

# UNIVERSITY OF PUNE



## Structure and Syllabus

FOR

## **T.E. Automobile Engineering 2012 Course**

**UNDER FACULTY OF ENGINEERING**

**EFFECTIVE FROM July 2014**

# University of Pune

## T. E. (Automobile) (2012) Semester – I (w.e.f. Academic Year 2014-15)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
316481	Design of Machine Elements	4	--	2	30 <sup>#</sup>	70 <sup>@</sup>	25	--	--	125
302042	Heat Transfer*	4	--	2	30	70	--	50**	--	150
302043	Theory of Machines-II*	4	--	2	30	70	--	--	50 <sup>s</sup>	150
302044	Metrology and Quality Control*	3	--	2	30	70	--	--	50	150
316482	Automotive Electrical and Electronics	3	--	2	30	70	25	--	--	125
316483	Skill Development	--	--	2	--	--	50	--	--	50
<b>Total of Semester – I</b>		<b>18</b>	<b>--</b>	<b>12</b>	<b>150</b>	<b>350</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>750</b>

\*\* Evaluation should be on performance in practical examination and oral based on Term Work and Theory  
 \$Common Oral will be based on both TOM-I and TOM-II term work at end of First Semester of T.E.

## T. E. (Automobile) Semester – II

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302047	Numerical Methods and Optimization*	4	--	2	30	70	--	50	--	150
316484	Design of Engine Components	4	--	2	30 <sup>#</sup>	70 <sup>@</sup>	25	--	--	125
316485	Automotive Transmission	4	--	2	30	70	25	50	--	175
316486	Automotive Aerodynamics and body Engineering	3	--	2	30	70	25	--	--	125
302051	Manufacturing Process-II*	3	--	--	30	70	--	--	--	100
302052	Machine Shop – II*	--	--	2	--	--	25	--	--	25
316487	Seminar	--	--	2	--	--	--	--	50	50
<b>Total of Semester – II</b>		<b>18</b>		<b>12</b>	<b>150</b>	<b>350</b>	<b>100</b>	<b>100</b>	<b>50</b>	<b>750</b>

Note:-

\*-Common with mechanical engineering.

**Important Notes:-**

1. In-Sem Theory examination will be conducted, approximately after one and half month of the commencement of each semester
2. In-Sem Theory examination will be based on first three units (10 marks Question from each unit) from Syllabus and will be conducted by the University of Pune.
3. Total time allotted for In-Sem Theory examination will be 1 hr
4. ( # ) Total time allotted for In-Sem Theory examination (DME and DEC) will be 1 hr 30 min.
5. Total time allotted for End-Sem Theory examination will be 2 hrs 30 min.
6. ( @ ) Total time allotted for End-Sem Theory examination (DME and DEC) will be 3 hrs

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T. E. (Automobile)

Semester – I

Design of Machine Elements (316481)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316481	Design of Machine Elements	4	--	2	30	70	25	--	--	125

## **COURSE OBJECTIVES**

This course “Design of Machine Elements” is designed with the following objectives in mind:

1. The student shall gain appreciation and understanding of the design function in mechanical Engineering, the steps involved in designing and the relation of design activity with manufacturing activity.
2. Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process. E.g., Fasteners, shafts, couplings etc. and will be able to design these elements for each application.

## **COURSE OUTCOMES**

1. Ability to analyze the stress and strain of mechanical components and understand, identify and quantify failure modes for mechanical part.
2. Ability to decide optimum design parameters for mechanical systems.
3. Enhancement in proficiency of CAD software for designing Mechanical systems and to generate production drawing

## **Unit – I Design Process and design of Simple Machine elements**

Machine Design, Design Process, Design considerations, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever .lever for safety valve, bell crank lever, curved beams of circular cross section and components subjected to eccentric loading. (08 hrs.)

## **Unit – II Design of Shafts, Keys and Couplings**

Shafts: Transmission shaft, shaft design on the basis of strength and torsional rigidity, A.S. M. E. code for shaft design, design based on lateral rigidity.

Keys and Splines: Design of Parallel and taper key, Design of splines.

Couplings: Flange coupling, flexible coupling, Oldham’s coupling. (08 hrs.)

## **Unit – III Design of Power Screw, Bolted Joints and Welded joints**

Power Screw and Bolted Joints: Forms of threads, torque analysis and design with square and trapezoidal threads, self locking of screw, and design of any type of screw jack, Basic types of fastenings, Design of bolted joints under tension, eccentrically loaded bolted joint in shear and parallel to axis of bolt, torque requirement for tightening.

Welded Joints: Welding symbols, types of welds, stresses in butt and fillet welds, strength of butt, parallel and transverse fillet welds, eccentric load in plane of weld, welded joints subjected to bending and torsion. (08 hrs.)

## **Unit – IV Design for Fluctuating Loads**

Fluctuating stresses, S-N diagram for fatigue loading, Endurance limit, Endurance strength modifying factors, Stress concentration-causes and remedies, Notch sensitivity, Design for finite and infinite life under reverse stresses, Cumulative damage in fatigue failures, Soderberg and Goodman diagrams, Impact loading. (08 hrs.)

## **Unit – V Sliding contact and Rolling contact Bearing**

Sliding contact Bearing: Theory of Hydrodynamic lubrication, mechanism of pressure development in oil film, Design of journal bearing, length to diameter ratio, unit bearing pressure, radial clearance and minimum oil film thickness, Selection of sliding contact bearing from manufacturer’s catalogue. (08 hrs.)

Rolling contact Bearing: Static and dynamic load carrying capacities, equivalent bearing load, load life relationship, selection of bearing life, selection of rolling contact bearings form manufacturer’s catalogue.

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## ***Unit – V Design of Gears***

Classification of gears, types of gears, standard gear tooth system, Number of teeth and face width, force analysis, beam strength equation, velocity factor, load concentration factor, effective load on gear, wear strength (Buckingham's) equation, estimation of module beam and wear strength (Numerical treatment limited to spur and helical gears). Transverse and normal module, virtual number of teeth for Helical and spiral gears.

### **Term Work:**

1. Term work shall consist of design projects based on Power Screw which shall consist of two half imperial size (A2) sheets: One involves assembly drawing with part list and other involving drawings of individual components, which consists of manufacturing tolerances, surface finish symbols and geometric tolerances to make it working drawing. A design report giving all necessary calculations of design of components and assembly must be submitted in a separate file.
2. Design project should be in the form of “design of mechanical system” comprising of machine elements studied in the syllabus. Design data book must be used wherever necessary for selection of components.
3. Six home assignments based on above units. (one assignment on each unit)

### **Text Book:**

1. V. B. Bhandari, “Design of Machine Elements”, Tata McGraw Hill Publications, New Delhi.
2. Textbook of “Machine Design” By R.S.Khurmi And J.K.Gupta S. Chand Publication, New Delhi.

### **Reference Books:**

1. J. E. Shigley and C. R. Mischke, “Mechanical Engineering Design”, McGraw Hill Inc. New York.
2. M. F. Spotts and T. E. Shoup, “Design of Machine Elements”, Prentice Hall International.
3. W. C. Orthwein, “Machine Component Design”, West-Pub. Co. and Jaico Pub. House.
4. R. C. Juvinat, “Fundamentals of Machine Components Design”, John Wiley and Sons.
5. A. S. Hall, A. R. Holowenko and H. G. Laughlin, “Theory and Problems of Machine Design”, Schaum's Outline Series.

### **Design Data Books:**

1. “Design Data Handbook”, P.S. G. College of Technology, Coimbatore.
2. “Design Data Handbook”, K. Mahadevan, K. Balveera Reddy.

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## T. E. (Automobile) Semester – I Heat Transfer (302042)

\* Evaluation should be on performance in practical examination and oral based on Term Work and Theory Syllabus

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302042	Heat Transfer	4	--	2	30	70	--	50*	--	150

### **COURSE OBJECTIVES**

Heat transfer is the thermal energy in transit due to a spatial temperature difference. The topic of heat transfer has enormous applications in mechanical engineering, ranging from cooling of microelectronics to design of jet engines and operations of nuclear power plants. In this course,

1. Students will learn about what is heat transfer, what governs the rate of heat transfer and importance of heat transfer.
2. They will also learn the three major modes of heat transfer viz., conduction, convection, and radiation. In addition to these three main modes of heat transfer, students will also learn the phenomena of heat transfer during phase change (boiling and condensation heat transfer).
3. The course provides practical exposure to the heat transfer equipments like, heat exchangers, heat pipes, fins, etc.

### **COURSE OUTCOMES**

1. Formulate basic equations for heat transfer problems.
2. Apply heat transfer principles to design and evaluate performance of thermal systems.
3. Calculate the effectiveness and rating of heat exchangers.
4. Calculate heat transfer by radiation between objects with simple geometries.
5. Calculate and evaluate the impact of boundary conditions on the solutions of heat transfer problems.
6. Evaluate the relative contributions of different modes of heat transfer.

### **Unit – I Conduction**

**Introduction and Basic Concepts:** Application areas of heat transfer, Modes and Laws of heat transfer, Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity, thermal diffusivity.  
(02 hrs.)

**One dimensional steady state heat conduction without heat generation:** Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance and conductance, three dimensional heat conduction equations in cylindrical and spherical coordinates (no derivation) and its reduction to one dimensional form, critical radius of insulation for cylinders and spheres, economic thickness of insulation.  
(06 hrs.)

### **Unit – II Heat Generation and Transient Conduction**

**One dimensional steady state heat conduction with heat generation:** Heat conduction with uniform heat generation in plane wall, cylinder & sphere with different boundary conditions.  
(04 hrs.)

**Transient heat conduction:** Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, Introduction to transient heat analysis using charts.  
(04 hrs.)

### **Unit – III Boundary Conditions and Extended Surfaces**

**Boundary and initial conditions:** Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition.  
(02 hrs.)

**Heat transfer through extended surface:** Types of fins, Governing Equation for constant cross sectional area fins, solution (with derivation) for infinitely long & adequately long (with insulated end) fins and short fins (without derivation), efficiency & effectiveness of fins.  
(06 hrs.)

### **Unit – IV Convection**

**Fundamentals of convection:** Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers.  
(02 hrs.)

**Forced convection:** Dimensionless numbers and their physical significance, empirical correlations for external & internal flow for both laminar and turbulent flows.  
(05 hrs.)

**Natural convection:** Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.  
(03 hrs.)

## **Unit –V Radiation**

**Thermal Radiation:** Fundamental concepts of radiation, different laws of radiation, Radiation shape factor, Heat exchange by radiation between two black and diffuse gray surfaces, Radiation shields. (08 hrs.)

## **Unit –VI Heat Exchangers and Phase Change Phenomenon**

**Heat exchangers:** Classification and applications, heat exchanger analysis – LMTD for parallel and counter flow heat exchanger, effectiveness– NTU method for parallel and counter flow heat exchanger, introduction to cross flow heat exchanger, LMTD correction factor, design criteria for heat exchanger, introduction to heat pipe. (06 hrs.)

**Condensation and Boiling:** Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation (No numerical treatment). (02 hrs.)

## **Term-Work**

### **LIST OF EXPERIMENTS**

Any eight experiments (1-11) and two assignments (12-14) from the following list

1. Determination of Thermal Conductivity of metal rod
2. Determination of Thermal Conductivity of insulating powder
3. Determination of Thermal Conductivity of Composite wall
4. Determination of heat transfer coefficient in Natural Convection
5. Determination of heat transfer coefficient in Forced Convection
6. Determination of temperature distribution, fin efficiency in Natural / Forced Convection
7. Determination of Emissivity of a Test surface
8. Determination of Stefan Boltzmann Constant
9. Determination of effectiveness of heat exchanger
10. Study of pool boiling phenomenon and determination of critical heat flux
11. Determination of equivalent thermal conductivity of heat pipe
12. Assignment on 1-D transient heat transfer programme using finite difference methods.
13. Assignment to solve transient heat transfer problem using Heisler and Grober charts.
14. Assignment on multipass / crossflow heat exchanger using effectiveness charts.

### **Text Books:**

1. F.P. Incropera, D.P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley.
2. Y.A. Cengel and A.J. Ghajar, “Heat and Mass Transfer – Fundamentals and Applications”, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, “A Textbook on Heat Transfer”, Universities Press.
4. A.F. Mills, “Basic Heat and Mass Transfer”, Pearson.

### **Reference Books:**

1. S.P. Venkatesan, “Heat Transfer”, Ane Books Pvt. Ltd.
2. Holman, “Fundamentals of Heat and Mass Transfer”, McGraw – Hill publication.
3. P.K. Nag, “Heat & Mass Transfer”, McGraw Hill Education Private Limited.
4. M. Thirumaleshwar, “Fundamentals of Heat and Mass Transfer”, Pearson Education India.
5. R.C. Sachdeva, “Fundamentals of Engineering Heat and Mass Transfer”, New Age Science.
6. B.K.Dutta, “Heat Transfer-Principles and Applications”, PHI.
7. C.P. Kothandaraman, S.V.Subramanyam, “Heat and Mass Transfer Data Book”, New Academic Science.

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T. E. (Automobile)

Semester – I

Theory of Machines - II (302043)

\* Common Oral will be based on both TOM-I and TOM-II term work at the end of First Semester of T.E.

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302043	Theory of Machines -II	4	--	2	30	70	--	--	50*	150

## **COURSE OBJECTIVES**

1. To develop competency in understanding of theory of all types of gears.
2. To understand the analysis of gear train.
3. To understand step-less regulations and mechanisms for system control – Gyroscope.
4. To make the student conversant with synthesis of the mechanism.
5. To develop competency in drawing the cam profile and understand the follower motion.

## **COURSE OUTCOMES**

1. The students will understand the gear theory which will be the prerequisite for gear design.
2. The student will understand torque transmitting capacity in gear trains which will be the prerequisite for gear box design.
3. The student will conversant with working principle of control mechanism.
4. The student will understand design of mechanism and cam profile.

## **Unit – I Spur Gear**

Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, minimum number of teeth, interference and under cutting, Force analysis and Friction in gears. (08 hrs.)

## **Unit – II Helical, Bevel, Worm and Worm Wheel**

Helical gears: nomenclature, center distance, virtual number of teeth. Spiral Gear terminology and Efficiency Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted. (08 hrs.)

## **Unit – III Gear Trains**

Types of Gear Trains, analysis of epicyclic gear trains, Holding torque – Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel epicyclic Gear train. Types of gearboxes. (08 hrs.)

## **Unit – IV Step–Less-Regulation (Theoretical Treatment only) & Gyroscope**

Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, Conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. (04 hrs.)  
Gyroscopes, Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four wheel drive vehicle moving on curved path, Stability of a two wheel vehicle. (06 hrs.)

## **Unit –V Synthesis of Mechanism**

Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Graphical synthesis: Two and three position synthesis using relative pole method and inversion method for single slider crank and four bar mechanism. Freudenstein's equation for four bar Mechanism, Three position function generation using the equation. (08 hrs.)

## **Unit –VI Cam and Follower**

Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, analysis of circular arc cam with flat face follower. Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (3-4-5 Polynomial cam only) (08 hrs.)

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## Term-Work

### List of Experiments:

#### Compulsory:

1. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model.
2. To study various types of gearboxes- constant mesh, sliding mesh, synchromesh gear box, Industrial gearbox, differential gearbox.
3. To measure holding torque of the epicyclic gear train.
4. To verify the gyroscopic principles.
5. To draw the cam profiles and study the effect of
  - a. Different follower motions.
  - b. Different follower (roller) dimensions
6. To synthesize the four bar and slider crank mechanisms using relative pole and inversion methods with three precision positions.

#### Any two from the following

1. To draw conjugate profile for any general type of gear tooth
2. Study of Continuous Variable Transmission and Infinite Variable Transmission.
3. To measure the range of speeds obtained using any one type of continuously variable transmission device.
4. To verify the cam jump phenomenon for an eccentric cam
5. Kinematic analysis of transmission system of any machine such as automobile/ machine tool

### Text Books

1. S.S.Ratan, "Theory of Machines", Third Edition, McGraw Hill Education ( India) P Ltd. New Delhi.
2. Beven T, "Theory of Machines", Third Edition, Longman Publication.
3. A.G. Ambekar, "Mechanism and Machine Theory", PHI.
4. N.K. Meheta, "Machine Tool Design", Tata McGraw Hill Publication,
5. J.J.Uicker, G.R.Pennock, J.E.Shigley, "Theory of Machines and Mechanisms", Third Edition, International Student Edition, OXFORD.

### Reference Books:

1. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
2. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication.
3. R L Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
4. David H. Myszka, "Machines and Mechanism", PHI.
5. Sadhu Singh, "Theory of Machines", Pearson
6. D.K. Pal, S.K. Basu, "Design of Machine Tools", Oxford & Ibh Publishing Co Pvt. Ltd.
7. Dr.V.P.Singh, "Theory of Machine", Dhanpatrai and sons.
8. C.S.Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI.



# University of Pune

T. E. (Automobile)

Semester – I

Metrology and Quality Control (302044)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302044	Metrology and Quality Control	3	--	2	30	70	--	--	50	150

## COURSE OBJECTIVES

1. Selection of tool and techniques for determining geometry and dimensions.
2. Design and calibration of measuring tools and equipments.
3. Application of Quality Control Techniques.
4. Application of Quality Management Concept.

## COURSE OUTCOMES

1. An ability to apply knowledge of various tools and techniques used to determine geometry and dimensions of components in engineering applications.
2. An ability to perform experiments, as well as to analyze and interpret data.
3. An ability to design gauges to meet desired needs within realistic constraints.
4. An understanding of Quality Control Techniques and its applications in engineering industries.

### Unit – I Measurement standards and comparators

Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, introduction to uncertainty in measurement, linear and angular measuring instruments and their applications.

**Calibration:** Concept and procedure, traceability, Gauge R&R

**Comparators:** Mechanical, Pneumatic, Optical, Electrical (LVDT). Checking all geometrical forms.

(06 hrs.)

### Unit – II Design of gauges, Interferometers and Surface Roughness measurements

**Design of Gauges:** Tolerances, Limits and Fits, Taylor's principle, Types of gauges and gauge design (numerical).

**Interferometer:** Principle, NPL Interferometer, Laser Interferometer and their applications.

**Surface Roughness Measurement:** Surface texture, Parameters for measuring surface roughness, Contact & non-contact type surface roughness measuring instruments.

(08 hrs.)

### Unit – III Metrology of Thread, Gears and Advance Metrology

**Measurement of Thread form:** Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle, pitch, Floating Carriage Micrometer (Numerical).

**Gear Metrology:** Types of errors, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications.

**Advancements in Metrology:** Introduction & applications of: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology, Automatic inspection system, Machine vision for online-offline inspection.

(06 hrs)

### Unit – IV Introduction to Quality and Quality Tools

Quality: Dimensions, Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools, Introduction to N Seven Tools, Quality Circle, Criteria for Quality Award (National & International).

(06 hrs)

### Unit – V Statistical quality control

**Statistical quality control:** Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable ( $\bar{X}$  & R Chart) & Attribute (P & C Chart), Process capability (Indices:  $c_p$ ,  $c_{pk}$ ,  $p_{pk}$ ), Statistical Process Control (Numerical). Production Part Approval Method (PPAP).

**Acceptance Sampling:** Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical).

(08 hrs)

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## **Unit –VI Total Quality Management**

Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, QMS (ISO 9000, TS16949, ISO14000), Quality Audit, FMECA, Zero defect, TPM. Six Sigma: DMAIC - Concept and Applications. (06 hrs)

### **Term-Work**

#### **LIST OF EXPERIMENTS**

##### **A] Any Four from experiment no. 1 to 5 & Any Four 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) (Refer ISO 17025).
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.**

#### **Text Books:**

1. Hume K. J., "Engineering Metrology", Macdonald Publications
2. Jain R. K., "Engineering Metrology", Khanna Publication.
3. Juran J. M., "Quality Handbook", McGraw Hill Publications.
4. Grant S.P., "Statistical Quality Control", Tata McGraw hill Publication.
5. Kulkarni V. A. and Bewoor A. K., "Quality Control", John Wiley Publication.

#### **Reference Books:**

1. Narayana K. L., "Engineering Metrology".
2. Galyer J. F & Shotbolt C. R., "Metrology for engineers"
3. Gupta I. C., "Engineering Metrology", Dhanpatrai Publications
4. Judge A.W., "Engineering Precision Measurements", Chapman and Hall
5. Francis T. Farago, Mark A. Curtis, "Handbook of dimensional measurement".
6. ASTM, "Handbook of Industrial Metrology", Prentice Hall of India Ltd.
7. Basterfield Quality control
8. Harrison M. Wordsworth, Steffen Godfrey, "Modern Methods for Quality control and Improvement", Willy publication.

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T. E. (Automobile)

Semester – I

Automotive Electrical and Electronics (316482)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316482	Automotive Electrical and Electronics	3	--	2	30	70	25	--	--	125

## **COURSE OBJECTIVES**

1. To study automotive wiring harness and circuit.
2. To study automotive battery and its types.
3. Student shall gain thorough understanding types of sensors use in automotive vehicle.
4. To study electronically control unit (ECU).
5. To study all the types of light used in automobile.

## **COURSE OUTCOMES**

1. Students able to carry out fault diagnosis of electrical and electronic defect and carry out remedial action.
2. Gain of knowledge of modern technologies used in recent developed vehicles.

### **Unit – I Introduction to automotive electrical systems**

Automotive electricity generation, storage & distribution systems, wiring harness, circuit diagrams and symbols, 12/24/42 volt system, positive earth and negative earth, earth return and insulated return systems, Multiplexed wiring systems, Electromagnetic compatibility & interference, Introduction of Controlled Area Networks (CAN) protocols .

#### **Battery:**

Principle of lead acid battery, Types, Constructional details, Recharging the battery, Battery ratings, Battery Performance, Battery capacities, Battery efficiency, Battery tests, Battery failures, Alkaline battery, maintenance free batteries, hybrid batteries. (06 hrs.)

### **Unit – II Charging, Starting & Ignition System**

Magnetos Constant current & voltage systems, Current & voltage regulator, Semi conductor type regulator, Alternator with regulator, starting system with layout, selection of motor, matching battery, Drive mechanisms, Ignition coil, Distributor, Cam angle & Contact angle gap, Advance mechanisms, Ballast Resistance, Limitations of coil ignition, Transistorized Ignition systems, Spark plugs, types, construction. (06 hrs.)

### **Unit – III Automotive Accessories & Lighting Systems**

Vehicle lighting System: Head, Indicator, Fog lamps, Brake lights, Gas discharge, LED lighting, Dash board Indicators: Fuel gauge, oil pressure gauge, Temperature gauges, Speedometer, Warning Lights, Electric horn, Horn relay, Wind shield wipers, Power window. (06 hrs.)

### **Unit – IV Automotive Sensors & Actuators**

Working principle of sensors, Types of sensors, Airflow rate sensor, angular position sensor, Throttle angle sensor, Temperature sensor, MAP sensors, sensors feedback control, Principle of actuator, Types of actuators, engine control actuators, Solenoid actuators, motorized actuators. (06 hrs.)

### **Unit – V Engine Management Control System (EMS)**

Layout and working (open loop and closed loop control), ECU and microcontroller, group and sequential injection techniques, fuel system components, cold and warm start system, idle speed control, acceleration / deceleration and full load enrichment and fuel cut-off, fuel control MAPs. Electronic Ignition system and spark timing control. (06 hrs.)

### **Unit – VI Vehicle Management System**

ABS system with layout and working, Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system , crash sensor, seat belts, Cruise control, Vehicle security systems alarms, vehicle tracking system, Collision avoidance, Radar warning system, Introduction to Global Positioning Systems. (06 hrs.)

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**Term work:** (Minimum eight, out of which Experiment No. 10 is compulsory.)

1. Demonstration of automotive electrical and electronic systems layout.
2. Study and testing of battery performance parameter.
3. Demonstration and testing of alternators.
4. Demonstration and testing of starting motors & Electronic ignition system.
5. Demonstration of dash board panel instruments & controls.
6. Demonstration of headlight beam alignment.
7. Testing of auto electrical components on multifunctional tester.
8. Testing of CDI coil, spark plug and armature.
9. Study of ECU diagnostic system for fault finding.
10. Visit to any authorized service station for On Board Diagnosis.

**Text Books:**

1. P. L. Kohli, 'Automotive Electrical Equipments', Tata McGraw Hill Pub. Co. Ltd.
2. Tom Denton, 'Automobile Electrical & Electronic Systems', SAE International.

**Reference Books:**

1. Bechfold SAE 1998, 'Understanding Automotive Electronics'.
2. V. A. W. Hilliers, 'Fundamentals of Automotive Electronics', Hatchin, London
3. Tomwather J. R., Cland Hunter, 'Automotive Computer & Control System',
4. Prentice Inc. NJ
5. Robert N. Brandy, 'Automotive Computers & Digital Instrumentation', Prentice
6. Hall Eaglewood, Cliffs, NJ
7. Young, Griffiths, 'Automobile Electrical & Electronic Equipments', The English
8. Language Book Co., London.

# University of Pune

T. E. (Automobile)

Semester – I

Skill Development (316483)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316483	Skill Development	--	--	2	--	--	50	--	--	50

## ***COURSE OBJECTIVES***

1. Help students develop self-motivation, good work habits, personal discipline and skills needed to troubleshooting the practical problems of the machine.
2. To get awareness about the national level project competitions and develop presentation skills.
3. Encourage and nurture students' interest in engineering as a profession.

## ***Each student must complete any two assignments from the following***

1. Dismantle any two or four stroke engine and assemble it to bring back in working condition.
2. Dismantle any machine and assemble it to bring back in working condition.
3. Participate in any national project competition like BAJA, SUPRA, IIT Robocon etc.
4. Participate and present a paper in Events like Avishkar / Any National Conference.
5. Complete fifteen days industrial training at any automobile industry.

## **Note:-**

1. For 4<sup>th</sup> assignment student have to submit a Paper presented and along with certificate and he has give presentation on that paper to the respective teacher
2. For 5<sup>th</sup> assignment student have to submit a training report and along with certificate and he has give presentation to the respective teacher

# University of Pune

T. E. (Automobile)

Semester – II

## Numerical Methods and Optimization (302047)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302047	Numerical Methods and Optimization	4	--	2	30	70	--	50	--	150

### COURSE OBJECTIVES

**To be able to:**

- 1 Recognize the difference between analytical and Numerical Methods.
- 2 Effectively use Numerical Techniques for solving complex Mechanical engineering Problems.
- 3 Prepare base for understanding engineering analysis software.
- 4 Develop logical sequencing for solution procedure and skills in soft computing.
- 5 Optimize the solution for different real life problems with available constraints.
- 6 Build the foundation for engineering research.

### COURSE OUTCOMES

**Ability to:**

1. Use appropriate Numerical Methods to solve complex mechanical engineering problems.
2. Formulate algorithms and programming.
3. Use Mathematical Solver.
4. Generate Solutions for real life problem using optimization techniques.
- 5 Analyze the research problem

### Unit – I Errors and Approximations

Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.

**Roots of Equation**

Bisection Method, False position Method, Newton Raphson method and Successive approximation method. (08 hrs)

### Unit – II Simultaneous Equations

Gauss Elimination Method, Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tridiagonal Matrix (08 hrs)

### Unit – III Optimization

Introduction to optimization, Classification, Constrained optimization: Graphical and Simplex method. One Dimensional unconstrained optimization: Newton's Method. Modern Optimization Techniques: Genetic Algorithm (GA), Simulated Annealing (SA). (10 hrs)

### Unit – IV Curve Fitting & Interpolation

**Curve Fitting:** Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation.

**Interpolation :**

Lagrange's Interpolation, Newton's Forward interpolation, Hermit Interpolation, inverse interpolation. (06 hrs)

### Unit – V Numerical Integration

Trapezoidal rule, Simpson's Rule ( $1/3^{\text{rd}}$  and  $3/8^{\text{th}}$ ), Gauss Quadrature 2 point and 3 point method. Double Integration: Trapezoidal rule, Simpson's  $1/3^{\text{rd}}$  Rule. (06 hrs)

### Unit – VI Numerical Solutions of Differential Equations

**Ordinary Differential Equations [ODE]** Taylor series method, Euler Method, Modified Euler Method(Iterative), RungeKuttafourth order Method, Simultaneous equations using RungeKutta2nd order method.

**Partial Differential Equations [PDE]: Finite Difference methods**

Introduction to finite difference method, PDEs- Parabolic explicit solution, Ellipticexplicit solution. (10 hrs)

## Term-Work

1. Program on Roots of Equation (Validation by suitable solver, all four compulsory)
  - a) Bisection Method,
  - b) False position Method,
  - c) Newton Raphson method
  - d) Successive approximation method
2. Program on Simultaneous Equations (Validation by suitable solver, all three compulsory)
  - a) Gauss Elimination Method,
  - b) Thomas algorithm for tridiagonal matrix,
  - c) Gauss-Seidal method.
3. Program on Numerical Integration(Validation by suitable solver, all four compulsory)
  - a) Trapezoidal rule,
  - b) Simpson's Rules ( $1/3^{\text{rd}}$ ,  $3/8^{\text{th}}$ ) [In one program only]
  - c) Gauss Quadrature Method- 2 point, 3 point. [In one program only]
  - d) Double integration: Trapezoidal rule, Simpson's  $1/3^{\text{rd}}$ Rule.
4. Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory)
  - a) Straight line,
  - b) Power equation
  - c) Exponential equation
  - d) Quadratic equation
5. Program on Interpolation(Validation by suitable solver, all three compulsory)
  - a) Lagrange's Interpolation,
  - b) Newton's Forward interpolation,
  - c) Inverse interpolation
6. Program on ODE(Validation by suitable solver, all three compulsory)
  - a) Euler Method(Iterative),
  - b) Runge-Kutta Methods- fourth order,
  - c) Simultaneous equations.(Runge-Kutta 2nd order: *One step only*).
7. Program on PDE(Validation by suitable solver)
8. Theory assignment on Modern Optimization techniques.

### GUIDELINES TO CONDUCT PRACTICAL EXAMINATION:

Any one program from each set A & B with flowchart and solver: **Duration: - 2 hrs.**

**Set A:** (Weightage – 60 %)

- a) Simultaneous Equation.
- b) Partial Differential Equation.
- c) Interpolation.

**Set B:**(Weightage – 40 %)

1. Roots of Equations.
2. Curve Fitting.
3. Ordinary Differential Equations.
4. Integration

### Text Books:

1. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4/e, Tata McGraw Hill Editions
2. Dr. B. S. Garewal, Numerical Methods in Engineering and Science, Khanna Publishers,.
3. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientist, Tata Mc-GrawHill Publishing Co-Ltd.
4. Rao V. Dukkupati, Applied Numerical Methods using Matlab, New Age International Publishers

### Reference Books:

1. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education Asia
2. E. Balagurusamy, Numerical Methods, Tata McGraw Hill
3. P. Thangaraj, Computer Oriented Numerical Methods, PHI
4. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.

# University of Pune

T. E. (Automobile)

Semester – II

Design of Engine Components (316484)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316484	Design of Engine Components	4	--	2	30	70	25	--	--	125

## ***COURSE OBJECTIVES***

1. To understand basics behind engine component selection.
2. To design cooling and lubrication systems for engine.
3. To get thorough knowledge about engine testing and test equipments.
4. Learning recent trends in automobile engine and its impact on engine performance.

## ***COURSE OUTCOMES***

1. Design of small assembly.
2. Understanding of use of Design Data Book

### ***Unit – I Engine Functional Design***

Selection of engine type, Stroke & Bore, No. of cylinders, Cylinder arrangement, Design considerations for combustion chamber, Engine balancing, Selection of firing order and cooling system (08 hrs.)

### ***Unit – II Design of Cooling & Lubrication System***

Heat calculations and Heat balance sheet for design of cooling system, Design of radiator, water pump, selection of lubricating oil and pump (08 hrs.)

### ***Unit – III Engine Component Design***

Materials for Engine Components, Design of Piston (On the Basis Strength & Thermal), Piston pin, Connecting rod. (08 hrs.)

### ***Unit – IV Engine Component Design***

Cylinder head, Crankshaft, Cylinder liner, Design of Valve, Rocker arm, Push rod, Cam shaft, cam and follower, Failure analysis of critical components. (08 hrs.)

### ***Unit – V Engine Testing Equipment***

Fault finding equipment, Vacuum gauge test, Mechanical fuel pump testing, Cylinder power balance, Cylinder compression test, Cylinder leakage test, Ignition timing, Exhaust gas CO and HC analyzer, Oscilloscope engine analyzers, and Distributor dwell-angle (08 hrs.)

### ***Unit – VI Recent Trends in Automobile Engine***

Variable Timing Control (VTC), Variable-Valve Timing (VVT), Variable compression ratio (VCR) and Lift Electronic Control (VTEC), Homogenous Charge Compression Ignition (HCCI) Advanced Turbulent Flow Technology (ATFT), Dual Twin Spark –ignition(DTS-i), Stratified Charged Engine, Wankel Engine, Four valve engine and Dual fuel engine. (08 hrs.)

## **Term Work:**

1. Assembly & Detail drawing of existing engine by actual measurements
2. Demonstration on stress concentration by photo elasticity



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3. Design of engine components. Detail drawing of components sheet of A1 size
4. Engine assembly drawing sheet of A1 size
5. Details of any five components of engine. (With any modeling software.)

## **Text Book:**

1. S. P. Patil, "Mechanical System Design", Jaico Publications.
2. V. B. Bhandari, "Design of Machine Elements", Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi
3. R. S. Khurmi, J.K. Gupta, "A Text Book of Machine Design" Edition 11, Eurasia Publishing House

## **Reference Books:**

1. V. L. Maleev, "I. C. Engine", McGraw Hill Book Co. Ltd., New Delhi, Second Edition
2. J.B. Heywood, "I. C. Engine Fundamentals", McGraw Hill Book Co., New Delhi
3. Joseph E. Shigley & Larry D. Mitchell, "Mechanical Engineering Design", Sixth Edition, McGraw-Hill International Book Company
4. George E. Dieter, "Engineering Design- A Material and Processing Approach", Second Edition, McGraw-Hill International Edition
5. Paul H. Black & O. Eugene Adams Jr., "Machine Design", Third Edition, McGraw-Hill International Edition.

# University of Pune

T. E. (Automobile)

Semester – II

Automotive Transmission (316485)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316485	Automotive Transmission	4	--	2	30	70	25	50	--	175

## ***COURSE OBJECTIVES***

1. The student shall gain appreciation and understanding of the working principle of all the transmission system components.
2. Student shall gain a thorough understanding of the different types of clutches, gearboxes, driveline and final drive and its application.
3. Student shall gain appreciation and understanding of disassembly and assembly of all system, various type of maintenance.

## ***COURSE OUTCOMES***

1. Students will gain knowledge of transmission system of the vehicle.
2. Students will get hands on practice of drive system.

## ***Unit – I Vehicle Layouts***

Introduction, Classification of automobile, Types of chassis layout with reference to power plant locations and type of drive, Types of chassis- fully forward, semi forward, Truck or bus chassis, two & three wheeler chassis layout. (05 hrs.)

## ***Unit – II Clutches & Gear Box***

Clutches: Principle, Functions, General requirements, Torque capacity, Types of clutches, Cone clutch, Single-plate clutch, Diaphragm spring clutch, Multi-plate clutch, Centrifugal clutch, Electromagnetic clutch, Lining materials, Over-running clutch, Clutch control systems.

Gear Box: Necessity of gear box, Resistance to motion of vehicle, Requirements of gear box, Functions of gear box, Types, Sliding mesh, Constant mesh, Synchromesh. Principle, construction and working of synchronizing unit, Requirements & applications of helical gears, Gear selector mechanism, Two wheeler gear box, Lubrication of gear box, Overdrive gears, Performance characteristics. (10 hrs.)

## ***Unit – III Drive Lines***

Effect of driving thrust and torque reaction, propeller shaft-universal joints, hooks and constant velocity U.J., Drive line arrangements – Hotchkiss drive & torque tube drive, Rear wheel drive & front wheel drive layouts. (06 hrs.)

## ***Unit – IV Final Drive & Rear Axle***

Purpose of final drive & drive ratio, Different types of final drives, need of differential, Constructional details of differential unit, Non-slip differential, Differential lock, Differential housing, Function of rear axle, Construction, Types of loads acting on rear axle, Axle types - semi-floating, full floating, three quarter floating, Axle shafts, Final drive lubrication. (09 hrs.)

## ***Unit – V Fluid Flywheel, Torque convertor, Epicyclic Gear Boxes***

Fluid Flywheel, Torque convertor: Operating principle, Construction and working of fluid flywheel, Characteristics, Advantages & limitations of fluid coupling, Torque convertor, and construction and working of torque converter, Performance characteristics, Comparison with conventional gear box.

Epicyclic Gear Boxes : Simple epicyclic gear train, Gear ratios, Simple & compound planet epicyclic gearing, Epicyclic gear boxes, Wilson epicyclic gear train - Construction and operation, Advantages, Clutches and brakes in epicyclic gear train, compensation for wear, performance characteristics. (09 hrs.)

## ***Unit – V Automatic Transmission***

Principle of semi automatic & automatic transmission, Hydramatic transmission, Fully automatic transmission, Semi automatic transmission, Hydraulic control system, Continuous variable transmission (CVT) – operating principle, basic layout and operation, Advantages and disadvantages. (07 hrs.)

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## **Term Work (Any 9 Experiment 11 compulsory)**

1. Demonstration of garage, garage equipment's & tools, preparation of different garage layouts.
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, slip joint).
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.
11. Visit to modern garage.

## **Text Books:**

1. Dr. Kripal Singh, "Automobile Engineering-Vol. 1", 13<sup>th</sup> Edition, Standard Publishers Distributors.
2. N. K. Giri, "Automotive Mechanics", Khanna Publishers, Delhi, Eighth Edition

## **Reference Books:**

1. Newton, Steed & Garrot, "Motor Vehicles", 13th Edition, Butterworth London
2. A. W. Judge, "Modern Transmission", Chapman & Hall Std., 1989
3. Chek Chart, "Automatic Transmission", A Harper & Raw Publications
4. J. G. Giles, "Steering, Suspension & Tyres", – Liffie Book Ltd., London
5. W. Steed, "Mechanics of Road Vehicles", Liffie Book Ltd.
6. Heisler, "Vehicle and Engine Technology", Second Edition, SAE International Publication

# University of Pune

T. E. (Automobile)

Semester – II

Automotive Aerodynamics and body Engineering (316486)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316486	Automotive Aerodynamics and body Engineering	3	--	2	30	70	25	--	--	125

## **COURSE OBJECTIVES**

1. Identify various forces and moments associated with aerodynamics.
2. Gain thorough understanding of the different types of vehicles.
3. To understand the physics of fluid flow over vehicle body and its optimization techniques.
4. State and illustrate applications of ergonomics and safety in the designing of vehicle body.
5. To select appropriate process for designing of vehicle body with aesthetic appearance.

## **Unit – I Fundamental of Aerodynamics**

Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil, Aerodynamic drag and its types and various forces and moments, its effects on performance, Various body optimization techniques for minimum drag, Testing techniques, Component balance to measure forces and moments, Down force. (05 hrs.)

## **Unit – II Vehicle Aerodynamics and Wind Tunnel**

Scope, historical development trends, flow phenomenon related to vehicles, performance of cars, light vans, resistance to vehicle motion, drag cars as bluff body, flow field around car, strategies for aerodynamic development of car, optimization of car bodies for low drag.

Principles of wind technology, limitation of simulation, stress with scale models, Existing automobile wind tunnel, full scale wind tunnels, climatic tunnels, measuring equipments and transducers, measurement techniques, velocity measurements, flow visualization techniques. (07 hrs.)

## **Unit – III Shape Optimization Technique of Vehicle**

The origin of forces and moments, effects, Front end modification, front and rear windshield angles, vehicle dynamics under side wind, force moment coefficients, dirt accumulation on vehicle, wind noise, air flow around individual components, boat failing, hatch back, fast back & square back dust flow pattern at rear, effect of gap configuration, effect of fastener.

Introduction to CFD methodology – Application to vehicle aerodynamics. (05 hrs.)

## **Unit – IV Car and Bus Body Details**

**Car body:** Types- Saloon, Convertibles, Limousine, Estate Van, Racing and sport cars. Regulations, Drivers visibility, Tests for visibility, Methods of improving visibility, Space in cars, safety design, car body construction, front assembly, Roof Assembly, Under floor, bonnet etc.

**Bus body:** Types - Mini Bus, Single Dekker, double Dekker, two levels, split level and articulated bus. Bus body layout – floor height, Engine Locations, Entrance cum exit location, Seating dimensions, seating layouts, passenger comfort. Construction details: frame construction, double skin construction, types metal sections used – regulations, conventional & integral type construction, Emergency door location, luggage space location. (07 hrs.)

## **Unit – V Commercial Vehicle Body Details**

Types of bodies: - flat platform, drop side, fixed side, tipper body, tanker body. Light construction vehicle body types, dimensions of driver seat in relation to control, driver cabin design, design of chassis frame. (05 hrs.)

## **Unit – VI Body Loads & Ergonomics**

Idealized structure, structural surfaces, shear panel method, symmetric & asymmetric vertical loads in car, longitudinal load and load distribution on vehicle structure.

Ergonomics and anthropometry, Drivers work station- Design of driver seat for comfort and safety, Types of seat used in automobiles, Types of safety belts, Air bags used in automobiles, Use of energy absorbing system in automobiles, Impact protection from steering controls, Importance of Bumper in automobile. (07 hrs.)

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**Term Work:** (Any eight experiment from the following list. Out of which any one experiment from 8 and 9, and experiment 11 is compulsory)

1. Typical Car - body construction with sketches.
2. To study the construction of typical truck body and draw sketches.
3. To study passenger seat position, requirement and construction by using standard dimension of bus.
4. Study of effect of different shapes, styles and exterior objects on drag force
5. Calculation of aerodynamic forces and pitching, rolling, yawing moments.
6. Measurement of drag, lift force of a scaled model in wind tunnel.
7. To demonstrate constructional and operational features of mechanical and power window mechanism.
8. Design of intercity bus and prepare a sheet by using any drafting software.
9. Design a Luxury bus structure with seating layout and prepare sheet by using any drafting software.
10. Study and analysis of flow conditions over the vehicle with the help of CFD software.
11. Visit to Automotive body building workshop.

**Text Books:**

1. J. Powloski, "Vehicle Body Engineering", Business Books Ltd., London.

**Reference Books:**

1. John Fenton, "Vehicle Body Layout & Analysis", Hutchinson, London.
2. Sydney F. Page, "Body Engineering", Chapman & Hill Ltd., London, 3rd Edition
3. J.G. Giles, "Body Construction and Design", Vol. 6, Iffe Books/Butterworth & Co. London
4. P. L. Kohli, "Automotive Chassis & Body", Papyrus Publishing House, New Delhi.
5. Dr. V. Sumantran and Dr. Gino Sovram, Vehicle Aerodynamics Published by SAE International, USA
6. John Fenton, "Handbook of Automotive Body Construction and Design Analysis" Professional Engineering Publishing.

# University of Pune

## T. E. (Automobile) Semester – II Manufacturing Process – II (302051)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
<b>302051</b>	Manufacturing Process-II*	<b>3</b>	--	--	<b>30</b>	<b>70</b>	--	--	--	<b>100</b>

### ***COURSE OBJECTIVES***

1. To analyze and understand the metal cutting phenomenon
2. To select process parameter and tools for obtaining desired machining characteristic
3. To understand design of manufacturing processes.
4. To analyze the effect of process parameter with respect to defined process characteristic

### ***COURSE OUTCOMES***

1. Student should be able to apply the knowledge of various manufacturing processes.
2. Student should be able to identify various process parameters and their effect on processes.
3. Student should be able to design and analyze various manufacturing processes and tooling.
4. Student should be able to figure out application of modernization in machining.
5. Students should get the knowledge of Jigs and Fixtures so as to utilize machine capability for variety of operations.

### ***Unit – I Machine tools and their applications***

**Drilling machine:** Types of drills and operations. Twist drill geometry, Types of drilling machine, Tool holder.

**Milling machine:** Types of milling machines, Cutter-types and geometry and their applications. Universal dividing head, Methods of Indexing: Simple, Compound, Differential. Numericals based on indexing.

Calculation of machining time for Drilling and Milling processes(Numericals)

**Broaching:** Introduction to broaching, Broach tool geometry, Types of broaching machines and operations.

Planner and Boring Machines.(Introduction and types) (07 hrs.)

### ***Unit – II Grinding and Finishing processes***

#### **Grinding machines**

Introduction, Types and Operations of grinding machines, Sequencing of grinding operations

Grinding wheel – Shapes, Designation and selection, Mounting , Balancing and Dressing of grinding wheels, Maximum chip size determination, Machining time calculation for cylindrical and plunge grinding (Numericals).

**Superfinishing processes** – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters) (07 hrs.)

### ***Unit – III Theory of Metal cutting***

**Single point cutting tool:** Tool geometry, Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate.

Process parameters and their effect on cutting forces.

**Merchant’s circle of forces (graphical and analytical)** Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation, Calculation of Total power and Specific energy. Measurement of cutting forces by tool dynamometer for turning, drilling, milling and grinding operations.

**Machinability** - Factors affecting machinability, Tool life, Tool wear, Types of tool wear and remedial actions, Cutting fluid and their types, Effect of process parameters on tool life, Taylor's tool life relation (Derivation along with numerical).

**Economics of machining:** Optimum cutting speed for maximum production rate, Optimum cutting speed for minimum cost (Numerical) (07 hrs.)

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## **Unit – IV Advanced Machining Processes**

Introduction, classification of advanced machining processes.

Principles, Working, Process Parameters, Estimation of MRR (simple numerical), Advantages, Limitations and Application for following processes:

Electric Discharge Machining (EDM), LASER Beam Machining (LBM), Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM) and Electro Chemical Machining (ECM) (07 hrs.)

## **Unit –V CNC/DNC Technology**

**CNC Technology:** Introduction, Construction and working of CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC)

**CNC Tooling:** New trends in Tool Materials, Turning tool geometry (ISO 1832 Coding system), Tool inserts (coated and uncoated), Modular tooling system for Turning. Milling tooling systems, Tools presetting, Work holding.

**CNC Programming:** Word address format (WAF) -ISO Standard, G & M codes, Type of CNC Control systems, Manual part programming, Subroutine, Canned cycles. (07 hrs.)

## **Unit –VI Jigs and fixtures**

Concept of degree of freedom, 3-2-1 principle of location,

General guidelines to design Jigs and fixtures, advantages of jig and fixtures

**Jigs:** Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, Latch type jig.

**Fixtures:** Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Assembly and Inspection fixtures.

Indexing methods, Power work holding devices with their advantages,

Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures. (07 hrs.)

### **Text Books:**

1. S. K Hajra Choudhury , Elements of workshop technology – Vol. II,, Media Promoters And Publishers, Mumbai
2. Amitabh Ghosh and Asok kumar Mallik, Manufacturing science, Ellis Horwood Ltd
3. Mikell. P. Grover, Fundamentals of Modern Manufacturing, Pearson Publications
4. P. C. Sharma, Production Engineering, S. Chand Publication.

### **Reference Books:**

1. Production technology –HMT, Tata McGraw Hill publication
2. Lindberg, Roy A., Processes and materials of manufacture, P H I Learning
3. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson Education, Fourth Edition.
4. J. P. Kaushish, Manufacturing process, PHI Learning, Second Edition.
5. G. K Lal, Fundamentals of Design and Manufacturing, Alpha Science International Ltd(2005)
6. M.C Shaw, Metal Cutting Principles, Oxford university press
7. Yoram Koren , Numerical Control of Machine Tools Khanna Publication
8. Ibrahim Zeid, Mastering CAD-CAM , McGraw Hill
9. P. K Mishra, Non- conventional machining, Narosa Publishing House
10. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi
11. Gary F. Benedict, Non – traditional manufacturing processes, Marcel Dekker Inc.
12. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS
13. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill
14. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education, Third Edition.

# University of Pune

## T. E. (Automobile) Semester – II Machine Shop – II (302052)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
302052	Machine Shop - II*	--	--	2	--	--	25	--	--	25

### ***COURSE OBJECTIVES***

1. To set the manufacturing set-up appropriately and study the corresponding set up parameters.
2. To select appropriate process parameter for obtaining desired characteristic on work piece.
3. To understand the operational problems and suggest remedial solution for adopted manufacturing process.

### ***COURSE OUTCOMES***

1. Ability to develop knowledge about the working and programming techniques for various machines and tools

### **Term Work**

Each student must complete and submit following term work:

#### **I. Following job should be completed individually**

1. Any one assembly consisting of at least five components involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement.

#### **II. Journal consisting of following assignments.**

1. Report based on industrial visit to gear or thread manufacturing
2. Two views of at least one jig and a fixture designed, for the simple component on a half empirical sheet. (manual drafting)
3. Process planning sheets for job 1.a and 1.b.

#### **Note:**

- Practical must be conducted by the concerned faculty member.

Job drawing essentially consisting of Geometric Dimensioning and Tolerances.



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T. E. (Automobile)  
Semester – II  
Seminar (316487)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem	End Sem.				
316487	Seminar	--	--	2	--	--	--	--	50	50

**The Seminar topic must be related to one of the following:**

1. Mechanical/ Automobile Engineering
2. Interdisciplinary subjects
3. Recent trends in Engineering

## INSTRUCTIONS FOR SEMINAR REPORT WRITING

It is important that the procedures listed below be carefully followed by all the students.

Prepare 3 **COPIES** of your Seminar report.

1. Limit your seminar report to preferably 20 – 25 pages
2. The footer

***For e.g. Mechanical Engineering***

Institute Name, Mechanical Engineering Times New Roman 10 pt. and centrally aligned.

3. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned
4. Print the report using
  - a) Letter quality computer printing.
  - b) The main part of report should be Times New Roman 12 pt. and justified.
  - c) Use 1.5 line spacing.
  - d) Entire report shall be one chapter. No chapters for Seminar report.
5. Use the paper size **8.5" × 11"** or **A4 (210 × 197 mm)**. Please follow the margins given below.

Margin Location	Paper 8.5" × 11"	Paper A4 (210 × 197 mm)
Top	1"	25.4 mm
Left	1.5"	37 mm
Bottom	1.25"	32 mm
Right	1"	25.4 mm

6. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
7. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.
8. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).
9. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, **black and white**. **Illustrations downloaded from internet are not acceptable.**
  - a) Illustrations should not be more than **two** per page. One could be ideal
  - b) Figure No. and Title at bottom with **12 pt**
  - c) Legends below the title in **10 pt**
  - d) Leave proper margin in all sides
  - e) Illustrations as far as possible should not be xeroxed.
10. **Photographs** if any should of glossy prints
11. Please use **SI** system of units. If students would like to add the equivalent in inch-pound (British) units, they must be stated in parenthesis after the **SI** units. In case the final result comes out in any other units (say due to empirical formula etc.) covert the unit to **SI** unit.

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12. Please **number the pages** on the front side, centrally below the footer
13. **References** should be either in order as they appear in the report or in alphabetical order by last name of first author
14. **Symbols** and **notations** if any should be included in nomenclature section only
15. Following will be the order of report
  - i) **Cover page** and **Front page** as per specimen on separate sheet
  - ii) **Certificate** from Institute as per specimen on separate sheet
  - iii) **Acknowledgement**
  - iv) **List of Figures**
  - v) **List of Tables**
  - vi) **Nomenclature**
  - vii) **Contents**
16. All section headings and subheadings should be numbered. For sections use numbers **1, 2, 3, ....** and for subheadings **1.1, 1.2, ....** etc and section subheadings **2.1.1, 2.1.2, ....** etc.
17. **References** should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If **figures** and **tables** are taken from any reference then indicate source of it. Please follow the following procedure for references

## **Reference Books**

Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3<sup>rd</sup> ed., Oxford University Press, UK, 1996, pp. 110 – 112.

## **Papers from Journal or Transactions**

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.

Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

## **Papers from Conference Proceedings**

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

## **Reports, Handbooks etc.**

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.  
ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

## **Patent**

Patent no, Country (in parenthesis), date of application, title, year.

## **Internet**

www.(Site) [Give full length URL]

A Seminar on (TNR, 16pt, centrally aligned)

**Title (TNR, 27pt, Bold, Centrally Aligned,  
Title Case)**

By (TNR, 16pt, Centrally Aligned)

**Mr. Student's Name** (TNR, 16pt, Centrally Aligned)

Guided by (TNR, 16pt, Centrally Aligned)

**Guide's Name** (TNR, 16pt, Centrally Aligned)

**Institute**

**Logo**

Department of Automobile Engineering

**Name of the Institute**

[2011-12](TNR, 22pt, Title Case Centrally Aligned)

University of Pune

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Name of the Institute

Institute

Logo

## CERTIFICATE

This is to certify that *Mr.* ..... has successfully completed the Seminar work entitled “Performance analysis of.....” under my supervision, in the partial fulfillment of Bachelor of Engineering - Automobile Engineering (Branch) of University of Pune.

Date :

Place :

Guide's Name  
Guide

\_\_\_\_\_  
Head  
Department and  
Institute Name

Seal

\_\_\_\_\_  
Principal,  
Institute Name