Savitribai Phule Pune University

Faculty of Engineering

Syllabus For Third Year of Automobile Engineering

(Course 2015)

(with effect from 2017-18)

T. E. (Automobile) (2015 Course) Semester – I
(w.e.f Academic Year 2017-18)

Code	Subject	Teaching Scheme (Hrs/Week)			Examination Scheme					Total	Credit
		Lect.	Tut	Pract.	In-Sem	ESE	TW	PR	OR		
316481	Design of Machine Elements	4	--	2	30@	70@	50	--	--	150	5
302042	Heat Transfer*	4	--	2	30	70	--	50	--	150	5
302043	Theory of Machines-II*	3	1	--	30	70	25	--	25	150	4
302045	Metrology and Quality Control*	3	--	2	30	70	--	--	25	125	4
316482	Automotive Electrical & Electronics	3	--	2	30	70	--	--	25	125	4
316483	Skill Development	--	--	2	--	--	25	25	--	50	1
Total		17	01	10	150	350	100	75	75	750	23

T. E. (Automobile)(2015Course) Semester – II

Code	Subject	Teaching Scheme (Hrs/Week)			Examination Scheme					Total	Credit
		Lect.	Tut.	Pract.	In-Sem	ESE	TW	PR	OR		
302047	Numerical Methods and Optimization*	4	--	2	30	70	--	50	--	150	5
316484	Design of Engine Components	4	--	2	30@	70@	25	--	25	150	5
316485	Automotive Transmission	3	--	2	30	70	--	--	25	125	4
316486	Automotive Aerodynamics and body Engineering	3	1	--	30	70	--	--	25	125	4
302051	Manufacturing Process-II*	3	--	--	30	70	--	--	--	100	3
302052	Machine Shop-II*	--	--	2	--	--	50	--	--	50	1
302053	Seminar*	--	--	2	--	--	25	--	25#	50	1
302054	Audit Course*	--	--	--	--	--	--	--	--	--	--
Total		17	01	10	150	350	100	50	100	750	23

#Though it is under Oral head Internal Panel to be appointed by Principal and HOD. Examination schedule will not be prepared at University level.

***Marked subjects are common with TE (Mechanical Engineering)**

@Examination time for In-sem examination 1 Hr 30 Min. and End-sem examination 3 Hrs.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316481:Design of Machine Elements

Teaching Scheme:	Credits:	Examination Scheme:
TH: 04 hrs/week	TH: 04	In-Sem: 30
PR: 02 hrs/week	TW: 01	End-Sem: 70
		TW: 50

Prerequisites:-

1. Engineering mathematics
2. Engineering graphics
3. Strength of materials
4. Theory of machines

Course Objectives:-

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

1. The student shall gain the knowledge and understand the concept of design and steps involved in designing a machine element for manufacturing.
2. Shall be able to select proper materials for different machine elements depending on their physical and mechanical properties.
3. Students can understand the different types of failure modes and criteria.
4. Students shall gain knowledge of different types of machine elements and the design process. E.g., Power screws, shafts, couplings, welded joints, keys, bearings, gears etc. and able to design these elements for any application.

Course Outcomes:-

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

Course Contents

Unit - I	Design Process and design of Simple Machine elements	8 hours

Machine Design, Classification, Design procedure, 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, curved beams of circular cross section, rectangular cross section and crane hook.

Unit - II	Design of Shafts, Keys and Couplings	8 hours

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 spilnes.

Couplings: Flange coupling, flexible coupling.

Unit-III	Design of Power Screw, Bolted Joints and Welded joints	8 hours

Power Screw and Bolted Joints: Forms of threads, torque analysis and design with square and trapezoidal threads, self locking screw and design 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.

Unit-IV	Design for Fluctuating Loads	8 hours

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

Unit - V	Design of Spur and Helical Gears	8 hours

Spur Gears: Force analysis, Number of teeth, Face width & Beam strength of gear tooth, Incremental dynamic tooth load, Effective load on gear tooth, Estimation of module based on beam strength and wear strength.

Helical Gears: Virtual number of teeth, Tooth proportions, Force analysis, Beam strength and Wear strength of helical gears, Effective load on gear tooth, Herringbone gears.

Unit- VI	Design of Bevel and Worm Gears	8 hours

Bevel Gears: Types, Terminology of bevel gears, Force analysis, Beam strength and Wear strength of bevel gears, Effective load on gear tooth, Spiral bevel gears

Worm Gears: Terminology, Force analysis, Friction in worm gears, Strength rating and wear rating of worm gears, Thermal considerations

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. A design report giving all necessary calculations of design of components and assembly must be submitted. (Design data book must be used wherever necessary for selection of components.)
2. Six home assignments based on above units. (One assignment on each unit)
    A. Design of Cotter joint and Knuckle joint.
    B. Design of shaft and coupling.
    C. Design of Welded Joints.
    D. Numerical on Combined Loading.
    E. Design of Spur gear and Helical gear.
    F. Design of bevel and worm gear.

Books:

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. Juvinal, “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 OutlineSeries.

Design Data Books:

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

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sand(2015 Course)
302042: Heat Transfer*

Teaching Scheme:	Credits:	Examination Scheme:
TH: 04 hrs/week	TH: 04	In-Sem: 30
PR: 02 hrs/week	PR: 01	End-Sem: 70
		PR: 50

Course Objectives:-

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyze the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Determine the radiative heat transfer between surfaces.
6. Describe the various two phase heat transfer phenomenon. Execute the effectiveness and rating of heat exchangers.

Course Outcomes:-

1. Analyze the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.
2. Implement the general heat conduction equation to thermal systems with and without internal heat generation and transient heat conduction.
3. Analyze the heat transfer rate in natural and forced convection and evaluate through experimentation investigation.
4. Interpret heat transfer by radiation between objects with simple geometries.
5. Analyze the heat transfer equipment and investigate the performance.

Course Contents

Unit - I		10 hours

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, Thermal contact Resistance

Boundary and initial conditions: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition.

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.

Unit - II		8 hours

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

Heat transfer through extended surface: Types of fins and its applications, Governing Equation for constant cross sectional area fins, solution for infinitely long & adequately long (with insulated end) fins, efficiency & effectiveness of fins.

Unit-III		6 hours

Thermal Insulation – Types and selection, Economic and cost considerations, Payback period

Transient heat conduction: Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, Transient heat analysis using charts.

Unit-IV	Convection	10 hours

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

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

Natural convection: Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.

Unit - V	Radiation	8 hours

Fundamental concepts, Spectral and total emissive power, real and grey surfaces, Stefan Boltzmann law, Radiation laws – Planks, Wiens, Kirchoff's and Lambart's cosine law with simple applications, Irradiation and radiosity, Electrical analogy in radiation, Radiation shape factor, radiation heat exchange between two black and diffuse gray surfaces, radiation shield

Unit- VI	Heat Transfer Equipments	8 hours

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 (simple numerical treatment).

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, cross flow heat exchanger, LMTD correction factor, design criteria for heat exchanger, Introduction to TEMA standards.

Introduction to heat pipe, Introduction to electronic cooling - Discussion on active and passive methods.

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 Thermal Contact Resistance
5. Determination of heat transfer coefficient in Natural Convection
6. Determination of heat transfer coefficient in Forced Convection
7. Determination of temperature distribution, fin efficiency in Natural / Forced Convection
8. Determination of Emissivity of a Test surface
9. Determination of Stefan Boltzmann Constant
10. Determination of effectiveness of heat exchanger
11. Study of pool boiling phenomenon and determination of critical heat flux
12. Assignment on 1-D transient heat transfer program using finite difference methods.
13. Assignment to solve transient heat transfer problem using Heisler and Grober charts.
14. Assignment on multi-pass / cross-flow heat exchanger using effectiveness charts.

Books:

Text Book:

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. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.

6. M.M.Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
7. V.M.Domkundwar, Heat Transfer,

Reference Books:

1. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
2. S.P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
3. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
4. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
5. B.K. Dutta, Heat Transfer-Principles and Applictaions, PHI.
6. C.P. Kothandaraman, S.V.Subramanyam, Heat and Mass Transfer Data Book, New Academic Science

Data Books:

1. Databook, SPPU provided by the Exam Center

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical (2015 Course)
302043: Theory of Machines-II*

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30
TUT: 01 hrs/week	TW: 01	End-Sem: 70
		OR: 25
		TW: 25

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 develop competency in drawing the cam profile.
4. To make the student conversant with synthesis of the mechanism.
5. To understand step-less regulations.
6. To understand mechanisms for system control – Gyroscope.

Course Outcomes:-

1. Student will be able to understand fundamentals of gear theory which will be the prerequisite for gear design.
2. Student will be able to perform force analysis of Spur, Helical, Bevel, Worm and Worm gear.
3. The student to analyze speed and torque in epi-cyclic gear trains which will be the prerequisite for gear box design.
4. Student will be able to design cam profile for given follower motions and understand cam Jump phenomenon, advance cam curves.
5. The student will synthesize a four bar mechanism with analytical and graphical methods.
6. **a.** The student will analyze the gyroscopic couple or effect for stabilization of Ship, Aeroplane and Four wheeler vehicle.
   b. Student will be choose appropriate drive for given application (stepped / step-less).

Course Contents

Unit - I	Spur Gear	8 hours

Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, interference and under cutting – Methods to avoid interference. Minimum number of teeth on gear and pinion only, Force analysis and Friction in gears.

Unit - II	Helical, Bevel, Worm and Worm Wheel	6 hours

Helical and Spiral Gears: terminology, geometrical relationships, tooth forces, torque transmitted and efficiency, virtual number of teeth for helical gears

Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted.

Bevel Gear: Theoretical treatment only

Unit-III	Gear Trains	6 hours

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.

Unit-IV	Cam and Follower	8 hours

Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles

for different follower motions, Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (up to 3-4-5 Polynomial cam only)

Unit - V	Synthesis of Mechanism	6 hours

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. Three position synthesis of four bar mechanism using Freudenstein's equation. Analytical synthesis using kinematic coefficient in four bar mechanism.

Unit- VI	Step–Less-Regulation (Theoretical Treatment only) & Gyroscope	8 hours

Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. Gyroscopes, Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four wheel vehicle moving on curved path.

Term Work:

Tutorial (Term-work) shall consist of

Part A: Compulsory

1. To study manufacturing of gear using gear generation with rack as a cutter and to generate involute profile
2. Kinematic analysis of synchromesh, machine tool gear box, differential gear box(Self Study)
3. Speed and torque analysis of epicyclic gear train to determine holding torque
4. To draw the cam profile and study variation in pressure angle with respect to change in base circle diameter and draw pitch circle for both the cases.(Half imperial drawing sheet)
5. To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points.(Half imperial drawing sheet)
6. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect
7. Study of Continuous Variable Transmission and Infinite Variable Transmission.

Part B: Any two from the following

1. To draw conjugate profile for any general type of gear tooth.(Half imperial drawing sheet)
2. To verify the cam jump phenomenon for an eccentric cam.
3. Synthesis a four bar mechanism based on Freudenstein's equation using any programming Language.
4. To measure the range of speeds obtained using any one type of continuously variable
5. transmission device.
6. Industrial visit to understand Machines and Mechanisms.

Books:

Text Book:

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. N. K. Mehta, Machine Tool Design and Numerical Control, 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. Sadhu Singh, Theory of Machines, Pearson
5. D.K. Pal, S.K. Basu, Design of Machine Tools, Oxford &Ibh Publishing Co Pvt. Ltd.
6. Dr.V.P.Singh, Theory of Machine, Dhanpatrai and sons.
7. C.S.Sharma&KamleshPurohit, "Theory of Machine and Mechanism", PHI.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical(2015 Course)
302045: Metrology and Quality Control*

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30
PR: 02 hrs/week	TW: 01	End-Sem: 70
		OR: 25

Course Objectives:-

Students are expected to –

1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
2. Calibrate measuring instruments and also design inspection gauges.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
4. Select and apply appropriate Quality Control Technique for given application.
5. Select and Apply appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).

Course Outcomes:-

The student should be able to –

1. Understand the methods of measurement, selection of measuring instruments / standards of measurement, carryout data collection and its analysis.
2. Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design
3. Understand and use/apply Quality Control Techniques/ Statistical Tools appropriately.
4. Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.

Course Contents

Unit - I	Measurement standards and Design of gauges	6 hours

Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability,

Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate.

Design of Gauges: Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).

Unit - II	Comparators, Thread and Gear Metrology, Surface Roughness Measurement	6 hours

Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).

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

Gear Metrology: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications

Surface Roughness Measurement: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf.

Unit-III	Advances in Metrology	6 hours

Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes

Machine Vision Systems: vision system measurement – Multisensory systems.
Interferometer: Principle, NPL Interferometer
Laser Metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications

Unit-IV	Introduction to Quality and Quality Tools	6 hours

Concept of Quality: Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old new New Seven Tools, Quality Circles.
Importance of Quality deployment at Design and Manufacturing Engineering: Opportunities for improvement product design, Importance of– initial planning for quality, concept of controllability: self-controls – defining quality responsibilities on the factory flow – self inspection.

Unit - V	Statistical quality control	8 hours

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability(Indices: cp, cpk, ppk), 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)

Unit- VI	Total Quality Management	6 hours

TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defect, TPM. Six Sigma: DMAIC - Concept and Applications.
Quality Management System: Need for quality management system – design of quality management system - quality management system requirements – ISO 9001, TS-16949, ISO-14000, Quality Audit.

Term Work:

List of Experiments

Part A] Experiment no. 1, 4 and 6 are mandatory. Perform any three from experiment no. 2 to 5 & any three from experiment no. 7 to 10.

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, (MSA: Gauge R & R).
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
7. Determination of geometry and dimensions of given composite object / single point tool, using profile projector and 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 Micrometer / Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

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

Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using Seven quality control tools for

engineering application. Submission of this assignments USING STANDAED FORMATS.

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).

Part C] Industrial visit to:

Calibration lab /Quality control lab / CMM Lab / Gear Inspection Unit

OR

QA/QC Unit of Automotive Industry / Engineering Industry.

Books:

Text Book:

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. I. C. Gupta, Engineering Metrology, Dhanpath Rai.
3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.
4. Juran J. M., Quality Handbook, McGraw Hill Publications.
5. Grant S.P., Statistical Quality Control, Tata McGraw hill 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 Publiartions
4. Judge A.W., Engineering Precision Measurements, Chapman and Hall
5. Francis T. Farago, Mark A. Curtis, Handbook of dimensional measurement.
6. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.
7. Connie Dotson, Fundamentals of Dimensional Metrology, Thamson Publn., 4th Edition.
8. Basterfield D. H., Quality control, Pearson Education India, 2004.
9. Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication.
10. Harrison M. Wordsworth, Stefeen Godfrey, Modern Methods for Quality control and Improvement, Willy Publication.

Online Education resources: viz. NPTEL web site:

1. nptel.ac.in/courses/112106179;
2. www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;
3. www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/;
4. freevideolectures.com › Mechanical › IIT Madras
5. nptel.ac.in/courses/112107143/37;

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316482: Automotive Electrical & Electronics

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30
PR: 02 hrs/week	TW: 01	End-Sem: 70
		OR: 25

Prerequisites:-

1. Basic Electrical Engineering
2. Electronics and Electrical Engineering
3. Applied Thermodynamics

Course Objectives:-

1. Students should get familiar with the basics of Auto electrical circuits/harness & automotive batteries.
2. Students should gain brief understanding of automobile electrical systems (Charging, Starting & Ignition).
3. Acquire essentials of automotive sensors & Actuators along with Engine Management Systems.
4. To understand vehicle management systems.

Course Outcomes:-

1. Gain knowledge of automotive electrical systems.
2. Understand the electronic control of engine & chassis.
3. Able to diagnose & troubleshoot auto electrical & electronic systems.

Course Contents

Unit - I	Introduction to automotive electrical systems	6 hours

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.

Unit – II	Charging, Starting & Ignition System	6 hours

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, Spark Advance mechanisms, Ballast Resistance, Limitations of coil ignition, ,Electronic Ignition system, Spark plugs, types, construction & characteristics.

Unit -III	Automotive Accessories & Lighting Systems	6 hours

Vehicle lighting System: Head& Side lamps/Indicators, Fog lamps, Brake lights, High Intensity Discharge headlamps, LED lighting ,Advanced front lighting system (AFS), Headlamp leveling & Adjustments, Dash board Indicators: Fuel gauge, oil pressure gauge, Temperature gauges, Speedometer, Warning Lights, Electric horn, Horn relay, Wind shield wipers, Power window, Head-up display (HUD)

Unit -IV	Automotive Sensors & Actuators	6 hours

Working principle of sensors, Types of sensors, Airflow rate sensor, Position sensor, Throttle angle

sensor, Temperature sensor, MAP sensors, Knock/Detonation Sensor, Load cell, Lambda Sensor(Exhaust gas O_2 Sensor), yaw rate sensor, sensor feedback control, Electronic Control Unit (ECU), Principle of actuator, Types of actuators, engine control actuators, Solenoid actuators, motorized actuators (Stepper motors).

Unit -V	Engine Management System (EMS)	6 hours

Layout and working (open loop and closed loop control), SI Engine Management System: group and sequential injection techniques(TBI, PFI, MPFI),fuel system components, cold and warm start system, idle speed control, acceleration / deceleration and full load enrichmentand fuel cut-off.and spark timing control. Diesel Engine (CI) Management System: Fuel quantity (Spill control), Injection timing control, Idle speed control, CRDI, fuel control MAPs.

Unit -VI	Vehicle Management System	6 hours

ABS system with layout and working, Electronic control of suspension – Damping control, Driver state monitoring (DSM),Supplementary Restraint System of air bag system, seat belts, Adaptive Cruise control, Vehicle security systems alarms, vehicle tracking system, Collision avoidance, Radar warning system, Introduction to Global Positioning Systems, Lane Departure Warning System, Tire Pressure Monitoring System, Smart parking assist system (SPAS)

Term Work:

(Any two experiments from Sr. No 01 to 03, any five experiments from Sr. No 04 to 09, any one experiment from Sr. No 10 to 11)

1. Study & demonstration of automotive electrical and electronic systems with its detailed layout.
2. Demonstration of dash board panel instruments & controls.
3. Demonstration of headlight beam alignment.
4. Testing of automotive battery.
5. Demonstration and testing of alternators.
6. Demonstration and testing of starter motors.
7. Demonstration and testing of CDI/HT Coil and armature.
8. Testing of auto electrical components on multifunctional tester.
9. Testing & cleaning of spark plug.
10. Study of fault codes, scan tools & diagnosis process for fault finding in the ECU.
11. Visit to any authorized service station for On Board Diagnosis.

Books:

Text Book:

1. P. L. Kohli, “Automotive Electrical Equipments”, Tata McGraw Hill Pub. Co. Ltd.
2. Tom Denton, “Automobile Electrical & Electronic Systems”, 3rd Edition, Elsevier Butterworth-Heinemann

Reference Books:

1. William B. Ribbens, “Understanding Automotive Electronics”, 6th Edition, Newnes an imprint of Elsevier Science.
2. Allan W. M. Bonnick, “Automotive Computer Controlled Systems”, Butterworth-Heinemann.
3. V. A. W. Hilliers, “Fundamentals of Automotive Electronics”, Hatchin, London.
4. Tomwather J. R., Cland Hunter, “Automotive Computer & Control System”, Prentice Inc. NJ
5. Robert N. Brandy, “Automotive Computers& Digital Instrumentation”, Prentice Hall Eaglewood, Cliffs, NJ
6. Young, Griffithe, “Automobile Electrical & Electronic Equipments”, The English Language Book Co., London.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316483: Skill Development

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TW/PR: 01	TW: 25
PR: 02 hrs/week		PR: 25

Course Objectives:-

1. To develop the skill for required in shop floor working.
2. To have knowledge of the two wheeler service.
3. Use of theoretical knowledge in practice.

Proposed List of Experiments:(Any 3)

1. Two Wheeler service and maintenance (4 stroke single cylinder)
2. Assembly and Disassembly of Automotive Gear box(Synchromesh or Automatic)
3. Mini project on any Automotive system.(Group of 2 to 5 students)
4. 3D Modeling of any automotive sub assembly by actual measurements (using any modeling software).

Term-Work:-

1. Experiment contains:-
   - Service Procedure
   - Trouble shooting of Braking system, Powertrain, Steering and Suspension, and Electrical electronics systems.
2. Experimental procedure and trouble shooting of gearbox.
3. Any automotive sub system working model or Design and Development of any other system related to automobile engineering.(Ex. Power window, wiper system etc)
4. 3D Modeling of any automotive sub assembly by actual measurements(using any modeling software). Ex. Brake caliper assembly, steering system etc.

Practical Examination

Practical examination will be based on assembly and disassembly of any gearbox assembly. In addition to this some questions will be asked to the student based on Two wheeler servicing , maintenance and mini project. Questions will ask to student based on software use for modeling.

Note: Term work will carry 25 Marks and practical examination will carry 25 marks.

A. The assessment has to be carried out based on close monitoring of involvement and intellectual contribution of student.

B. The batch teacher should assess the concerned student

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical(2015 Course)
302047: Numerical Methods and Optimization*

Teaching Scheme:	Credits:	Examination Scheme:
TH: 04 hrs/week	TH: 04	In-Sem: 30
PR: 02 hrs/week	PR: 01	End-Sem: 70
		PR: 50

Course Objectives:-

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:-

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.

Course Contents

Unit - I	Roots of Equation and Error Approximations	8 hours

Roots of Equation: Bisection Method, Newton Raphson method and Successive approximation method.
Error Approximations: Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.

Unit - II	Simultaneous Equations	8 hours

Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tridiagonal Matrix, Jacob iteration method.

Unit-III	Optimization	8 hours

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

Unit-IV	Numerical Solutions of Differential Equations	10 hours

Ordinary Differential Equations [ODE]: Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using RungeKutta2nd order method.
Partial Differential Equations [PDE]: Finite Difference methods
Introduction to finite difference method, Simple Laplace method, PDEs- Parabolic explicit solution, Elliptic explicit solution.

Unit - V	Curve Fitting and Regression Analysis	8 hours

Curve Fitting: Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation.
Regression Analysis: Introduction to multi regression analysis, Lagrange's Interpolation, Newton's Forward interpolation, Inverse interpolation (Lagrange's method only).

Unit- VI	Numerical Integration	6 hours

Numerical Integration (1D only): Trapezoidal rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule, Gauss Quadrature 2 point and 3 point method.

Double Integration: Trapezoidal rule, Simpson's 1/3rd Rule.

Term Work:

1. Program on Roots of Equation (Validation by suitable solver, all three compulsory)
   a) Bisection Method,
   b) Newton Raphson method
   c) 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. Demonstration of optimization technique using suitable solver.
4. Program on ODE(Validation by suitable solver, all three compulsory)
   a) Euler Method,b) Runge-Kutta Methods- fourth order,
   b) Simultaneous equations.(Runge-Kutta 2nd order: *One step only*).Simple pendulum equation or Spring mass damper equation.
5. Program on PDE(Validation by suitable solver): Laplace equation
6. 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
7. Program on Interpolation(Validation by suitable solver, all three compulsory)
   a) Lagrange's Interpolation,
   b) Newton's Forward interpolation
8. Program on Numerical Integration(Validation by suitable solver, all four compulsory)
   a) Trapezoidal rule,
   b) Simpson's Rules (1/3rd, 3/8th) [In one program only],
   c) Gauss Quadrature Method- 2 point, 3 point. [In one program only],
   d) Double integration: Trapezoidal rule.

Note:

1. Solver is compulsory for all above programs and compared with actual solution.
2. Manual solution for each problem.
3. Algorithms and Flowcharts are compulsory for all programs.

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 (Laplace equation with solver)

c) Interpolation: Lagrange's interpolation, Newton's Forward interpolation (Any one)

Set B: (Weightage – 40 %)

a) Roots of Equations, b) Curve Fitting, c) Ordinary Differential Equations, d) Integration.

Books:

Text Book:

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. Dukkipati, Applied Numerical Methods using Matlab, New Age International Publishers

Reference Books:

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

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316484 : Design of Engine Components

Teaching Scheme:	Credits:	Examination Scheme:
TH: 04 hrs/week	TH: 04	In-Sem: 30
PR: 02 hrs/week	TW/OR: 01	End-Sem: 70
		TW: 25
		OR: 25

Prerequisites:-

1. IC Engine
2. Theory of machine
3. Heat transfer
4. Machine Design

Course Objectives:-

This course "Design of Engine components" is designed with the following objectives in mind:

1. Ability to gain the knowledge and understand the concept of design and steps involved in designing engine components.
2. Ability to select proper materials for different engine components depending on their physical and mechanical properties.

Course Outcomes:-

By the end of this course, students will be able to

1. Select appropriate engine type for specific application.
2. Estimation of loads and stresses induced in engine components.
3. Design engine component for single and multi cylinder engine.
4. Prepare a detailed engine drawing and assembly of engine.

Course Contents

Unit - I	**Design of Cylinder and Piston**	**8 hours**

Materials for Engine Components, Design of Cylinder liner, Cylinder head, Design of Piston On the Basis Strength and heat flow.

Unit - II	**Design of Connecting rod and Crankshaft**	**8 hours**

Design considerations and design of Connecting rod, Crankshaft.

Unit-III		**8 hours**

Design of valve gear train: Design of Valve, rocker arm, Push rod and cam shaft.
Engine system Design: Design of cooling system. Selection of lubricating oil and design of oil pump.

Unit-IV	**Design of Flywheel**	**8 hours**

Components of flywheel, stresses in flywheel, turning moment diagram and design of flywheel.

Unit - V	**Design of Bearing**	**8 hours**

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.
Rolling contact bearing: Static and dynamic load carrying capacities, equivalent bearing load, load life relationship, selection of bearing life, selection of rolling contact bearings.

Unit- VI		**6 hours**

Engine Functional Design: Selection of engine type on the basis of Stroke and Bore, Number of cylinders, Cylinder arrangement. Design considerations for combustion chamber.

Engine Testing Equipment: Mechanical fuel pump testing, Cylinder power balance, Exhaust gas CO and HC analyzer, Oscilloscope engine analyzers, and Distributor dwell-angle

Term Work:

1. Design of engine. Assembly and detailed drawing of engine on A1 size sheet and report.
2. 3D modeling of at least five major components of engine. (by using any modeling software.)

Books:

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.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316485: Automotive Transmission

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30
PR: 02 hrs/week	TW: 01	End-Sem: 70
		OR: 25

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.

Course Contents

Unit - I	**Vehicle Layouts**	**4 hours**

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.

Unit - II	**Clutches & Gear Box**	**10 hours**

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.

Unit-III	**Drive Lines**	**6 hours**

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.

Unit-IV	**Final Drive & Rear Axle**	**6 hours**

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.

Unit - V	**Fluid Flywheel, Torque convertor, Epicyclic Gear Boxes**	**8 hours**

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.(Numerical treatment on epicyclic gearbox)

Unit- VI	Automatic Transmission	6 hours

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.

Term Work:

Any 7 Experiments from Experiments No. 1 to 9.Experiment No. 12 is Compulsory.

1. To Study Different Vehicle Layouts.
2. Demonstration of Two Wheeler Clutch
3. Demonstration of Four Wheeler Clutch (Light / Heavy Duty Vehicle).
4. Demonstration of Constant Mesh Gearbox and Synchromesh Gearbox.
5. Demonstration of Drive Line (Universal Joint, Propeller Shaft, Slip Joint).
6. Demonstration of Final Drive & Differential.
7. To Study Different Types of Axles.
8. To Study Fluid Flywheel and Torque Converter.
9. To Study Continuous Variable Transmission (CVT).
10. Any One Visit from Below
    a) Visit to Vehicle Service Station to Study Power Transmission of Vehicle
    b) Visit to any Automotive Industry for Vehicle Transmission / Assembly Line

Books:

Text Book:

1. Kripal Singh, "Automobile Engineering-Vol. 1", 13th 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 W. Judge, "Modern Transmission", Chapman & Hall Std., 1989
2. Chek Chart, "Automatic Transmission", A Harper & Raw Publications
3. J. G.Giles, "Steering, Suspension & Tyres", – Lliffe Book Ltd., London
4. W. Steed, "Mechanics of Road Vehicles", Lliffe Book Ltd.
5. Heisler, "Vehicle and Engine Technology", Second Edition, SAE International Publication

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering(2015 Course)
316486: Automotive Aerodynamics and body Engineering

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30
Tut: 01 hrs/week	Tut: 01	End-Sem: 70
		OR: 25

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.

Course Contents

Unit - I	Fundamental of Vehicle Aerodynamics	6 hours

Scope of study, History of vehicle aerodynamics, Present and future trends, Flow phenomenon related to vehicle: external and internal flow, Development of drag & lift on Aerofoil, Aerodynamic drag and its types and various forces and moments, Resistance to vehicle motion, the passenger car as bluff body, Flow field around car, Analysis of drag: Possible approaches, Physical mechanisms, Local origins, Drag & Lift.

Unit - II	Vehicle Aerodynamics and Shape Optimization	6 hours

Drag fractions and their local origins: optimization of car bodies for low drag, Aerodynamics performance improvement using front and rear end modification, windshield and A-pillar, roof, spoilers, Wheel & wheel housings, attachments. Strategies for body shape development: Objectives, Detail Optimization, Shape optimization, Facelift, Adaptation of attachments, Forecasting and expert systems. Water and dirt accumulation on vehicle.

Unit-III	Wind Tunnels and Wind Noise	7 hours

Scope, Fundamentals of wind tunnel technique, Limitations of Simulation, Tests with reduced scale models, Existing Automobile Wind tunnels.
Introduction to CFD methodology – Application to vehicle aerodynamics.
Wind noise: Mechanism of generation and transmission, Design features.

Unit-IV	Car and Bus Body Details	8 hours

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.

Unit - V	Commercial Vehicle Body Details	5 hours

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.

Unit- VI	Body Loads & Ergonomics	6 hours

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, Use of energy absorbing system in automobiles, Impact protection from steering controls, Importance of Bumper in automobile.

Term Work:

Any six experiments from Sr.No 1-7 and Sr.No 8 and 9 are compulsory.

1. Demonstration of Car body construction with sketches.
2. To study the construction of typical truck body and draw sketches.
3. Demonstration of 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. Measurement of drag, lift force of a scaled model in wind tunnel.
6. To demonstrate constructional and operational features of mechanical and power window mechanism.
7. Study and analysis of flow conditions over the vehicle with the help of CFD software.
8. Prepare the layouts of intercity and luxury bus by using any drafting software as well as manually.
9. Visit to Automotive body building workshop.

Books:

Text Book:

1. J. Powloski, “Vehicle Body Engineering”, Business Books Ltd., London.
2. W.H. Hucho, "Automotive aerodynamics"

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, llefe 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.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302051: Manufacturing Process-II*

Teaching Scheme:	Credits:	Examination Scheme:
TH: 03 hrs/week	TH: 03	In-Sem: 30 End-Sem: 70

Course Objectives:-

1. To analyze and understand the metal cutting phenomena.
2. To select process parameter and tools for obtaining desired machining characteristic
3. To understand principles of manufacturing processes.

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 figure out application of modern machining.
4. Students should get the knowledge of Jigs and Fixtures for variety of operations.

Course Contents

Unit - I	Theory of Metal cutting	7 hours

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 machining.

Merchant's circle of forces (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. Introduction to tool dynamometers.

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 equation (Derivation along with numerical).

Unit - II	Machine tools and their application	7 hours

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

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 simple and compound Indexing).Machining time calculations

Broaching: Introduction to broaching, Broach tool geometry, Planner and Boring Machines: Introduction.

Unit-III	Finishing processes	7 hours

Grinding machines

Introduction: Types and Operations of grinding machines.

Grinding wheel – Shapes, Designation and selection, Mounting, Balancing and Dressing of grinding wheels, Machining time calculation for cylindrical and plunge grinding.

Super-finishing processes – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)

Unit-IV	Advanced Machining Processes	7 hours

Introduction, classification of advanced machining processes.

Principles, Working, Process Parameters, 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)

Introduction to micro machining.

Unit - V	CNC Technology	7 hours

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

CNC Programming: Word address format (WAF) –ISO Standards, G & M codes, Type of CNC Control systems, Manual part programming (plain milling and Turning), Subroutine, Canned cycles.

Unit- VI	Jigs and fixtures	7 hours

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, Introduction to Assembly and Inspection fixtures. Indexing fixtures.

Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures.

Books:

Text Book:

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. K Lal, Fundamentals of Design and Manufacturing, Alpha Science International Ltd(2005)
5. M.C Shaw, Metal Cutting Principles, Oxford university press
6. Yoram Koren , Numerical Control of Machine Tools Khanna Publication
7. P. K Mishra, Non- conventional machining, Narosa Publishing House
8. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi
9. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS
10. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill
11. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education, Third Edition.
12. Cyrll Donaldson, George H. LeCain and V. C. Goold, Tool design, Tata McGraw- Hill. Third Edition

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302052: Machine Shop II*

Teaching Scheme:	Credits:	Examination Scheme:
PR: 02 hrs/week	TW: 01	TW: 50

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. **Jobs (Both the following jobs should be completed individually)**

a. Any one marketable assembly consisting of at least three components with tolerance involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement.

b. Development and execution of one simple turning job on CNC (Trainer) machine.

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

a. Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)

b. Process planning sheets for job 1.a and 1.b.

c. Report based on industrial visit to manufacturing plant.

Note: - Practical are to be performed under the guidance of concerned faculty member.
Job drawing essentially consisting of Geometric Dimensioning and Tolerance

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302053: Seminar*

Teaching Scheme:	Credits:	Examination Scheme:
PR: 02 hrs/week	TW/OR: 01	TW: 25 OR: 25

Course Objectives:-

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Course Outcomes:-

With this seminar report and presentation, the student is expected to learn/achieve the following:

1. Establish motivation for any topic of interest and develop a thought process for technical presentation.
2. Organize a detailed literature survey and build a document with respect to technical publications.
3. Analysis and comprehension of proof-of-concept and related data.
4. Effective presentation and improve soft skills.
5. Make use of new and recent technology (e.g. Latex) for creating technical reports

Evaluation scheme

The evaluation of the seminar report is proposed with the following stages.

Stage-I:

In this stage the student is expected to deliver the following:

1. Topic selection
2. Literature review
3. State of the art related to the topic of interest

Stage-II:

1. Problem statement
2. Methodology
3. Scope and objectives

A review of the students progress should be made after In-Sem examination, within a week. During this review, the student is expected to complete Stage-1 and Stage-2.

Stage-III:

1. Quantification of results
2. Concluding remarks or summary

Stage-IV:

1. Final report
2. Final presentation/viva

The final presentation/viva will be assessed by a committee in-cluding an expert (preferably from industry with minimum 5 years experience) and an internal panel. The internal panel will consist

of the seminar guide and two subject experts, approved by the HOD and the principal of the institute. Examination schedule will be prepared at institute level (and not at University level), though it is under Oral head. The appointment of the internal panel and the external (industrial) expert will be taken care by the respective institute. The seminar presentation will be help after the term end and before university external vivas.

Contents of the Seminar report:

The contents of the seminar report as mentioned in section-3 are expected to include the following:

- Abstract/Summary
- Introduction: Scope and Methodology
- Literature review The review should be conducted from at least five
- research papers published during last five years.
- Case study
- References

Instructions for seminar report writing:

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

1. Prepare two spiral bound copies of your Seminar report.
2. Limit your seminar report to preferably 20 to 25 pages only.
3. Header For e.g. Title of the seminar.
4. The footer For e.g. page numbers
5. Institute Name, Mechanical /Automobile Engineering and centrally aligned.
6. The report shall be prepared using **Latex** preferably (default font througout) with double spacing throughout on A4 page.

Page	Left margin	Right margin	Top margin	Bottom margin
A-4 (8.5_11 inch)	1.5"	1"	1"	1"

7. Section titles should be bold typed in all capital letters and should be left aligned.
8. Sub-Section headings should be aligning at the left, bold and Title Case (the _rst letter of each word is to be capitalized).
9. Figure No. and Title at bottom with 10 pt; Legends below the title in 10 pt
10. Please use SI system of units only.
11. References should be either in order as they appear in the report or in alphabetical order by last name of first author.
12. Symbols and notations if any should be included in nomenclature section only

The report will be made in the following order:

1. Cover page and Front page as per specimen on separate sheet
2. Certificate from Institute as per specimen on separate sheet
3. Acknowledgement
4. List of Figures
5. List of Tables
6. Nomenclature
7. Contents
8. 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.

9. 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 rd ed., Oxford University Press, UK, 1996, pp. 110 112.

Papers from Journal or Transactions

1. Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 98.
2. 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

1. Colbourne, D. and Ritter, T. J., Quantitative assessment of ammable 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.

1. 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.

Web-links

www.(Site) [Give full length URL]

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302054: Audit Course I :- Fire & Safety

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TH: --	In-Sem: --
PR: --	TW: --	End-Sem: --
		PR: --

Description:

To generate, develop and sustain a voluntary movement on Fire & Safety Engineering at the National Level aimed at educating and influencing society to adopt appropriate policies, practices and procedures that prevent and mitigate human suffering and economic loss arising from all types of accidents.

Course Objectives:-

On completion of this Basic Fire Safety Course, participants will be able to:-

- Describe the chemistry of fire
- Identify fire hazards in the workplace
- Follow evacuation procedures
- Select and use appropriate firefighting equipment

Course Outcomes:-

Students will be able

1. To create and sustain a community of learning in which students acquire knowledge in fire, safety and hazard management and learn to apply it professionally with due consideration for ethical, human life & property safety issues.
2. To pursue research and development in fire safety engineering, hazard management and disseminate its findings.
3. To meet the challenges of today and tomorrow in the most effective, efficient and contemporary educational manner.
4. To help in building national capabilities in fire safety engineering, disaster management, hazard management, industrial safety education through practical training to ensure a fire safe nation.

Course Contents

I	**Fire & Safety Overview**	**--**
Fire & safety legislation, Safety Personnel Supplier for construction sites/commissioning of plants. Understanding the physics and chemistry of fire. Development and spread of fire. Action in the event of fire		
II	**Fire Fighting Techniques**	**--**
Means of raising alarm, means of summoning the fire brigade, action on hearing the fire alarm Evacuation procedures Practical demonstration in the use of foam and CO_2 fire extinguishers using our state of the art gas fired training system.		
III	**Fundamentals of Fire Engineering Science**	**--**
Fire Tech & Design, Fire Risk Assessment, Fire Control Technology, Fire Fighting Drills, Fire Tender with Crew on Hire. Fire & Safety Audit. Fire & Safety Consultancy Services.		
IV	**Industrial Aspects of Fire & Safety**	**--**
Industrial Training on Fire & Safety and Disaster Management. Repair of all kinds of Fire Equipment		

including Flooding System. Repair of Fire Tender including Pump and power take-off systems.

V	Maintenance of Fire Safety Equipments	--

AMC of Fire System. Refilling of Fire Extinguishers. Ultrasonic Thickness Test of Extinguishers, Vessels and Pipe lines. Hydro Testing of Fire Extinguishers, Vessels and Pipe Lines. Supply of Fire & Safety Equipment and Spares.

Case Study & Group Work:

- Identification of fire & safety technology
- To study the Fire Fighting Properties of Foam Concentrate
- Case Studies of Salvage operations in different types of occupancy
- Design and drawing of parts contained in the syllabus
- Compilation of Results & Presentation
- Case Study on the projects (products or processes) carried out by your institution or an organization in your vicinity, for safety.

Books:

Reference Books:

1. Accident Prevention manual for Industrial Operations, NSC, Chicago 1982.
2. The manual of fire ship – 6 – A by HMSO
3. Electricity Fire Risks – G.S. Hodges
4. Fire Pumps and Hydraulics: I.E. Ditts and T. M. Harris.
5. Fire Service Manual (Volume 2) Fire Service Operations – Petrochemical Incidents
6. The Principles and Practice of Fire Salvage Operation by Fire Salvage association.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302054: Technology Audit Course II :- Entrepreneurship Development

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TH: --	In-Sem: --
PR: --	TW: --	End-Sem: --
		PR: --

Description:

EDP is a program meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

This course will help in developing the awareness and interest in entrepreneurship and create employment for others. Students get familiar with the characteristics and motivation of successful entrepreneurs. Students learn how to identify and refine market opportunities, how to secure financing, how to develop and evaluate business plans and manage strategic partnerships. Students learn various concepts including the basics of management, leadership, motivation, decision-making, conflict management, human resource development, marketing and sustaining an organization. Students also get basic knowledge of accounting practices and finance. The core course in Entrepreneurship Development & Management equips students with skills and knowledge required to start and sustain their own business.

Course Objective:

- To impart basis managerial knowledge and understanding;
- Develop and strengthen entrepreneurial quality, i.e., motivation or need for achievement.
- To analyze environmental set up relating to small industry and promoting it.
- Collect and use the information to prepare project report for business venture.
- Understand the process and procedure involved in setting up small units.
- Develop awareness about enterprise management.

Course Outcome:
The students will be able to

- Appreciate the concept of Entrepreneurship
- Identify entrepreneurship opportunity.
- Develop winning business plans

Course Contents

Entrepreneurship

Definition; Growth of small scale industries in developing countries and their positions large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries Government policy for small scale industry; stages in starting a small scale industry, requirements to be an entrepreneur, SWOT Analysis.

Projects

Identification and Selection of projects; project report: contents and formulation, concept of project

evaluation, methods of project evaluation: internal rate of return method and net present value method.

Market Assessment and Product feasibility

Marketing -Concept and Importance Market Identification, Customer needs assessment, Market Survey Product feasibility analysis.

Business Finance & Accounts

Business Finance: Costing basics, Sources of Finance, Break Even Analysis,
Business Accounts: Preparation of balance sheets and assessment of economic viability, decision, making, expected costs, planning and production control, quality control, marketing, Book Keeping, Financial Statements, Financial Ratios and its importance, Concept of Audit.

Project Planning and control

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

Institutional Support and Policies

institutional support towards the development of entrepreneurship in India, technical consultancy organizations, E-Commerce: Concept and process, government policies for small scale enterprises.

Case Study & Group Work:

- Assess yourself-are you an entrepreneur?
- Prepare a Project Report for starting a small scale business.
- An Interview with an Entrepreneur.

Books:

References:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Khanka, S. S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
4. Badhai, B 'Entrepreneurship for Engineers', Dhanpat Rai & co. (p) Ltd.
5. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
6. Gupta and Srinivasan, 'Entrepreneurial Development', S. Chand & Sons, New Delhi.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302054: Audit Course III :- Intellectual Property Right

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TH: --	In-Sem: --
PR: --	TW: --	End-Sem: --
		PR: --

Course Objectives:-

Intellectual property refers to the rights which are attached to the creation of the mind and which take the form of a property. Though intangible in nature, intellectual property has become the driving force of many companies today. Fortune 500+ companies undoubtedly are the best examples of what a company can achieve through the proper understanding and management of IPR.

Thus the study of intellectual property rights is inevitable for managers, considering the fact that India is fast emerging as an economy with considerable investment in cutting-edge research and development. India is also emerging as an economy where foreign companies propose to invest considerably, both technically and financially, provided proper protection is guaranteed to their intangible assets which form the cornerstone of their business.

Course Contents

Introduction

- Concepts of IPR
- The history behind development of IPR
- Necessity of IPR and steps to create awareness of IPR

IP Management

- Concept of IP Management
- Intellectual Property and Marketing
- IP asset valuation

Patent Law

- Introduction to Patents
- Procedure for obtaining a Patent
- Licensing and Assignment of Patents
  - Software Licensing
  - General public Licensing
  - Compulsory Licensing
- Infringement of Patents
- Software patent US and Indian scenario

Copyrights

- Concept of Copyright Right
- Assignment of Copyrights
- Registration procedure of Copyrights
- Infringement (piracy) of Copyrights and Remedies
- Copyrights over software and hardware

Designs

- Concept of Industrial Designs
- Registration of Designs

- Piracy of registered designs and remedies

Trademark Law

- Concept of trademarks
- Importance of brands and the generation of "goodwill"
- Trademark registration procedure
- Infringement of trademarks and Remedies available
- Assignment and Licensing of Trademarks

Case Study & Group Work:

- Identify the projects (products or processes) carried out by your institution or an organization in your vicinity, which have been patented.
- A case study on significance of patents for a developing nation like India.
- Group discussion on creative / novel ideas and the feasibility of converting the idea into product or process.
- Discussion on Correlation between IPR and Entrepreneurship in the backdrop of Make in India Initiative.

Books:

Reference Books:

1. Ganguli Prabuddha, 'Intellectual Property Rights: Unleashing the knowledge economy', Tata McGraw Hill, New Delhi
2. Wadehra R. L., 'Law Relating to patents, trademarks, copyrights, designs and geographical indicators – 2nd', Universal Law Publishing.
3. Narayan P. S. 'Intellectual Property Law in India', Asia Law House Hyderabad.

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich (2015 Course)
302054: Audit Course IV - Lean Management

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TH: --	In-Sem: --
PR: --	TW: --	End-Sem: --

Course Objectives:-

- To learn Lean Thinking and its applications
- To get knowledge of Tools & Techniques used in Lean Management
- To understand Business Impact of Lean Management

Course Outcomes:-

- Will be able to do practice Lean Management at the workplace
- Will be able to contribute in Continuous Improvement program of the Organization

Course Contents

- Brief History of Lean Thinking
- Toyota Production System
- Five Steps to Lean
- Seven Types of MUDA – Waste in Manufacturing
- MURA – Unevenness / Fluctuation
- MURI – Overburden, Physical Strain
- Lean Tools & Techniques
- Value Stream Mapping
- Five 'S'
- Visual Management
- Plan-Do-Check-Act (PDCA)
- Kanban
- Lean Distribution
- Various Lean Management Systems
- Just In Time Production
- Total Quality Management (TQM)
- Total Productive Maintenance (TPM)
- Problem Solving Techniques
- A3 Reporting Technique

Books:

Reference Books:

1. Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Second Edition James P. Womack and Daniel T. Jones, Free Press, June 2003, ISBN: 0743249275
2. Learning to See: Value Stream Mapping to Create Value and Eliminate Muda Mike Rother and John Shook, Lean Enterprise Institute, June 2003, ISBN: 0966784308
3. Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Second Edition Pascal Dennis, Productivity Press Inc, September 2007, ISBN: 9781563273568
4. Gemba Kaizen: A Commonsense, Low-Cost Approach to Management Masaaki Imai, McGraw-Hill, March 1997, ISBN: 0070314462
5. World of Kaizen : By Shyam Talawadekar Paperback Publisher: Kaizen Publisher; 4 th edition (2016) ISBN-10: 819326780X ISBN-13: 978-8193267806

Savitribai Phule Pune University, Pune
Third Year of Automobile Engineering/Mechanical/Mechanical Sandwich
(2015 Course)
302054: Audit Course V:- Smart Manufacturing

Teaching Scheme:	Credits:	Examination Scheme:
TH: --	TH: --	In-Sem: --
PR: --	TW: --	End-Sem: --
		PR: --

Description:

Smart Manufacturing is an amalgamation of Information Technology, Cloud Computing & traditional Mechanical, Production Engineering towards achieving excellence in manufacturing. Maximum results with minimum resources being used. The course will introduce the concepts of Smart Manufacturing, how various technologies can be leveraged to achieve minimum breakdowns, First Time Right Production, 100% Delivery on Time with minimum turnaround time. Nine Pillars of Smart Manufacturing will be explained to the Students.

The course will make the students aware of developments in Technology those are going to alter the Traditional Manufacturing scenario. The following topics may be broadly covered in the classroom. The practical will be in the form of Group Discussion based on Case Study.

Course Objective:

- To know more about Smart Manufacturing & Industry 4.0
- To get knowledge of various converging Technologies
- To prepare ourselves for the ever changing Manufacturing Techniques

Course Outcome: The students will be

- comfortable with terminology and practices in Smart Manufacturing
- able to face the challenges in Industry & also contribute towards advancement.
- active part of Industry 4.0 (Fourth Industrial Revolution)

Course Contents:

- Introduction to Industry 4.0
- Historical Background
- Nine Pillars of Smart Manufacturing
- Big Data & analytics
- Autonomous Robots
- Simulation
- Universal System Integration
- IIOT – Industrial Internet of Things
- 3 D Printing – Additive Manufacturing
- Cloud Computing
- Augmented Reality
- Convergence of Nine Pillars
- Business Propositions delivered with Smart Manufacturing
- Adding Smartness to Manufacturing – Adoption & Scaling
- Economic Aspects
- Ecosystem Required for Smart Manufacturing
- Skill set Required for Smart Manufacturing
- Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing

Books:

Reference Books:

1. Smart Manufacturing by Shoukat Ali; Publisher: LAP LAMBERT Academic Publishing (10 August

2016)Language: EnglishISBN-10: 3659933554ISBN-13: 978-3659933554

2. Industry 4.0: The Industrial Internet of Things 2016by Alasdair Gilchrist (Author)
Publisher: Apress; 1st ed. edition (30 July 2016)
Language: English
ISBN-10: 1484220463
ISBN-13: 978-1484220467

3. Industry 4.0 Data Analytics31 July 2016 by Rajesh Agnihotri and Samuel New
Publisher: CreateSpace Independent Publishing Platform (31 July 2016)
Language: English
ISBN-10: 1534778284
ISBN-13: 978-1534778283

4. 3D Printing: The Next Industrial Revolution4 May 2013by Christopher Barnatt
Publisher: Createspace Independent Publishing Platform (4 May 2013)
Language: English
ISBN-10: 148418176X
ISBN-13: 978-1484181768

5. Augmented Reality: Principles and Practice by Dieter Schmalstieg and Tobias Hollerer
Publisher: Pearson Education; First edition (5 October 2016)
Language: English
ISBN-10: 9332578494
ISBN-13: 978-9332578494