McGraw-Hill, 2nd edition, 1996.

#### **Web Resources**

1. <http://nptel.ac.in/courses/112105046/27> - Introduction To Fluid Power /Types Of Hydraulic Fluids And Their Properties
2. [http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2\\_Hydraulics\\_control\\_in\\_machine\\_tools.pdf](http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2_Hydraulics_control_in_machine_tools.pdf) - Hydraulic System Elements: Control Of Fluid Power Elements
3. <http://nptel.ac.in/courses/112106175/downloads/Module%201/FAQ/FAQ-Lecture%201.pdf> - Hydraulic Servo-System For Rotary And Linear Motions
4. <http://www.iranfluidpower.com/pdf/BTP%20Fluid%20power/Hydraulic%20Troubleshooting.pdf> - Maintenance And Trouble Shooting Of Hydraulic Circuits
5. <http://nptel.ac.in/courses/112105046/35> - Pneumatic Systems & Pneumatic Circuits

### LIST OF EXPERIMENTS

No	Title	Learning Outcomes
1.	Symbols used in hydraulics and pneumatics	Students will be given a list of symbols for Hydraulic and Pneumatic components. They will use the software and prepare the symbols with designation. This sheet will be attached.
2.	To and fro motion of the double acting cylinder.	Design the circuit using Hydraulic power pack, Double acting cylinder, Direction control valve, Hydraulic motor.
3	Three different speed of piston in one stroke.	Design the circuit using pump unit, 4/3 DCV, three 2/2 DCV, two Flow control valve, check valve, one cylinder
4.	Sequential operation of the two linear actuators using sequence valve	Design the circuit using Hydraulic power pack, Two Double acting cylinder, Direction control valve, Two sequence valve, Two check valves.
5.	Determine effect of Bleed Off and Regenerative Circuit on the movement of actuator.	Design the circuit using Hydraulic power pack, Double acting cylinder, Direction control valve, flow control valve.
6.	Speed control of the linear actuator with Meter In and Meter out Circuits.	Design the circuit using Hydraulic power pack, Double acting cylinder, Direction control valve, flow control valve.
7.	To and fro motion of the double acting cylinder for Pneumatics.	Design the circuit using Pneumatic power pack, Double acting cylinder, 3/2 DCV, 5/2 DCV
8.	AND operation using twin pressure valve and to study OR operation with shuttle Valve.	Design the circuit using Pneumatic power pack, Double acting cylinder, twin pressure valve, 5/2 DCV, shuttle Valve.
9.	Pneumatic circuit using flow control valve and time delay valve.	Design the circuit using Pneumatic power pack, Double acting cylinder, flow control valve, 5/2 DCV, time delay valve.
10.	Cascading of two cylinder and three cylinders	Design the circuit using Pneumatic power pack, Double acting cylinder, flow control valve, 5/2 DCV, time delay valve



Subject: Intelligent Vehicle Technology(OE-VII)								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0621				Semester: <b>VI</b>
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	16/40	-	24/60	-	100

### Course Objectives

1. Understand the intelligent vision system used in automobiles
2. Understand the architecture of intelligent transportation system
3. Understand adaptive control techniques of an autonomous vehicle
4. Understand about the successful autonomous vehicle projects

## CONTENTS

### UNIT 1

[12 hours]

#### **Introduction to Intelligent Vision System**

Vision Based Driver Assistance System –Vehicle optical Sensor, Laser Radar, Non Contact ground velocity detecting Sensor, Road Surface Recognition Sensor, Vehicle Sensors for Electronic Toll Collection System, Components of a Vision Sensor System , Driver Assistance on Highways –Lane Recognition, Traffic Sign Recognition, Driver Assistance in Urban Traffic- Stereo Vision, Shape base analysis and Pedestrian Recognition.

### UNIT 2

[12 hours]

#### **Vehicle Information System and Intelligent Transportation**

Intelligent Transportation System (ITS) – Vision for ITS Communications, Multimedia communication in a car –Current ITS Communication Systems and Services, Vehicle to Vehicle and Road to Vehicle Communication Systems, Inter and Intra Vehicle Communication, VANETS- Devices-Optical Technologies and Millimeter Wave technologies.

### UNIT 3

[12 hours]

#### **Adaptive Control Techniques for Intelligent Vehicles.**

Automatic Control Of Highway Traffic And Moving Vehicles, Adaptive Control Of Highway Traffic And Moving Vehicles, Adaptive Control –Gain Scheduling, Model Reference Adaptive Control, Self Tuning Adaptive Control System Model - System Identification Basics, Recursive Parameter Estimation, Estimator Initialization, Design Of Self-Tuning Controllers –Generalized Minimum Variance (GMV) Control, Pole Placement Control And Model Predictive Control.

### UNIT 4

[12 hours]

### **Decisional Architectures for Autonomous Vehicles**

Control Architectures And Motion Autonomy –Deliberative Architectures, Reactive Architectures, Hybrid Architectures, Overview Of Sharp Architecture, Models Of Vehicles, Concepts Of Sensor Based Maneuver, Reactive Trajectory Following, Parallel Parking, Platooning, Main Approaches To Trajectory Planning, Non-Holonomic Path Planning.

### **Course Outcomes**

After learning the course the students should be able:

1. Understand the intelligent vision system used in automobiles
2. Understand the architecture of intelligent transportation system
3. Understand adaptive control techniques of an autonomous vehicle
4. Understand about the successful autonomous vehicle projects

### **Text Books**

1. LjuboVlacic, Michel Parent and Fumio Harashima,“Intelligent Vehicle Technologies”, ButterworthHeinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
2. Ronald K Jurgen, “Automotive Electronics Handbook ”, Automotive Electronics Series, SAE, USA, 1998

### **Reference Book**

NicuBizon,Lucian D Ascalescu And NaserMahdavitAbatabaei “Autonomous Vehicles Intelligent Transport Systems And Smart Technologies”,Nova Publishers-2014–ISBN-978-1-63321-326-5

### **Web Resources**

1. <https://www.businesswire.com/news/home/20170105005817/en/ITRI-Introduces-Intelligent-Vision-System-Companion-Robots> - Vision Systems
2. <https://www.techopedia.com/definition/30056/autonomous-car> - Autonomous Vehicle

Subject: Basic Aptitude								
Program: <b>B.Tech. Automobile Engineering</b>				Subject Code: AU0631			Semester: <b>VI</b>	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
2	0	0	2	16/40	-	24/60	-	100

### Course Objectives

Syllabus is designed to endure Students ability to solve complex problems involving multiple calculations simultaneously

### CONTENTS

#### UNIT 1

[6 hours]

Partnerships, Percentage, Compound Interest.

#### UNIT 2

[6 hours]

Trigonometry, Number Systems, Ratio, proportion & Variations

#### UNIT 3

[6 hours]

Averages, Speed, Time & Distance, Simple & Compound Interest

#### UNIT 4

[6 hours]

Permutation and Combination, Probability, Profit, Loss and Discount

### Course Outcomes

After learning the course the students should be able to solve competitive problems

### Text Books

Quantitative Aptitude for Competitive Examinations (Old Edition), by , 2008

### Web Resources

<https://www.youtube.com/watch?v=rHzggZDd4>

<https://www.youtube.com/watch?v=lxm6ez2cx6Y>

# **8<sup>TH</sup> SEMESTER**

**DEPARTMENT OF AUTOMOBILE ENGINEERING  
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING  
INDUS UNIVERSITY**

B.Tech Automobile Engineering Teaching Scheme 2021-2024 Batch (Sem VIII)											
SEMESTER - VIII (w.e.f. Year 2021-2024)											
Sub. Code	Name of the subject	C R E D I T	Teaching Scheme (per week)				Evaluation Scheme				Total Marks
							Theory		Practical		
			CIE	End Sem	CIE	End Sem					
			Th	Th	Pr	Pr					
AU0802	Project	15	0	0	15	15	0	0	60	40	100

**Course Outcomes:**

1. Develop leadership, interpersonal skill and team work.
2. To analyze and synthesize the data
3. Perform the practical work with appropriate accuracy
4. Interpret the drawings, manufacture, assemble, inspect & if necessary modify the parts /unit/assembly of the project work.
5. Familiar with fast changes in technology