



# Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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## B. Tech.in Automobile Engineering

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME									
			THEORY			PRACTICAL			L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*					
BTAU501	DCS	SUPPLY CHAIN MANAGEMENT AND OR	60	20	20	0	0	3	0	0	3	

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;

\***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objectives (CEOs):

Describe various theories of organizations, their characteristics, strengths, and Weaknesses. (A) Identify what differentiates various types of organizations. (B) Analyze how organizations come to be the way they are, including the factors, pressures, and historical influences that shape them. (C) Describe the basic language and concepts of the modern organization.

### Course Outcomes (COs):

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Collaborative project experiences involving both written and oral presentations.
2. Courses with significant experiential learning components.
3. Experiences with identifying, accessing, evaluating, and interpreting information and data in support of assignments, projects, or research.
4. Course experiences with large-scale datasets.

## Syllabus

### Unit-I

**Supply Chain:** Introduction, Fundamentals of Supply Chain and Importance, Development of SCM concepts and Supply chain strategy, Strategic Supply Chain Management and Key components, Internal and External drivers for automobile industries, Key National and International issues for automotive industries.

### Unit-II

**Supply Chain Inventory Management:** Economic Order quantity Models, Recorder Point Models, Multichannel Inventory systems, Supply chain Facilities Layout, Capacity Planning,

  
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Inventory optimization, Dynamic Routing and Scheduling, Demand forecasting.

**SC Integration:** Push, pull and push-pull systems, SC strategies, direct shipment, cross-docking transshipment, centralized versus decentralized control, central versus local facilities.

### Unit-III

**Introduction:** History and development of Operations Research, Scientific Methods, Characteristics, Scope, Models in Operations Research,

**Linear Programming:** Formulation, graphical methods, simplex method, Big- M- method.

### Unit-IV

#### Linear programming models:

**Assignment Models:** Definition, Mathematical Representation, Formulation and Solution, Alternate optimal solution.

**Transportation Models:** Definition, Formulation and solution, Alternate optimal solution, Stepping stone method, Modified distribution (MODI) or u-v method.

Loading and unloading operations and queuing processes in automotive industries.

### Unit-V

**Network Analysis:** Network diagram, Time estimation, Basic steps in PERT and CPM, PERT computation, CPM computation, critical path, Float, Cost analysis, crashing the network.

**Waiting Line Model:** Introduction, classification, state in queue, probability distribution of arrival and service times, Single server model (M/M/1), Multiple server model (MMS), Birth and death process.

### Reference Books:

1. *Textbook of Logistics and Supply Chain Management*, By D K Agrawal
2. *Fundamentals of Supply Chain Management: Twelve Drivers of Competitive Advantage*, By John T. Mentzer.
3. "Operations Research", by Tasha Hamady 7th edition, (USA: Macmillan Publishing Company), 2003
4. "Operations Research", by Perm Kumar Gupta, Dr. D.S Hira, S.Chand publication.
5. "Operations Research", by Gupta & Hira, S. Chand. 1e, 2008
6. "Operations Research", by Tasha, Tata McGraw Hill.2002
7. "Operations Research", by Wagner, PHI. New Delhi, 2003
8. "Operations Research", by Ravi dram & Philips, Tata McGraw Hill.2005



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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	MID TERM EXAM	QUIZ/ ASSIGNMENT	END SEM	QUIZ/ ASSIGNMENT				
BTME 502	DCS	METROLOGY AND MECHANICAL MEASUREMENT	60	20	20	30	20	2	1	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;

\*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objectives (CEOs)

To introduce basic principles and applications of (A) Metrology and Inspection (B) Linear and angular, force, torque and temperature measurements, (C) Displacement, Velocity/Speed, and Acceleration, Measurement, (D) metrology of screw threads and gears.

### Course Outcomes (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Students will describe basic concepts of Metrology
2. Students will select linear measuring instrument for measurement of various components
3. Students will select angular and taper measurement devices for measurement of various components
4. Students will select appropriate temperature measuring device for various applications
5. Students will describe methods of measurement for various quantities like force, torque, power, displacement, velocity/seed and acceleration
6. Students will be able to describe the metrology of screw threads and gears.

### Syllabus

#### Unit - I

**General concepts of measurement:** Definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

  
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### Unit – II

**Linear and angular measurements:** Slip gauges, micrometers, Vernier's, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

**Measurement of surface finish:** Surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity,

### Unit – III

**Metrology of screw threads and gears:** internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

### Unit – IV

**Temperature Measurement:** Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards.

**Pressure and Velocity Measurement:** Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids.

### Unit-V

**Strain Measurement:** Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple Gauge Bridge, bridge constant, apparent strain and temperature compensation, bending compensation. Motion.

**Force measurement:** Load cells, piezoelectric load cells

**Torque measurement:** Measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

### Reference books:

1. "Elements of Workshop Technology", by Hajra Choudhury, Vol.II. Media Promoters
2. "Manufacturing Technology - Metal Cutting and Machine Tools", by Rao. P.N, Tata McGraw-Hill, New Delhi, 2003.
3. "Machine Tool Practices", by Richard R Kibbe, John E. Neely, Roland O. Merges and Warren J.White, Prentice Hall of India, 1998.
4. "Fundamentals of Metal Machining and Machine Tools", by Geoffrey Boothroyd, Mc Graw Hill, 1984.

  
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5. "Process and Materials of Manufacture," by Roy. A.Lindberg, Fourth Edition, PHI/Pearson Education 2006.
6. "Engineering metrology and instrumentation," by Rajput R.K, Kataria & sons publishers.
7. "A text book of engineering metrology," by Gupta. I.C., Dhanpat rai and sons.

#### List of Experiments

1. To Measure the angle using Sine bar.
2. To study and use of Vernier's, micrometer and dial gauges
3. To study Performance on surface measurements
4. To study Measurement of straightness, flatness and squareness
5. To study Measurements of Surface roughness using Mechanical Comparator.
6. To study Performance on linear and angular measurements and check different characteristics of measurements.
7. To study Performance on Temperature measurements and check different characteristics of measurements and also do calibration.
8. To study Performance on Stress, strain and force measurements and check different characteristics of measurements and also do calibration.
9. To study Performance on Speed/Velocity, acceleration measurements.
10. To study Measurement of screw threads by one wire and two wire

UNITS

UNIT 1

UNIT 2

  
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			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTAU 503	DCS	AUTOMOTIVE TRANSMISSION SYSTEM	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

\*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objectives (CEOs)

This course provides a fundamental understanding (A) To develop the basic knowledge of the students in mechanics torque conversion areas (B) To develop the skills of the Students in the areas of alternative drives and concepts (C) To develop the basics of the students in the field of transmission system of the vehicle.

### Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand the working principle of the transmission system components.
2. Students would be able to understand the different types of clutches, gearboxes, driveline and final drive and its application.
3. Students would be able to understand about the multi stage and poly phase torque converters and their performance characteristics.
4. Students would be able to understand about Automatic transmission.

## Syllabus

### Unit - I

**Transmission Requirements:** Requirements of transmission system, general arrangement of power transmission, general arrangement of rear engine vehicle with live axles, general Arrangement of dead axle and axles transmission; four wheel drive transmission.

### Unit - II

**Clutches:** Introduction, Types of clutches, Materials requirement for designing of clutches, working and principle of cone, single plate, diaphragm spring, multiline, centrifugal, over running and free electromagnetic clutch.

  
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**Gear box:** Need of gear boxes, types of sliding mesh, constant mesh and Epicyclic, gear boxes, synchronizers: principle, early and later Warner synchronizer, Vauxhall synchronizer gear materials lubrication and design of gear box.

### Unit - III

**Fluid coupling:** Principle of operation, Construction details, Torque capacity, Performance characteristics, Problems on design, Reduction of drag torque.

**Torque converter:** Principle of operation, Constructional details, Performance characteristics. Converter coupling, Construction, Free wheel, Characteristic performance

### Unit - IV

**Automatic Transmission & Application of Automatic Transmission:** Principle of working of Epicyclic gear train, Construction and working principle of Ford T model gear box, Wilson gear box, construction, working and derivation of gear ratios, Octal electromagnetic transmission, Automatic over-drive, Hydraulic control system for automatic transmission. Chevrolet Automatic transmission, Turbo glide transmission, Power glide transmission, Toyota "ECT-I" (Automatic transmission with intelligent electronic control systems) - Mercedes Benz automatic transmission, Hydraulic clutch actuation system for automatic transmission.

### Unit-V

**Hydrostatic drives:** advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janney Hydrostatic drive.


**Electrical drives:** Advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.

### Reference Books:

1. "Torque converters", by Heldt P.M; Publisher: Chilton Book Co.
2. "Motor Vehicles", by Newton, Steeds & Garret; Publisher: B.H. Publication.
3. "Modern Transmission Systems", by Judge, A.W., Publisher: Chapman & Hall Ltd.
4. "Automatic Transmission", by Check Chart; Publisher: Harper & Row Publication.
5. "Automobile Engineering", by Dr. Kripal Singh; Publisher: Standard Publishers Distributors, Vol. 1", and 13th Edition.

### List of Experiments

1. Demonstration of garage, garage equipment's and tools, preparation of different garage layout.
2. Demonstration of washing & greasing of vehicle.
3. Engine oil change & periodic maintenance of vehicle.
4. Dismantling & assembly of Clutch (light / heavy duty vehicle).
5. Dismantling & assembly of Constant mesh gearbox and synchromesh gearbox.
6. Dismantling & assembly of Drive line (universal joint, propeller shaft, and slip joint).

  
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7. Dismantling & assembly Final drive & differential.
8. Rear axle hub greasing.
9. Dismantling & assembly of automatic transmission.
10. Dismantling & assembly of fluid flywheel & torque converter.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME 504	DCS	INTERNAL COMBUSTION ENGINES	60	20	20	30	20	3	1	2	5

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;

**\*Teacher Assessment** shall be based following components: Quiz/Assignment/Project/Participation in Class, given that no component shall exceed more than 20 marks.

**Course Educational Objectives (CEOs)**

This course provides a fundamental understanding (A) To impart the knowledge of working of I.C. engines (B) To impart the knowledge of fuel injection and ignition system (C) To impart the detail knowledge of fuel combustion (D) To develop the knowledge of cooling and lubrication system of IC engines (E) To impart the ability of determination of engine performances through Testing.

**Course Outcomes (COs)**

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Demonstrate the working of IC engines.
2. Describe the fuel injection and ignition system.
3. Explain the fuel combustion within IC engine.
4. Understand the cooling and lubrication system.
5. Evaluate Engine performance.

**Syllabus**

**Unit - I**

**Air Standard Cycles:** Internal and external combustion engines, classification and applications of I.C. Engines, IC engine components and terminology, four stroke cycle engines and two stroke cycle engines, Assumptions made in air standard cycle, Otto cycle, diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles, Stirling and Ericsson cycles, air standard efficiency, specific work output, specific weight, work ratio, mean effective pressure, deviation of actual engine cycle from ideal cycle, valve and port timing diagrams.

**Unit - II**

**Carburetion:** factors influencing carburetion, mixture requirements for various operating conditions, types of carburetors.

**Fuel Injection System:** Functional requirements of an injection system, types of inject systems, components of injection system.

  
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**Ignition System:** Requirements of ignition system, battery ignition system, magneto ignition system, electronic ignition system, firing order, ignition timing.

### Unit - III

**Combustion in S.I. engines:** Stages of combustion in S.I. engines, effect of engine variables on ignition lag, combustion phenomenon, knock in S.I. engines, effects of engine variables on knock, combustion chamber for S.I. engines.

**Combustion in C.I. engines:** Stages of combustion in C.I. engines, variables affecting delay period, knock in C.I. engines, C.I. engine combustion chambers.

### Unit - IV

**Lubrication and Cooling Systems:** Functions of a lubricating system, types of lubrication system; mist, wet sump and dry sump systems, crankcase ventilation, properties of lubricant, SAE rating of lubricants, engine performance and lubrication, necessity of engine cooling, effect of engine variables on engine heat transfer, different types of cooling systems.

### Unit - V

**Performance parameters of IC engines:** Engine power, engine efficiencies, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, specific fuel consumption (BSFC, ISFC), variable affects engine performance, heat balance, engine performance curves.

**Engine measurements and Testing:** Friction power, indicated power, brake power, fuel and air consumption, speed, temperature of coolant and exhaust, noise and emission measurement.

**Pollution and Its Control:** Pollutants from S.I. and C.I. engines, Methods of emission control, alternative fuels for I.C. Engines, catalytic convertor.

### Reference Books:

1. "Internal Combustion Engine Fundamentals", by J.B. Heywood, McGraw-Hill, 5<sup>th</sup> edition.
2. "Fundamentals of Internal Combustion Engines", by Paul W. Gill & James H. Smith, Oxford & IBH Pub. Ltd., 4<sup>th</sup> edition.
3. "A Course in Internal Combustion Engines", by V. M. Domkundwar, Dhanpat Rai Publication, 3<sup>rd</sup> edition.
4. "Internal Combustion Engines", by V. Ganesan, Tata McGraw-Hill, 2<sup>nd</sup> edition.
5. "Internal Combustion Engines", by M.L. Mathur & R.P. Sharma, Dhanpat Rai Publications, 4<sup>th</sup> edition.

### List of Experiments

1. To study the working of 2 stroke and 4 stroke petrol (S.I.) engine
2. To study the working of 2 stroke and 4 stroke diesel (C.I.) engine
3. To study valve/port timing diagram of I.C. Engines.
4. To study fuel injection and ignition system of both S.I. & C.I. engines.
5. To study the different lubrication systems of I.C. engine.
6. Evaluate performance of 4-stroke C.I. engine and prepare heat balance sheet.
7. Evaluate performance of 2-stroke C.I. engine and prepare heat balance sheet.

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8. Performance evaluation of four stroke S.I. engine.
9. Performance evaluation of two stroke S.I. engine
10. Performance evaluation of multi-cylinder Diesel/Petrol Engine.

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			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME 505	DCS	CAD/CAM/CIM	60	20	20	30	20	2	1	4	5

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

\*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objectives (CEOs):

This course provides a fundamental understanding of (A) The Design concepts with the help of computer Application (B) Comprehensive Knowledge of computer applications including geometric, Modeling, Assemblies and Manufacturing.

### Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Student will be able to understand the various Design concepts with the help of computer application.
2. Students would be able to get familiarized with the computer graphics application in design and understand the basic 2D & 3D commands of CAD and distinguish the CAD from manual paper drafting, in current industrial & product development scenarios.
3. Students would be able to understand the Solid and Assembly modeling tools to develop virtual product and part programming for manufacturing in various experiments & real life.
4. Students will be able to acquire knowledge of the applications of computers in design and manufacturing of real world product.

## Syllabus

### Unit - I

**Introduction:** Introduction to CAD , Why CAD Software ,Scope, objective, benefit , limitation & evaluation, Engineering Design process, Considerations, Formulation Importance, Regulatory and social issues in Indian context, Conceptual Design, Product Design Cycle, Total life cycle, Digital Prototyping, Information requirements of mfg organizations; business forecasting and aggregate production plan; MPS, MRP and Production Activity Control (PAC), introduction of CAD, CAE, CAM, CAP, CAPP, CATD and CAQ.

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### Unit – II

**Graphics Fundamentals & Standards:** Definition, Software configuration of a Graphic system, Functions of a Graphics package, CAD Interface, Coordinate system, Creating Basic Drawings, Creating Additional Drawing Objects, Altering Objects, Drawing Organization and Inquiry Commands, Modify and Manipulating Objects, Construction and Reference Geometry, Hatching Objects, Utility Commands, Layers & Blocks, Text, Table & Dimensions, Introducing Printing, Plotting, and Layouts. Database for graphic modeling; PDM, PIM, EDM; define EDM, features of EDM need for CAD data standardization, data exchange formats; GKS, PHIGS, CORE, IGES, DXF STEP DMIS AND VDI; ISO standard for data exchange.

### Unit – III

**Geometric Modeling & Assembly:** Introduction to Geometric Modeling , Types of models, Construction of 3D Solid Primitives , Create 3D Solids from Objects, Extrude , Revolve, Sweep, Loft , Combine or Slice 3D Objects, Move Rotate & Scale 3D Objects, Object Sectioning , Save and Publish Section Objects Wire frame Models, Wire frame Entities, Curve Representation. Assembly Modeling, Mating conditions, Generation of assembling sequences, basics of boundary presentation- Spline, Bezier, B-Spline, and NURBS; Sculpture and Ruled surfaces, Precedence diagram, Liaison-sequence analysis. Mechanical tolerance: Tolerance concepts, Geometric tolerance, Types of geometric tolerances, Location tolerances, drafting practices in dimensioning and Tolerancing, Tolerance Analysis.


### Unit – IV

**Computer-Aided Manufacturing & Part Programming:** Computer-Aided Manufacturing, Computer Applications in a Manufacturing Plant, Key Aspects of CAM in a Manufacturing System and Manufacturing Control, G Code & M Code generation through CAD CAM software, Feature Technology , NC, DNC, CNC, Programmed Automations, Machine control unit, Part program, NC tooling. NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers. ISO codes for turning tools and holders; ATC, modular work holding and pallets; time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC; simple part programming examples.

### Unit-V

**Computer Integrated Manufacturing & Group Technology:** Introduction to CIM, Scope of Computer integrated Manufacturing, CIM Wheel, Types of Manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, FMS. Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; EMS; material handling robots; Computer Aided Process Planning (CAPP).

  
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### Reference Books:

1. "CAD/CAM/CIM; Radhakrishnan", by P, Subramanian S and Raju V; New Age Pub.
2. "Principles of CIM", by S.Kant Vajpay; PHI
3. "CAD/CAM", by Rao PN;;TMH
4. "CAD/CAM Computer Aided Design and Manufacturing", by Mikell P. Groover and Emory W. Zimmer, Jr.
5. "Computer Integrated Design and Manufacturing", by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.
6. "Mastering CAD", by George Omura with Brian Benton Autodesk.
7. "PTC Creo Parametric 3.0 for Designers" by Tickoo S, Textbooks Published by BPB
8. "SOLIDWORKS 2017 for Designers", by Tickoo S, Textbooks Published by BPB
9. "CATIA V5-6R2016 for Designers", by Tickoo S, Textbooks Published by BPB
10. "Autodesk Inventor Professional 2017 for Designers", by Tickoo S, Textbooks Published by BPB

### List of Experiments

The students will be required to carry out the following exercises using educational software (Auto CAD, Creo, Solid works, Master CAM etc).

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
2. Layout drawing of a building using different layer and line colours indicating all Building details. Name the details using text commands, Make a title Block.
3. To Draw Orthographic projection Drawings (Front, Top and side) of safety valve, knuckle joint, cotter joint & Plummer block etc.
4. Make an Isometric dimensioned drawing from orthographic drawings.
5. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
6. Draw 3D models by extruding, revolve, sweep, loft & other 3D Modelling commands in AutoCAD.
7. Prepare Assembled 3d cad models of knuckle joint, cotter joint & Plummer block through Creo cad modelling software.
8. Apply Constraints & Mechanism on 4 bar & piston cylinder mechanism through Creo Mechanism tools.
9. Generate G codes & M codes of any models through CAM tools of Creo Software.
10. Write the program prepare any work piece through CNC Machine.

  
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BTAU506	DS	AUTOMOTIVE PROTOTYPING LAB	0	0	0	0	50	0	0	4	2

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

**Course Objectives:-**

The primary objective of the course is to Explain & Demonstrate the (A) Prototyping Process with help of (B) Surfacing & Meshing, (C) Sheet Metals & Plastic Modeling & (D) 3D Printing Technology.

**Course Outcomes:-**

1. Students would be able to understand how to create high quality 3D models for rapid prototyping.
2. Students would be able to understand the Surface, mesh, sheet metals & Plastic modeling to develop product to use in various experiments & real life.
3. Students would be able to Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology.
4. Students would be able to understand economic implications of 3D printing including its impact on startup businesses and supply chains.

**Course Contents:-**

**Unit-I Prototyping in Automotive Industry**

History, Development of RP systems in automotive industry, Rapid prototyping Process chain, Applications in automotive Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing Principle, Fundamental, Rapid Prototyping Data format, Other translators, automotive applications of RP On demand manufacturing, Direct material deposition, Shape Deposition Manufacturing & its automotive applications.

**Unit-II Liquid and Solid Based Rapid Prototyping Systems:**

Liquid based system, Classification, Stereolithographic Apparatus (SLA), D-MEC's Solid Creation System, Rapid Freeze Prototyping (RFP), Micro fabrication, use of liquid based RP in Automobiles.

Solid based system: Stratasys' Fused Deposition Modeling, Solidscape's Benchtop System, Cubic Technologies' Laminated object Manufacturing, Multi- Jet Modeling System, Solidimension's Plastic Sheet Lamination, LD Sheet Lamination , Paper Lamination Technology, use of solid based RP in Automobiles.

**Unit-III Automotive Surfacing & Meshing**

Introduction Surface Models, Surface Entities, Surface Representation, Parametric Representation of Analytic



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Surfaces - Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Coons Surface, Blending Surface, Offset Surface, Triangular Patches, Sculptured Surface, Rational Parametric Surface, Trim and Untrim Surfaces, Create & Edit NURBS & Control Vertices.

Create 3D Mesh Primitives, Modify Mesh Objects, Change Mesh Smoothness Levels. Modify Mesh Faces.

## Unit-IV Automotive Sheet Metals working :

Introduction, use of sheet metals & Plastic modeling in automotive, flat, flange, planar, boundary blend, hole, punch, notch, thread, rip, corner relief, bend, unbend, split, editing & conversion. Solid shell & surface thicken.

## Unit-V Automotive Parts 3D Printing:

3D printing technologies, principles, Automotive Applications, possibilities of 3D printing, 3D Scanning & 3D Printing, Economics, Law, Ethics & intellectual property issues in 3D printing. create high quality 3D models for rapid prototyping step by step create models in Sketch Up, AutoCAD, Rhino, Creo or any 3D modeling program, using the 3D printer capability to obtain hands-on experience in producing industrial design from concept to prototype, Creating & Printing of 3D models design for Automobile.

## References:

- 1) Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, by Ian Gibson, David Rosen, Brent Stucker
- 2) Rapid Prototyping: Principles and Applications, by Chee Kai Chua, Kah Fai Leong, Chu Sing Lim
- 3) 3D Printing: Build Your Own 3D Printer and Print Your Own 3D Objects, by James Floyd Kelly
- 4) 3D Printing: A Practical Guide for Librarians, by Sara Russell Gonzalez, Denise Beaubien Bennett
- 5) 3D Printing For Dummies, by Kalani Kirk Hausman, Richard Horne
- 6) AutoCAD 2D & 3D tutorials and guide by Autodesk Inc.
- 7) Creo parametric Guide, by Parametric Technology Corporation (PTC).

## List of Experiments:

1. To study the concepts of rapid prototyping and its various application in automobile field.
2. To study of Stereolithographic Apparatus (SLA).
3. To study of D-MEC's Solid Creation System.
4. To study of Rapid Freeze Prototyping (RFP).
5. To study of Stratasys' Fused Deposition Modeling.
6. To study of Laminated object Manufacturing.
7. To study of Solidimension's Plastic Sheet Lamination.
8. To create a surface for automotive body using CAD tool.
9. To create a meshing of any automotive part using CAD tool.
10. Automotive Sheet metal creation using CAD tools.
11. Prepare a CAD model with complex geometry & Generating STL files from the CAD Models & Working on STL files.
12. 3D Printing of Automotive Parts.





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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTAU 507	DS	INDUSTRIAL TRAINING	0	0	0	0	30	0	0	2	1

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

\*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objective of Industrial Training:-

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an Engineering problem and possibly an industry guide for their Major Project in final semester

### Scheme of Studies:-

Duration: Minimum 2 weeks in summer break after IV semester, assessment to be done in V semester.

### Scheme of Examination:-

For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

#### (a) Term Work in Industry

**Marks Allotted**

Attendance and General Discipline:-

Daily diary Maintenance:-

Initiative and participative attitude during training:-

Assessment of training by Industrial Supervisor:-

**Total:**

#### (b) Practical/Oral Examination (Viva-Voce) in Institution

**Marks Allotted**

1. Training Report:-

2. Seminar and cross questioning:-

**Total**

\*During training students will prepare a first draft of training report in consultation with section

  
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in-charge. After training they will prepare final draft with the help of T.P.O. /Faculty of the Institute. Then they will present a seminar on their training and they will face viva-voce on training in the Institute.


#### Learning through industrial training:-

During industrial training students must observe following to enrich their learning Industrial environment and work culture.

1. Organizational structure and inter personal communication.
2. Machines/equipment/instrument-their working and specifications.
3. Product development procedure and phases.
4. Project Planning, monitoring and control.
5. Quality control and assurance.
6. Maintenance system
7. Costing system
8. Stores and purchase systems.
9. Layout of Computer/EDP/MIS centers.
10. Roles and responsibilities of different categories of personnel.
11. Customer services.

#### Students are supposed to acquire the knowledge on above by-

1. Direct Observations without disturbing personnel at work.
2. Interaction with officials at the workplace in free/ tea time
3. Study of Literature at the workplace (e.g. User Manual, processes, schedules, etc.)
4. "Hand's on" experience
5. Undertaking/assisting project work.
6. Solving problems at the work place.
7. Presenting a seminar
8. Participating in group meeting/discussion.
9. Gathering primary and secondary data/information through various sources, storage, retrieval and analysis of the gathered data.
10. Assisting official and managers in their working
11. Undertaking a short action research work.
12. Consulting current technical journals and periodicals in the library.

  
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### Daily Diary: - Industrial Training

Name of the Trainee----- College -----

Industry / work place ----- Week No-----

Department /Section ----- Date -----

Dates----- Brief of observations made, work done, problem/project undertaken,  
Discussion held, literature consulted etc

Signature of Supervisor  
(TPO/Faculty)

Signature of Trainee

Signature of Official in-  
charge for Training (In Industry)

### Supervision of Industrial Training

Faculty and TPO are supposed to plan industrial training in such a manner that students get exposure on most of the above area in the field.

One faculty member or TPO will plan industrial training of students in consultation with training manager of the industry (work place) as per the predefined objectives of training.


Monitoring visits will be made by training and placement officer/faculty in-charge for the group of Students, of the college during training.

### Guidance to the faculty / TPO for Planning and implementing the Industrial Training:-

Keeping in view the need of the contents, the industrial training program, this is spread to Minimum 2 weeks duration, has to be designed in consultation with the authorities of the work place; Following are some of the salient points:

Spelling out the objectives of the industrial training in behavioral terms and same is informed in advance to the 1) students, 2) Authorities of the work place and 3) Supervising faculty members.

1. Discussing and preparing students for the training for which meetings with the students has to be planned.
2. Meeting with industrial personnel and orienting them regarding the objective of the training and the expectations of the program.
3. Correspondence with the authorities of the work place.
4. Orientation classes for students on how to make the training most beneficial- monitoring daily diary, writing weekly reports, how to interact with various categories of industrial

  
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- personnel, how to behave and undertake responsibilities, how to gather information from the workplace, ethics etc.
5. Guiding students to make individual plans (week wise/ day wise) to undertake industrial training.
  6. Developing a system of maintaining training records, by teachers for every batch of students for convenient retrieval.
  7. Inviting industrial personnel to deliver lectures on some aspects of training

#### Action plan for planning stages at the Institutional Level:-

S. No.	Activity	Commencing Week	Finishing Week	Remark
1.	Meeting with Principal			
2.	Meeting with colleagues			
3.	Correspondence with work place(Industry concerned)			
4.	Meeting with authorities of work place			
5.	Orientation of students for industry training			
6.	Scrutinizing individual training plan of students			
7.	Commencement of individual training			
8.	First monitoring of industrial training			
9.	Second monitoring of industrial training			
10.	Finalization of Training report			
11.	Evaluation of performance at industry level			
12.	Evaluation of Industry Program in the Institutions.			

  
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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	MST EXAM	QUIZ/ ASSIGNMENT	END SEM	LAB WORK				
BTAU 508	DCS	VEHICLE MAINTENANCE AND RECONDITIONING LAB	0	0	0	0	20	0	0	2	1

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;

\***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

### Course Educational Objectives (CEOs)

To knowledge of (A) Maintenance and Safety, Engine Subsystem (B) Clutch, Steering, Brake, suspension (C) Wheel, Air Conditioning and Electrical Components.

### Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand the need of maintenance and safety.
2. Students would be able to understand about maintenance of engine subsystem.
3. Students would be able to understand transmission and driveline, i.e. propeller shaft, rear axle etc.
4. Students will be able to understand the maintenance of steering, brake, and wheel.
5. Students would be able to understand automobile safety and their need.
6. Students would be able to understand the maintenance of air conditioning and electrical components.

### Syllabus

#### Unit - I

**Introduction of Maintenance:** Maintenance need, importance, primary and secondary functions, classification of maintenance work, vehicle insurance, basic problem diagnosis, automotive service procedures, workshop operations vehicle maintenance, vehicle identification.

**Safety:** personnel safety, machines and equipment safety, vehicles, fire safety - first aid, basic tools - special service tools - measuring instruments - condition checking of seals, gaskets and sealants, scheduled(preventive) maintenance unscheduled (breakdown) maintenance services - service intervals - towing and recovering, reports, log sheets, trip sheets and other forms.

#### Unit- II

**Maintenance of Engine Subsystem:** General engine service, dismantling of engine components, engine repair, working on the underside, front, top, ancillaries service of basic engine parts,

  
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cooling and lubricating system, fuel system, intake and exhaust system, electrical system, electronic fuel injection and engine management service, fault diagnosis, emission controls.

### Unit-III

**Transmission and Driveline Maintenance:** General checks, adjustment and service dismantling, identifying, checking and reassembling transmission, removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints, rear axle service points removing axle shaft and bearings, servicing differential assemblies error diagnosis.

### Unit – IV

**Steering:** maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering service-worm type steering, power steering system.

**Brake:** maintenance and service of hydraulic brake, drum brake, disc brake, parking brake, bleeding of brakes.

**Suspension:** maintenance and service of coil spring, leaf spring, shock absorbers, dismantling and assembly procedures.

**Wheel:** wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

### Unit-V

**Air Conditioning :** maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator, replacement of hoses, leak detection, AC charging, fault diagnosis, vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

**Electrical Components:** Maintenance of batteries, starting system, charging system and body electrical -fault diagnosis using scan tools.

### Reference Books:

1. "Automotive Mechanics", by Ed May, Volume 1 and 2, McGraw Hill Publications, 2003
2. "Fleet Management", by John Doke, McGraw Hill Co., 1984
3. "Engineering: Lightweight", by Brian Cantor, Patrick Grant, Colin Johnson Automotive Functional, and Novel Materials, Taylor and Francis, 2008.
4. "Automobile and Mechanical Electrical Systems", by Tom Denton, Butterworth-Heinemann, 2011
5. "The Automobile Chassi", by Jornsens Reimpell Helmut Sto; Engineering Principles, Jurgen Betzler (P) Ltd

### List of Experiments

1. Study of cylinder re-boring-checking the cylinder bore.
2. Study of valve grinding, valve lapping.
3. Setting the valve angle and checking for valve leakage
4. Calibration of fuel injection pump
5. Wheel alignment – testing of camber, caster

  
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6. Testing kingpin inclination, toe-in and toe-out
7. Chassis alignment testing
8. Brake adjustment and brake bleeding.
9. Head light adjustment.
10. Tyre changing
11. Wheel balancing

  
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