K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Master of Technology (Automobile Engineering)

M.Tech (AE)

Program Code: 54

2020-22

Approved in the 23rd Meeting of Academic Council Held on 23 June 2020

Member Secretary
Academic Council
K.R. Mangalam University

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

K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

Master of Technology (Automobile Engineering)

M.Tech (AE)

Program Code: 54

2020-22

Approved in the 23rd Meeting of Academic Council Held on 23 June 2020

About K. R. Mangalam University

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

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

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

KRM University is unique because of its:

· Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.

· Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives:

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

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

About the School of Engineering & Technology (SOET)

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

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

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

School Vision

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

School Mission

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

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

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

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

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

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

M7: Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.
M8: To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

The Programs offered by School

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

M.Tech in Automobile Engineering

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

Eligibility Criteria: Candidates must have a B.E. / B. Tech degree in Mechanical Engineering with a minimum of 50% marks in aggregate. The reservation and relaxation for SC/ST/OBC/PWD and other categories shall be as per the rules of central/state government, whichever is applicable.
Course Outline: Chassis & Body Engineering, Advanced Manufacturing Technology, Automobile Air Conditioning, Advanced Automotive Transmission, Alternate Energy Sources for Automobiles.
Career Options: Automotive Engineer, Product Development Manager, Design Engineer, Corporate Sales Manager.

Program Duration: 2 Years
The maximum period for the completion of the M.Tech. (AE) Programme offered by the University shall be Two years.
Class Timings:
The classes will be held from Monday to Friday from 9.10 am to 4.00 pm.
Scheme of Studies and Syllabi

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

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

Semester	**1**	**2**	**3**	**4**	**Total**
Courses	8	8	3	2	21

Credits	23	23	16	20	82

Scheme of studies and Syllabi as per Credit Based Choice System (CBCS) and Learning Outcome Based Framework

Semester I

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

Semester II

SN	Category		Course Code	Course Title	L	T	P	C
1	Major	CC	ETME 702	Automobile Air Conditioning	4	-	-	4
2	Minor	CC	ETME 704	Design of Experiments & Research methodology	3	1	-	4
3	Minor	CC	ETME 706	Advanced Automotive Transmission	3	1	-	4
4	Major	CC	ETME	Vehicle Safety & Maintenance	4	-	-	4

			708					
5	DE	DE		Elective II (Production of Automotive Component-ETME710)	4		-	4
6	Major	SE	ETME 752	Automobile air conditioning Lab	-	-	2	1
7	Major	SE	ETME 754	Automobile CAD Lab with simulation	-	-	2	1
8	SEC	SE	ETME 756	Seminar – II	-	-	-	1
					20	**-**	**4**	**23**

Semester III

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

Semester IV

SN	**Category**		**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	DE	DE		Elective-IV (Two and Three wheeler Technology, ETME-806)	4	-	-	4
2	DSS	SE	ETME852	**Dissertation Part-B**	-	-	-	16
					4	**-**	**-**	**20**

Total Credits: 82

Detailed Syllabus

SEMESTER I

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="4">Department of Mechanical Engineering</td></tr>
<tr><td colspan="3" rowspan="2">2. Course Name:
Chassis and Body Engineering</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME701</td><td>4-0-0</td><td>4</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="4">Programme Core</td></tr>
<tr><td colspan="6">7. Pre-requisite(s), if any: Basics of Chassis and Body</td></tr>
<tr><td colspan="6">8. Frequency of offering (check one): Odd</td></tr>
<tr><td colspan="6">9. Brief Syllabus:
This course gives introductory knowledge about Chassis and Body Engineering, and application of refrigeration and air conditioning in various field. It enables the students to understand the working of these systems. It also enhances the students thinking capability to calculate the efficiency and COP of the systems. This course is also helping students to answer fundamental questions of Refrigeration and Airconditioning at the time of the interview.</td></tr>
<tr><td colspan="6">10.Total lecture, Tutorial and Practical Hours for this course:48</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:48</td><td colspan="4">Practice-</td></tr>
<tr><td colspan="2">Tutorials:-</td><td colspan="2">Lab Work:</td></tr>
<tr><td colspan="6">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="5">On completion of this course, the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="5">Classify the chassis layout with reference to the power-train location and design of steering system for proper rolling of the tires.</td></tr>
<tr><td>CO 2</td><td colspan="5">Explain the different components in the drive line and understand the details of differential unit.</td></tr>
<tr><td>CO 3</td><td colspan="5">Summaries the different types of rear axles and to understand the need for suspension systems and its types.</td></tr>
<tr><td>CO 4</td><td colspan="5">Explain the various braking systems and in which circumstances each one of them is used.</td></tr>
</table>

CO 5	Explain the types of suspension system and its constructional details which are used in automobile.

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

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

Unit Number: 2	Title: Drive line study	No. of hours: 8

Content Summary:

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

Unit Number: 3	Title: braking System	No. of hours: 12

Content Summary:

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

Unit Number: 4	Title: Suspension Systems	No. of hours: 8

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

TEXT BOOKS:

1. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.
2. P.M.Heldt, "Automotive Chassis", Chilton Co., New York, 1982.
3. W.Steed, "Mechanics of Road Vehicles", Illiffe Books Ltd., London. 1992.

REFERENCES:

1. Harban Singh Rayat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.
2. G.J.Giles, "Steering Suspension and Tyres", Illiffe Books Ltd., London, 1975.
3. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang, "Automobile Engineering", Khanna Pub. New Delhi, 2005.
5. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.

REFERENCE BOOKS:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati Second Edition New age International.
2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Classify the chassis layout with reference to the power-train location and design of steering system for proper rolling of the	**Cognitive** L1,L2		**Psychomotor** L2,L3

	tires.			
C02.	Explain the different components in the drive line and understand the details of differential unit.	**Cognitive** L1,L2		**Psychomotor** L3,L4
CO3.	Summaries the different types of rear axles and to understand the need for suspension systems and its types.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Explain the various braking systems and in which circumstances each one of them is used.	**Cognitive** L1,L2		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2							-	-
CO2	3	3		2							-	-
CO3	2	3		2							-	-
CO4	2	3		2							-	-

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

10. Department:	Department of Mechanical Engineering		
11. Course Name: Chassis and Body Engineering	12. Course Code	13. L-T-P	14. Credits
	ETME703	3-1-0	4
15. Type of Course:	Programme Core		
16. Pre-requisite(s), if any: Basics of Chassis and Body			
17. Frequency of offering (check one): Odd			
18. Brief Syllabus: This course gives introductory knowledge about Chassis and Body Engineering, and application of refrigeration and air conditioning in various field. It enables the students to understand the working of these systems. It also enhances the students thinking capability to calculate the efficiency and COP of the systems. This course is also helping students to answer fundamental questions of Refrigeration and Airconditioning at the time of the interview.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials:-	Lab Work:	
11. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.			

COs	On completion of this course, the students will be able to:
CO 1	Classify the chassis layout with reference to the power-train location and design of
CO 2	CO2 Explain the different components in the drive line and understand the details of
CO 3	Summarize the different types of rear axles and to understand the need for

CO 4	Explain the various braking systems, and in which circumstances each one of them
CO 5	Explain the types of suspension system and its constructional details which are used

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

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

Unit Number: 2	Title: Drive line study	No. of hours: 12

Content Summary:

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

Unit Number: 3	Title: braking System	No. of hours: 12

Content Summary:

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

Unit Number: 4	Title: Suspension Systems	No. of hours: 12

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

TEXT BOOKS:

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

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

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

REFERENCES:

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

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

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

REFERENCE BOOKS:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati Second Edition New age International.
2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Classify the chassis layout with reference to the power-train location and design of steering system for proper rolling of the	**Cognitive** L1,L2		**Psychomotor** L2,L3

	tires.			
C02.	Explain the different components in the drive line and understand the details of differential unit.	**Cognitive** L1,L2		**Psychomotor** L3,L4
CO3.	Summaries the different types of rear axles and to understand the need for suspension systems and its types.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Explain the various braking systems and in which circumstances each one of them is used.	**Cognitive** L1,L2		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3										-	-
CO2	2			3							-	-
CO3	2				3						-	-
CO4	2	2									-	-
CO5	2					3						

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			
CO5	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: Automotive Engines & Emission	3. Course Code	4. L-T-P	5. Credits
	ETME705	3-1-0	4
6. Type of Course:	Programme Core		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Odd			
9. Brief Syllabus: This course makes the students to understand basics of Automobile Engineering, conversant with Vehicle Performance & Safety.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials:-	Lab Work:	
11. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.			
COs	On completion of this course, the students will be able to:		

CO 1	Understand the importance of IC engine as a prime mover and compare its performance based on thermodynamic cycles and combustion process.
CO 2	Identify harmful IC engine emissions and use viable alternate fuels in engines.
CO 3	Analyze and evaluate engine performance and adopt improvement devices and new combustion concepts
CO 4	Classify and analyze alternate power sources for automobiles.
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Engine theory	No. of hours: 12

Content Summary:

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

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

Unit Number: 2	Title: combustion and pollution	No. of hours: 12

Content Summary:

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

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

Unit Number: 3	Title: **Exhaust Emission**	No. of hours: 12

Content Summary:

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

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

Unit Number: 4	Title: Alternate fuel	No. of hours: 12

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

Reference Books:

Textbooks:

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

Reference Books:

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

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Understand the importance of IC engine as a prime mover and compare its performance based on thermodynamic cycles and	**Cognitive** L1,L3		**Psychomotor** L2,L3

	combustion process.			
C02.	Identify harmful IC engine emissions and use viable alternate fuels in engines.	**Cognitive** L1,L3		**Psychomotor** L3,L4
CO3.	Analyze and evaluate engine performance and adopt improvement devices and new combustion concepts	**Cognitive** L1,L4,L5		**Psychomotor** L2,L3
CO4	Classify and analyze alternate power sources for automobiles.	**Cognitive** L1,L2,L4		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2						3					
CO3		2										
CO4	2	2										

CO	PSO1	PSO2	PSO3	PSO4

CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name:
ADVANCED MANUFACTURING TECHNOLOGY</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME707</td><td>4-0-0</td><td>4</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="3">Programme Core</td></tr>
<tr><td colspan="5">7. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="5">8. Frequency of offering (check one): Odd</td></tr>
<tr><td colspan="5">9. Brief Syllabus:
This course makes the students to impart knowledge in Modern machining process like Ultrasonic, Water Jet and Electro-discharge machining. Also the function of CNC machine.</td></tr>
<tr><td colspan="5">10.Total lecture, Tutorial and Practical Hours for this course:48</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:48</td><td colspan="3">Practice-</td></tr>
<tr><td>Tutorials:-</td><td colspan="2">Lab Work:</td></tr>
<tr><td colspan="5">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="4">On completion of this course, the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="4">Knowledge of Advanced Manufacturing Processes</td></tr>
<tr><td>CO 2</td><td colspan="4">Ability to Adapt to Emerging Technologies</td></tr>
<tr><td>CO 3</td><td colspan="4">Understanding of Advanced Materials and Manufacturing Techniques.</td></tr>
</table>

CO 4	Understanding the principles of NC, CNC and, automation.
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Machining Process	No. of hours: 12

Content Summary:

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

Unit Number: 2	Title: Electrochemical machining	No. of hours: 12

Content Summary:

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

Unit Number: 3	Title: **Electrical Discharge machining**	No. of hours: 12

Content Summary:

Electrical Discharge Machining : Mechanisms of metal removal, Basic circuitry, Evaluation of metal removal rate, Machining accuracy, Surface finish, Analysis for optimization, tool material, dielectric fluid, application & limitation. Plasma Arc Machining : Non-thermal generation of plasma, mechanics of metal removal, various parameters, accuracy and surface finish, applications.

Unit Number: 4	Title: CNC	No. of hours: 12

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

Reference Books:

Text **Books**

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

References:

1. Production Technology, HMT

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Knowledge of Advanced Manufacturing Processes	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	Ability to Adapt to Emerging Technologies	**Cognitive** L1,L2		**Psychomotor** L3,L4
CO3.	Understanding of Advanced Materials and Manufacturing Techniques.	**Cognitive** L1,L3		**Psychomotor** L2,L3
CO4	Understanding the principles of NC, CNC and, automation.	**Cognitive** L1,L3		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	2											
CO3	3											
CO4	3				3							

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name: Engine testing and pollution measurement Lab</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME 751</td><td>0-0-2</td><td>1</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="3">Programme Core</td></tr>
<tr><td colspan="5">7. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="5">8. Frequency of offering (check one): Odd semester</td></tr>
<tr><td colspan="5">9. Brief Syllabus
It is an introductory course where basic engine hands on experience for conduction of tests for determination of performance characteristics of the engines. The goals of the experiments include determination of HC, CO, CO_2, O_2 from the exhaust emissions. Also, the study of gas analyzer through different modes makes it compatible for basic elementary knowledge for the students.</td></tr>
<tr><td colspan="5">10.Total lecture, Tutorial and Practical Hours for this course:</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:0</td><td colspan="3">Practice</td></tr>
<tr><td colspan="2">Tutorials:0</td><td>Lab Work: 2</td></tr>
<tr><td colspan="5">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="4">Upon the completion of this course the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="4">To determine the IHP through Morse test and Analysis of exhaust gases from emissions</td></tr>
<tr><td>CO 2</td><td colspan="4">To prepare the heat balance sheet for different engine conditions</td></tr>
<tr><td>CO 3</td><td colspan="4">To determine the emissions of CO, and other hydrocarbons from exhaust</td></tr>
<tr><td>CO 4</td><td colspan="4">To determine various parameters of the engine performance in single cylinder/multi cylinder engine</td></tr>
<tr><td colspan="5">12. List of experiments</td></tr>
<tr><td colspan="5">1. Performance study of petrol and diesel engines both at full load and part load conditions</td></tr>
<tr><td colspan="5">2. Study of Morse test for petrol and diesel engines.</td></tr>
</table>

3. Determination of compression ratio, volumetric efficiency, and optimum cooling water flow rate in engines
4. Preparation of heat balance sheet through test of an automotive engine
5. Testing of two and four wheelers using chassis dynamometers.
6. Study of NDIR gas analyzer and FID, NOx analyzer
7. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer Diesel smoke measurement.
Reference Books: 1. "Automobile Engineering" by Kirpal Singh 2. "Automobile Engineering" by R.K. Rajput 3. "Automotive Mechanics" by Joseph Heitner 4. "Automobile Engineering" by T.K. Garrett and G. N. Borthwick

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.	**Cognitive** L1,L2		**Psychomotor** L3,L4
C02.	Identify the uses of gauges and comparators Identify the uses of gauges and comparators.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO3.	Understand the significance of measurement system, errors, transducers,	**Cognitive** L1,L2		**Psychomotor** L2,L3

	intermediate modifying and terminating devices.			
CO4	Interpret measurement of field variables like force, torque and pressure.	**Cognitive** L1,L2,L3		**Psychomotor** L2,L3

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or teamwork	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2		-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

CO-PO/PSO Mapping

CO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">10. Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td colspan="2" rowspan="2">11. Course Name: Automotive System Components Lab</td><td>12. Course Code</td><td>13. L-T-P</td><td>14. Credits</td></tr>
<tr><td>ETME 753</td><td>0-0-2</td><td>1</td></tr>
<tr><td colspan="2">15. Type of Course:</td><td colspan="3">Programme Core</td></tr>
<tr><td colspan="5">16. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="5">17. Frequency of offering (check one): Odd semester</td></tr>
<tr><td colspan="5">18. Brief Syllabus
This course gives introductory knowledge about various automotive components. It also enhances the students thinking capability to find out the problems of automobile. This course is also helping students to answer fundamental questions about different components at the time of the interview.</td></tr>
<tr><td colspan="5">10.Total lecture, Tutorial and Practical Hours for this course:24</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:0</td><td colspan="3">Practice</td></tr>
<tr><td>Tutorials:0</td><td colspan="2">Lab Work: 2</td></tr>
<tr><td colspan="5">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="4">Upon the completion of this course the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="4">Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.</td></tr>
<tr><td>CO 2</td><td colspan="4">Identify the uses of gauges and comparators Identify the uses of gauges and comparators.</td></tr>
<tr><td>CO 3</td><td colspan="4">Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.</td></tr>
<tr><td>CO 4</td><td colspan="4">Interpret measurement of field variables like force, torque and pressure.</td></tr>
</table>

12. List of experiments
1. To Study the chassis, body, and Frame of the vehicle with actual model.
2. To Study the clutch of the vehicle by dismantling and assembling.
3. To Study the gear system of the vehicle by dismantling and assembling.
4. To Study the rear and front axle by dismantling and assembling.
5. To Study the steering system of the vehicle by dismantling and assembling with actual vehicle.
6. To study the engine of the vehicle by dismantling and assembling
Reference Books: 1. "Automobile Engineering" by Kirpal Singh 2. "Automobile Engineering" by R.K. Rajput 3. "Automotive Mechanics" by Joseph Heitner 4. "Automobile Engineering" by T.K. Garrett and G. N. Borthwick

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.	**Cognitive** L1,L2		**Psychomotor** L3,L4
C02.	Identify the uses of gauges and comparators Identify the uses of gauges and comparators.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO3.	Understand the significance of	**Cognitive** L1,L2		**Psychomotor** L2,L3

	measurement system, errors, transducers, intermediate modifying and terminating devices.			
CO4	Interpret measurement of field variables like force, torque and pressure.	**Cognitive** L1,L2,L3		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or teamwork	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2		-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

CO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name:
AUTOMOBILE AIR CONDITIONING</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME702</td><td>4-0-0</td><td>4</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="3">Programme Core</td></tr>
<tr><td colspan="5">7. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="5">8. Frequency of offering (check one): Odd</td></tr>
<tr><td colspan="5">9. Brief Syllabus:
To Enable the student to understand the components of the automotive air-conditioning and their functions and the latest developments in this field. Also understands various components of automotive air conditioning system, Properties of the different refrigerant and service maintenance of air conditioning system.</td></tr>
<tr><td colspan="5">10.Total lecture, Tutorial and Practical Hours for this course:48</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:48</td><td colspan="3">Practice-</td></tr>
<tr><td>Tutorials: -</td><td colspan="2">Lab Work:</td></tr>
<tr><td colspan="5">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="4">On completion of this course, the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="4">Understanding the principles of automotive air conditioning</td></tr>
<tr><td>CO 2</td><td colspan="4">Knowledge of system components: Students will learn about the various components that make up an automotive air conditioning system,</td></tr>
<tr><td>CO 3</td><td colspan="4">Understanding of modern air conditioning technologies</td></tr>
<tr><td>CO 4</td><td colspan="4">Safety and environmental considerations.</td></tr>
<tr><td>CO 5</td><td colspan="4">---</td></tr>
<tr><td colspan="5">12. UNIT WISE DETAILS</td></tr>
</table>

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

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

Unit Number: 2	Title: Air conditioning fundamentals	No. of hours: 12

Content Summary:

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

Unit Number: 3	Title: Refrigerant	No. of hours: 12

Content Summary:

Refrigerant: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil Simple problems - Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion, Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system.

Unit Number: 4	Title: Air routing and temperature control	No. of hours: 12

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

Reference Books:

TEXTBOOK:

1. Tom Birch, "Automotive Heating and Air Conditioning" Pearson Education Inc.
2. Boyce H. Dwiggins, Jack Erjavec., "Automotive Heating and Air-Conditioning", Delmer

publisher.

3. William H Crouse and Donald L Anglin, “Automotive air conditioning”, McGraw - Hill Inc.

REFERENCES:

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

CO Mapping with Bloom’s Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	To acquaint the students about basic knowledge of air conditioning and components	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	Understanding the principles of automotive air conditioning	**Cognitive** L1,L3		**Psychomotor** L3,L4
CO3.	Knowledge of system components: Students will learn about the various components that make up an automotive air conditioning system,	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Understanding of modern air conditioning technologies	**Cognitive** L1,L3		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4					3							

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: Design of Experiments & Research methodology	3. Course Code	4. L-T-P	5. Credits
	ETME704	3-1-0	4
6. Type of Course:	Programme Core		
7. Pre-requisite(s), if any: Basics of fluid mechanics			
8. Frequency of offering (check one): Odd			
9. Brief Syllabus: This course gives basic and elementary knowledge about ethics and standards of research. It enables the students to understand the need of research towards the social impact. It also enhances the students thinking capability to compare the present scenario of research with past standard and future trends in the specified field. This course will also help student to write the research proposal for innovative research.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials:-	Lab Work:	

11. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	On completion of this course, the students will be able to:
CO 1	Understand some basic concepts of research and its methodologies.
CO 2	Have basic awareness of data analysis-and hypothesis testing procedures with identify appropriate research topics.
CO 3	Select and define appropriate research problem and parameters
CO 4	Organize and conduct research (advanced project) in a more appropriate manner
CO 5	Write a research report and thesis or may write research proposal.

12. UNIT WISE DETAILS

Unit Number: 1	Title: Research Methodology	No. of hours: 12

Content Summary:

Foundations of Research Methodology, Introduction to research, what is Research, Objectives & motivations for research, Types of Research, Introduction to Qualitative Research, Introduction

to Quantitative Research Conceptualization, Business Problem, Problem Formulation		
Unit Number: 2	Title: Process Design	No. of hours: 12
Content Summary: Research Process & Research Design, Introduction to Research Process, Steps in Research Process Introduction to Research Design, Types of Research Design: Exploratory, Descriptive and Causal Research, Nature of good design.		
Unit Number: 3	Title: Sampling and data collection	No. of hours: 12
Content Summary: Sampling Technique, Sampling, Population, Sampling Frame, Sample, Bias, and Statistical Terms in Sampling: statistic, parameter, Sampling Distribution, Sampling & non-sampling errors, Probability & Non-Probability Sampling, Sample Size Determination. Data Collection Method, Introduction to Primary & Secondary data, Methods of primary data collection, Methods of secondary data collection, Advantages & disadvantages of data collection. Measurement & Scaling Technique, Scales of Measurement, Questionnaire Designing.		
Unit Number: 4	Title: Analysis	No. of hours: 12
Content Summary: Analysis & Report Writing, Data Preparation, Data aggregation, Data accuracy, Data structure, Data transformation, Descriptive Statistics, Univariate analysis, Correlation/Regression, Inferential Statistics, Hypothesis Testing Process, Large sample test, small sample, Parametric and Non-Parametric Test, Report Writing, Types of Research output, Key Elements of Report Writing.		
Contents beyond Syllabus 1. 2. 3.		

Reference Books:

Textbooks:

1. Malhotra N.K. (2011) Marketing Research, Pearson Education, Inc.
2. Zikmund W.G. (2007) Business research Methods, Thomspns, Akash Press New Delhi.

Reference Books/Materials:

1. Beri G.C. (2010) Marketing Research 3rd Edition, TMH Publishers Ltd, New Delhi.
2. Chawla D. & Sondhi N. Research Methodology Concepts and Cases, S. Chand & Company Ltd.
3. Cooper & Schindler (2015) Business Research Methods, Mcgraw-Hill.
4. Dr. Shajahan S. (2006) Research Methods for Management, JAICO publishing house.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Understand some basic concepts of research and its methodologies.	**Cognitive** L1,L3		**Psychomotor** L2,L3
C02.	Have basic awareness of data analysis-and hypothesis testing procedures with identify appropriate research topics.	**Cognitive** L1,L2		**Psychomotor** L3,L4
CO3.	Select and define appropriate research problem and parameters	**Cognitive** L1,L3		**Psychomotor** L2,L3
CO4	Organize and conduct research (advanced project) in a more appropriate manner	**Cognitive** L1,L2,L4		**Psychomotor** L2,L3
CO5	Write a research report and thesis or may write research proposal.	**Cognitive** L1,L2,L6		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2						3					
CO3		2										
CO4	2	2										

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="4">Department of Mechanical Engineering</td></tr>
<tr><td colspan="3" rowspan="2">2. Course Name:
ADVANCED AUTOMOTIVE TRANSMISSION</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME706</td><td>3-1-0</td><td>4</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="4">Programme Core</td></tr>
<tr><td colspan="6">7. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="6">8. Frequency of offering (check one): Odd</td></tr>
<tr><td colspan="6">9. Brief Syllabus:
To impart knowledge about the critical importance of the transmission system in an automobile and to create awareness about the evolution, components involved and different types of transmission system widely used in automobiles.</td></tr>
<tr><td colspan="6">10.Total lecture, Tutorial and Practical Hours for this course:48</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:48</td><td colspan="4">Practice-</td></tr>
<tr><td colspan="2">Tutorials: -</td><td colspan="2">Lab Work:</td></tr>
<tr><td colspan="6">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="5">On completion of this course, the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="5">Understanding of Transmission Systems.</td></tr>
<tr><td>CO 2</td><td colspan="5">Analyze and identify the various components of an automotive transmission system, such as gears, shafts, clutches, torque converters.</td></tr>
<tr><td>CO 3</td><td colspan="5">Acquire knowledge of the operating principles and functionality of different transmission systems.</td></tr>
<tr><td>CO 4</td><td colspan="5">Understand emerging trends and technologies in the field of automotive transmissions.</td></tr>
<tr><td>CO 5</td><td colspan="5">---</td></tr>
<tr><td colspan="6">12. UNIT WISE DETAILS</td></tr>
<tr><td colspan="2">Unit Number: 1</td><td colspan="2">Title: Introduction</td><td colspan="2">No. of hours: 12</td></tr>
<tr><td colspan="6">Content Summary:
TRANSMISSION SYSTEMS: Clutch, types of clutch, clutch design, Gear box, types of gear</td></tr>
</table>

boxes, gear box design, overdrive gears, Fluid flywheel & torque converter, Epicyclic gear box, semi-automatic & automatic transmission Propeller shaft.

Unit Number: 2	Title: Transmission System	No. of hours: 12

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

Unit Number: 3	Title: Braking System	No. of hours: 12

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

Unit Number: 4	Title: Drive system and energy management	No. of hours: 12

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

Contents beyond Syllabus
1.
2.
3.

Reference Books:

TEXT TEXTBOOK:

1. Heldt P.M, Torque Converters, Chilton Book Co.
2. K. Newton, W.Steeds and T.K.Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India.

REFERENCES

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

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Understanding of Transmission Systems.	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	analyze and identify the various components of an automotive transmission system, such as gears, shafts, clutches, torque converters.	**Cognitive** L1,L4		**Psychomotor** L3,L4
CO3.	acquire knowledge of the operating principles and functionality of different transmission systems.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Understand emerging trends and technologies in the field of automotive transmissions.	**Cognitive** L3,L4		**Psychomotor** L2,L4

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3	3						3					
CO4						3						

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: **VEHICLE SAFETY & MAINTENANCE**	3. Course Code	4. L-T-P	5. Credits
	ETME708	4-0-0	4
6. Type of Course:	Programme Core		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Even			
9. Brief Syllabus: The students will be able to have a complete knowledge of the Vehicle safety with their operating procedure also know the maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials: -	Lab Work:	

11. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	On completion of this course, the students will be able to:
CO 1	Enhancing the knowledge of safety driving and minimizing the vehicle's accident;
CO 2	Improving the fuel efficiency and prolonging the vehicle lifespan.
CO 3	Reducing the vehicle total maintenance cost.
CO 4	Effectively analyzing the vehicle problem and the possible causes of the problem;
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Safety concepts	No. of hours: 12

Content Summary:

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

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

Unit Number: 2	Title: Safety equipments	No. of hours: 12

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

Unit Number: 3	Title: Maintenance tools, shops	No. of hours: 12

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

Unit Number: 4	Title: Engine repairing	No. of hours: 12

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

Contents beyond Syllabus
1.
2.
3.

REFERENCES

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

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

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

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

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Enhancing the knowledge of safety driving and minimizing the vehicle's accident;	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	Improving the fuel efficiency and prolonging the vehicle lifespan.	**Cognitive** L1,L4		**Psychomotor** L3,L4
CO3.	Reducing the vehicle total maintenance cost.	**Cognitive** L1,L5		**Psychomotor** L2,L3
CO4	Effectively analyzing the vehicle problem and the possible causes of the problem;	**Cognitive** L1,L4		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3		3					3					
CO4		3			3							

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: **PRODUCTION OF AUTOMOTIVE COMPONENT**	3. Course Code	4. L-T-P	5. Credits
	ETME710	4-0-0	4
6. Type of Course:	Programme Elective		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Even			
9. Brief Syllabus: Sound knowledge of powder metallurgy, extrusion process, forging process and casting process used for manufacturing of automotive component. Also know the process of powder injection molding			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials: -	Lab Work:	

11. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	On completion of this course, the students will be able to:
CO 1	The primary outcome of automotive component production is the creation of high-quality parts
CO 2	Improving the fuel efficiency and prolonging the vehicle lifespan.
CO 3	Supply Chain and Job Creation: The production of automotive component
CO 4	Innovation and Technology Advancements.
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Powder metallurgy	No. of hours: 12

Content Summary:

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

Unit Number: 2	Title: FORGING AND EXTRUSION PROCESS	No. of hours: 12

Content Summary:

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

Unit Number: 3	Title: CASTING AND MACHINING	No. of hours: 12

Content Summary:

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

Unit Number: 4	Title: Recent trends in manuacturing	No. of hours: 12

Content Summary:

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

Contents beyond Syllabus

1.
2.
3.

TEXT BOOK

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

REFERENCES

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

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	The primary outcome of automotive component production is the creation of high-quality parts	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	Improving the fuel efficiency and prolonging the vehicle lifespan.	**Cognitive** L1,L4		**Psychomotor** L3,L4
CO3.	Supply Chain and Job Creation: The production of automotive component	**Cognitive** L1,L3		**Psychomotor** L2,L3
CO4	Innovation and Technology Advancements.	**Cognitive** L1,L3		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3									
CO2					3							
CO3	3											
CO4	3					3						

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name: Automobile air conditioning Lab</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ETME 752</td><td>0-0-2</td><td>1</td></tr>
<tr><td colspan="2">6. Type of Course:</td><td colspan="3">Programme Core</td></tr>
<tr><td colspan="5">7. Pre-requisite(s), if any:</td></tr>
<tr><td colspan="5">8. Frequency of offering (check one): Even semester</td></tr>
<tr><td colspan="5">9. Brief Syllabus
The main purposes of a Heating, Ventilation and Air-Conditioning (HVAC) system are to help maintain good indoor air quality (IAQ) through adequate ventilation with filtration and provide thermal comfort.</td></tr>
<tr><td colspan="5">10.Total lecture, Tutorial and Practical Hours for this course:24</td></tr>
<tr><td colspan="2" rowspan="2">Lectures:0</td><td colspan="3">Practice</td></tr>
<tr><td colspan="2">Tutorials:0</td><td>Lab Work: 2</td></tr>
<tr><td colspan="5">11. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.</td></tr>
<tr><td>COs</td><td colspan="4">Upon the completion of this course the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="4">Illustrate the fundamental principles and applications of refrigeration and air conditioning system</td></tr>
<tr><td>CO 2</td><td colspan="4">Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems</td></tr>
<tr><td>CO 3</td><td colspan="4">Present the properties, applications and environmental issues of different refrigerants</td></tr>
<tr><td>CO 4</td><td colspan="4">Operate and analyze the refrigeration and air conditioning systems.</td></tr>
<tr><td colspan="5">12. List of experiments</td></tr>
<tr><td colspan="5">1. To Study Vapor compression Refrigeration System</td></tr>
<tr><td colspan="5">2. To learn various types of refrigerant used in Automobile A.C. system</td></tr>
<tr><td colspan="5">3. Study of various tools and equipments used in Automobile refrigeration laboratory</td></tr>
</table>

4. To study important component of air conditioning system used in Automobile.
5. Study of a range of controls used in Air conditioning system
6. Write a troubleshoot chart for automobile air conditioning system.
TEXTBOOK: 1. Tom Birch, "Automotive Heating and Air Conditioning" Pearson Education Inc. 2. Boyce H. Dwiggins, Jack Erjavec., "Automotive Heating and Air-Conditioning", Delmer publisher. **3.** William H Crouse and Donald L Anglin, "Automotive air conditioning", McGraw - Hill Inc. **REFERENCES:** 1. Goings. L.F., "Automotive air conditioning", American Technical services. 2. Paul Weiser, "Automotive air conditioning", Reston Publishing Co Inc.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Illustrate the fundamental principles and applications of refrigeration and air conditioning system	**Cognitive** L1,L2		**Psychomotor** L3,L4
C02.	Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems	**Cognitive** L2,L3		**Psychomotor** L2,L3
CO3.	Present the properties, applications and environmental issues of different refrigerants	**Cognitive** L1,L3		**Psychomotor** L2,L3

CO4	Operate and analyze the refrigeration and air conditioning systems.	**Cognitive** L1,L4		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or teamwork	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2		-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

CO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: Automobile CAD Lab with simulation	3. Course Code	4. L-T-P	5. Credits
	ETME 754	0-0-2	1
6. Type of Course:	Programme Core		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Even semester			
9. Brief Syllabus The Automobile CAD Lab with simulation is a specialized facility that combines computer-aided design (CAD) software with simulation tools			
10.Total lecture, Tutorial and Practical Hours for this course:			
Lectures:0	Practice		
	Tutorials:0	Lab Work: 2	

11. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	Upon the completion of this course the students will be able to:
CO 1	Proficiency in CAD Software: Students will develop a strong understanding of Computer-Aided Design (CAD)
CO 2	Application of CAD in Automotive Design:
CO 3	Simulation and Analysis: Students will learn how to utilize simulation tools
CO 4	Design Optimization: Students will understand the principles of design optimization.

12. List of experiments

1. Introduction to Solid Modelling & Pro/E Package
2. Working with sketch mode of Pro/E
3. Introduction to MATLAB Programming
4. Assembly modelling in Pro/E
5. Generating, editing and modifying drawings in Pro/E

6. Make the simulation of following automobile components:
TEXTBOOK: "Automotive Engineering: Lightweight, Functional, and Novel Materials" by Brian Cantor, Patrick Grant, and Colin Johnson. **REFERENCES:** "Automotive Engineering: Powertrain, Chassis System and Vehicle Body" by David Crolla.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Proficiency in CAD Software: Students will develop a strong understanding of Computer-Aided Design (CAD)	**Cognitive** L1,L2		**Psychomotor** L3,L4
C02.	Application of CAD in Automotive Design:	**Cognitive** L2,L3		**Psychomotor** L2,L3
CO3.	Simulation and Analysis: Students will learn how to utilize simulation tools	**Cognitive** L1,L4		**Psychomotor** L2,L3
CO4	Design Optimization: Students will understand the principles of design optimization.	**Cognitive** L1,L3		**Psychomotor** L2,L3

	Engineering	Problem	Design/dev	Conduct inve	Modern tool	The engineer	Environmen	Ethics	Individual or	Communic	Project man	Life-long

	Knowledge	analysis	elopment of solutions	stigations of complex problems	usage	and society	t and sustainability		teamwork	ation	agement and finance	Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

CO-PO/PSO Mapping

CO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: ALTERNATE ENERGY SOURCES FOR AUTOMOBILES	3. Course Code	4. L-T-P	5. Credits
	ETME801	4-0-0	4
6. Type of Course:	Programme Core		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Odd			
9. Brief Syllabus: The basic purpose of this course is to know the several of sources of alternate fuels for automotive Engines and study the performance of engine using different fuels.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials:-	Lab Work:	

11. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	On completion of this course, the students will be able to:
CO 1	To understand the numerous of sources of alternate fuels for automotive Engines
CO 2	To study the performance of engine using different fuels.
CO 3	To understand the Biomass energy and Reformulated Conventional Fuel
CO 4	To analyze the effects of alternate fuels on environment.
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

Introduction

Types of energy sources, their availability, need of alternative energy sources, Nonconventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto

fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological up gradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, roadmap for alternative fuels.

Unit Number: 2	Title: Solar energy and gaseous fuels	No. of hours: 12

Content Summary:

Solar energy & Gaseous fuels: Solar energy geometry, Solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P.V. effect solar cells and characteristics. Application of solar energy for automobiles. Introduction and principle of Fuel cell, Working Principle, types of Fuel Cells, Advantages of Fuel Cell.

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

Unit Number: 3	Title: **Biodiesel and biomass**	No. of hours: 12

Content Summary:

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

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

Unit Number: 4	Title: Reformulated fuels	No. of hours: 12

Content Summary:

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

Introduction to alternative power trains: Components of an EV, EV batteries, chargers, drives, transmission, and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology Applications of DFT. Dual fuel engine operation. Advantages and disadvantages of dual fuel technology.

Contents beyond Syllabus

1.
2.
3.

Reference Books:

TEXTBOOKS:

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

REFERENCES BOOKS:

1. Alternative fuels for vehicle book by M.poulton
2. Alternative fuels guidebook by R. Bechtold.SA

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	To know the several of sources of alternate fuels for automotive Engines	**Cognitive** L1,L3		**Psychomotor** L2,L3
C02.	To study the performance of engine using different fuels.	**Cognitive** L1,L3		**Psychomotor** L3,L4
CO3.	To get knowledge of Biomass energy and Reformulated Conventional Fuel	**Cognitive** L1,L4,L5		**Psychomotor** L2,L3
CO4	To analyze the effects of alternate fuels on environment.	**Cognitive** L1,L2,L4		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2				3			3					
CO3	3											
CO4		3					3					

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

1. Department:	Department of Mechanical Engineering		
2. Course Name: **Two and Three wheeler Technology**	3. Course Code	4. L-T-P	5. Credits
	ETME806	4-0-0	4
6. Type of Course:	Programme Elective		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Odd			
9. Brief Syllabus: The course is designed to understand different types of two and three wheelers types, construction and working. Students will also be able to learn about different functions of two and three wheelers.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials: -	Lab Work:	
11. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.			

COs	On completion of this course, the students will be able to:
CO 1	Understand the fundamentals of two- and three-wheel technology
CO 2	Recent developments in two and four stroke engines.
CO 3	Study of chassis, frame, suspension, and steering.
CO 4	Repair and maintenance of two- three wheeler vehicles and electrical systems.
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

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

Power Plant : Selection criteria and Design considerations for two wheeler & three wheeler

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

Unit Number: 2	Title: Chassis and sub systems	No. of hours: 12

Content Summary:

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

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

Unit Number: 3	Title: Electric propulsion unit and energy storage	No. of hours: 12

Content Summary:

Brakes and Wheels: Brake types – Drum brakes, Disc brakes – construction and working principle / purpose. Hand Brake and Paddle brake and its actuating mechanism. Design criteria actuating mechanism components selection considerations. Brake circuit Layout for two wheeler and three wheeler vehicles. Wheels - Front and Rear – Wheel rim types – construction of spokes wheel - construction of cast wheel – construction of Alloy wheels. Tyre – functions – materials – types – construction of tube type tyre and tubeless tyres, it's advantages & comparison – methods vulcanizing of Tubes & Tyres for Tubeless tyres.

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

Unit Number: 4	Title: Maintenance	No. of hours: 12

Content Summary:

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

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

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

Contents beyond Syllabus

1.
2.
3.

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Understand the fundamentals of two- and three-wheel technology	**Cognitive** L1,L2		**Psychomotor** L2,L3

C02.	Recent developments in two and four stroke engines.	**Cognitive** L1,L4		**Psychomotor** L3,L4
CO3.	Study of chassis, frame, suspension, and steering.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Repair and maintenance of two- three wheeler vehicles and electrical systems.	**Cognitive** L1,L2,L3		**Psychomotor** L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3		3									
CO3	3											
CO4					3							

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			

CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped

COURSE TEMPLATE

10. Department:	Department of Mechanical Engineering		
1. Course Name: **Electric and Hybrid Vehicles**	2. Course Code	3. L-T-P	4. Credits
	ETME809	4-0-0	4
5. Type of Course:	Programme Elective		
6. Pre-requisite(s), if any:			
7. Frequency of offering (check one): Odd			
8. Brief Syllabus: This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. This course goes deeper into the various aspects of hybrid and electric drive trains such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.			
10.Total lecture, Tutorial and Practical Hours for this course:48			
Lectures:48	Practice-		
	Tutorials: -	Lab Work:	
11. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.			

COs	On completion of this course, the students will be able to:
CO 1	Understand the fundamentals of electric and hybrid vehicle technology
CO 2	Analyze and compare different types of electric and hybrid vehicles.
CO 3	Explain the environmental and energy-related benefits of electric and hybrid vehicles.

CO 4	Stay updated on emerging trends and advancements in electric and hybrid vehicle technology
CO 5	---

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

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

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

Unit Number: 2	Title: Drive trains	No. of hours: 12

Content Summary:

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

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

Unit Number: 3	Title: Electric propulsion unit and energy storage	No. of hours: 12

Content Summary:

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

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

Unit Number: 4	Title: Drive system and energy management	No. of hours: 12

Content Summary:

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

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Contents beyond Syllabus 1. 2. 3.
Reference Books: **TEXT BOOKS** 1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, **REFERENCES BOOKS** 1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press. 2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley.

CO Mapping with Bloom's Taxonomy

CO	Definition	**Cognitive levels** 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	**Affective levels** 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	**Psychomotor levels** 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1.	Understand the fundamentals of electric and hybrid vehicle technology.	**Cognitive** L1,L2		**Psychomotor** L2,L3
C02.	Analyze and compare different types of electric and hybrid vehicles.	**Cognitive** L1,L4		**Psychomotor** L3,L4
CO3.	Explain the environmental and energy-related benefits of electric and hybrid vehicles.	**Cognitive** L1,L2		**Psychomotor** L2,L3
CO4	Stay updated on emerging	**Cognitive**		**Psychomotor**

	trends and advancements in electric and hybrid vehicle technology	L1,L3		L2,L3

CO-PO/PSO Mapping

	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3										
CO3	3						3					
CO4					3							

CO	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			

1=weakly mapped
2= moderately mapped
3=strongly mapped