Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Automobile Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology for the overall development of students.

Mission

Imparting quality education, looking after holistic development of students, and conducting need-based research and extension activities.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to

engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of automobile engineering including thermal, manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate automobile systems considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer based methods and tools to develop mechanical systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam

B. Tech. Automobile Engineering

Course Structure for Semester VII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTAMC701	PCC 29	Automobile Air Conditioning	2	1	--	20	20	60	100	3
BTAMC702	PCC 30	Vehicle Performance and Testing	2	1	--	20	20	60	100	3
BTAMC703	PCC 31	Automotive Emission and Control	2	1	--	20	20	60	100	3
BTAMC704A	PEC 2	Vehicle Architecture and Packaging	2	1	--	20	20	60	100	3
BTAMC704B		Computer Simulation of IC Engine Processes								
BTAMC704C		Automobile Design (Product Design, PLM, CAE, Catia)								
BTMEC704C		Finite Element Method								
BTMEC705A	OEC 5	Engineering Economics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTMEC705B		Intellectual Property Rights								
BTMEC705C		Wind Energy								
BTMEC705D		Knowledge Management								
BTAML706	PCC 32	Automobile Air Conditioning Lab	--	--	2	30	--	20	50	1
BTAML707	PCC 33	Vehicle Maintenance Management Lab	--	--	2	30	--	20	50	1
BTAML708	PCC 34	Vehicle Performance and Testing Lab	--	--	2	30	--	20	50	1
BTAMS709	Project 4	Seminar	--	--	2	30	--	20	50	1
BTAMF710	Project 5	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1

BTAMP711	Project 6	Project Stage-I**	--	--	6	30	--	20	50	3
		Total	11	4	14	230	80	390	700	20

***In case of students opting for Internship in the eighth semester, the Project must be industry-based*

B. Tech. Automobile Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
Choose any two subjects from the ANNEXURE-A#			-	-	--	20	20	60	100	3
			-	-	--	20	20	60	100	3
BTAMP803	Project 7	Project Stage-II Or Internship and Project*	--	--	30	50	--	100	150	15
Total			--	--	30	90	40	220	350	21

** Six months of Internship in the industry*

[#] These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

 # Students doing project in the Institute will have to appear for CA/MSE/ESE

ANNEXURE -A

Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of the Professor
1	BTAMC801A	Optimization from fundamentals	12 Weeks	IITB	Prof. Ankur A. Kulkarni
2	BTAMC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTAMC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTAMC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S

5	BTAMC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan
6	BTAMC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

Semester VII

Automobile Air Conditioning

BTAMC701	PCC 29	Automobile Air Conditioning	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Apply design concept to develop refrigeration system for refrigerated vehicle.
CO2	Explain psychometric concepts in design of air-conditioning in vehicle.
CO3	Explain effects of various operating parameters on performance of A/C System.
CO4	Explain troubleshooting methods and maintenance of automotive air conditioning system.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents:

Unit-I:

Introduction to air conditioning and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapor compression cycle, bell Coleman cycle), effects of various operating parameters on performance of A/C System, Vapour absorption refrigeration system (No numerical), Applications of air conditioning.

Unit-II:

Refrigerants and Air Conditioning Components Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping, Future refrigerants.

Automobile Air conditioning components: Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants. Refrigerant charge capacity determination.

Unit-III:

Psychrometry, Psychometric properties, tables, charts, Psychometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor,

Load analysis Outside and inside design consideration, Factors forming the load on refrigeration and air conditioning systems, Load calculations for automobiles, Effect of air conditioning load on engine performance, Air conditioning electrical and electronic control, pressure switching devices, sensors and actuators.

Unit-IV:

Air distribution system Comfort conditions, Air management and heater systems, air distribution modes (Fresh/Recirculation, Face, Foot, Defrost, and Demist), A/C ducts and air filters, Blower fans, Temperature control systems (manual/semiautomatic, automatic). Vehicle operation modes and Cool-down performance.

Unit-V:

Diagnostics, Trouble Shooting, Service and Repair Initial vehicle inspection, temperature measurements, pressure gauge reading and cycle testing, leak detection and detectors, Sight glass. Refrigerant safety/handling, refrigerant recovery; recycle and charging, system oil, system flushing, odor removal, retrofitting. Removing and replacing components, Compressor service.

Unit-VI:

Refrigerated van:

Functioning, design, classifications, applications, Interior design, temperature and humidity control.

Text Book:

1**.** Textbook of "Refrigeration and Air Conditioning" By R. S. Khurmi and J.K.Gupta S. Chand Publication.

2. Steven Daly: "Automotive air conditioning and Climate control systems" Butterworth-Heinemann publications.

References:

1. "Principles of Refrigeration"; Roy J Dossat, Pearson Education Inc.
2. "Automotive air conditioning" William H Crouse and Donald L Anglin.
3. "Refrigeration and Air Conditioning", Arora and Damkondwar, Dhanpatrai and Company.
4. "Refrigeration and Air Conditioning", C.P.Arora, Tata McGraw Hills Pub.
5. Steven Daly, "Automotive air conditioning and Climate control systems", Elsevier Ltd, 2011.

6. Boyce H Dwiggins, “Automotive Heating and Air Conditioning”, Delmar Thomson Learning Ltd, 2001.

Vehicle Performance and Testing

BTAMC702	PCC 30	Vehicle Performance and Testing	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the performance parameters related to performance analysis of automotive systems.
CO2	Conduct the performance test for components and systems of vehicle.
CO3	Explain the different tracks used for vehicle testing with the testing procedure.
CO4	Apply the knowledge regarding safety systems, EMI and sensors used for automotive functioning.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents:

Unit-I:
Vehicle Performance Parameters:
Fuel economy, acceleration, deceleration, grad ability, top speed, handling, comfort, life durability, EGR systems, Impact of vehicular systems on performance: Suspension system, Steering system, Brakes, Tyres, carriage unit. Catalytic converters function and construction, Lambda close loop control system for gasoline vehicles.

Unit-II:
Drive train and Component testing:

Vehicular transmission performance: comparison of automotive clutches epicyclic transmission, torque converter, final drive and differential. testing of vehicle components: clutch, gear box (for noise and shifting force), brake testing, wheels and tyre testing – tyre wear pattern identification and causes.

Unit-III:
Vehicle testing:
Road test, free acceleration test, coast down test, passer by noise test, road load data acquisition for vehicle.
Test tracks: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water Laboratory testing: Testing on chassis dynamometer, transition testing (Euro III onwards), accelerated testing, virtual testing, evaporative emission testing, oil consumption testing, endurance test, high speed performance test.

Unit-IV:
Comfort, Convenience and Safety
Seats: types of seats, driving controls accessibility, and driver seat anthropometry.
Steering: steering column angle, collapsible steering, and power steering. Adaptive cruise control, navigation system, adaptive noise control, driver information system.
Safety: Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety.

Unit-V:
Collisions and Crash Testing Crash testing:
Human testing, dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition, braking distance test.

Unit-VI:
Noise and vibration:
Mechanism of noise generation, engine noise and vibration, causes and remedies on road shocks, wind noise and measurement. Automobile testing instrumentation: Sensors types and selection, instrumentation for functional tests, model test and full scale testing.

Texts/References: -
1. “Automotive Handbook”, Bosch.
2. “Engine Testing Theory and Practice”, Michel Plint.
3. “Motor Vehicle Inspection”, W. H. Crouse and D. L. Anglin.
4. “Automobile Engineering” (Anna University) Ramlingam.
5. “Automobile engineering”, Kripal Singh.
6. “Automotive Mechanics”, JosepfHeitner.
7. ARAI vehicle emission test manual Inspection SAE handbook vol. 2 and 3.
9. “Vehicle Operation and Performance”, J. G. Giles,
10. “Automobile engineering” Kripal Singh.

11. “Automotive Vehicle Safety”, George Pieters, Barbara Pieters.
12. “Aerodynamics of road vehicles”, Wolt, Heinrich Hucho.
13. “Engine performance Diagnosis and Tune up Shop Manual”, Gousha H. M.
14. “Automobile Engineering”, Rangawala.

Automotive Emission and Control

BTAMC703	PCC 31	Automotive Emission and Control	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify and understand possible harmful emissions and the legislation standards
CO2	Categorize, interpret and understand the essential properties of fuels for petrol and diesel engines influences the emission.
CO3	Analyse Engine parameters that influence engine emission.
CO4	Describe the SI engine and CI engine emission control systems.
CO5	Explain various exhaust after-treatment systems.
CO6	Identify various emission instruments, techniques and the test cycle for emission levels measurement.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit-I:Introduction

Historical background, Pollutants-sources-formation-effects-transient operational effects on pollution. Historical background, Regulatory test procedures.

Unit-II:SI engine Combustion and Pollutant Formation

Chemistry of SI engine Combustion, HC and CO formation in 4 stroke and 2 stroke SI engines, NO formation in SI Engines, Effect of operating variables on emission formation.

Unit-III:**CI engine Combustion and Emissions**
Basic of diesel combustion-Smoke emission in diesel engines-Particulate emission in diesel engines, Colour and aldehyde emissions from diesel engines, Effect of operating variables on emission formation.

Unit-IV: Control Techniques for SI and CI
Design changes, optimization of operating factors, exhaust gas re-circulation, fumigation, air injector PCV system-Exhaust treatment in SI engines-Thermal Reactors-Catalytic converters, Catalysts, Use of unleaded petrol.

Unit-V:Emission Measurement, Test procedures & regulations
Test cycles for light & medium duty vehicles, test procedure for evaporative emissions, Emission standards for light and heavy duty vehicles & motor cycle emission standard. NDIR analyzers, FID, Chemiluminescence, NOx analyzer, oxygen analyzer, smoke measurement, constant volume sampling, and particulate emission measurement

Unit-VI:Environmental Pollution
Definition, cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management.

Texts/References:
1. Springer and Patterson, Engine Emission, Plenum Press, 1990.
2. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill Co., 1994.
3. SAE Transactions, Vehicle emission, 1982 (3 vol).
4. Obert. E. F., "Internal Combustion Engines", 1982.
5. Taylor C.F., "Internal Combustion Engines", MIT Press, 1972.
6. Heywood. J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1995.
7. Automobiles and Pollution SAE Transaction, 1995.
8. B. P. Pundir, Engine Emissions, Narosa Publications.
9. E. F. Oberts, "Internal Combustion Engine and Air Pollution", Harper & Row Publisher, NY

Vehicle Architecture and Packaging

BTAMC704A	PEC 2	Vehicle Architecture and Packaging	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**

Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents:

Unit I:
Introduction
Brief introduction to CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance– Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

Unit II:
Planning and Control and Computerized Process Planning
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems

Unit III
Cellular Manufacturing
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite

part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Unit IV

Guided Vehicle System (Agvs)

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planningand Control– Quantitative analysis in FMS Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application Vehicle Guidance technology –Vehicle Management & Safety.

Unit V

Industrial Robotics

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Text Books:

1. Mikell.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, SubramanyanS.andRaju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

References:

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India,2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tiwari&T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill, Publishing Company, 2000.

Computer Simulation of IC Engines Processes

BTAMC704B	PEC 2	Computer Simulation of IC Engines Processes	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	

CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents:

UNIT-I:
Computer Simulation and Thermodynamics of Combustion
Introduction, Heat of Reaction, Complete Combustion In C/H/O/N Systems, Constant Volume Adiabatic Combustion, Constant Pressure Adiabatic Combustion. Calculation of Adiabatic Flame Temperature.
UNIT-II:
SI Engine Simulation with Fuel-Air as Working Medium
DeviationBetween Actual and Air Standard Cycles of Operation- Problems, SI Engine Simulation with Adiabatic Constant Volume Combustion with Fuel and Air Being Considered, Calculation of Temperature Drop Due to Fuel Vaporization, Calculation of Mean Effective Pressure, Torque and Thermal Efficiency at Full Throttle, Part Throttle and Supercharged Conditions

UNIT-III:
Actual Cycle Simulation in SI Engines
Progressive Combustion; GasExchange Process, Heat Transfer Process, Friction. Procedure of Validating Computer Code with Experimental Data Based on Performance Parameters and Pressure Crank Angle Diagram.

UNIT-IV:
Simulation of 2-Stroke SI Engine Simulation of the Process,Determination of the Pressure-Crank Angle Variation, Computation of Performance Parameters

UNIT-V:
Diesel Engine Simulation
Main Difference between SI and CI EngineSimulation, Differences Between Ideal and Actual Cycles, Mathematical Combustion Model for Diesel Engine, Heat Transfer and Gas Exchange Processes

REFERENCES:

1. Ganesan, V., "Computer Simulation of Spark Ignition EngineProcess", Universities Press (I) Ltd, Hyderabad, 1996.
2. Ganesan. V., "Computer Simulation of Compression IgnitionEngine Process", Universities Press (I) Ltd, Hyderabad, 2000.
3. AshleyCapbel, "Thermodynamic Analysis of Combustion Engine", John Wiley and Sons, New York - 1986.
4. Benson.R.S., Whitehouse. N.D., "Internal Combustion Engines",Pergamon Press, oxford, 1979.
5. Ramoss.A.L., "Modelling of Internal CombusionEngines Processes", McGraw-Hill Publishing Co., 1992.

Automobile Design (Product Design, PLM, CAE, Catia)

BTAMC704C	PEC 2	Automobile Design (Product Design, PLM, CAE, Catia)	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Domain related training (Approx. 20 Hrs)

Unit 1:

Introduction to Styling, Basic of Design - Introduction to Design, Good Design & it's Examples of All Time, Industrial Design & its use. Design Process - Typical Product Life Cycle, Automotive Design Process (for production release), Design Studio (Automotive studio) Process or Product Conceptualization Process, Case Study. CAS Surfaces or Digital Clay Models, Class A Surfaces - Role of Class A surface Engineer, Requirements for a Surface to fulfill " Class A Surface" Standards, Case Studies for Class A Surfaces, Class A Surface Creation for Bonnet

Unit 2:

Introduction to Body In White: Introduction & familiarization to Body In White (BIW), various type of BIW, Types of BIW sub system, various aggregates of BIW. Bonnet Design Case Study: Function of Bonnet, Defined Input to Bonnet, Intended Input to Bonnet Design. Steps in Bonnet design, Study of Class A Surfaces, Hood Package Layout , Typical Sections, Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D, Hood Structural Members, CAE 1(Durability, Crash), Panel Detail Design, Body Assembly Process, CAE 2(Durability, crash, individual panel level), Design Updating & Detailing Prototypes, Design Updating & Production Release

Unit 3:

Introduction to CAE & its importance in the PLM, Introduction to FEA & its applications (NVH, Durability & Vehicle Crashworthiness). Introduction of Pre-Processor, Post-Processor & Solvers. Importance of discretization & Stiffness Matrix (for automobile components). Importance of oil canning on an automobile hood with Case study related to Durability Domain. Modal analysis on the hood (Case Study related to NVH Domain). Introduction of vehicle crashworthiness & Bio-mechanics (Newtonian laws, energy management, emphasis of impulse in car crashes). Head impact analysis as a Case study on the hood of an automobile (EuroNCAP test regulation). Importance of Head performance criteria (HPC). Introduction to failure criteria (By explaining the analogy of using uni-axial test results for predicting tri-axial results in reality), Mohr's Circle, Von-Mises stress criteria, application of various failure criteria on brittle or ductile materials

Unit 4:

Introduction to CAD,CAM & CAE, FEA - Definition, Various Domains – NVH, Dura, Crash, Occupant Safety, CFD. Implicit vs. Explicit Solvers, Degree of Freedom, Stiffness Matrix, Pre-Post & Solver; Types of solvers, Animation. Durability - Oil Canning, Oil Canning on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. NVH – Constrained Modal Analysis, Constrained Modal Analysis on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. Crash – Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria, Von-Mises Stress

Unit 5:

Sheet metal design & Manufacturing Cycle, Simultaneous Engineering (SE) feasibility study, Auto Body & its parts, Important constituents of an automobile, sheet metal, sheet metal processes. Type of draw dies, Draw Model development & its considerations. Forming Simulations, Material Properties, Forming Limit Curve (FLD), Pre Processing, Post-Processing, Sheet metal formability- Simulation

Unit 6:

Die Design – Sheet metal parts, Sheet metal operations (Cutting, Non-Cutting etc.), Presses, Various elements used in die design, Function of each elements with pictures, Types of dies, Animation describing the working of dies, Real life examples of die design. **Fixture Design -** Welding (Spot/Arc Welding), Body Coordinates, 3-2-1 principle, Need for fixture, Design considerations, Use of product GD&T in the fixture design, fixture elements. Typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Typical unit design for sheet metal parts (Rest/Clamp/Location/Slide/Dump units/Base), Types of fixture (Spot welding/ Arc welding/ Inspection fixture/Gauges)

Tools related training (Approx. 20 Hrs):

Depending on the tools available in the college, the relevant tool related training modules shall be enabled to the students.

AutoCAD, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD P&ID, Autodesk 3ds Max, Autodesk Alias, Autodesk SketchBook, Automotive, CATIA V5, CATIA V6, FEA, Autodesk Fusion 360, Autodesk Inventor, Autodesk Navisworks, Autodesk Ravit, Autodesk Showcase, Autodesk Simulation, PTC Creo, PTC ProENGINEER, Solid Edge, SOLIDWORKS.

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.
4. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.

References:

1. IbrahimZeid,"CAD/CAM TheoryandPractice", TataMcGrawHillPublication,
2. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
3. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
4. Onwubiko, C., "Foundation of Computer Aided Design", West Publishing Company. 1989
5. R.W.Heine, C. R.Loper and P.C.Rosenthal, *Principles of Metal Casting*, McGraw Hill, Newyork, 1976.
6. J. H.Dubois And W. I.Pribble, *Plastics Mold Engineering Handbook*, Van NostrandReihnhold, New York, 1987.
7. N. K. Mehta, Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
8. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
9. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.

10. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
11. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, SpringerVerlag, 2004. ISBN 1852338105

Finite Element Method

BTMEC704C	PEC 2	Finite Element Method	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural, thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two and three dimensional problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			1								
CO2	1	2	2	2								
CO3	1	3		1	1							
CO4	1	2			1							
CO5	1	2	1	1	2							
CO6	2	2										

Course Contents

Unit I: Introduction
Finite element analysis and its need; Advantages and limitations of finite element analysis (FEA); FEA procedure.

Unit II: Elements of Elasticity

Stress at a point; Stress equation of equilibrium; 2-D state of stress; Strains and displacements; Stress-strain relationship for 2-D state of stress; Plane stress and plane strain approach.

Unit III:Relevant Matrix Algebra
Addition, subtraction and multiplication of matrices; Differentiation and integration of matrices; Inverse of a matrix; Eigen values and eigen vectors; Positive definite matrix; Gauss elimination.

Unit IV: One-dimensional Problems
Introduction; FE modelling; Bar element; Shape functions; Potential energy approach; Global stiffness matrix; Boundary conditions and their treatments; Examples.

Unit V: Trusses and Frames
Introduction; Plane trusses; Element stiffness matrix; Stress calculations; Plane frames; examples.

Unit VI: Two-dimensional Problems
Introduction and scope of 2-D FEA; FE modelling of 2-D problem; Constant strain triangle; Other finite elements (no mathematical treatment included); Boundary conditions.

Texts:
1.T. R. Chandrupatla, A. D. Belegundu, ―Introduction to Finite Elements in Engineering‖, Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.
2.P. Seshu, ―A Textbook of Finite Element Analysis‖, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3.R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, ―Concepts and Applications of Finite Element Analysis‖, John Wiley & Sons, Inc.

References:
K. J. Bathe, ―Finite Element Procedures‖, Prentice Hall of India Pvt. Ltd., 2006.

Engineering Economics

BTMEC705A	OEC 5	Engineering Economics	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, Benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Compute the depreciation of an asset using standard Depreciation techniques to assess its impact on present or future value.
CO5	Apply all mathematical approach models covered in solving engineering economics problems: mathematical formulas, interest factors from tables, Excel functions and graphs. Estimate reasonableness of the results.
CO6	Examine and evaluate probabilistic risk assessment methods.
CO7	Compare the differences in economic analysis between the private and public sectors. Recognize the limits of mathematical models for factors hard to quantify.
CO8	Develop and demonstrate teamwork, project management, and professional communications skills

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											3	
CO2											3	
CO3											3	
CO4											3	
CO5					3						3	
CO6											3	
CO7											3	
CO8									2		3	

Course Contents:

Unit 1: Introduction to Economics

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Eng**i**neering Economics: Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis: V ratio, Elementary economic Analysis: Material selection for product Design selection for a product, Process planning.

Unit 2: Value Engineering

Make or buy decision, Value engineering: Function, aims, and Value engineering procedure. Interest formulae and their applications: Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor: equal payment series capital recovery factor:

Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

Unit 3: Cash Flow
Methods of comparison of alternatives: present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

Unit 4: Replacement and Maintenance Analysis
Replacement and Maintenance analysis: Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset: capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit 5: Depreciation
Depreciation: Introduction, Straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, service output method of depreciation-

Unit 6: Evaluation of Public Alternatives
Introduction, Examples, Inflation adjusted decisions: procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Texts:

1. PanneerSelvam R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

References:

1. Chan S. Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, “Engineering Economics and analysis”, Engineering Press, Texas, 2010.
3. E. P. Degarmo, W. G. Sullivan and J. R. Canada, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A. Khan, "Engineering Economy", Dorling Kindersley, 2012.

Intellectual Property Rights

BTMEC705B	OEC 5	Intellectual Property Rights	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic fundamental terms such as copyrights, Patents, Trademarks etc.,
CO2	Interpret Laws of copy-rights, Patents, Trademarks and various IP registration Processes.
CO3	Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms commercial strategies.
CO4	Create awareness at all levels (research and innovation) to develop patentable technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2								1				
CO3		1						1				
CO4										1		
CO5	1							1				
CO6								2				

Course Contents:

Unit 1: Introduction to Intellectual Property
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit 2: Trade Marks
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 3: Law of Copy Rights
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Unit 4: Law of Patents
Foundation of patent law, patent searching process, ownership rights and transfer.

Unit 5: Trade Secrets
Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

Unit 6: New Development of Intellectual Property

New developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international trade mark law, copy right law, international patent law, and international development in trade secrets law.

Texts:

1. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage learning.
2. Prabuddha Ganguli, "Intellectual property right: Unleashing the knowledge economy", Tata McGraw Hill Publishing Company Ltd.

References:

1. Ajit Parulekar, Sarita D'Souza, "Indian Patents Law-Legal and Business implications", Macmillan India Ltd., 2006.
2. B. L. Wadhera, "Law related to patents, Trademarks, Copyrights, Designs and Geographical indications", Universal law Publishing Pvt. Ltd., India, 2000.
3. P. Narayanan, "Law of copyright and Industrial Designs", Eastern Law house, Delhi, 2010.

Wind Energy

BTMEC705C	OEC 5	Wind Energy	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand historical applications of wind energy
CO2	Understand and explain wind measurements and wind data
CO3	Determine Wind Turbine Power, Energy and Torque
CO4	Understand and explain Wind Turbine Connected to the Electrical Network AC and DC
CO5	Understand economics of wind energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2	2	2	1		1
CO2		3	2	1	3	2	2	2	2			1
CO3	3	3	1	1	2	2	1					1
CO4	3	3		1								1
CO5	3	2	1									1

Course Contents:

Unit 1: Introduction
Historical uses of wind, History of wind electric generations

Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull statistics, Weibull parameters, Rayleigh and normal distribution

Unit 2: Wind Measurements
Biological indicators, Rotational anemometers, other anemometers, Wind direction

Unit 3: Wind Turbine Power, Energy and Torque
Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.

Unit 4: Wind Turbine Connected to the Electrical Network
Methods of generating synchronous power, AC circuits, The synchronous generator, Per unit calculations, The induction machine, Motor starting, Capacity credit features of electrical network

Unit 5: Wind Turbines with Asynchronous Electric Generators
Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self excitation of the induction generators, Single phase operation the induction generator, Field modulated generators, Roesel generator.
Asynchronous Load: Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.

Unit 6: Economics of Wind Systems
Capital costs, Economic concepts, Revenues requirements, Value of wind generated electricity

Texts:
1. S. Ahmad, "Wind Energy: Theory and Practice", Prentice Hall of India Pvt. Ltd.

References:
1. Garg L. Johnson, "Wind Energy Systems" Prentice Hall Inc., New Jersey, 1985.
2. Desire Le Gouriers, "Wind Power Plants: Theory and Design" Pergamon Press, 1982.

Knowledge Management

BTMEC705D	OEC 5	Knowledge Management	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
CO2	Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.
CO3	Identify and select tools and techniques of KM for the stages of creation, acquisition, transfer and management of knowledge.
CO4	Analyze and evaluate tangible and intangible knowledge assets and understand current KM issues and initiatives.
CO5	Evaluate the impact of technology including telecommunications, networks, and internet/intranet role in managing knowledge.
CO6	Identify KM in specific environments: managerial and decision making communities; finance and economic sectors; legal information systems; health information systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1						3
CO2												3
CO3												3
CO4								2				3
CO5					3				2			3
CO6												3

Course Contents:

Unit 1: Introduction
Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge.

Unit 2: Learning Organization
Five components of learning organization, knowledge sources and documentation.

Unit 3: Essentials of Knowledge Management
Knowledge creation process, knowledge management techniques, systems and tools.

Unit 4: Organizational Knowledge Management
Architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization.

Unit 5: Knowledge Management System

Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies.

Unit 6: Futuristic KM

Knowledge engineering, Theory of computation, data structure.

Texts:

1. Thohothathri Raman, "Knowledge Management: A resource book", Excel, 2004.
2. M. Elias, Awad Hasan, M. Ghazri, "Knowledge Management", Pearson Education.

References:

1. Amrit Tiwana, "Strategy &Knowledge Platforms", The KM Toolkit–Orchestrating IT, Pearson, PHI, 2nd edition.
2. Peter Senge et al., "The Fifth Discipline Field Book–Strategies and Tools for Building A learning Organization", Nicholas Brealey, 1994.
3. Sudhir Warier, "Knowledge Management", Vikas Publications.
4. Madanmohan Rao, "Leading with Knowledge", Tata McGraw Hill Publications.

Automobile Air Conditioning Lab

BTAML706	PCC 32	Automobile Air Conditioning Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks External Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Sketch various components of air conditioning systems with their function.
CO2	Conduct the performance test for air conditioning system of vehicle.
CO3	Prepare a layout of air conditioning system of passenger car, luxury bus.
CO4	Explain the latest trends in automotive refrigeration systems.
CO5	Demonstrate the skill foor fault finding and maintenance of air conditioning systems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

CO5												

List of Experiments: - (Experiment 1, 2, 3 and 10 are compulsory and perform any four from remaining)

1. Demonstration of different components with the help of cut sections/models/charts- Compressor, Condenser, Evaporators, Expansion device, Blower fans, Hating systems etc.
2. Test on vapor compression test rig.
3. Test on air conditioning test rig.
4. Demonstration of various methods of goods transport refrigeration systems.
5. Study and demonstration on car and bus air conditioning system.
6. Study of latest trends in automotive refrigeration systems.
7. Study and demonstration of controls in refrigeration.
8. Study of installation/operations/maintenance practices for refrigeration systems.
9. Study of leak testing and leak detection methods.
10. Visit to maintenance shop of automotive air conditioning and prepare report on it.

Vehicle Maintenance Management Lab

BTAML707	PCC 33	Vehicle Maintenance Management Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks External Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify problems occurred in engine system by performing engine tune up.
CO2	Illustrate the critical inspection parameters for faulty engine operation.
CO3	Carry out wear measurement of different engine components.
CO4	Carry out wheel balancing and wheel alignment.
CO5	Check and adjust valve clearance of four stroke SI engine of a car.
CO6	Prepare layout of gaseous fuel systems with their constructional and operational features.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

List of Practical's/Experiments/Assignments: (Any 8)

1. Visit to Service Station to study computerized wheel alignment.
2. To check and adjust wheel balancing by using computerized wheel balancing machine
3. Demonstration of trouble shooting on multi cylinder petrol/diesel engine
4. Dismantle and assemble of two-wheeler single cylinder four stroke engine.
5. Trouble shooting of braking system.
6. Tune up the four stroke SI engine of a car for best performance.
7. To check and adjust valve clearance of four stroke SI engine of a car.
8. Visit to fuel injection pump testing station.
9. Dismantling and assembly of carburettor.
10. Demonstration of CNG fuel kit.
11. Demonstration of LPG fuel kit

Vehicle Performance and Testing Lab

BTAML708	PCC 34	Vehicle Performance and Testing Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks External Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Comprehend measurement system for automotive testing.
CO2	Test performance of two and four wheelers.
CO3	Test to measure the noise levels in the vehicle.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

List of Experiment: (Any 8)

1. Estimation of power requirement for vehicle propulsion by taking actual vehicle example.
2. Perform coast down test.

3. On road fuel consumption test at different speeds.
4. Brake efficiency measurement
5. Pass - by noise test.
6. Free acceleration test.
7. Vibration measurement in passenger compartment
8. Laboratory testing of vehicle on chassis dynamometer for performance and emission.
9. Report based on visit to vehicle testing and research organization.
10. Visit for on road emission testing of petrol and diesel vehicles for PUC/RTO.

Seminar

BTAML709	Project 4	Seminar	0-0-2	1 Credit

Examination Scheme:
Continuous Assessment: 30 Marks
End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the seminar
CO2	Explain the motivation for selecting the seminar topic and its scope
CO3	Search pertinent literature and information on the topic
CO4	Critically review the literature and information collected
CO5	Demonstrate effective written and verbal communication

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					2	2	2	2	1		1
CO2								2		2		1
CO3	2					1	1	1	3	3		3
CO4	2		1			2	1	2	2	2		2
CO5												

Course Contents:

Before the end of Semester VII, each student will have to deliver a seminar on a subject mutually decided by candidate and his/her guide. The student should select the topic for his/her seminar which is latest and relevant. The student, as a part of the term work, should submit the write-up of the seminar topic in duplicate, typed on A4size sheets in a prescribed format and bound at the end of semester.
The performance of the student will be evaluated on the basis of the contents, the presentation

and discussion during the delivery of seminar before the evaluation committee appointed by the Department.

Field Training/Internship/Industrial Training - III

BTAMF710	Project 5	Field Training/Internship/Industrial Training - III	---	1 Credit

Examination Scheme: End Semester Exam: 50 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	To make the students aware of industrial culture and organizational setup
CO2	To create awareness about technical report writing among the student.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1			2		1			3	3
CO2		1	1			2		1			3	2

Students will have to undergo 6 weeks training programme in the Industry during the summer vacation after VIth semester examination. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.

Also, students should take up a small case study and propose the possible solution(s).

They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in final year B.Tech. Programme. They will have to give a power point presentation in front of the group of examiners.

Project Stage - I

BTAMP711	Project 6	Project Stage - I	0-0-6	3 Credits

Examination Scheme: Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the project and problem definition
CO2	Explain the motivation, objectives and scope of the project
CO3	Review the literature related to the selected topic of the project
CO4	Design the mechanism, components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1								1		
CO2									1	2	2	
CO3		1				1						
CO4			3	2	2		1		1	1	1	1
CO5	1		1					1			2	1

Course Contents:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
5. Software development for particular applications.
6. A combination of the above.

It is expected that the students should complete at least 40% of the total project work in VII Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry.

The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format, before the end of VII semester. The report shall be comprehensive and presented typed on A_4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

VIII Semester

Project Stage – II/Internship

BTAMP803	Project 7	Project Stage – II or Internship*	0-0-30	15 Credits

Examination Scheme: Continuous Assessment: 50 Marks End Semester Exam: 100 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the aim and objectives for this stage of the project
CO2	Construct and conduct the tests on the system/product
CO3	Analyze the results of the tests.
CO4	Discuss the findings, draw conclusions, and modify the system/product, if necessary.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2			2	2	2	1	1					
CO3		1			1	2		1		1		
CO4			2	1	2	1	2			3		1

Course Contents:

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A_4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

List of final year courses with their equivalent SWAYAM courses

Sr. No.	Name of Subject as per Curriculum	Equivalent SWAYAM/ NPTEL Courses	Relevance %
1	Automobile Air Conditioning	No	
2	Vehicle Performance and Testing	Fundamentals of Automotive Systems	20%
3	Automotive Emission and Control	Fundamentals of Automotive Systems	20%
4	Automobile Design	No	
5	Special Purpose Vehicles	No	
6	Automobile Engineering	No	
7	Vehicle Architecture and Packaging	No	
8	Computer Simulation of IC Engine Processes	No	
9	Vehicle Aerodynamics	Introduction to Aerodynamics	20%
10	Fundamentals of Computational Fluid Dynamics	Computational Fluid Dynamics	40%
11	Ergonomics in Automotive Design	Ergonomics In Automotive Design	70%
12	Noise and Vibration	Noise & Vibration Control	60%
13	Finite Element Method	Finite Element Method	50%
14	Robotics	Robotics	50%
15	Virtual Reality	Virtual Reality	50%
16	Electric and Hybrid Vehicles	Introduction to Hybrid and Electric Vehicles	80%
17	Wind Energy	Wind Energy Technology	100%
18	Entrepreneurship	Entrepreneurship Essentials	20%

	Development		
19	Plant Maintenance	No	
20	Engineering Economics	No	
21	Intellectual Property Rights	Intellectual Property Rights and Competition Law	50%