Dr. Babasaheb Ambedkar Technological University
(Established as University of Technology in the State of Maharashtra) (Under Maharashtra Act No. XXIX of 2014)
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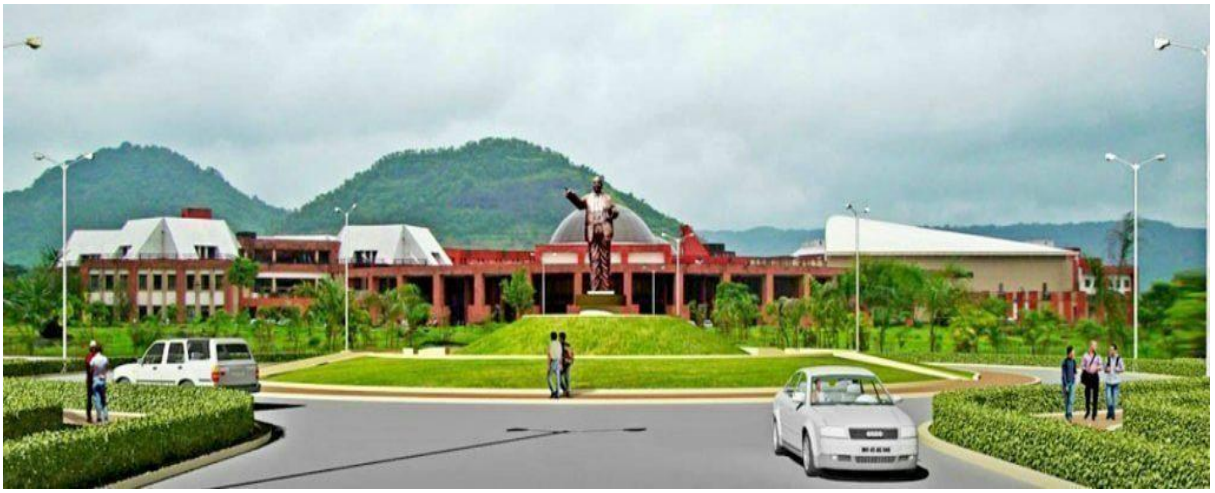
CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH.

Final Year AUTOMOBILE ENGINEERING

ACADEMIC YEAR2024-2025



Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Course Structure for Semester VII
B. Tech in Automobile Engineering (2024-25)

Semester VII										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 15	BTAC701	Vehicle Performance and Testing	3	-	-	20	20	60	100	3
HSSMC4	BTHM702	Industrial Engineering and Management	3	-	-	20	20	60	100	3
PEC 5	BTAPE703/ BTMPE703	Elective-V	3	-	-	20	20	60	100	3
OEC 3	BTMOE704	Open Elective-III	3	-	-	20	20	60	100	3
OEC 4	BTMOE705	Open Elective-IV	3	-	-	20	20	60	100	3
PCC 16	BTACL706	Automobile Engineering Lab -V	-	-	4	60	-	40	100	2
PROJ-6	BTAP 707	Mini Project			6	30		20	50	3
PROJ-7	BTAI608 (IT – 3)	IT – 3 Evaluation	-	-	-	-	-	100	100	1
		Total	**15**	**2**	**10**	**190**	**100**	**460**	**750**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective V:

Sr. No	Course code	Course Name
1	BTAPE703A	Design & Manfg. of Automotive Components
2	BTAPE703B	Virtual Reality
3	BTAPE703C	Actuation System
4	BTAPE703D	Electric and Hybrid Vehicles
5	BTAPE703E	Safety & Regulations (Automotive)
6	BTAPE703F	Motor Insurance Practices
7	BTMPE703B	Biomechanics

Open Elective III:

Sr. No	Course code	Course Name
1	BTMOE704A	Sustainable Development
2	BTMOE704B	Entrepreneurship Development
3	BTMOE704C	Plant Maintenance

Open Elective VI:

Sr.No	Course code	Course Name
1	BTMOE705A	Engineering Economics
2	BTMOE705B	Biology for Engineers
3	BTMOE705C	Intellectual Property Rights

Course Structure for Semester VIII

B. Tech in Automobile Engineering (2024-25)

Semester VIII										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
		Choose any two subjects from ANNEXURE-A#				20	20	60	100	3
						20	20	60	100	3
PROJ-8	BTAP801/ BTAI801	Project Work OR Internship	-	-	16	60	-	40	100	8
		Total	**-**	**-**	**16**	**100**	**40**	**160**	**300**	**14**

ANNEXURE-A# (Provisional)

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

THE LIST MAY ALTER AND MODIFY AS PER THE AVAILABILITY OF THE SUBJECTS ON THE NPTEL/ SWYAM Platform AND USEFULNESS, EVERY YEAR

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	BTAMC801A	Optimization from fundamentals	12 Weeks	IITB	Prof. Ankur A. Kulkarni
2	BTMEC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTMEC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTMEC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S

5	BTMEC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan
6	BTMEC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

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

SEM	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	18	19	22	21	25	21	21	14	161

SEMESTER VII

Vehicle Performance and Testing

BTAC701	Vehicle Performance and Testing	PCC 15	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0 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.

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.
8. “Vehicle Operation and Performance”, J. G. Giles,
9. “Automobile engineering” Kripal Singh.
10. “Automotive Vehicle Safety”, George Pieters, Barbara Pieters.
11. “Aerodynamics of road vehicles”, Wolt, Heinrich Hucho.

12. “Engine performance Diagnosis and Tune up Shop Manual”, Gousha H. M.
13. “Automobile Engineering”, Rangawala.

Industrial Engineering and Management

BTHM702	Industrial Engineering and Management	HSSMC4	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 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	Impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge ofmathematics, probability and statistics, and the domain knowledge of IndustrialManagement and Engineering
CO2	Produce ability to adopt a system approach to design, develop, implement and innovate integrated systems that include people, materials, information, equipment and energy.
CO3	Understand the interactions between engineering, businesses, technological and environmental spheres in the modern society.
CO4	Understand their role as engineers and their impact to society at the national and global context.

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	1
CO2									2	2	2	
CO3								2				
CO4								2				2

Course Contents:

Unit 1: Introduction

Managing and managers, management- science, theory and practice, functions of management, evolution of management theory, contributions of Taylor, Fayol and others.

Planning: The nature and purpose of planning, objectives, strategies, policies and planning premises, decision making.

Organizing: The nature and purpose of organizing, departmentation, Line/ staff authority and decentralization, effective organizing and organizational culture.

Unit 2: Human Resource Management

Staffing: Human resource management and selection, orientation, apprentice training and Apprentice Act (1961), performance appraisal and career strategy, job evolution and merit rating, incentive schemes.

Leading: Managing and human factor, motivation, leadership, morale, team building, and communication.

Controlling: The system and process of controlling control techniques, overall and preventive control.

Unit 3: Production/Operations Management

Operations management in corporate profitability and competitiveness, types and characteristics of manufacturing systems, types and characteristics of services systems.

Operations planning and Control: Forecasting for operations, materials requirement planning, operations scheduling.

Unit 4: Design of Operational Systems

Product/process design and technological choice, capacity planning, plant location, facilities layout, assembly line balancing, and perspectives on operations systems of the future.

Unit 5: Introduction to Industrial Engineering

Scope and functions, history, contributions of Taylor, Gibreth, Gantt and others.

Work Study and Method Study: Charting techniques, workplace design, motion economy principles.

Work Measurement: Stopwatch time study, micromotion study, predetermined time system (PTS), work sampling.

Ergonomics

Basic principles of ergonomics

Concurrent Engineering: Producibility, manufacturability, productivity improvement.

Total Quality Management: Just in time (JIT), total quality control, quality circles, six sigma.

Texts:

1. H. Koontz, H. Weirich, “Essentials of Management”, Tata McGraw Hill book Co., Singapore, International Edit 5th edition, 1990.
2. E. S. Buffa, R. K. Sarin, “Modern Production/Operations Management”, John Wiley and Sons, New Y International Edition, 8th edition, 1987.
3. P. E. Hicks, “Industrial Engineering and Management: A New Perspective”, Tata McGraw Hill Book Singapore, International Edition, 2nd edition, 1994.

References:

1. J. L. Riggs, “Production Systems: Planning, Analysis and Control”, John Wiley & Sons, New York, International Edition, 4th edition, 1987.
2. H. T. Amrine, J. A. Ritchey, C. L. Moodie, J. F. Kmec, “Manufacturing Organization and Management”, Pearson Education, 6th edition, 2004.
3. International Labour Organization (ILO), “Introduction to Work Study”, International Labour Office, Geneva, 3rd edition, 1987.

Elective-V
Design & Manufacturing of Automotive Components

BTAPE703A	Design &Manufacturingof Automotive	PEC 5	3L-0T-0P	3 Credits

	Components			

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Unit I: Design Of Shaft

Materials used for shaft, manufacturing of shaft and types of shaft, Standard size of transmission shafts, stresses in shafts Maximum permissible working stresses for transmission for transmission shafts Design of shaft- shaft subjected to twisting moment only, shaft subjected to bending moment, shaft subjected to combined twisting moment and bending moment Design of shaft subjected to fluctuating load, axial load in addition to combined torsion and bending loads Design of shaft on the basis of rigidity

Unit II: Design of Cylinder And Piston

Introduction to I.C engines and components Materials selection based on engine components and its function- Design of cylinder block and cylinder. Description on function of piston in an I.C engines-Design of Piston Description on piston rings-compression ring-oil rings, piston failure

Unit III: Design of Connecting Rod 8

Introduction - material selection for connecting rod Design of connecting rod small end Design of connecting rod big end and shank design Design of connecting rod-cap bolt design

Unit IV: Design of Crankshaft 8

Introduction about crank shaft and its function in an I.C Engine. Materials selection for crankshaft Balancing of I.C. engines, MI of Crankshaft, significance of firing order. Design of crankshaft under bending and twisting, balancing weight calculations. Development of short and long crank arms. Front and rear end Details. Matrix from element stiffness

Unit V: Design of Cylinder Head and Valve Actuating Mechanisms Introduction about cylinder block and head in an I.C Engine Design of cylinder block head, bolt loads and gasket Design of valve spring and valves Design of push rod

Text Books:

1. Kulkarni S. G, “Machine Design”, Tata McGraw-Hill Education, 2008.
2. Bhandari V, “Design of Machine Elements”,Tata McGraw-Hill Education, 2010.

Reference Books/Other Reading Material

1. William Orthein, “Machine Component Design”, Jaico Publishing House, 1998 - 99.
2. Shigley J, “Mechanical Engineering Design”, Mc Graw Hill, 2001.
3. Joseph Edward Shigley and Charles R.Mischke, “Mechanical Engineering Design”,McGraw-HillInternational Edition, 1989.
4. Gitin M.Maitra and LN Prasad, “Hand Book of Mechanical Design”, Tata McGraw Hill, 1985.
5. Spots M. F, “Design of Machine Elements”, Prentice Hall of India Private Ltd., New Delhi, 1983.
6. William Orthwein, “Machine Component Design”, Vol. I and II, Jaico Publising house, Chennai, 1996
7. Design Data, PSG College of Technology, 2008.

Virtual Reality

BTAPE703B	Virtual Reality	PEC 5	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/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 the concept in Automobile industry
CO2	Model and simulate real life problem of Automobile industries.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit -I: Introduction: A short history of early virtual reality, early commercial VR Technology, VR becomes an Industry, The five classical components of VR Systems.

Input Devices: Trackers, Navigations and Gesture Interfaces.

Three-Dimensional Position Trackers: Tracker performance parameters, Mechanical trackers, Magnetic trackers, Ultrasonic trackers, Optical Trackers and Hybrid Inertial Trackers Navigation and Manipulation Interfaces: Tracker based Navigation/Manipulation Interfaces, Trackballs, and three Dimensional Probes Gesture Interfaces: The Pinch Glove, the 5DT Data Glove, the Dijiglove, Cyberglove.

Unit -II: Output Devices:

Graphical, Three-Dimensional Sound and Haptic Displays:

Graphical Display: The human visual system, personalgraphics displays, large volume displays. Sound displays: the human auditory system, the convolvotron, and Speaker based three-dimensional sound. Haptic Feedback: The human haptic system, Tactile Feedback Interfaces, Force Feedback Interfaces

Unit -III: Computing Architectures for Virtual Reality: The Rendering Pipeline: The graphical rendering pipeline, the haptics rendering pipeline. PC Graphics Architectures: PC Graphics Accelerators, Graphics Benchmarks. Work Station Based Architectures: The Sun Blade 1000 Architecture, The SGI Infinite Reality Architecture, Distributed VR Architectures: Multipipeline Synchronization, Collocated rendering Pipelines, Distributed Virtual Environments.

Modelling:

Geometric Modelling: Virtual Object Shape, Object Visual Appearance. Kinematics Modelling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, viewing the three-dimensional words. Physical Modelling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing. Behaviour Modelling and Model Management: Level of Detail Management, Cell Segmentation.

Unit -IV: Virtual Reality Programming: Toolkits and Scene Graphs. World Toolkit: Model Geometry and Appearance, The WTK Scene Graph, Sensors and Action Functions, WTK Networking, JAVA 3D: Model Geometry and Appearance, Java 3D Scene graph, Sensors and Behaviours, Java 3D Networking, WTK and Java 3D Performance

Comparison.
General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptic Scene Graph, Collision Detection and response, Graphics and PHANTOM Calibration.
Human Factors in Virtual Reality: Methodology and Terminology: Data Collection and Analysis, Usability Engineering Methodology. User Performance Studies: Test bed Evaluation of universal VR Tasks, Influence of System Responsiveness on User Performance, Influence of Feedback Multimodality.

Unit –V: Traditional Virtual Reality Applications: Medical Application, Virtual Anatomy, Triage and Diagnostic and Rehabilitation. Education, Arts and Entertainment: VR in Education, VR and, Surgery the Arts, Entertainment Application of VR. Military VR Application: Army use of VR, VR Application in Navy, Air Force use of VR.
Emerging Application of VR: VR Application and Manufacturing: Virtual Prototyping, other VR Application in Manufacturing; Application of VR in Robotics: Robot Programming, Robot Teleoperation. Information Visualization: Oil Exploration and Well
Management, Volumetric Data Visualization

References

1. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd edition. Wiley India
2. John vince, "Virtual Reality Systems", Pearson Education Asia
3. "Understanding Virtual Reality", Sherman, Elsevier.

Actuation System

BTAPE703C	Actuation System	PEC 5	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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	Acquire characteristics of the fluid and air.
CO2	Design, operation and use of hydraulic machines
CO3	Design, operation and use of pneumatic machines

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:
Types of hydraulic fluids, functions of hydraulic fluids, advantages of a fluid power system, basic components of a hydraulic system, basic components of a pneumatic system, comparison of different power systems.Governing principles and laws: Pascal's law, force power and force displacement relations, practical applications of pascal's law and evaluate the parameters.

Unit- II:
Hydraulic Pumps:
Classification of Pumps based on- displacement, delivery and motion, Differences between positive displacement pumps and non-positive displacement with Performance curves, working and construction of gear, vane and piston pumps, mechanical, volumetric and overall efficiency of pumps (numerical treatment), performance parameters of gear, vane and piston pumps.

Unit-III:
Hydraulic Actuators:
Classification, types of hydraulic cylinders - single-acting cylinders, gravity-return single-acting cylinder, spring-return single-acting cylinder, double-acting cylinder, telescopic cylinder, tandem cylinder, graphical symbols of different linear actuators, classification of dcvs, shuttle valves, two-way valves, three-way valves. Four-way valves. Advantages of a poppet valve and Disadvantages, graphic symbols for various types of direction control valves, and its applications, working principle of solenoid-actuated valves

Unit-IV:
Hydraulics Circuit:
Control of a Single-Acting and Double-Acting Hydraulic Cylinder Hydraulic Cylinder, Regenerative Cylinder Circuit, Load-Carrying Capacity During Extension, Pump-Unloading Circuit, Double-Pump Hydraulic System, Counterbalance Valve Application, Hydraulic Cylinder Sequencing Circuits, Locked Cylinder Using Pilot Check Valves, Cylinder Synchronizing Circuits, Speed Control of a Hydraulic Cylinder.
Unit-V:
Pneumatics:
Principle of Pneumatics: Laws of compression, types of compressors, selection of compressors, Comparison of Pneumatics with Hydraulic power transmissions, Types of filters, regulators, lubricators, mufflers, dryers, Pressure regulating valves, Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, Pneumatic actuators-rotary, reciprocating. Air motors- radial piston, vane, axial piston, Basic pneumatic circuit, Direct and indirect control of single and double acting cylinder.
Typical Automotive Applications:
Power steering, fork lift hydraulic gear, hydro-pneumatic suspension (Air suspension), Clutch actuating System, Pneumatic circuit to control the door of vehicle, air brake and maintenance and troubleshooting of pneumatic circuits
Accumulators: Types, applications of accumulators**.** Accumulator as a hydraulic shock absorber.

Texts/References:

1. "Pneumatic Systems",S. R. Majumdar, Tata McGraw Hill 1996.
2. "Oil Hydraulics- Principle and Maintenance", S. R Majumdar, Tata McGraw Hill 2002.
3. "Industrial Hydraulics",J. J. Pipenger, McGraw Hill
4. "Industrial Fluid Power", Pinches, Prentice hall
5. "Basic Fluid Power",D. A. Pease, Prentice hall
6. "Hydraulics and Pneumatics", H. L. Stewart, Industrial Press

Electric and Hybrid Vehicles

BTAPE703D	Electric and Hybrid Vehicles	PEC 5	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/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 need of EVs and HEVs in today's transportation context.
CO2	Describe and compare EV and HEV technology.
CO3	Suggest factors to design an electric vehicle.
CO4	Comment on significance of fuel cell technology for vehicular application
CO5	Explain nonelectrical hybrid systems for 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												
CO4												
CO5												

Course Contents:

Unit -I:

Electric Vehicles and Motors

Electric vehicle, introduction, components, advantages, disadvantages, applications, vehicles. DC motors series wound shunt wound- compound wound and separately excited motors AC motors Induction- synchronous- brushless DC motor switched reluctance motors.

Unit -II:

Hybrid Vehicles and Propulsion Methods

Introduction to hybrid vehicles performance characteristics of road vehicles; calculation of road load- predicting fue economy- grid connected hybrids.

Unit -III:

Hybrid Architecture and Power Plant Specifications

Series configuration locomotive drives- series parallel switching- load tracking architecture. Pre transmission paralle and combined configurations Mild hybrid- power assist- dual mode- power split- power split with shift- Continuous Variable transmission (CVT) - wheel motors. Grade and cruise targets- launching and boosting- braking and energ recuperation- drive cycle implications.

Unit -IV:

Sizing the Drive System and Energy Storage Technology

Matching electric drive and ICE, sizing the propulsion motor; sizing power electronics, Batterybasics: lead acid battery different types of batteries, battery parameters, advanced battery technology.

Unit-V:

Fuel Cells

Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell

phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fue cell EV- super and ultra-capacitors- PEM fuel cell vehicles

Nonelectric Hybrid Systems

Short term storage systems flywheel accumulators, continuously variable transmissions hydraulic accumulator' hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

Text Books:

1. "The Electric Car: Development and Future of Battery- Hybrid and Fuel Cell Cars", Mike Westbrook- M H Westbrook- British library Cataloguing in Publication Data.
2. "Electric and Hybrid Vehicles", Robin Hardy- Iqbal Husain- CRC Press.
3. "Propulsion Systems for Hybrid Vehicles", John M. Miller Institute of Electrical Engineers- London.
4. "Alternative Fuels", S.S. Thipse, Jaico publications.

Reference Books:

1. Energy Technology Analysis Prospects for Hydrogen and Fuel Cells- International Energy Agency- France.
2. Handbook of Electric Motors- Hamid A Toliyat- Gerald B Kliman- Marcel Decker Inc.

Safety & Regulations (Automotive)

BTAPE703E	Safety & Regulations (Automotive)	PEC 5	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Contents:

Unit 1:

INTRODUCTION Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Unit:2:

SAFETY CONCEPTS 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:3:

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

Unit:4

COLLISION WARNING AND AVOIDANCE Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.

Unit:5

COMFORT AND CONVENIENCE SYSTEM Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

Text & Reference Books:

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.
2. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.

3. Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.

Motor Insurance Practices

BTAPE703F	Motor Insurance Practices	PEC 5	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: Automobile Engineering.

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

CO1	Classify motor vehicle insurances.
CO2	Discuss applications of insurance principles in vehicle insurance.
CO3	Describe various forms in motor vehicle insurance.
CO4	Discuss MACT in detail.
CO5	Analyze fraud management and internal audit in relation with motor vehicle insurance.

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												

Course Contents:

Unit 1: Principles of Insurance and Motor Insurance:

History of Insurance, Business of Insurance, Transfer of Risk, Classification of Insurance – Life & General Insurance, Market Role of Specialist (e.g. Surveyor)

History of Motor Insurance: Law and Practice of Motor Insurance in India: Applicability of Principles of Insurance: Total Loss (TL) / Constructive Total Loss (CTL) / Theft Claims: Legal Aspects of Insurance, Act No. 59 of 1988 (The Motor Vehicles Act, 1988) The Motor Vehicles (Amendment) Bill, 2008 – Part B: Key Issues and Analysis.

Unit 2: Type of motor vehicles, documents and policies:

Types of Motor Vehicles – Meaning and classification of motor vehicles – Motor insurance documents – Proposal form – Proposal form for 'Liability Only Policy' – Certificate of Insurance – Cover Note – Policy forms – Endorsement – Renewal notice – E-insurance to come into existence from next year – Types of Motor Policies – Coverage for motor policies – Coverage for Private Car – Coverage for Two Wheeler – Coverage for Commercial Vehicles – Motor trade policies – Motor Trade Internal Risks Policy – New technologies – In-car Technologies – New technology in auto field.

Unit 3: Motor Insurance Claims:

Motor Insurance Claims, Doctrine of cause of Accident, Motor Insurance Claims Procedures, Claim Documents, Types of Losses, Various Causes of Accident, Salvage/Scrap Disposal, Accident Repairing Cost, Compensation for Third Party Injury or Property Damage, The Consensus vs. Scientific Approach, Science of Damage Estimation and the Technology Support – Surveyor and His role in Loss Minimisation – Role of Surveyor – Steps in Motor Survey – Guidelines on Automobile Survey – Role of Motor Surveyor in Loss Minimisation – Role of Road Safety in Insurance – Concerns of Community – Road Safety Promotion by Insurance – Causes of Accident – Role of Fleet Operators – Underwriting in Motor Insurance, Transport Development Council – Roadside Assistance – Exclusions in Road Side Assistance – Frauds in Motor OD Claims – Seamless Claims Management – Frauds in motor insurance – Way to Mitigate Frauds**.**

Unit 4: Marketing in Motor Insurance:

Market practice of Motor Insurance in India – Caveats for filing add-on covers – Guidelines applicable in India – India Motor Tariff 2002 – Amendments subsequent to discontinuance of tariff – Tariff system after detariffing – International practice in motor insurance rating – Underwriting in motor insurance – Principles and practice of premium computation – Introduction – Indian Motor Insurance market – Model wise Risk assessment – Motor Underwriting.

Motor Third Party Pool – Dysfunctional Motor Market – Motor Third Party Pool – Review of Pool – Knock for Knock Agreement – International Issues in Insurance Markets – International Translation of Driver's License – Some Market Practices.

Unit 5: IT Applications in Motor Insurance:

Importance of Analytics and IT Intervention – IT Intervention and Competition – IT Intervention and Data Analytics – Need for and Importance of Statistics – TAC as Data Depository – TAC as National Repository for Statistical Data.

Fraud Management and Internal Audit:

Frauds in TP Claims – Frauds in Motor Insurance – Types of Fraud – Underwriting Frauds – Methods of Detection of underwriting fraud – Frauds Committed with Internal Support – Preventive Management of Fraud Cases – Issues to be Audited**.**

Text Books:

1. Handbook on Motor Insurance – IRDA
2. Automobile Insurance – Actuarial Model: Lemaire Jean, Springer

Reference Books:

1. Motor Vehicle Act, 1988 together with Central Motor Vehicle Rules, 1989, Eastern Book Company, Lucknow, 2nd Edition 1989.
2. Lemaire Jean, Automobile Insurance – Actuarial Model, Springer
3. Georges Dionne HEC, Montreal, Automobile Insurance: Road Safety, New Drivers, Risks, Insurance Fraud and

Regulation, Springer
4. P S Palande, R S Shah, M L Lunawat, Insurance in India: Changing Policies and Emerging Opportunities, SAGE Publications
5. IRDA website https://www.irdai.gov.in

Biomechanics

BTMPE703B	PEC 5	Biomechanics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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 various forces and mechanisms and define Newton's law of motion, work and energy, moment of inertia
CO2	Describe forces and stresses in different human joints
CO3	Discuss bio fluid mechanics in cardiovascular and respiratory system in human body
CO4	Differentiate between hard tissues and soft tissues
CO5	Understand concepts of implants and Identify different techniques used in biomechanics implants

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	1			1	1	1	1		1	1
CO2	2	2	2			1	2		1		1	1
CO3	2	2	2			1	1	1	1			1
CO4	1	1	1				1	1	1			1
CO5	1	1	2				1	1			1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**

Review of principle of mechanics, vector mechanics-resultant forces of coplanar and non-coplanar and concurrent and non-concurrent forces, parallel forces in planes, equilibrium of coplanar forces, Newton's law of motion, work and energy, moment of inertia.

Unit 2: Biomechanics of Joints **[07 Hours]**

Skeletal joints, forces and stresses in human joints, type of joints, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

Unit 3: Bio-fluid Mechanics **[07 Hours]**

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, cardiovascular and respiratory system.

Unit 4: Hard Tissues **[07 Hours]**

Bone structure and composition, Mechanical properties of bones, cortical and cancellous bones, visco-elastic properties, Maxwell and Vigot model – Anisotropy

Unit 5: Soft Tissues and Biomechanics of Implant **[07 Hours]**

Structure and functions of soft tissue: cartilage, tendon, ligament and muscle, Material properties of cartilage, tendon and ligament and muscle

Biomechanics of Implant: Specification for prosthetic joints, biocompatibility, requirement of biomaterial, characterization of different type of biomaterials, fixation of implants.

Texts/References:

1. Y. C. Fung, "Biomechanics: Mechanical properties of living tissues", Springer-Verlag, 2nd edition, 1993.
D. J. Schneck, J. D. Bronzino, "Biomechanics: Principle and Applications", CRC Press, 2nd edition, 2000.

Open Elective-III

Sustainable Development

BTMOE704A	OEC3	Sustainable Development	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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 difference between development and sustainable development
CO2	Explain challenges of sustainable development and climate change
CO3	Explain sustainable development indicators
CO4	Analyze sustainable energy options
CO5	Understand social and economic aspects of sustainable development

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	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2

CO4	3	3			2	3	3	2				1
CO5			3			2	3	2				1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Status of environment, Environmental, Social and Economic issues, Need for sustainability, nine ways to achieve sustainability, population, resources, development and environment.

Unit 2: Global Warming and Climate Change **[07 Hours]**
Global Warming and climate Change since industrial revolution, Greenhouse gas emission, greenhouse effect, Renewable energy, etc.

Unit 3: Challenges of Sustainable Development and Global Environmental Issues[07 Hours]
Concept of sustainability, Factors governing sustainable development, Linkages among sustainable development, Environment and poverty, Determinants of sustainable development, Case studies on sustainable development, Population, income and urbanization Health care, Food, fisheries and agriculture , Materials and energy flows.

Unit 4: Sustainable Development Indicators and Environmental Assessment [07 Hours]

Need for indicators, Statistical procedures Aggregating indicators, Use of principal component analysis, Three environmental quality indices.

Environmental Assessment
National environmental policy act of 1969, Environmental Impact Assessment, Project categories based on environmental impacts, Impact identification methods, Environmental impact assessment process.

Unit 5: Environmental Management and Social Dimensions **[07Hours]**
Revisiting complex issues, Sector policies concerning the environment, Institutional framework for environmental management, Achievements in environmental management, People's perception of the environment, Participatory development, NGOs, Gender and development, Indigenous peoples, Social exclusion and analysis.

Texts:
1. J. Sayer, B. Campbell, "The Science of Sustainable Development: Local Livelihoods and the Global Environment", Biological Conservation, Restoration and Sustainability, Cambridge University Press, London, 2003.
2. J. Kirkby, P. O'Keefe, Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.
3. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008.

References:
1. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis group, 2001.
2. Low, N. "Global ethics and environment", London, Rout ledge, 1999.
3. Douglas Muschett, "Principles of Sustainable Development", St. Lucie Press, 1997.

Entrepreneurship Development

BTMOE704B	OEC 4	Entrepreneurship Development	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**

Lecture: 3 hrs/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	enlarge the supply of entrepreneurs for rapid industrial development
CO2	Develop small and medium enterprises sector which is necessary for generation of employment
CO3	Industrialize rural and backward regions
CO4	Provide gainful self-employment to educated young men and women
CO5	Diversify the sources of entrepreneurship.

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			
CO2									2			
CO3											2	
CO4											2	3
CO5												3

Course Contents:

Unit 1: Introduction to Entrepreneurship **[07 Hours]**

Evolution of the Concept of Entrepreneur Functions of Entrepreneur, Characteristics of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship, Growth of Entrepreneurship, Barriers of Entrepreneurship, Role of Entrepreneurship in India, Entrepreneurial Motivation, Major Entrepreneurial Competencies.

Unit 2: Small Scale Industries (SSI) **[07 Hours]**

Characteristics of Small Scale Industry, Basis for Classification of Small Scale Industry: Resource Based, Demand Based, Ancillary, Subsidiary Based or Sub-Controlled Type, Technology Based etc. Government Policy for Small Scale Industry, Growth of SSI in Developing Countries, Role of National and State Agencies Providing Assistance To SSI's, Relationship between Small and Big Industries, Ownership Structure, Registration of SSI.

Unit 3: Project Identification and Project Formulation **[07 Hours]**

Meaning of Project, Project Identification and Selection, Elements of Project Formulation, Concept and Significance of Project Formulation, Meaning, Significance and Contents of Project Report.

Accounting for Small Enterprises: Objective of Accounting, Accounting Process, Journal, Ledger, Preparation of Balance Sheet and Assessment of Economic Viability

Unit 4: Project Appraisal **[07 Hours]**

Concept of Project Appraisal, Project Appraisal Methods, Cash Flows as Costs and Benefits, Payback Period, Average Rate of Return. Discounted Cash Flow Techniques, Working Capital Management, Cost of Capital, Financing of Enterprises, Project Sickness & Corrective Measures.

Unit 5: Marketing Management **[07 Hours]**

Market Segmentation, Marketing Mix, and Packaging, Pricing Policy, Distribution Channels, and Govt. Purchases from

SSIS.

Laws Concerning Entrepreneur: Income Tax Laws, Excise Duty ,The Central Sales Tax Act, Professional Tax, Value Added Tax (VAT), Service Tax, The Workmen Compensation Act, The Minimum Wages Act, The Maternity Benefit Act, The Payment of Bonus Act

Institutional Support

Government Policies for Small Scale Entrepreneurs, Institutional Setup, District Industries Centers, Industrial Estates , SIDCO, NSIC, Directorate of Industries, Commercial Banks, New Entrepreneurial Development Agencies.

Women Entrepreneurship: Growth, Problems, Recent Trends.

References:

1. S. S. Khanka, "Entrepreneurial Development", S. Chand and Company Ltd.
2. C. B. Gupta, N. P. Srinivasan, "Entrepreneurship Development in India", S. Chand and Sons.
3. B. Badhai, "Entrepreneurship Development Programme", Mansell Publishing Ltd.
4. V. Desai, "Dynamics of Entrepreneurial Development and Management", Hindustan Publishing House.
5. David H. Holt, "Entrepreneurship", PHI Learning.
6. Roy Rajeev, "Entrepreneurship", Oxford University Press.

Plant Maintenance

BTMOE704C	OEC3	Plant Maintenance	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Objectives: To exemplify different types of plants and its function and analyse the principles used in plants maintenance. To understand various basic aspects related to running of industry the safety methods in plants. This course provides problems based techniques related with location, layout, maintenance, replacement of machines, etc.

Pre-Requisites: None

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

CO1	Recognize and enlist probable failures in mechanical elements.
CO2	Dismantle, assemble and align mechanisms in sequential order for given assembly.
CO3	Compare maintenance practices like on-line, shut down, corrosion, productive and preventive maintenance.
CO4	Analyze economics of plants and list factors affecting the maintenance of a plant.
CO5	Correlate the linkages between different maintenance aspects and how they impact on overall maintenance effectiveness.
CO6	Analyze different maintenance techniques and select an appropriate technique for a particular plant.

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		1	2	1	1	2			2
CO2	2			1	1	2	2					2

CO3	2	2	1	1	1		1	1	1			
CO4	1	1		2	1	2	1		2		1	2
CO5	2	2			1	2	2				1	2
CO6	1					1					1	1

Course Contents:

Unit 1: Introduction
Introduction to concept of maintenance, Type of maintenance; Preventive, Productive, corrective, online, shut down and their significance.

Unit 2: Preventive Maintenance
Preventive maintenance and its importance, Repair cycle, systematic recording, preventive maintenance, Programming and types of schedules, Manpower and machine planning, Lubrication methods and practice, Color code schedule.

Unit 3: Online Maintenance and Shut down Maintenance
On-line maintenance, attending to joints, Valves, Pumps and other equipment's leakages,
Making shaft arrangement, stand-by unit, repairing damage to insulation, etc. without stopping the plant, attending faulty equipment, Fault finding and troubleshoots.

Shut down Maintenance
Shut down maintenance, Economic aspects of timing, duration of Timing and duration of shut down maintenance, Execution by using PERT and CPM.

Unit 5: Maintenance of Mechanical Equipment
Maintenance of major equipment like boiler, furnaces, kilns, shells and tube heat exchangers, pump and compressor, Towers, Cooling vessels, Valves piping.

Unit 6: Plant Condition Monitoring
Plant condition monitoring systems, instrumentation, Data collection and analysis, life expectancy and maintenance scheduling.The economics of maintenance management.

Text:
1. Lindley R. Hinggin, L.C. Morrow, "Maintenance Engineering Handbook", Tata McGraw Hill Book Company.

References:
1. Duncan C. Richardson, PE, "Plant Equipment and Maintenance Engineering Handbook", McGraw Hill Education, New York, Chicago, 2014.

Open Elective-IV
Engineering Economics

BTMOE705A	OEC4	Engineering Economics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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 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 **[07 Hours]**

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Engineering 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 **[07 Hours]**

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 **[07 Hours]**

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 **[07 Hours]**

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 and Evaluation of Public Alternatives [07 Hours]

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-

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

Biology for Engineers

BTMOE705B	OEC 4	Biology for Engineers	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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 origin of life and Evolution, Cells, Biomolecules-Lipids
CO2	Understand Biomolecules
CO3	Understand Cell structure and function and cell cycle
CO4	Explain Mendelian genetics
CO5	Understand and Explain DNA structure, DNA replication, Transcription, Translation

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	2	3		1		1			1		1
CO2	1	2	3		1		1			1		1
CO3	1	2	3		1		1			1		1
CO4	1	2	3		1		1			1		1
CO5	1	2	3		1		1			1		1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Origin of life and Evolution, Cells, Biomolecules-Lipids

Unit 2: Biomolecules **[07 Hours]**
Carbohydrates, water, Amino acids and proteins, Enzymes, Nucleotides

Unit 3: Cell structure **[07 Hours]**
Cell structure and function, Prokaryotes, Eukaryotes

Unit 4: Cell cycle **[07 Hours]**
Cell division, mitosis, meiosis, culture growth,

Unit 5: Genetics and DNA **[07 Hours]**
Mendelian genetics, genetic disorders, Mendelian inheritance principle, pedigree analysis, Non- Mendelian inheritance
DNA
Chromatin, DNA structure, DNA replication, Transcription, Translation.

Texts:

1. Arthur T. Johnson, "Biology for Engineers", CRC Press.

References:

1. N. A. Campbell, J. B. Reece, "Biology", International edition, Benjamin Cummings, New York, 7th edition or later, 2007 or later.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", Wiley, New York, 7th edition, 2013.

Intellectual Property Rights

BTMOE705C	OEC4	Intellectual Property Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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	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 **[07 Hours]**
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit 2: Trade Marks **[07 Hours]**
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 **[07 Hours]**
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 and Trade Secrets **[07 Hours]**
Foundation of patent law, patent searching process, ownership rights and transfer.

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 5: New Development of Intellectual Property **[07 Hours]**
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.

Automobile Engineering Lab –V

BTACL706	PCC16	Automobile Engg lab V	0-0-4	2 Credit

Practical Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Vehicle Performance and Testing Lab (Part A)
List of Experiment: (Any Three)

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.

Vehicle Maintenance Management Lab (Any Three)
List of Practical's/Experiments/Assignments:

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

Listof Practicals/Experiments/Assignments(Any Two)
A] Any One from experiment No. 1 to 5 and Any One from experiment No. 6 to 10

1. Determination of linear and angular dimensions of given composite part using precision/non precision measuring instruments.
2. Error determination with linear / angular measuring instruments.
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one)
4. Verification of dimensions & geometry of given components using Mechanical & Pneumatic comparator.
5. Machine tool alignment testing on any two machines.
6. Identification of surfaces using optical flat/interferometers and measure surface roughness using surface roughness tester.
7. Determination of geometry & dimensions of given composite object using profile projector and measurement of various angles of single point cutting tool using tool maker's microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier, Span, Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

B] Statistical Quality Control (SQC) (Any Two)

Note - Use of computational tools are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

C] Industrial visit to Calibration lab /Quality control lab / Gear manufacturing unit / Automotive Industry / Engineering Industry.

SEMESTER VII
Mini Project

BTAP707	Mini Project	PROJ-6	0L-0T-6P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 6 hrs/week	Continuous Assessment: 30 Marks Mid Semester Exam: -- End Semester Exam: 20 Marks

IT – 3

BTAI608 (IT – 3)	IT – 3 Evaluation	PROJ-7	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: -- hrs/week	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

SEMESTER VIII
Project

BTAP801/ BTAI801	Project / Internship	PROJ-8	0L-0T-16P	08 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 16 hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

- BTAP707 Mini Project and BTAP801/ BTAI801 Project /Internship are independent and allotment will also be done independently in respective semester.
- BTAP707 Mini Project will be done in-house only.
- Evaluation of both will be done independently as per the time schedule in AC.

- In case student(s) choose in-house project, it may be an extension of the Mini Project, however, Mini Project should be completed in all respect in semester VII itself.