# KUMARAGURUCOLLEGE OF TECHNOLOGY

**(An Autonomous Institution Affiliated to Anna University, Chennai)**

## COIMBATORE – 641049

**REGULATIONS 2014**

**CURRICULUM AND SYLLABUS**

## III- VIII Semesters

# B.E., AUTOMOBILE ENGINEERING

# Department of Automobile Engineering



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# Department of Automobile Engineering

## Vision

To be recognized as Learning and Research Department in Automobile Engineering in India that attracts outstanding researchers, leading industries, competent faculty and interested students

## Mission

- To prepare Automobile Engineering Students for a successful career in global Automotive industry through effective teaching, training and research.
- To mould Students of Automobile Engineering as value based engineers, creative researchers and innovative entrepreneurs.

## Programme Educational Objectives

1. Prepare Graduates to pursue successful career in automotive and allied industries as an Engineer

2. Prepare Graduates to pursue higher education, research and teaching profession in the related areas of automobile engineering.

3. Prepare Graduates to become entrepreneur in manufacturing, retailing and servicing sectors.

## Program Outcomes

1. Ability to apply mathematical concepts, scientific techniques and Engineering Knowledge.
2. Ability to identify, formulates, and analyse Automotive engineering problems.
3. Ability to design and develop solutions for practical problems of Automobile systems and processes.
4. Ability to investigate, interpret, analyze data and report results for complex problem.
5. Ability to use modern computing tools to design and develop Automotive components and systems.
6. Ability to apply skill and subject knowledge base to study and address the needs and impact on the society.
7. Ability to offer solutions with reference to the social, legal and environmental issues and to maintain sustainability.
8. Ability to understand ethical, social and professional responsibilities to practice in the right way.
9. Ability to contribute effectively as an individual and also as a team player.
10. Ability to communicate effectively using graphical techniques, reports and presentations with a broad range of information technology skills.
11. Ability to plan and execute projects with due considerations for quality, financial constraints and time schedules.
12. Ability to understand the need for lifelong learning to update on latest technologies through self learning.



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**Coimbatore – 641 049**
**CURRICULUM 2014**

## B.E.-Automobile Engineering

### SEMESTER III

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| U14MA*T*301 | Numerical Methods | 3 | 1 | 0 | 4 |
| U14AU*T*301 | Automotive Chassis | 3 | 0 | 0 | 3 |
| U14AU*T*302 | Thermodynamics and Thermal Engineering | 3 | 1 | 0 | 4 |
| U14AU*T*303 | Automotive Manufacturing Technology | 3 | 0 | 0 | 3 |
| U14AU*T*304 | Automotive Materials and Metallurgy | 3 | 0 | 0 | 3 |
| U14AU*T*305 | Strength of Materials | 3 | 1 | 0 | 4 |
| **Practical** | | | | | |
| U14AU*P*301 | Manufacturing Technology Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*302 | a) Strength of Materials Laboratory<br>b) Metallurgy Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*303 | Automotive Chassis and Engine Components Laboratory | 0 | 0 | 2 | 1 |
| U14GH*P*301 | Social Values | 1 | 0 | 1 | 1 |
| | | **Total Credits:25** | | | |

### SEMESTER IV

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| U14AU*T*401 | Fluid Mechanics and Machinery | 3 | 1 | 0 | 4 |
| U14AU*T*402 | Automotive Electrical and Electronics | 3 | 0 | 0 | 3 |
| U14AU*T*403 | Automotive Engines | 3 | 0 | 0 | 3 |
| U14AU*T*404 | Mechanics of Machines | 3 | 1 | 0 | 4 |
| U14AU*T*405 | Modeling and Simulation of Automotive Systems | 3 | 1 | 0 | 4 |
| U14GS*T*001 | Environmental Science and Engineering | 3 | 0 | 0 | 3 |
| **Practical** | | | | | |
| U14AU*P*401 | Automotive Components Modeling Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*402 | a) Thermal Engineering Laboratory<br>b) Fluid Mechanics & Machinery Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*403 | Automotive Electrical & Electronics Laboratory | 0 | 0 | 2 | 1 |
| U14GH*P*401 | National & Global Values | 1 | 0 | 1 | 1 |
| | | **Total Credits:25** | | | |

### SEMESTER V



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| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| U14AU*T*501 | Automotive Finite Element Analysis | 3 | 1 | 0 | 4 |
| U14AU*T*502 | Measurements & Metrology | 3 | 0 | 0 | 3 |
| U14AU*T*503 | Automotive Engine Systems | 3 | 0 | 0 | 3 |
| U14AU*T*504 | Machine Components Design | 3 | 1 | 0 | 4 |
| U14AU*T*505 | Automotive Sensors and Embedded Systems | 3 | 1 | 0 | 4 |
| U14AU*T*506 | Fuels and Lubricants | 3 | 0 | 0 | 3 |
| **Practical** | | | | | |
| U14AU*P*501 | Finite Element Analysis Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*502 | Fuels, Lubricants and Engine Performance & Testing Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*503 | Mini Project 1 | 0 | 0 | 2 | 1 |
| U14EN*P*501 | Communication Skills Laboratory | 0 | 0 | 3 | 1 |
| | | **Total Credits:25** | | | |

**SEMESTER VI**

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| U14AU*T*601 | Chassis Design | 3 | 1 | 0 | 4 |
| U14AU*T*602 | Engine Design | 3 | 1 | 0 | 4 |
| U14AU*T*603 | Automotive Transmission | 3 | 0 | 0 | 3 |
| U14AU*T*604 | Automotive Pollution and Control | 3 | 0 | 0 | 3 |
| U14AU*T*605 | Automotive Systems | 3 | 0 | 0 | 3 |
| E1 | Elective 1 | 3 | 0 | 0 | 3 |
| **Practical** | | | | | |
| U14AU*P*601 | Chassis and Engine Design Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*602 | Automotive Systems Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*603 | Mini Project 2 | 0 | 0 | 4 | 2 |
| U14AU*P*604 | Technical Seminar 1 | 0 | 0 | 2 | 1 |
| | | **Total Credits:25** | | | |



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## SEMESTER VII

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| U14AU*T*701 | Vehicle Dynamics | 3 | 1 | 0 | 4 |
| U14AU*T*702 | Vehicle Body Engineering | 3 | 0 | 0 | 3 |
| U14AU*T*703 | Special Purpose Vehicles | 3 | 0 | 0 | 3 |
| U14GS*T*007 | Professional Ethics | 3 | 0 | 0 | 3 |
| E2 | Elective 2 | 3 | 0 | 0 | 3 |
| E3 | Elective 3 | 3 | 0 | 0 | 3 |
| **Practical** | | | | | |
| U14AU*P*701 | Vehicle Dynamics Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*702 | Vehicle Maintenance and Testing Laboratory | 0 | 0 | 2 | 1 |
| U14AU*P*703 | Project Phase I | 0 | 0 | 4 | 2 |
| U14AU*P*704 | Technical Seminar 2 | 0 | 0 | 2 | 1 |
| | | **Total Credits:24** | | | |

## SEMESTER VIII

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Theory** | | | | | |
| E 4 | Elective 4 | 3 | 0 | 0 | 3 |
| E 5 | Elective 5 | 3 | 0 | 0 | 3 |
| E 6 | Elective 6 | 3 | 0 | 0 | 3 |
| **Practical** | | | | | |
| U14AU*P*801 | Project Phase II | 0 | 0 | 18 | 6 |
| | | **Total Credits:15** | | | |

## Electives

| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Automotive Design & Thermal** | | | | | |
| U14AU*T*E01 | Automotive Aerodynamics | 3 | 0 | 0 | 3 |
| U14AU*T*E02 | Computational Fluid Dynamics | 3 | 0 | 0 | 3 |
| U14AU*T*E03 | Vehicle Concept Design and Styling | 3 | 0 | 0 | 3 |
| U14AU*T*E04 | Design for Manufacture and Assembly | 3 | 0 | 0 | 3 |
| U14AU*T*E05 | Computer Simulation of IC Engine Processes | 3 | 0 | 0 | 3 |
| U14AU*T*E06 | Noise, Vibration and Harshness | 3 | 0 | 0 | 3 |
| U14AU*T*E07 | Automotive HVAC | 3 | 0 | 0 | 3 |
| U14AU*T*E08 | Combustion Engineering | 3 | 0 | 0 | 3 |
| U14AU*T*E09 | Alternate Fuels | 3 | 0 | 0 | 3 |



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| Code No. | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| **Automotive Technology & Manufacturing** | | | | | |
| U14AU*T*E10 | Hydraulic and Pneumatic Systems | 3 | 0 | 0 | 3 |
| U14AU*T*E11 | Robotics | 3 | 0 | 0 | 3 |
| U14AU*T*E12 | Vehicle Troubleshooting and Maintenance | 3 | 0 | 0 | 3 |
| U14AU*T*E13 | Composite Materials and Structures | 3 | 0 | 0 | 3 |
| U14AU*T*E14 | Automotive Components Manufacturing | 3 | 0 | 0 | 3 |
| U14AU*T*E15 | Tyre Technology | 3 | 0 | 0 | 3 |
| U14AU*T*E16 | Unconventional Machining Processes | 3 | 0 | 0 | 3 |
| U14AU*T*E17 | Rapid Prototyping Tooling and Manufacturing | 3 | 0 | 0 | 3 |
| U14AU*T*E18 | Design of Jigs, Fixtures and Press tools | 3 | 0 | 0 | 3 |
| **Automotive Electronics & Systems** | | | | | |
| U14AU*T*E19 | Embedded Communication System Protocols | 3 | 0 | 0 | 3 |
| U14AU*T*E20 | Virtual Instrumentation | 3 | 0 | 0 | 3 |
| U14AU*T*E21 | Fuel Cell Technology | 3 | 0 | 0 | 3 |
| U14AU*T*E22 | Automotive Safety | 3 | 0 | 0 | 3 |
| U14AU*T*E23 | Electric and Hybrid Vehicles | 3 | 0 | 0 | 3 |
| U14AU*T*E24 | Vehicle Testing and Validation | 3 | 0 | 0 | 3 |
| U14AU*T*E25 | Modern Automobile Accessories | 3 | 0 | 0 | 3 |
| **General & Management** | | | | | |
| U14AU*T*E26 | Entrepreneurship Development | 3 | 0 | 0 | 3 |
| U14AU*T*E27 | Project Management | 3 | 0 | 0 | 3 |
| U14AU*T*E28 | Quality Control and Reliability | 3 | 0 | 0 | 3 |
| U14AU*T*E29 | Energy Studies | 3 | 0 | 0 | 3 |
| U14AU*T*E30 | Vehicle Dealership Management | 3 | 0 | 0 | 3 |
| U14AU*T*E31 | Vehicle Transport Management | 3 | 0 | 0 | 3 |
| U14AU*T*E32 | Microprocessor Based System Design | 3 | 0 | 0 | 3 |
| U14AU*T*E33 | Technical Textiles for Automobiles | 3 | 0 | 0 | 3 |
| U14GS*T*002 | Total Quality Management | 3 | 0 | 0 | 3 |
| U14GS*T*003 | Principles of Management | 3 | 0 | 0 | 3 |
| U14GS*T*004 | Operations Research | 3 | 0 | 0 | 3 |
| U14GS*T*005 | Engineering Economics and Financial Management | 3 | 0 | 0 | 3 |
| U14GS*T*006 | Product Design and Development | 3 | 0 | 0 | 3 |
| U14GS*T*008 | Foundation Skills in Integrated Product Development | 3 | 0 | 0 | 3 |



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## ONE CREDIT COURSES

| Course Code | Course Title |
|---|---|
| U14AU*I*N01 | Overview of Motorsports Engineering |
| U14AU*I*N02 | Automotive Styling |
| U14AU*I*N03 | Electronic Engine Management Systems |
| U14AU*I*N04 | Vehicle Service Management |
| U14AU*I*N05 | Vehicle Maintenance |

## SUMMARY OF CREDITS FOR 2014 REGULATION

| S.No | Courses | Semesters | | | | | | | | Total credits in % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total Credits |
| 1 | Humanities and Social Sciences (HSS), including Management | 4 | 4 | 1 | 4 | 1 | 0 | 3 | 0 | **17** | **9.09** |
| 2 | Basic Sciences(BS,) including Mathematics, Physics, Chemistry, Biology | 12 | 11 | 4 | 0 | 0 | 0 | 0 | 0 | **27** | **14.44** |
| 3 | Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical /Electronics /Mechanical / Computer Engineering, Instrumentation | 4 | 9 | 10 | 9 | 8 | 0 | 0 | 0 | **40** | **21.39** |
| 4 | Professional Subjects-Core (PSC), relevant to the chosen specialization/branch | 4 | 0 | 10 | 12 | 15 | 19 | 12 | 0 | **72** | **38.50** |
| 5 | Professional Subjects Electives (PSE) & Open Subjects Electives (OSE) | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 9 | **18** | **9.63** |
| 6 | Project Work, Seminar and/or Internship in Industry or elsewhere | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 6 | **13** | **6.95** |
| **Total Credits** | | **24** | **24** | **25** | **25** | **25** | **25** | **24** | **15** | **187** | **100** |



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# SEMESTER III



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**U14MA*T* 301 NUMERICAL METHODS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

**After successful completion of this course, the students should be able to:**

**CO1:** Solve a set of algebraic equations representing steady state models formed in engineering problems[K3]

**CO2:** Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables[K3]

**CO3:** Find the trend information from discrete data set through numerical differentiation and summary information through numerical integration[K4]

**CO4:** Predict the system dynamic behavior through solution of ODEs modeling the system[K5]

**CO5:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.[K3]

**CO6:** Have the necessary proficiency of using MATLAB for obtaining the above solutions.[K2]

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | S | S | | | | | | | | |
| CO2 | S | S | | S | S | | | | | | | |
| CO3 | M | S | S | | M | | | | | | | |
| CO4 | S | M | S | | | | | | | | | |
| CO5 | M | S | S | | S | | | | | | | |
| CO6 | S | | | | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment | |
| 3. Seminar | |

## INTRODUCTION

**3 Hours**

Simple mathematical modeling and engineering problem solving – Algorithm Design – Flow charting and pseudocode – Accuracy and precision – round off errors



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**NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS** **7 +3 Hours**

Solution of nonlinear equations – False position method – Fixed point iteration – Newton Raphson method for a single equation and a set of non- linear equations Solution of linear system of equations by Gaussian elimination, Gauss Jordan method - Gauss Seidel method.

**CURVE FITTING AND INTERPOLATION** **7 +3 Hours**

Curve fitting – Method of least squares – Newton's forward and backward difference formulas – Divided differences – Newton's divided difference formula – Lagrange's interpolation – Inverse interpolation.

**NUMERICAL DIFFERENTIATION AND INTEGRATION** **7+3 Hours**

Numerical differentiation by using Newton's forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Numerical double integration.

**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** **10+3 Hours**

Initial value problems – Single step methods: Taylor's series method – Truncation error – Euler and Improved Euler methods – Fourth order Runge – Kutta method – Multistep methods: Milne's predictor – corrector method.

**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATION(PDEs)** **11+3 Hours**

PDEs and Engineering Practice – Laplace Equation derivation for steady heat conduction – Numerical solution of the above problem by finite difference schemes – Parabolic Equations from Fourier`s Law of Transient Heat Conduction and their solution through implicit schemes – Method of Lines – Wave propagation through hyperbolic equations and solution by explicit method.
Use of MATLAB Programs to workout solutions for all the problems of interest in the above topics

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Steven C.Chapra and Raymond P. Canale, " Numerical Methods for Engineers with Programming and Software Applications", SixthEdition, WCB/McGraw-Hill, 1998.
2. John H. Mathews and Kurtis D. Fink, "Numerical Methods using Matlab", Fourth Edition, Prentice Hall of India, 2004.
3. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.


**Other references:**


1. Sastry S.S, "Introductory Methods of Numerical Analysis", Third Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2003.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods",S.Chand Co. Ltd., New Delhi, 2007.




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**U14AU*T*301** **AUTOMOTIVE CHASSIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## Course Outcomes

After successful completion of this course, the students should be able to:

**CO1:** Understand the construction details of various types of automotive chassis and basic functions of subsystems in the chassis.

**CO2:** Distinguish various types of suspension system, brake system, steering system and wheels & tyres in the vehicles.

**CO3:** Apply the knowledge for selection of suitable subsystems for a vehicle.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | W | W | | | W | | | | | | M |
| CO2 | W | W | W | | | W | | | | | | M |
| CO3 | M | M | M | | | W | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End-semester Examinations | |

## INTRODUCTION **9 Hours**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Ackerman's and Daut's Steering Mechanisms, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

## DRIVE LINE **9 Hours**

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Multi–axle vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks.



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## AXLES 9 Hours

Construction of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

## SUSPENSION SYSTEM 9 Hours

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Boggy suspension system, Independent Suspension System, Shock Absorbers, Types and Constructional details.

## BRAKING SYSTEM 9 Hours

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Loading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Anti–Lock Braking System, Constructional Details.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Kripal Singh, "Automobile Engineering" ,Standard Publishers,2011
2. R.K. Rajput, "A Text–Book of Automobile Engineering", Laxmi Publications Pvt.Ltd,2007.
3. N.K. Giri, "Automotive Mechanics" Khanna Publishers, New Delhi, 2005.


**Other references:**


1. Heldt P.M., "Automotive Chassis" Chilton Co., New York,1990.
2. Newton Steeds and Garret, "Motor Vehicles" 13th Edition, Butterworth, London, 2005.
3. Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005.




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**U14AU*T*302** **THERMODYNAMICS AND THERMAL ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the basics and laws of thermodynamics with respect to heat engines and thermal equipment.

**CO2:** Apply the knowledge of working fluids in various thermodynamic equipment.

**CO3:** Understand the modes of heat transfer with respect to various heat exchangers.

**Pre-requisite:**

1. Engineering Physics

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | M | | | M | | | | | | M |
| CO2 | S | M | M | | | M | | | | | | M |
| CO3 | S | M | M | | | M | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar/Quiz | 2. GATE Score |
| 3. Semester Exam | |

## BASIC THERMODYNAMICS **10+3 Hours**

Systems, Zeroth low, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement – Clausius statement – Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

## AIR STANDARD CYCLES AND COMPRESSORS **9+3 Hours**

Otto, Diesel and Dual combustion. Air standard efficiency. Mean effective pressure, Reciprocating compressors. Intercooling – Minimum work requirement

## STEAM AND JET PROPULSION **8+3 Hours**

Properties of steam — Simple Rankine cycle- Brayton cycles –Simple jet propulsion system

## REFRIGERATION AND AIR-CONDITIONING **9+3 Hours**



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Principles of Psychrometry and refrigeration – Vapour compression – Vapour absorption types – Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning, introduction to HVAC and its applications in automotive.

**HEAT TRANSFER** **9+3 Hours**

Modes of Heat Transfer – Conduction, Convection and Radiation. Basics of Conduction in parallel, radial and composite wall – Basics of Convective heat transfer – Fundamentals of Radiative heat transfer. Introduction to Heat Exchanger.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005.
3. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006


**Other references:**


1. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
3. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.




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**U14AU*T*303** **AUTOMOTIVE MANUFACTURING TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Casting, Welding & Machining processes used for automotive components manufacturing

**CO2:** Understand the basic methods of Forming

**CO3:** Apply the knowledge for selecting suitable manufacturing process for various automotive components manufacturing.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | | S | | M | | | | | | | |
| CO2 | W | | S | | M | | | | | | | |
| CO3 | S | | S | | M | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## CASTING **10 Hours**

Casting types, procedure to make sand mould, types of core making, moulding tolls, machine moulding, special moulding processes – $CO_2$ moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects, Application of Castings in Automobile.

## FORMING PROCESSES AND POWDER METALLURGY **10 Hours**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Forming and Shaping of Plastics –Moulding Types, Thermoforming, Press forming Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy. Application of Forming, Hydro forming, Powder Metallurgy in Automobile.



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**WELDING** **8 Hours**

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing. Application of Welding in Automobile.

**MACHINING** **12 Hours**

Introduction to the Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan, Turret lathe CNC machines & Operations.

Principles and applications of the Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining. Application of Machining in Automobile

**ASSEMBLY** **3 Hours**

Assembly methods, straight assembly, group assembly, line balancing.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.
3. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", 4/e, Pearson Education, Inc. 2007.
4. R.K.Jain and S.C. Gupta, "Production Technology", Khanna Publishers. 16th Edition, 2001.


**Other references:**


1. "H.M.T. Production Technology – Handbook", Tata McGraw-Hill, 2000.
2. Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
3. M. Adithan and A.B. Gupta, "Manufacturing Technology", New Age, 2006




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**U14AU*T*304**

# AUTOMOTIVE MATERIALS AND METALLURGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the importance of engineering materials and their structures and Phase diagrams.
**CO2:** Understand the various heat treatments process
**CO3:** Understand the Testing of materials and its properties.
**CO4:** Understand about the Fe & Non-Fe alloys, Non-Metallic materials and Modern Materials
**CO5:** Select the materials for particular engineering application

**Pre-requisite:**

1. Engineering Physics, Material Science and Engineering Chemistry

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | M | | | W | | | | | | M |
| CO2 | M | | M | | | M | | | | | | M |
| CO3 | M | | M | | | W | | | | | | M |
| CO4 | M | | M | | | M | | | | | | M |
| CO5 | S | | M | | | M | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS **8 Hours**

Overview of crystal structures and defects, Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphism, eutectic, peritectic, eutectoid and peritectroid reactions, Iron – Iron carbide equilibrium diagram.

## HEAT TREATMENT **8 Hours**

Definition – Annealing, types – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, types.



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## MECHANICAL PROPERTIES AND TESTING **6 Hours**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.

## FERROUS AND NON-FERROUS ALLOYS **8 Hours**

Composition, structure and properties of carbon steels - low alloy steels, stainless steels, tool steels, Cast irons - grey iron, ductile iron, white iron and malleable iron, Non-ferrous alloys - copper and copper alloys, aluminium and aluminium alloys, magnesium and magnesium alloys, nickel and nickel alloys and titanium and titanium alloys.

## NON-METALLIC MATERIALS **8 Hours**

Polymeric materials - Formation of polymer structure - Properties and applications of engineering polymers - Advanced structure ceramics, WC, TiC, $Al_2O_3$, SiC, $Si_2N_4$, CBN and Diamond - Properties, processing and applications. Composite materials: Types, production techniques, structure, properties and applications.

## MODERN MATERILAS **4 Hours**

Micro alloyed steels, High Strength Low alloy (HSLA) steel -Transformation induced plasticity (TRIP) steel, Maraging steel, Smart materials, Shape memory alloys Metallic glasses - Quasi crystals and nano crystalline materials.

## APPLICATION OF MATERIALS **3 Hours**

Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel , clutch plate, axle, bearings, chassis, spring, body panel, radiator, brake lining etc. Automotive technical textiles.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. William D Callsber “Material Science and Engineering”, John Wiley and Sons 1997.


**Other references:**


1. Raghavan.V.Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 1999
2. Sydney H.Avner “Introduction to Physical Metallurgy” McGraw-Hill Book Company, 1994.




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## U14AU*T*305 STRENGTH OF MATERIALS

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concepts of stress and strain

**CO2:** Analyze the beams of different cross sections for shear force, bending moment, slope and deflection

**CO3:** Understand the concepts necessary to design the structural elements and pressure vessels

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | M | M | | | | | W | W | W | |
| CO2 | S | S | M | M | | | | | W | M | S | |
| CO3 | S | M | M | M | | | | | W | M | W | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Internal Test | 2. GATE Score |
| 3. End Semester Examinations | |

**10+3 Hours**

### CONCEPT OF STRESSES AND STRAINS

Concept of stress and strain, Hooke's law – Tension, Compression, and Shear, stress-strain diagram – Poisson's ratio, elastic constants and their relationship – Deformation of simple and compound bars. Thermal stresses – simple and Composite bars. Principal plane, principal stress, maximum shearing stress – Uniaxial, biaxial state of stress – Mohr's circle for plane stresses.

### ANALYSIS OF BEAMS **9 +3 Hours**

Types of beams and loads – shear force and bending moment diagrams for cantilevers, simply supported and over hanging beams. Theory of pure bending- Bending stresses in simple and composite beams. Shear stress distribution in beams of different sections.

### DEFLECTION OF BEAMS **9 +3 Hours**

Slope and deflection of cantilever, simply supported beam by double integration method – Macaulay's method – Moment area method – Castigliano's theorem.



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## TORSION OF SHAFTS **8+3 Hours**

Theory of pure torsion, torsion of circular shafts and composite shafts.

## COLUMNS AND CYLINDERS **9+3 Hours**

Columns and struts: Member subjected to combined bending and axial loads, Euler's theory, Crippling load, Rankine's theory.

Cylinders And Shells: Thin cylinder, thin spherical shells under internal pressure – Thick cylinders – Lame's equation – Shrink fit and compound cylinders.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Bansal R.K, "A Text Book of Strength of Materials", Lakshmi Publications Pvt. Limited, New Delhi, 2010.
2. Prabhu T.J, "Mechanics of solids", Private Publication, 2002.
3. Rajput R.K, "Strength of materials", Fourth Edition, S. Chand Limited, 2007.
4. Ferdinand P.Beer, and Rusell Johnston E, "Mechanics of Materials", SI Metric Edition, McGraw Hill, 2011.
5. William A. Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, McGraw Hill International Edition, 3rd Edition, 2007.


**Other references:**


1. Srinath L. S, "Advanced Mechanics of Solids", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
2. Egor P. Popov., "Engineering Mechanics Of Solids", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
3. James M. Gere, "Mechanics of Materials" Eighth Edition, Brooks/Cole, USA, 2013.
4. Shigley J. E, Applied Mechanics of Materials, International Student Edition, McGraw Hill Koyakusha Limited, 2000.




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**U14AU*P*301**

# MANUFACTURING TECHNOLOGY LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Use of appropriate method, Tools and machine tools for performing Lathe operations
**CO2:** Use of appropriate method, Tools and machine tools for performing drilling operations
**CO3:** Use of appropriate method, Tools and machine tools for performing grinding operations
**CO4:** Use of appropriate method, Tools and machine tools for manufacturing gears

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | S | | | S | W | | | M | M | | |
| CO2 | | S | | | S | W | | | M | M | | |
| CO3 | | S | | | S | W | | | M | M | | |
| CO4 | | S | | | S | W | | | M | M | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

## LIST OF EXPERIMENTS

1. LATHE
   1.1. Facing, plain turning and step turning
   1.2. Taper turning using compound rest.
   1.3. Taper turning using taper turning attachment
   1.4. Single start V thread, cutting and knurling
2. SHAPER AND SLOTTER
   2.1. Machining a V- block (in a Shaper)
   2.2. Machining internal key-way (in a Slotter)
3. DRILLING
   3.1. Drilling 4 or 6 holes at a given pitch circle on a plate
   3.2. Drilling, reaming and tapping
4. MILLING
   4.1. Plain Milling Exercise
   4.2. Gear Milling Exercise
5. GRINDING
   5.1. Cylindrical Grinding Exercise

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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| L | T | P | C |
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| 0 | 0 | 2 | 1 |

# U14AU*P*302 A)STRENGTH OF MATERIALS LABORATORY
# B) METALLURGY LABORATORY

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Required knowledge in the area of testing of materials and components of structural elements experimentally.

**CO2:** Understand the procedures for evaluating the mechanical behaviour of materials

**CO3:** Understand the experimental procedures in carrying out heat treatment operations

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | M | W | W | | | | S | | S | |
| CO2 | | | | S | M | | | | M | | M | |
| CO3 | | | | S | M | | | | M | | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

**a) STRENGTH OF MATERIALS LABORATORY**

1. Tension & Shear Test on Mild Steel Rod
2. a) Torsion Test on Mild Steel Rod
   b) Compression Test on Concrete Cube.
3. Hardness Test- Brinell, Vickers and Rockwell Hardness tests
4. Impact Test- Izod, Charpy Impact Tests
5. Test on Helical Springs- Compression and Tension Springs
6. Defection Test on Beams



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**b) METALLURGY LABORATORY**

1. Specimen preparation for metallographic examination
2. Study of metallurgical microscope, different types and their operations
3. Micro-structural study of Grey C.I, S.G Iron, Malleable C.I in unetched & Etched condition
4. Micro-structural study of Low, Medium, High Carbon steels
5. Micro-structural study of Quenched, Tempered, Case hardened steel
6. Micro-structural study of Al, Cu Alloys.

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*303** **AUTOMOTIVE CHASSIS AND ENGINE COMPONENTS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Dismantle and Assemble the automobile chassis and Engine components
**CO2:** Identify & differentiate components of SI & CI engines
**CO3:** Understand working of braking, steering, clutch, transmission, Suspension systems.
**CO4:** Differentiate various subsystems of two, three & Four wheeler vehicles

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | M | M | W | | | | | M | M | | |
| CO2 | | M | M | W | | | | | M | M | | |
| CO3 | | M | M | W | | | | | M | M | | |
| CO4 | | M | M | W | | | | | M | M | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

**AUTOMOTIVE CHASSIS LABORATORY**

1. Study and measurement of the Light duty vehicle chassis frame
2. Performance test on suspension test Rig
3. Performance test on chain test Rig

**Study, dismantling and assembling of**

4. Front Axle and Rear Axle
5. Differential
6. Steering systems along with any two types of steering gear box
7. Braking systems –compressed air power brakes, drum and disc brakes

**Study, Dismantling and Assembling of**

8. Clutch assembly of different types



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**ENGINE COMPONENTS LABORATORY**

1. Dismantling of 4 cylinder petrol engine.
2. Assembling of 4 cylinder petrol engine.
3. Dismantling of 4 cylinder diesel engine.
4. Assembling of 4 cylinder diesel engine.
5. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
6. Study of engine lubrication system components

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14GH*P*301** **SOCIAL VALUES**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 1 | 1 |

**(Common to all branches of Engineering and Technology)**

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Adopt and practice social values as his regular duties.
**CO2:** Take over the social responsibilities.
**CO3:** Give solutions and to manage the challenging social issues.
**CO4:** Voluntarily participate and organize social welfare programmes.
**CO5** Explore his ideology of techno social issues and provide the best solution.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | | W | W | | M | | S |
| CO2 | | | | | | | | S | | M | | |
| CO3 | | | | | | | W | M | | | W | |
| CO4 | | | | | | | | W | S | M | | W |
| CO5 | | | | | | | M | W | | | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment method | 1. Attitude |
| 2. End Semester Examination | 2. Behavior |

## ORGIN OF SOCIETY **5 Hours**

Evolution of universe: Creation theory,Big bang theory, Evolution theory, Permanence theory – Mithya, Maya – Evolution of living being – Evolution of Man – Formation of society and social values.

**Practical:** Group Discussion on Evolution of Man and formation of society, Panel discussion on Social values - Pancha Bhoodha Navagraha Meditation.

## SELF AND SOCIETY **2 Hours**

Duty to self, family, society and world –Realization of Duties and Responsibilitiesof individuals in the society (Five fold cultures) – impact of social media on present day youth and correction measures.

**Practical:** Case study – interaction with different professionals.



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**3 Hours**

## EDUCATION& SOCIETY

Education: Ancient and Modern Models.
**Practical:** Making Short film on impact of education in social transformation.

## DISPARITY AMONG HUMAN BEINGS **3 Hours**

Wealth's for humans, Factors leading to disparity in human beings and Remedies.
**Practical:**Debate on disparity and social values.

## CONTRIBUTION OF SELF TO SOCIAL WELFARE **4 Hours**

Participation in Social welfare – Related programmes– Recognized association – Activities for social awareness – Programme by Government and NGOs – Benefits of social service – Balancing the family and social life.
**Practical:** In campus, off campus projects.

## GENERAL PRACTICAL **16 Hours**

Ashtanga Yoga: Pathanjali maharishi & Yoga – Involvement – Rules of Asanas –Suryanamaskara (12 Steps)- Meditation.

**Standing** : Pada Hastasana, Ardha Cakrasana, Trikonasana, Virukchsana (Eka Padaasana)

**Sitting** : Padmasana, Vakrasana, Ustrasana, Paschimatanasana.

**Prone** : Uthanapathasana, Sarvangasana, Halasana, Cakrasana,

**Supine** : Salabhasana, Bhujangasana, Dhanurasana, Navukasana.

**Theory :16 Hr** **Tutorial: 14 Hr** **Total Hours: 30**

**References:**


1. Steven , Weinberg, "**The First Three Minutes"** : A Modern View of the Origin of the Universe (English), Perseus books group,1977
2. Vethathiri's Maharishi's, ***"Vethathirian Principles of Life"*** The World Community Service Centre, Vethathiri Publications, 2003.
3. Vethathiri's Maharishi's, ***"Karma Yoga: The Holistic Unity"*** The World Community Service Centre, Vethathiri Publications, 1994.
4. Vethathiri's Maharishi's, ***"Prosperity of India"*** The World Community Service Centre, Vethathiri Publications, 1983.


**Other references:**


1. Swami Vivekananda, "***The Cultural Heritage of India"*** 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
2. Vivekananda Kendra Prakashan Trust, **"YOGA"**, Vivekanandha Kendra Prakashan Trust,Chennai, 1977.




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# SEMESTER IV



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**U14AU*T*401**

# FLUID MECHANICS AND MACHINERY

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the properties of the fluid.
**CO2:** Understand and solve the fluid flow problems.
**CO3:** Understand the mathematical techniques of practical flow problems.
**CO4:** Understand the energy exchange process in fluid machines.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(Pos) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | M | S | | | | | M | W | | |
| CO2 | S | S | M | M | | | | | M | W | | |
| CO3 | S | S | M | S | | | | | M | W | | |
| CO4 | S | S | M | S | | | | | M | W | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal test | 2. GATE Score |
| 3. End Semester Examination | |

## PROPERTIES OF FLUIDS AND FLUID STATICS **9+3 Hours**

Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law – Pressure head, Pascal's law. Measurement of pressure – Piezometric tube, manometry.

## FLUID KINEMATICS AND FLUID DYNAMICS **10+3 Hours**

Fluid kinematics: Lagrangian and Eulerian description of fluid flow – Velocity and acceleration of fluid particles – Different types of fluid flow. Description of flow pattern: Stream line, streak line, path line. Principle of conservation of mass – Continuity equation.

Fluid dynamics: Euler's equation of motion along a streamline – Bernoulli's equation. Practical applications of Bernoulli's equation in flow measurement devices like venturimeter, orificemeter and pitot tube. Concept of impulse momentum equation & angular momentum principle with applications.



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## DIMENSIONAL AND MODEL ANALYSIS **8+3 Hours**

Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham Pi theorem. Model analysis – Advantages and applications of model testing. Similitude, derivations of important dimensionless numbers, model laws.

## FLOW THROUGH PIPES **8+3 Hours**

Laminar and turbulent flow characteristics, laminar flow through circular pipes – Hagen Poiseuille law, major and minor losses in pipes, pipe friction, Darcy – Weisbach equation, parallel, series and branched pipes.

## HYDRAULIC MACHINES **10+3 Hours**

Hydraulic turbine: Classification, difference between impulse and reaction turbine.
Construction and working of Pelton turbine, Francis turbine and Kaplan turbine, velocity triangle, heads and efficiencies.
Pumps: classification, difference between positive and non-positive displacement pumps. Construction and working of reciprocating pump. Centrifugal pump-heads of a centrifugal pump, priming, velocity triangle, work done, efficiencies of centrifugal pump.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Shames I H, 'Mechanics of Fluids', Kogakusha, Tokyo, 1998
2. R.K. Bansal – "Fluid mechanics and hydraulic machines," Laxmi Publications (P) Ltd, 2006
3. Rajput R. K, "A text book of Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd., New Delhi, Fourth edition, 2010.
4. Shiv Kumar, "Fluid Mechanics & Fluid Machines: Basic Concepts &Principles", Ane Books Pvt. Ltd., New Delhi, 2010.


**Other references:**


1. V.L. Streeter – "Fluid mechanics," McGraw-Hill, 1998
2. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007




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**U14AU*T*402** **AUTOMOTIVE ELECTRICAL AND ELECTRONICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Distinguish the various basic electrical and electronics systems of an automobile.

**CO2:** Recognize and understand the different wiring diagrams used in automobile manuals.

**Pre-requisite:**

1. Basics of Electrical and Electronics Engineering

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | M |
| CO2 | | | M | | | | | | | | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Presentations | |
| 3. End-semester examinations | |

## TYPES OF BATTERIES **9 Hours**

Batteries – types, construction and working principle of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminum air Battery, lithium ion batteries, Characteristics of batteries, battery rating, capacity and efficiency, Various Tests on battery, battery – charging techniques, maintenance of batteries.

## STARTING AND CHARGING SYSTEM **9 Hours**

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators ,types, construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, charging circuits

## IGNITION SYSTEM **9 Hours**

Components and working of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs –construction, working and types, Electronic Ignition System, Distributor–less Ignition System, Digital Ignition System



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**FUEL INJECTION SYSTEM** **9 Hours**

Introduction, electronic fuel carburetion, fuel injection- types and system overview, components of fuel injection system, diesel fuel injection – introduction of diesel fuel injection, diesel exhaust emissions, electronic control of diesel injection

**WIRING, LIGHTING AND OTHER INSTRUMENTS** **9 Hours**

Automotive electrical wiring, terminals and switching, multiplexed wiring system, electromagnetic compatibility(EMC), Lighting system – basic lighting system, Head Lamp and Indicator Lamps, Anti–Dazzling and Dipper system

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Tom Denton, Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann,2004
2. Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press,1999
3. Kholi .P.L.Automotive Electrical Equipment, Tata McGraw-Hill co ltd, New Delhi,2004
4. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book CoInc. NewYork, 2005.


**Other references:**


1. Judge.A.W.Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004 .
2. Robert Bosch, Automotive Handbook, Bently Publishers,2004




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## U14AU*T*403 AUTOMOTIVE ENGINES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Construction and operation of IC Engine
**CO2:** Understand the Fuels and Combustion in IC Engines
**CO3:** Apply the knowledge for Performance calculation of IC Engine

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | S | | S | S | | | | | | S |
| CO2 | M | | S | M | | | | | | | | S |
| CO3 | S | | S | | | S | | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

### ENGINE CONSTRUCTION AND OPERATION **10 Hours**

Four stroke SI and CI engines – Working principle – function, materials, constructional details of engine components – Valve timing diagram – Firing order and its significance – relative merits and demerits of SI and CI engines

Two stroke engine construction and operation. Comparison of four-stroke and two-stroke engine operation

### FUELS AND COMBUSTION **10 Hours**

Combustion equation, conversion of gravimetric to volumetric analysis – Determination of theoretical minimum quantity of air for complete combustion – Determination of air fuel ratio for a given fuel.

Properties and rating of fuels (petrol and diesel), chemical energy of fuels, reaction equation, combustion temperature, combustion chart.



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## COMBUSTION IN SI ENGINES **8 Hours**

Combustion in premixed and diffusion flames – Combustion process in IC engines. Stages of combustion – Flame propagation – Flame velocity and area of flame front – Rate of pressure rise – Cycle to cycle variation – Abnormal combustion – Theories of detonation – Effect of engine operating variables on combustion. Combustion chambers – types, factors controlling combustion chamber design.

## COMBUSTION IN CI ENGINES **9 Hours**

Importance of air motion – Swirl, squish and turbulence – Swirl ratio. Fuel air mixing – Stages of combustion – Delay period – Factors affecting delay period, Knock in CI engines – methods of controlling diesel knock. CI engine combustion chambers – Combustion chamber design objectives – open and divided. Induction swirl, turbulent combustion chambers. – Air cell chamber – M Combustion chamber

## ENGINE PERFORMANCE **8 Hours**

Performance parameters – BP, FP, IP, Torque specific fuel consumption, Specific Energy consumption, volumetric efficiency, thermal efficiency, mechanical efficiency, Engine specific weight, and heat balance. Testing of engines – different methods. Numerical problems

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Ganesan V, “Internal combustion engines”, 4th edition, Tata McGraw Hill Education, 2012.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. John. B, Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York, 1990 .
4. Ramalingam K. K, “Internal Combustion Engines”, Second Edition, Scitech Publications.
5. Sharma S. P, Chandramohan, “Fuels and Combustion”, Tata McGraw Hill Publishing Co, 1987.
6. Mathur and Sharma, “A course on Internal combustion Engines”, Dhanpat Rai & Sons, 1998.


**Other references:**


1. Edward F, Obert, “Internal Combustion Engines and Air Pollution”, Intext Education Publishers.
2. Ellinger, H.E., Automotive Engines, Prentice Hall Publishers, 1992.




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## U14AU*T*404 MECHANICS OF MACHINES

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand and remember the fundamentals of various mechanisms, structures, inversion mechanisms etc

**CO2:** Applying the knowledge for selecting the suitable drives like belt, ropes, pulleys etc.

**CO3:** Creating the cam profile for required conditions.

**CO4:** Analyzing the various vibrations in the moving components of a mechanism

**Pre-requisite:**

1. Engineering Mechanics

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | W | | | | | M | M | | M |
| CO2 | S | M | S | M | | | | | M | M | | M |
| CO3 | S | S | S | W | | | | | M | M | | M |
| CO4 | S | S | M | M | | | | | M | M | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment record | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End-semester examinations | |

**9+3 Hours**

### MECHANISMS

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

### FRICTION **9+3 Hours**

Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

### GEARING AND CAMS **9 +3Hours**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains – Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.



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**BALANCING** **9+3 Hours**

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

**VIBRATION** **9+3 Hours**

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Rattan S.S, "Theory of machines" Tata McGraw Hill publishing Co., New Delhi, 2002.
2. Rao J.S. and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition,Wiley Eastern Limited, 1992.
3. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi, 2001.


**Other references:**


1. Shingley J.E. and Vicker J.J. Theory of Machines and Mechanisms" McGraw Hill, 1986.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989.




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**U14AU*T*405** **MODELING AND SIMULATION OF AUTOMOTIVE SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Attempt modeling real life systems of interest in order to predict its dynamic behavior

**CO2:** Use simulation tools to determine dynamic response of system following external inputs

**CO3:** Take up advanced courses on system dynamics, monitoring and control with familiarity on terminology and techniques employed in the above.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | W | | | | | | |
| CO2 | | M | | | S | | | | | | | |
| CO3 | | | | | W | | | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Presentations | |
| 3. End-semester examinations | |

## MODELING ELEMENTARY SYSTEMS **9+3 Hours**

System, control system, Modeling – Linearity and Superposition – Lumped system dynamic behavior represented by ordinary differential equations –Modeling Translational and rotational mechanical Systems, Electrical systems, Electrical Analogous for Mechanical Systems, hydraulic systems and thermal systems.

## TIME RESPONSE ANALYSIS OF SYSTEMS **9+3 Hours**

Time response, test signals, obtaining dynamic response of first order and second order linear systems for step inputs through analytical solution of governing equations – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time – Experimental determination of above parameters.

## FREQUENCY RESPONSE OF ANALYSIS OF SYSTEMS **9+3 Hours**

Frequency response, frequency domain specifications, Excitation and response signals of systems – Transfer functions – The sinusoidal steady state – Magnitude and phase response – Bode plots from transfer functions, Contributions from first order poles and zeros and complex conjugate pole pairs in frequency response.



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**MATHEMATICAL MODELING OF ELEMENTARY SYSTEMS USING MATLAB** **9+3 Hours**

Introduction to MATLAB, elementary Math built-in Functions, general Commands, Programming in MATLAB, dynamic response of general (including non – linear) system models through numerical integration of ODEs using MATLAB, Simulink.
Case study: Elementary suspension system.

**AUTOMOTIVE SYSTEM MODELS USING SIMULINK /SCADA / LABVIEW** **9+3 Hours**

Mathematical models using SIMULINK/SCADA/LABVIEW: mathematical modeling of elementary systems, Engine Model, Anti-Lock Braking System, Clutch Engagement Model, Hydraulic System.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. P.D. Cha, J.J. Rosenberg & C.L. Dym, `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
2. Y. Jaluria, `Design and Optimization of Thermal Systems', Mc Graw Hill, 1998
3. Rao V.Dukkipati, 'MATLAB – An introduction with applications', New age international publishers, 2010.


**Other references:**


1. J. B. Brockman, ` Introduction to Engineering: Modeling and Problem Solving', John Wiley & Sons, 2009.
2. Johnson, G.," Labview Graphical programming " , McGraw-Hill, Newyork,1997
3. Wells, L.K and Travis, J., " Labview for Everyone", Prentice Hall, New Jersey, 1997




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**U14GS*T*001** **ENVIRONMENTAL SCIENCE AND ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Play a important role in transferring a healthy environment for future generations
**CO2:** Analyse the impact of engineering solutions in a global and societal context
**CO3:** Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems
**CO4:** Ability to consider issues of environment and sustainable development in his personal and professional undertakings
**CO5:** Highlight the importance of ecosystem and biodiversity
**CO6:** Paraphrase the importance of conservation of resources

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | W | | | S | | | | | | |
| CO2 | | | | | | S | | | | | | |
| CO3 | | | M | | | | | W | | | | |
| CO4 | | | M | | | W | M | | | | | |
| CO5 | W | | M | | | | M | | | | | |
| CO6 | | | M | | | | W | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End Semester examination | |

## INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURES **10 Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems – Mineral resources: Use and exploitation,



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environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

## ECOSYSTEMS AND BIODIVERSITY **14 Hours**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem, Food chains, food webs and ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) –

BIODIVERSITY : Introduction to Biodiversity – Definition: genetic, species and eCOsystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

## ENVIRONMENTAL POLLUTION **8 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

## SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness

## HUMAN POPULATION AND THE ENVIRONMENT **6 Hours**

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

**Field Work**

Visit to local area to document environmental assets- river / grassland / hill / mountain, visit to local polluted site- urban / rural / industrial / agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes etc.,

**Theory :45 Hr** **Total Hours: 45**



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**References:**


1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co., 2013
2. Masters G.M., and Ela W.P., Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India., 2002
4. Trivedi R.K and Goel P.K., "Introduction to Air pollution" Techno-science Pubications. 2003


**Other references:**


1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media. 1996
2. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998
3. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science Publishing Co., 2003
4. Syed Shabudeen, P.S. Environmental chemistry, Inder Publishers, Coimbatore. 2013




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**U14AU*P*401**

# AUTOMOTIVE COMPONENTS MODELING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Modeling the Automotive components using Design software

**CO2:** Assemble the Automotive components.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | M | | | | M | W | | M |
| CO2 | | | | | M | | | | M | W | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

## Part Design:

1. Piston
2. Connecting Rod
3. Crank shaft
4. Cam Shaft
5. Valve
6. Flywheel
7. Cylinder Block
8. Cylinder Head
9. Tyre & Rim
10. Clutch Components

## Assembly Design:

1. Piston ,Connecting Rod and Crank shaft Assembly
2. Clutch Assembly

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**U14AU*P*402**

# A) THERMAL ENGINEERING LABORATORY
# B) FLUID MECHANICS & MACHINERY LABORATORY

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Apply the knowledge for finding performance characteristics of thermal equipments

**CO2:** Apply the knowledge of heat transfer

**CO3:** Use the measurement equipments for flow measurement

**CO4:** Do performance test on different fluid machinery

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | M | W | W | | | | S | M | | M |
| CO2 | S | M | M | W | W | | | | S | M | | M |
| CO3 | S | M | M | W | W | | | | S | M | | M |
| CO4 | S | M | M | W | W | | | | S | M | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

**a) THERMAL ENGINEERING LABORATORY**

1. Experimental study on valve timing diagram in 4-stroke diesel engine and Experimental study on port timing diagram in 2-stroke petrol engine
2. Performance test on Air Compressor
3. Determination of COP of a Refrigeration System
4. Heat Transfer on PIN FIN Apparatus
5. Effectiveness of Parallel and counter-flow heat exchanger

**b) FLUID MECHANICS & MACHINERY LABORATORY**

1. Determination of the Coefficient of discharge of a given Orifice meter.
2. Determination of the Coefficient of discharge of a given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Performance Characteristic curves of centrifugal pump
5. Performance characteristics of Francis turbine.

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*403** **AUTOMOTIVE ELECTRICAL & ELECTRONICS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Recognize and understand the different wiring diagrams used in automobile manuals.

**CO2:** Understand basic electrical and electronic circuits used in automobile systems and also understand the basic programming with the 8085 microprocessor

**Pre-requisite:**

1. Basics of Electrical and Electronics Engineering Laboratory

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | M | | | | | | | | | |
| CO2 | S | | | | W | | | | | | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

AUTOMOTIVE ELECTRICAL LABORATORY

1. Testing of batteries and battery maintenance
2. Study of starting motors and generators
3. Diagnosis of ignition system faults
4. Study of Automobile electrical wiring
5. Study of power window

AUTOMOTIVE ELECTRONICS LABORATORY

1. Study of rectifiers, Logic gates,555 timer
2. Study of RTD, LVDT, and Load Cell.
3. Study of A to D and D to A converters
4. Micro Processor programming and interfacing

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours: 30**



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**U14GH*P*401**

# NATIONAL AND GLOBAL VALUES

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 1 | 1 |

**(Common to all branches of Engineering and Technology)**

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Act as a good and responsible citizen.
**CO2:** Conserve and protect eco cycle.
**CO3:** Voluntarily work with global welfare organization and provide solution for global peace.
**CO4:** Invent his Technical design by considering humanity and nature.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | | M | S | | M | | S |
| CO2 | | | | | | | S | | | | | |
| CO3 | | | | | | | W | M | M | M | | |
| CO4 | | | | | | | S | S | | | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Method | 1. Attitude |
| 2. End Semester Examination | 2. Behavior |

## ROLE OF A RESPONSIBLE CITIZEN — 4 Hours

Citizen – its significance–National and Global perspectives.
**Practical:** Group discussion on National and Global values.

## GREATNESS OF INDIAN CULTURE — 2 Hours

Emerging India – past and present, about Culture, Morality and spirituality– Beauty of Unity in diversity – Impact of western culture in India and Indian culture over other countries.
**Practical:**Demonstration and impact measurements of simple and good actions.

## GLOBAL WELFARE ORGANISATIONS — 2 Hours

Education – Health – Nature – Peace
**Practical:**Organizing an event linking with one of the Organizations In campus /off campus.



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**PRESERVING NATURE** **2 Hours**

Appreciating the flora and fauna on Earth – Importance ofEcological balance – Conservation.
**Practical:**Trekking, field visit.
**Practical:**Debate on disparity and social values.

**GLOBAL PEACE** **4 Hours**

One World and One Humanity – Global Peace.
**Global personalities:**Thiruvalluvar, Vallalar, Vivekanadar, Mahatma Gandhi,Vethathiri Maharishi – Plans for world peace.
**Practical:**Group discussion on individual plans for world peace.

**GENERAL PRACTICAL** **16 Hours**

Simplified physical Exercise – Kayakalpa practice (Follow up practice) – Meditatyion - Theory & Practice
**Pranayama** : Bhastrika, Kapala Bhati, Nadi suddhi, Sikari, Sitali.
**Mudhra** : Chin Mudhra, Vayu Mudhra, Shunya Mudhra, Prithvi Mudhra, Surya Mudhra, Varuna Mudhra, Prana Mudhra, Apana Mudhra, Apana Vayu Mudhra, Linga Mudhra, Adhi Mudhra, Aswini Mudhra.

**Theory :14 Hr** **Tutorial: 16 Hr** **Total Hours: 30**

**References:**


1. Drunvalo Melchizedek, "The Ancient Secret of the Flower of Life", Vol. 1, Light Technology Publishing; First Edition edition (April 1, 1999)
2. Dr.M. B. Gurusamy, "Globalisation – Gandhian Approach" Kumarappa Research Institution, 2001.
3. Vethathiri's Maharishi's, ***"Karma Yoga: The Holistic Unity"*** The World Community Service Centre, Vethathiri Publications, 1994.
4. Vethathiri's Maharishi's, ***"World peace"*** The World Community Service Centre, Vethathiri Publications,1957.
5. Vethathiri's Maharishi's, ***"Atomic Poison"*** The World Community Service Centre, Vethathiri Publications, 1983.
6. Vethathiri's Maharishi's, ***"The World Order Of Holistic Unity"*** The World Community Service Centre, Vethathiri Publications, 2003.


**Other references:**


1. Swami Vivekananda, "***What Religion Is"*** 41th edition, The Ramakirshna Mission Institute of Culture, 2009.




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# SEMESTER V



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**U14AU*T*501** **AUTOMOTIVE FINITE ELEMENT ANALYSIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the discretization and finite element approach

**CO2:** Select appropriate elements to solve physical and engineering problems with emphasis as an automobile engineering applications

**CO3:** Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

**Pre-requisite:**

1. Numerical Methods

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | W | | | W | | | | M | | | M |
| CO2 | S | W | | | W | | | | M | | | M |
| CO3 | S | W | | | W | | | | M | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar | |
| 3. Semester Exam | |

## INTRODUCTION **8+3 Hours**

Historical background – Relevance of FEA to design problems, Application to the continuum – Discretisation – Matrix approach, Matrix algebra – Gaussian elimination – Governing equationsfor continuum – Classical Techniques in FEM – Weighted residual method – Ritz method,Galerkin method

## ONE DIMENSIONAL PROBLEMS **12+3 Hours**

Finite element modeling – Coordinates and shape functions – Potential energy approach–Element matrices and vectors – Assembly for global equations – Boundary conditions – Higher order elements – Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams – Finite element formulation of stiffness matrix and load vectors – Assembly to Global equations –boundary conditions – Solutions and Post processing – Automotive Examples.



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**TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS** **6+3 Hours**

Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer – Automotive Examples.

**TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS** **10+3 Hours**

Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solutions Examples

**ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS** **9+3 Hours**

Natural coordinates, Iso parametric elements, Four node quadrilateral element– Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Displacement and Stress calculations – Examples.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education 2011, 4th Edition.
2. Logan D.L., "A First course in the Finite Element Method", Fifth Edition, Thomson Learning, 2012


**Other references:**


1. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2




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**U14AU*T*502**

# MEASUREMENTS AND METROLOGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Identify the basic measurement tools

**CO2:** Apply the concept of measurements in inspecting various parameters.

**Pre-requisite:**

1. Engineering Physics

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | M | | | | M | M | | M |
| CO2 | M | | | | M | | | | M | M | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End-semester Examinations | |

## INTRODUCTION TO METROLOGY **9 Hours**

Units and standards, terminology and measurement errors. Linear measuring instruments, dial gauges, comparators and linear measuring machines. Angular measuring instruments- measurement of straightness flatness and surface finish. Profilographs.

## MEASUREMENTS OF SCREW THREAD – GEAR ELEMENTS – SURFACE FINISH **9 Hours**

Internal and External screw threads: Measurements of various elements of thread – Best size wire – Two and three wire method. Gear: Measurements of various elements – Constant chord method – Base tangent method. Surface Finish: Surface topography definitions – Measurement of Surface Texture – Methods –Evaluation of Surface finish.

## PRESSURE AND FLOW MEASUREMENT **9 Hours**

Bourden tube, diaphragm, bellows and pressure capsules: Transducers used in pressure measurement- potentiometer, strain gauges, LVDT, capacitive and variable reluctance type transducers.

Obstruction type flow meter-, flow nozzles, pitot tube, Positive displacement flow meters – turbine flow meter, flouted tube flow meter, anemometer, ultrasonic flow meter, magnetic flow meters.



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## TEMPERATURE MEASUREMENT **9 Hours**

Temperature scales – mechanical temperature sensors, liquid in glass, vapour pressure, bimetal temperature gauges. Resistance type temperature sensors. Thermistors, thermocouples, Laws of thermocouple, types of thermocouples. Construction and circuits for thermocouples. High temperature measurement pyrometers.

## FORCE AND TORQUE MEASUREMENT **9 Hours**

Force measuring devices- weigh bridges, load cells, proving ring. Torque measurement – prony brake, rope brake and fan type brakes. Dynamometers – hydraulic, electric cradle and eddy current dynamometers. Transmission dynamometers. Chassis dynamometers.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Jain R.K., "Engineering Metrology", Khanna publishers, New Delhi, 2005.
2. Rangan C.S., Sarma G.E and Mani V.S "Instrumentation devices and systems". TMH Publishing Co. New Delhi, 2001.
3. Beckwith T.G & Buck N.L "Mechanical Measurements", Oxford and IBH publishing house New Delhi, 2004.
4. Patranabis D, "Principles of industrial instrumentation", TMH Publishing Co. New Delhi, 2000.
5. A. K. Sawhney, 'A Course in Electrical and Electronics Measurement and Instrumentation' Dhanpat Rai, 1994


**Other references:**


1. Jain R.K., "Mechanical & Industrial Measurements" , Khanna publishers, New Delhi, 2005.
2. Doeblin,"Measurement System Application &Design" McGraw Hill ,New Delhi, 2004.
3. Gaylor F.W and Shotbolt C.R "Metrology for Engineers", ELBS, 2006.




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## U14AU*T*503 AUTOMOTIVE ENGINE SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Intake and Exhaust Systems
**CO2:** Understand the Carburetion and injection in Engines
**CO3:** Understand the Supercharging, Turbocharging and Scavenging in Engines

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(Pos) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | W | | | | | M | | | | | M |
| CO2 | W | W | | | | | M | | | | | M |
| CO3 | W | W | | | | | M | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

### INTAKE AND EXHAUST SYSTEMS 9 Hours

Intake system components – Discharge coefficient, Pressure drop – Air filter, intake manifold, Connecting Pipe – Exhaust system components – Exhaust manifold and exhaust pipe – Spark arresters – Exhaust mufflers, Types, operation

### CARBURETION AND GASOLINE INJECTION 9 Hours

Mixture requirements for steady state and transient operation, Mixture formation studies of volatile fuels, design of elementary carburetor Chokes – Effects of altitude on carburetion – Carburetor for 2-stroke and 4-stroke engines – carburetor systems for emission control.

Petrol injection – Open loop and closed loop systems, mono point, multi-point and direct injection systems – Principles and Features, Bosch injection systems.

### DIESEL INJECTION 9 Hours

Requirements – Air and solid injection – Function of components – Jerk and distributor type pumps-pump calibration .Pressure waves – Injection lag – Unit injector – Mechanical and pneumatic governors – Fuel injector – Types of injection nozzle – Nozzle tests – Spray characteristics – Injection timing – Factors influencing fuel spray atomization, penetration and dispersion of diesel – Overview of Diesel Injection advanced technologies



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## LUBRICATION AND COOLING **9 Hours**

Need for cooling system – Types of cooling system – Liquid cooled system: Thermosyphon system, Forced circulation system, pressure cooling system – properties of coolant, additives for coolants
Need for lubrication system – Mist lubrication system, wet sump any dry sump lubrication – Properties of lubricants, consumption of oil.

## SUPERCHARGING AND SCAVENGING **9 Hours**

Objectives – Effects on engine performance – engine modification required – Thermodynamics of supercharging and Turbocharging – Turbo lag-Windage losses- Turbo charging methods – Engine exhaust manifold arrangements.
Classification of scavenging systems –Mixture control through Reed valve induction – Charging Processes in two-stroke cycle engine – Terminologies – Shankey diagram – perfect displacement, perfect mixing

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Ganesan V, "Internal combustion engines", 4th edition, Tata McGraw Hill Education, 2012.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. John. B, Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990 .
4. Ramalingam K. K, "Internal Combustion Engines", Second Edition, Scitech Publications.


**Other references:**


1. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company Inc.,
2. Publishers, 1987. Edward F, Obert, "Internal Combustion Engines and Air Pollution", Intext Education Publishers.




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## U14AU*T*504 MACHINE COMPONENTS DESIGN

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand and Apply Engineering Design process

**CO2:** Apply engineering principles and analytical techniques in the design process

**CO3** Design the Machine Components like Shafts and Springs Gear Design Flywheels and Bearings.

**Pre-requisite:**

1. Strength of Materials

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | M | | | | | M | S | W | |
| CO2 | S | S | S | M | | | | | M | M | M | |
| CO3 | S | S | S | M | | | | | M | W | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

### INTRODUCTION 9+3 Hours

Classification of design – Engineering materials and their physical properties as applied to design – Selection of materials – Factors of safety in design – Endurance limit of materials – Determination of endurance limit for ductile materials.

Limits-Types of fits – types of tolerance – calculation of minimum and maximum clearances and allowances.

### DESIGN OF SHAFTS AND SPRINGS 9+3 Hours

Introduction – Material and design stresses – Design of axles – Design of shafts on the basis of strength – Design of shaft on the basis of rigidity – Design of hollow shafts – Design of close coiled helical spring subjected to axial loading – Torsion of helical springs.

### GEAR DESIGN 9+3 Hours

Design considerations – strength of gear teeth – Lewis equation – Terminology of gears Dynamic tooth load – Design of spur gears – helical gears – bevel gears and worm gears.



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**FLYWHEELS** **9+3 Hours**

Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheels stresses of rim of flywheels. Design of hubs and arms of flywheel – Turning moment diagram.

**DESIGN OF BEARINGS** **9+3 Hours**

Design of journal bearings – Ball and Roller bearings – Types of Roller bearings – Bearing life – Static load capacity – Dynamic load capacity – Bearing material – Boundary lubrication – Oil flow and temperature rise.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Jain,R.K., "Machine Design", Khanna Publishers, 1992.
2. Sundararaja Murthy, T.V., "Machine Design", Khanna Publishers, New Delhi, 1991.
3. Bhandari,v.B., "Design of Machine Elements", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.


**Other references:**


1. Hall Allen,S. & other, "Machine Design" , Schaum publisher Co., 1982.
2. Sigley, "Machine Design", McGraw Hill,1981.
3. "Design Data Book ", PSG College of Technology, Coimbatore,1992




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**U14AU*T*505** **AUTOMOTIVE SENSORS AND EMBEDDED SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Apply the knowledge of engineering for the selection of sensors for measuring various parameters in automotive systems.

**CO2:** Apply the knowledge of sensors in the management of the vehicle control.

**CO3:** Program and interface various sensors used in automobiles using microcontrollers.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(Pos) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | W |
| CO2 | | | S | | | M | | | | | W | |
| CO3 | | | S | | | | | | | | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Quiz | |
| 3. Lab Experiments | |
| 4. End semester Examinations | |

## SENSORS **8+3 Hours**

Introduction to automotive sensors – resistive, inductive, capacitive transducers, Piezo electric transducers, Hall effect sensors, Ultrasonic sensors, Ranging radar (ACC)

**Power Train:-** Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, NOX sensors, Hotwire air mass meter **Chassis:-** Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors

## ACTUATORS **8+3 Hours**

Introduction to automotive Actuators – Solenoids, Operation and application of brushless DC motors, Servo and stepper motors, switched reluctance motors, Suspension semi active actuators, Mangetostrictive anti vibration actuators, Piezo Actuators



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**INTRODUCTION TO EMBEDDED SYSTEM** **10+3 Hours**

Introduction to embedded system, , applications of embedded system, Microcontroller v/s microprocessor, introduction to MPLAB, making and running projects in MPLAB, basic programs, introduction to PIC Microcontroller, Types and products of PIC - architecture - memory devices- addressing modes, memory mapping, System Peripherals and User peripehrals – ADC, Interfacing temperature sensor with PIC micro via ADC

**INTERRUPTS AND TIMERS** **10+3 Hours**

Programming interrupts, counters and timers and serial communication(MSSP), CCP(Capture Compare PWM gen module), External Memory

**INTERFACING WITH PIC** **9+3 Hours**

Interfacing with LCD, sensors and motor control applications

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Automotive Sensors, BOSCH. 2002
2. Ronald K. Jurgen, “Sensors and Transducers, 2nd Edition, SAE, 2003.


**Other references:**


1. Muhammad Ali Mazidi, Rolin McKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18" Pearson Education, 2007.




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## U14AU*T*506 FUELS & LUBRICANTS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the refining process of petroleum
**CO2:** Understand the various types of fuels and their properties
**CO3:** Apply the knowledge in testing the fuel properties
**CO4:** Understand the properties and purpose of lubricants.
**CO5:** Understand the Alternate fuels available

**Pre-requisite:**

1. Engineering Chemistry, Thermodynamics and Thermal Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | M | W | | | M | M | | | | | M |
| CO2 | W | M | W | | | M | M | | | | | M |
| CO3 | M | M | W | | | M | M | | | | | M |
| CO4 | M | W | W | | | W | W | | | | | M |
| CO5 | | M | | | | W | W | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal test | |
| 3. End semester examination | |

### MANUFACTURE OF FUELS AND LUBRICANTS **9 Hours**

Fuels, Structure of petroleum, refining process, thermal and catalytic cracking, products of refining process, manufacture of lubricating oil base stocks and finished automotive lubricants.

### FUELS FOR I.C. ENGINES **9 Hours**

Types of Fuels, Liquid and gaseous fuels, heating value of fuels, higher and lower heating values, chemical structure of hydro-carbons SI Engine fuels, Volatility characteristics, desirable characteristics of SI Engine fuels, knock rating and additives.

### COMBUSTION OF FUELS **9 Hours**

Stoichiometry - calculation of theoretically correct air required for combustion of liquid and gaseous fuels, volumetric and gravimetric analysis of the dry products of combustion, mass of dry gas per kg of fuel burnt, mass of carbon in the exhaust gas, mass of carbon burnt to carbon-monoxide per kg of fuel, heat loss due to incomplete combustion, exhaust gas analysis by Orsat apparatus.



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## LUBRICANTS 9 Hours

Theory of Lubrication, Effect of engine variables on friction, Types of Lubrications-Hydrodynamic and Hydrostatic lubrication. Requirements for automotive lubricants and types, oxidation deterioration and degradation of lubricants, additives of lubricants and synthetic lubricants, classification of lubricating oils, tests on lubricants. Grease, classification, properties, testing of grease.

## ALTERNATE FUELS 9 Hours

Alternate fuels for SI engines and CI engines, desirable characteristics, Octane and cetane rating, biodiesel. Introduction to electric, hybrid and fuel cell vehicles.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. V.Ganesan, "Internal Combustion Engines" Tata McGraw-Hill Publishing Co. New delhi, 1999
2. M.L.Mathur and P.Sharma "A Course in internal combustion engines", Dhanpatrai Publications,2012


**Other references:**


1. Francis, W – Fuels and Fuel Technology, Vol. I & II,1980
2. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
3. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.




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**U14AU*P*501**

# FINITE ELEMENT ANALYSIS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Analyze various 1D, 2D and 3D Structures using FEA tools.
**CO2:** Analyze heat transfer modes using FEA tools.
**CO3:** Analyze fluid flow through pipes using FEA tools.

**Pre-requisite:**

1. Thermodynamics, Fluid Mechanics and Strength of Materials

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | M | W | M | M | M | | | M | | S |
| CO2 | S | S | M | W | M | M | M | | | M | | S |
| CO3 | S | S | M | W | M | M | M | | | M | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

I. STRUCTURAL ANALYSIS
   1. 1-D truss
   2. 2-D truss
   3. 3-D truss
   4. Beam analysis
   5. 2-D structure with various loadings
   6. 2-D structures with different materials
   7. Plate with hole
   8. Modal analysis
   9. Transient Response

II. THERMAL ANALYSIS
   1. Steady State heat transfer
   2. Transient heat transfer

III. FLUID ANALYSIS
   1. Flow through pipes

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

# U14AU*P*502 FUELS, LUBRICANTS AND ENGINE PERFORMANCE TESTING LABORATORY

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Test the performance of various engines using dynamometers.

**CO2:** Asses the performance characteristics of automotive engines

**CO3:** Measure the properties of fuels and lubricants

**Pre-requisite:**

1. Automotive Engines
2. Thermodynamics and Thermal Engineering

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | S | | M | | | | S | | |
| CO2 | S | S | S | S | | M | | | | S | | |
| CO3 | S | S | S | S | | S | M | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS**

1. Performance study of petrol engine at full throttle and part throttle conditions.
2. Performance study of diesel engine both at full load and part load conditions.
3. Morse test on petrol engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in IC engines.
5. Heat balance test on an automotive diesel and petrol engine.
6. Engine tuning for performance improvement.
7. Distillation of fuels
8. Aniline Point test of diesel
9. Calorific value of liquid fuel & gaseous fuel.
10. Reid vapour pressure test and Corrosion Test
11. Flash and Fire points of fuels.
12. Cloud & Pour point Test.
13. Ash content and Carbon Residue Test
14. Viscosity of fuels & Lubricants
15. Drop point of grease and mechanical penetration in grease.

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*503 MINI PROJECT -1**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Develop their design and fabrication knowledge and skills.

**CO2:** Develop the report writing and communication skills.

**Pre-requisite:**

1. Design and Manufacturing

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | M | W | | M | S | W | | M | M | M | M |
| CO2 | | | | | | | | | | M | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews-40% | 1. Course Exit Survey |
| 2. Project Report-10% | |
| 3. Viva voce-50 % | |

**GUIDELINES:**

1. The Mini Project-I may be a theoretical study and analysis, prototype design, modeling & simulation or a combination of these.
2. Should be done as individual project.
3. The progress of the project is evaluated based on a minimum of two reviews and final viva-voce examination.
4. A project report is required to be submitted at the end of the semester in the required format.
5. The review presentations and project report should contain estimated & actual time schedule with charts (PERT/GANTT), prototype cost estimations, drawings, 3D models in addition to the details of project work carried out.

**Total Hours 30**



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**U14EN*P*501**

# COMMUNICATION SKILLS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Imparting the role of communicative ability as one of the soft skills needed for placement
**CO2:** Developing communicative ability and soft skills needed for placement
**CO3:** Making students Industry-Ready through inculcating team-playing capacity

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | M | | | | | | | M | |
| CO2 | | | | W | | | | | | M | S | |
| CO3 | | | | S | | | | | | W | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment method | 1. Course Exit Survey |
| 2. Presentation/Role Play/GD | |
| 3. Interview | |

## GRAMMAR IN COMMUNICATION **9 Hours**

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training.

## ASSERTIVE COMMUNICATION **9 Hours**

Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases.

## CORPORATE COMMUNICATION **9 Hours**

Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette.

## PUBLIC SPEAKING **9 Hours**

Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.



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**INTERVIEW & GD TECHNIQUES** **9 Hours**

Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.

**Total Hours 45**

**References:**


1. Bhatnagar R.P. & Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989, ISBN: 9780333925591
2. Devadoss K. & Malathy P., "Career Skills for Engineers", National Book Publishers, Chennai, 2013.
3. Aggarwal R.S., "A Modern Approach to Verbal & Non–Verbal Reasoning", S.Chand Publishers, India, 2012, ISBN : 8121905516


**Other references(CD's)**

1. Train2sucess series 1.Telephone Skills.2. Interviewing Skills 3. Negotiation Skills by Zenith Global Consultants Ltd. Mumbai.
2. BEC Series.



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# SEMESTER VI



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**U14AU*T*601** **CHASSIS DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**
After successful completion of this course, the students should be able to:

**CO1:** Understand the design assumptions.
**CO2:** Design of various automotive Chassis components

**Pre-requisite:**
1. Strength of Materials
2. Automotive Chassis

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | M | W | | | | | | W | W | | |
| CO2 | S | S | M | | | | | | M | M | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments/Mini Projects | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End semester Examination | |

## VEHICLE FRAME AND SUSPENSION **9+3 Hours**

Study of Loads-Moments and Stresses on Frame Members. Design of Frame for Passenger and Commercial Vehicles.
Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

## FRONT AXLE AND STEERING SYSTEMS **9+3 Hours**

Analysis of Loads-Moments and Stresses at different sections of Front Axle. Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings. Determination of Optimum Dimension and Proportions for Steering Linkages ensuring minimum error in Steering.

## DRIVE LINE AND REAL AXLE **9+3 Hours**

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.



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**GEAR BOX** **9+3 Hours**

Gear train calculations, layout of gearboxes. Design of gearboxes.

**BRAKING SYSTEM** **9+3 Hours**

Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design of brake shoes and friction pads.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Dean Averns, "Automobile Chassis Design Book", 2nd edition, Kotelian sky Press, 2009.
2. Julian Happian-Smith, "Introduction to Modern Vehicle Design", SAE International, 2004.
3. Giri, N.K., Automobile Mechanics, Khanna publishers, New Delhi, 2007.
4. Stokes. A, "*Manual Gearbox Design"*, Society of Automotive Engineers, 1992.


**Other references:**


1. Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
2. Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.




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**U14AU*T*602** **ENGINE DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the design assumptions.

**CO2:** Design of various Automotive Engine components

**Pre-requisite:**

1. Strength of Materials
2. Mechanics of Machines

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | M | W | | | | | | W | W | | |
| CO2 | S | S | M | | | | | | M | M | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment/Mini projects | |
| 3. End semester exam | |

**DESIGN OF CYLINDER AND PISTON** **9+3 Hours**

Choice of material for cylinder and piston, design assumptions and procedure for cylinder and piston. Design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

**DESIGN OF CONNECTING ROD** **9+3 Hours**

Design of Connecting Rod-determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts.

**DESIGN OF CRANKSHAFT** **9+3 Hours**

Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.

**DESIGN OF CLUTCH** **9+3 Hours**

Design of single plate clutch, multiplate clutch, design of centrifugal clutch, and cone clutch, energy dissipated, torque capacity of clutch, design of Clutch Components, Design details of roller and sprag type of clutches.



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**DESIGN OF VALVES AND VALVE TRAIN** **9+3 Hours**

Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam & camshaft. Design of rocker arm. Cam profile generation.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Engine Design – Giles J. G., Lliffe Book Ltd.1968
2. Engine Design – Crouse, Tata McGraw Publication, Delhi
3. Khurmi. R.S. & Gupta. J.K., A textbook of Machine Design, Eurasia Publishing House (Pvt) Ltd, 2001.


**Other references:**


1. Giri.N.K, Automobile Mechanics, Khanna Publishers, New Delhi, 2007.




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## U14AU*T*603 AUTOMOTIVE TRANSMISSION

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the purpose of clutch, gear box and drive train
**CO2:** Compare various types of transmission system
**CO3:** Understand the various types of drives

**Pre-requisite:**

1. Automotive Chassis

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | | | | |
| CO2 | M | | | | | | | | M | M | | W |
| CO3 | W | | | W | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar | |
| 3. Semester Exam | |

### CLUTCH AND GEAR BOX **9 Hours**

Problems on performance of automobile - such as resistance to motion, tractive effort, engine speed, engine power and acceleration. Requirement of transmission system. Different types of clutches, principle, Construction and torque capacity. Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox.

### HYDRODYNAMIC DRIVE **9 Hours**

Fluid coupling - Principle of operation, Constructional details, Torque capacity, Performance characteristics and Reduction of drag torque. Hydrodynamic Torque converter - Principle of operation, Constructional details and Performance characteristics. Multistage torque converters. Polyphase torque converters. Converter coupling

### PLANETARY GEAR BOXES **9 Hours**

Construction and operation of Ford – T-model gearbox, Wilson Gear box and Cotal electromagnetic transmission.



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## AUTOMATIC TRANSMISSION APPLICATIONS **9 Hours**

Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations.

## HYDROSTATIC AND ELECTRIC DRIVE **9 Hours**

Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive. Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Heldt P.M – "Torque Converters"- Chilton Book Co.-1992
2. Judge, A.W., Modern Transmission systems, Chapman and Hall Ltd., 1990.
3. Newton and Steeds – "Motor Vehicle"- Illiffee Publisher- 2000.
4. Design Practices, passenger Car Automotive Transmissions- SAE Hand book-1994.


**Other references:**


1. Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1992.
2. Heldt, P.M., Torque converters, Chilton Book Co., 1992.




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**U14AU*T*604** **AUTOMOTIVE POLLUTION AND CONTROL**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Familiarize the norms of pollution standards
**CO2:** Analyze the sources of pollution from automobiles
**CO3:** Understand the pollution control methods and apply.

**Pre-requisite:**

1. Environmental Science and Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | S | S | | | | | |
| CO2 | M | | W | | | M | M | | | | | |
| CO4 | M | | W | | | M | M | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

**INTRODUCTION** **6 Hours**

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards.

**POLLUTANT FORMATION IN SI ENGINES** **9 Hours**

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

**POLLUTANT FORMATION IN CI ENGINES** **10 Hours**

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

**CONTROL OF EMISSIONS FROM SI AND CI ENGINES** **10 Hours**

Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation – SCR – Fumigation – Secondary Air injection – PCV system – Particulate Trap – CCS – Exhaust treatment in SI engines –Thermal reactors – Catalytic converters – Catalysts – Use of unleaded petrol.



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**MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE** **10 Hours**

Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph – Smoke meters –SHED test.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-156091-563-3, 1991.
2. B.P.Pundir, " IC Engines Combustion and Emissions" Narosa Publishers, 2010
3. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2003.
4. John. B, Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990 .
5. Robert Bosch, "Emissions-Control Technology for Diesel Engines", BENTLEY ROBERT Incorporated, 2005


**Other references:**


1. Springer and Patterson, Engine Emission, Plenum Press, 1990.
2. SAE Transactions- "Vehicle Emission"- 1982 (3 volumes).
3. Obert.E.F.- "Internal Combustion Engines"- 1988
4. Marco Nute- " Emissions from two stroke engines, SAE Publication – 1998




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## U14AU*T*605 AUTOMOTIVE SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Apply the concept of embedded systems in the automobile applications.

**CO2:** Outline the stability and safety systems used in automobiles.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | M | | | | | | | |
| CO2 | | | | S | | M | | | S | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Tests | 1. Course Exit Survey |
| 2. Lab Experiments | |
| 3. Projects | |

### EMBEDDED CONTROL SYSTEMS **9 Hours**

Introduction to Embedded control systems, Microcontroller and processors used in Automotive systems, need for electronics in automobiles, Engine control unit, Electronic– Input devices- Sensors- wheel speed sensor, Crash sensor etc.

### ELECTRONIC FUEL INJECTION & IGNITION SYSTEM **9 Hours**

Introduction, feedback carburettor system, throttle body injection, advanced GDI and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

### BRAKING AND ELECTRONIC STABILITY CONTROL **9 Hours**

Vehicle motion control, collision avoidance control – cruise control, Adaptive cruise control, Electronic transmission control. Vehicle stabilization system -Antilock braking system, Traction control system, Anti slip regulation, Electronic stability program. On-board diagnosis system.

### PASSIVE SAFETY SYSTEMS **9 Hours**

Air bags and seat belt pretensioner systems: Sensor functions, Distributed front air bag sensing systems, Single-point sensing systems, Side-impact sensing – driver monitoring systems.



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## INFOTAINMENT SYSTEMS **9 Hours**

Global positioning systems, geographical information systems, navigation systems,Voice Command Systems, automotive vision system, lane departure warning system, driver assistance systems such as power seats, Power windows, and Remote keyless entry systems.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Automotive Computer Controlled Systems Diagnostic tools and techniques-Allan W. M. Bonnick, Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP
2. Electronic Engine Control Technologies, 2nd Edition-Ronald K. Jurgen-SAE International
3. Ljubo Vlacic, Michel Parent & Furnio Harshima, "Intelligent Vehicle Technologies: Theory and Applications", Butterworth-Heinemann publications, 2001
4. Denton. (2004) Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann.


**Other references:**


1. Ronald K. Jurgen. (1999) Automotive Electronics Handbook, McGraw-Hill Inc.,
2. Bosch. (1999) Automotive Electrics & Electronics, Robert Bosch GmbH, 3rd edition.
3. Telematics Communication Technologies and Vehicular Networks: Wireless Architectures and Applications-Chung-Ming Huang, National Cheng Kung University, Taiwan; Yuh-Shyan Chen, National Taipei University, Taiwan




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**U14AU*P*601**

# CHASSIS AND ENGINE DESIGN LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Design and analyze the Chassis components using Modeling / FEA tools

**CO2:** Design and analyze the Engine components using Modeling / FEA tools

**Pre-requisite:**

1. Nil

| CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | W | | | | | S | M | S | |
| CO2 | S | S | S | M | | | | | S | S | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS:**

DESIGN OF FOLLOWING CHASSIS COMPONENTS:

1. Chassis Frame
2. Helical spring
3. Leaf Spring
4. Clutch
5. Propeller Shaft

DESIGN OF FOLLOWING ENGINE COMPONENTS:

1. Cylinder
2. Piston
3. Connecting Rod
4. Crank Shaft
5. Valve

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*602**

# AUTOMOTIVE SYSTEMS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Apply the knowledge of sensors in the management of the vehicle control.

**CO2:** Interface and simulate various sensors used in automotive systems to different software's.

**Pre-requisite:**

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | M | | | | | | | | |
| CO2 | | | | M | S | | | | | | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

**LIST OF EXPERIMENTS:**

1. RPM Measurement Using
   - (i) Hall effect Sensor
   - (ii) Inductive Type Sensor
2. Brake Pedal Position measurement
   - (i) using Hall Eeffect sensor
   - (ii) Designing of P, PI, PID controllers using performance criteria
3. Labview Programming :
   - (i) Temperature Conversion
   - (ii) Debugging and Sub-VI creation
   - (iii) Loops and Waveform Charts
   - (iv) Case statements, Arrays and Clusters
   - (v) Strings and File Input/output
4. Data Acquisition Systems using Lab view
   - (i) Strain measurement system
   - (ii) Temperature measurement system
   - (iii) Pressure measurement system
5. Modeling and simulation of Automotive sub systems



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(i) mathematical modeling of elementary systems
(ii) Engine Model,
(iii) Anti-Lock Braking System,
(iv) Suspension System,
(v) Hydraulic System

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*603** **MINI PROJECT- 2**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Identify an innovative or creative idea/concept/solution to a problem

**CO2:** Demonstrate their report writing and presentation skills

**Pre-requisite:**

1. Design and Manufacturing

| CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | S | S | M | S | | | | | S |
| CO2 | | | | | | | | | | S | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews - 40% | 1. Course Exit Survey |
| 2. Project Report - 10 % | |
| 3. Viva-voce - 50% | |

**GUIDELINES:**

1. The Mini Project-2 will essentially contain a detailed design and fabrication of a model or a prototype of a mechanism or a subsystem of automotive system.
2. The project work may include literature review, modeling, analysis, simulation, fabrication, testing and analysis of test data etc.
3. Can be individual or a group project, with maximum of 3 students per group.
4. The progress of the project is evaluated based on a minimum of three reviews and final viva-voce examination.
5. A project report is required to be submitted at the end of the semester in the required format.
6. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), FMEA/DFMEA charts, prototype cost estimations, drawings, 3D models, manufacturing process charts, in addition to the details of project work carried out.

**Total Hours 60**



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## U14AU*P*604 TECHNICAL SEMINAR - 1

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Recollect and appreciate the basics of automobile and mechanical engineering concepts by self learning.

**CO2:** Prepare a presentation on the technical topic chosen in the proper format

**CO3:** Effectively communicate the contents to the target audience and handle questions with confidence

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | W | | | | | | | M |
| CO2 | | | | | | | | | | S | | |
| CO3 | | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Technical presentation | 1. Course Exit Survey |
| 2. Report writing | |

**GUIDELINES:**

1. The students would study and recollect the mechanical and automobile engineering fundamental theory subjects and the relevant application automotive product/technology by self learning through Curriculum Plus system.
2. The students would go through all the relevant chapters and answer the online quiz for the relevant chapters, which will be evaluated by the faculty coordinator as a continuous assessment.
3. The student will prepare a presentation individually on the topic from the relevant chapter chosen by him related to Automobile and approved by the faculty coordinator.
4. The contents of the presentation will include theory fundaments, applicable automotive products/technology, mathematics involved, experiments required for understanding the theory etc.
5. The student should be able to answer the questions asked by the audience during the presentation.

**Total Hours 30**



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# SEMESTER VII



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**U14AU*T*701** **VEHICLE DYNAMICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concept of mechanical vibrating system.

**CO2:** Analyze the performance, ride and handling mode of the vehicle.

**CO3:** Analyze the stability and noise of vehicle.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | W | | M | | | | | | | M |
| CO2 | S | S | W | | M | | | | | | | M |
| CO3 | S | S | W | | M | | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar | |
| 3. Semester Exam | |

## INTRODUCTION **9+3 Hours**

Fundamentals of vibration, - Single, two, multi degrees of freedom systems - Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Dunkerley, Holzer and matrix iteration methods, branched system, geared system. Modeling of an automobile for vibration study.

## PERFORMANCE MODE **9+3 Hours**

Acceleration - free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, deceleration - maximum decelerating rates, stopping distance, maximum braking force, adhesion utilization - Straight line motion - aerodynamic forces and moments, viscosity effects - separation and its control - aerodynamic lift and its control - ground effect - profile for minimum drag.

## RIDE MODE **9+3 Hours**

Effects of damping the vibration, vibration absorbers, pitch and bounce motion, oscillation centers - active and semi active suspension - Orthogonality of mode shapes, modal analysis, vehicle performance testing.



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## HANDLING MODE 9+3 Hours

Tyres - mechanics, testing and modeling, vehicle control - low speed cornering and static steering - Ackerman steering geometry, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), steady state handling – lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed - effect of braking on vehicle handling - constant radius testing - fish hook measurement testing.

## VEHICLE STABILITY AND NOISE 9+3 Hours

Load distribution. Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road.

Properties of sound – sound level designation and measurements techniques - Sound isolation and absorption - machine enclosures, silencers and mufflers.

**Theory :45 Hr** **Tutorial: 15 Hr** **Total Hours: 60**

**References:**


1. Gillespie T.D, “Fundamentals of Vehicle Dynamics”, SAE USA 1992.
2. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., 2002.
3. Giri N.K – Automotive Mechanics, Khanna Publishers, 2007.
4. Karl Popp, Werner O. Schiehlen, “Ground Vehicle Dynamics”, Springer, 2010.


**Other references:**


1. Rajesh Rajamani, “Vehicle Dynamics and Control”, Springer, 2012.
2. Georg Rill, “Road Vehicle Dynamics: Fundamentals and Modeling”, CRC Press, 2012.
3. Giles.J.G.Steering - “Suspension and Tyres”, Illiffe Books Ltd., London- 1998
4. Ellis. J.R, “Vehicle Dynamics”, Business Books Ltd., London, 1991.




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## U14AU*T*702 VEHICLE BODY ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand various category of vehicle frames
**CO2:** Understand various types of vehicle body construction
**CO3:** Familiarize various aerodynamic effects of vehicle body shape

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | M | S | | M | S | | | | | | S |
| CO2 | | M | S | | M | S | | | | | | S |
| CO3 | | M | S | | M | S | | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

### CAR BODY DETAILS **9 Hours**

Types Saloon, convertibles, Limousine, Estate Van, racing and sports car – Visibility: regulations, driver's visibility, tests for visibility – Methods of improving visibility and space in cars – Safety: safety design, safety equipments for car. Car body construction.

### BUS BODY DETAILS **9 Hours**

Classification of bus bodies – Based on distance traveled, Based on capacity of the bus and based on style & shape. Types of metal section used in the construction and regulations. Construction of conventional and integral type buses& comparison.

### COMMERCIAL VEHICLE DETAILS **9 Hours**

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of driver seat in relation to controls. Driver cabin design for compactness.

### VEHICLE AERODYNAMICS **9 Hours**

Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Testing with wind tunnel balance (scale models).



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## BODY MATERIALS, TRIM AND MECHANISMS **9 Hours**

Steel sheet, timber, plastics, GRP, properties of materials – Corrosion – Anticorrosion methods – Selection of paint – Modern painting process in details – Body trim items – Body mechanisms.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Powloski,J., Vehicle Body Engineering, Business Books Ltd., 1989.
2. Heinz Heisler, "Advanced Vehicle Technology", 2nd edition, Butterworth –Heinemann, 2002.
3. Wolf-Heinrich Hucho, "Aerodynamics of road vehicles", 4th edition, 2000.


**Other references:**


1. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd.,London, 1982.
2. Giles,G.J., Body construction and design, Illiffe Books Butterworth & Co., 1971.
3. Braithwaite,J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1977.
4. Dieler Anselm., The passenger car body, SAE International, 2000




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## U14AU*T*703 SPECIAL PURPOSE VEHICLES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand special type of vehicles based on the need and purpose.
**CO2:** Understand the working of power take off shaft
**CO3:** Understand various types of wheels for off road vehicles

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | W | | | W | M | | W |
| CO2 | M | | | | | W | | | W | W | | W |
| CO3 | M | | | | | W | | | W | M | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal test | |
| 3. End Semester Examination | |

### CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES — 6 Hours

Construction layout, capacity and applications. Power Plants, Chassis and Transmission, Multiaxle vehicles.

### EARTH MOVING MACHINES — 10 Hours

Earthmovers like dumpers, loaders - single bucket, Multi bucket and rotary types - bulldozers, excavators, backhoe loaders, scrappers, drag and self powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earth moving machines.

### SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS — 10 Hours

Scrappers, elevating graders, motor graders, self powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – capacity of shovels.

### FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES — 8 Hours

Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles.



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**VEHICLE SYSTEMS ,FEATURES** **11 Hours**

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGrawel Hill Publishing company Ltd.
2. Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd
3. Abrosimov.K. Bran berg.A and Katayer.K., Road making machinery, MIR Publishers, Moscow, 1971
4. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.


**Other references:**


1. SAE Handboob Vol. III. Wong.J.T., Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.
2. Off the road wheeled and combined traction devices – Ashgate Publishing Co. Ltd. 1988.
3. Schulz Erich.J, Diesel equipment I & II, Mcgraw Hill company, London.
4. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd., London.




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| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## U14GS*T*007 PROFESSIONAL ETHICS

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the ethical theories and concepts
**CO2:** Understanding an engineer's work in the context of its impact on society
**CO3:** Understand and analyze the concepts of safety and risk
**CO4:** Understand the professional responsibilities and rights of Engineers
**CO5:** Understand the concepts of ethics in the global context

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | M | S | S | | | | |
| CO2 | | | | | | S | M | | M | | | |
| CO3 | | | | | | M | W | | | | | |
| CO4 | | | | | | W | S | S | M | | | |
| CO5 | | | | | | | | S | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

### ENGINEERING ETHICS AND THEORIES **9 Hours**

Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan's theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations.

### SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.



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**SAFETY** **9 Hours**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy.

**RESPONSIBILITIES AND RIGHTS OF ENGINEERS** **9 Hours**

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination.

**GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS** **9 Hours**

Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Mike Martin and Roland Schinzinger, "Ethics in Engineering". (2005) McGraw-Hill, New York.
2. John R. Boatright, "Ethics and the Conduct of Business", (2003) Pearson Education, New Delhi.
3. Bhaskar S. "Professional Ethics and Human Values", (2005) Anuradha Agencies, Chennai.
4. Charles D. Fleddermann, "Engineering Ethics", 2004 (Indian Reprint) Pearson Education / Prentice Hall, New Jersey.


**Other references:**


1. Charles E. Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and cases", 2000 (Indian Reprint now available) Wadsworth Thompson Learning, United States.




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## U14AU*P*701 VEHICLE DYNAMICS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Analyze the Dynamic modeling and simulations of road vehicles and their subsystems.

**Pre-requisite:**

1. Nil

| CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | W | W | W | S | | | | M | M | W | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Problem solving | 1. Course Exit Survey |
| 2. Practical Classes | |
| 3. Semester Lab Examinations | |

**LIST OF EXPERIMENTS:**

1. Study on automotive systems simulation
2. Simulation and analysis of Rigid Axle Suspension system
3. Simulation and analysis of Independent Suspension system
4. Simulation and analysis of hydraulic brake system
5. Simulation and analysis of air brake system
6. Simulation of steady state cornering characteristics of vehicle
7. Modeling of tires and analysis of cornering characteristics
8. Roll stability and Rollover threshold analysis
9. Simulation of a half car model for pitch and bounce
10. Crash Test Simulation Analysis of a four wheeler.

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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**U14AU*P*702**

# VEHICLE MAINTENANCE AND TESTING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Prepare the Workshop layout and statements
**CO2:** Understand about the tools and Equipments used in Automotive workshop
**CO3:** Troubleshoot and service various sub systems in the vehicle
**CO4:** Test the Vehicle performance

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | M | M | | W |
| CO2 | M | | | | M | | | | M | | | M |
| CO3 | M | | | | M | | | | M | | | W |
| CO4 | M | | | | M | | | | M | | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment | 1. Course Exit Survey |
| 2. Model Practical Examinations | |
| 3. End Semester Practical Examinations | |

## LIST OF EXPERIMENTS:

1. Experimental Study and layout of an automobile repair, service and maintenance shop.
2. Experimental Study and preparation of different statements/records required for the repair and maintenance works.
3. Experimental Study about Tools and instruments used in the maintenance shop
4. Experimental Study about Gearbox, Braking, Steering, Suspension system Maintenance
5. Fault Diagnostics of LCV using Diagnostic kit
6. Lighting System Trouble shooting & Servicing and Head Lights- Beam alignment
7. Fault diagnostics of Air-Conditioning system
8. Gearbox Trouble shooting & Servicing.
9. Braking System Troubleshooting & Servicing



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10. Removal, fitting of tire and tube and Testing wheel balance
11. Testing of camber, caster, kingpin inclination, toe-in and toe-out
12. Performance Testing of Two Wheeler using 2-Wheeler Chassis Dynamometer
13. Performance Testing of Four Wheeler using 4-Wheeler Chassis Dynamometer
14. On-road Braking, Acceleration and Fuel economy test
15. On-road Vehicle handling test
16. Emission test on vehicles using Gas Analyzer and smoke meter

**(Note:Experiments beyond the syllabus should be conducted )**

**Total Hours 30**



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## U14AU*P*703 PROJECT PHASE – I

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Identify a practical problems and find a solution related to automotive
**CO2:** Understand the project management techniques
**CO3:** Demonstrate their report writing and presentation skills

**Pre-requisite:**

1. Minimum of Six semester of courses

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(Pos) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | S | S | M | W | | S | | | S |
| CO2 | | | | | | | | | | | S | |
| CO3 | | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews - 60% | 1. Course Exit Survey |
| 2. Project Report - 10 % | |
| 3. End Semester review -30% | |

**GUIDELINES:**

1. The Project work in Phase-I and II may contain a theoretical study and analysis, experimental analysis, design, modeling & simulation, fabrication of a model or a prototype or a combination of the above related to automotive area.
2. The project work may include literature review, modeling, analysis, simulation, fabrication, testing and analysis & correlation of test data etc.
3. Can be individual or a group project, with maximum of 3 students per group.
4. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
5. In Phase-I of the project, literature survey, projects task plan and design phases should have been completed
6. A project report is required to be submitted at the end of the semester in the required format.
7. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings in addition to the details of project work carried out.

**Total Hours 60**



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## U14AU*P*704 TECHNICAL SEMINAR - 2

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Gain knowledge of fast and rapid changing automotive technology by self learning.

**CO2:** Prepare a presentation on an emerging technology chosen in the proper format

**CO3:** Effectively communicate the contents to the target audience and handle questions with confidence

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | | | S | | | | | | | S |
| CO2 | | | | | | | | | | S | | |
| CO3 | | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Technical presentation | 1. Course Exit Survey |
| 2. Report writing | |

**GUIDELINES:**

1. The students will select topics on their own, the topics may be on any aspect of the automotive technology but normally beyond the curriculum and get it approved by faculty coordinator considering its importance, originality, challenging and within capability of the student.
2. The student will prepare a presentation individually on the approved topic for 15 minutes duration.
3. The presentation should cover the chosen technology topic, literature survey, application to automotive products, current and future scope for the technology, references etc.
4. The student should be able to answer the questions asked by the audience during the presentation.
5. A technical report on the chosen topic will be prepared with minimum 15 pages containing the details from the above presentation and will be submitted at the time of presentation.

**Total Hours 30**



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# SEMESTER VIII



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## U14AU*P*801 PROJECT PHASE – II

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 18 | 6 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Identify a practical problems and find a solution related to automotive
**CO2:** Understand the project management techniques
**CO3:** Demonstrate their report writing and presentation skills

**Pre-requisite:**

1. Minimum of Six semester of courses

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | S | S | M | W | | S | | | S |
| CO2 | | | | | | | | | | | S | |
| CO3 | | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews 50% | 1. Course Exit Survey |
| 2. Project report 10% | |
| 3. Viva Voce 40% | |

**GUIDELINES:**

1. To continue the Phase- I project and executing the same in consultation with the project coordinator and project guide
2. A Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment is a must to complete and an effort leading to paper publication or patenting is desired.
3. A working model or prototype is to be submitted for end semester evaluation
4. A project report is required to be submitted at the end of the semester in the required format.
5. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings, analysis report, DFMEA/FMEA charts in addition to the details of project work carried out.
6. Project work done at Industry should be duly supported by certificate from the Industry.
7. The progress of the project is evaluated based on a minimum of three reviews and end semester viva-voce examination.

**Total Hours 270**



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# ELECTIVES



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# AUTOMOTIVE DESIGN & THERMAL



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## U14AUTE01 AUTOMOTIVE AERODYNAMICS

| L | T | P | c |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the importance aerodynamics for automobiles

**CO2:** Apply the concept of wind tunnel for aerodynamic design of automobiles.

**CO3:** Analyze various aerodynamic shapes of car.

**Pre-requisite:**

1. Fluid Mechanics
2. Vehicle Body Engineering

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | W | M | M | S | | | | | M | S | |
| CO2 | S | S | S | M | M | | | | | M | S | |
| CO3 | S | S | S | M | M | | | | | M | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Project | |
| 3. End Semester Examination | |

### INTRODUCTION 9 Hours

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

### AERODYNAMIC DRAG OF CARS 9 Hours

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

### SHAPE OPTIMIZATION OF CARS 9 Hours

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.



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## VEHICLE HANDLING 9 Hours

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

## WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9 Hours

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd., - 1997.
2. Pope - "Wind Tunnel Testing " - John Wiley & Sons - 2nd Edition, New York - 1974.
3. Automotive Aerodynamic: Update SP-706 - SAE – 1987


**Other references:**


1. Vehicle Aerodynamics - SP-1145 - SAE – 1996.




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## U14AU*T*E02 COMPUTATIONAL FLUID DYNAMICS

| L | T | P | c |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand discretisation process of governing equation
**CO2:** Understand grid generation and its application
**CO3:** Understand different mathematical modules used in CFD
**CO4:** Understand Turbulence Energy Equation in mathematical form
**CO5:** Able to model and analyse fluid flow and heat transfer problems using commercial CFD packages.

**Pre-requisite:**

1. Fluid Mechanics
2. Numerical Methods

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | M | M | | M | | | | | | M |
| CO2 | S | S | M | M | | M | | | | | | M |
| CO3 | S | S | M | M | | M | | | | | | M |
| CO4 | S | S | M | M | | M | | | | | | M |
| CO5 | | | M | W | S | | | | | M | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Tests | 1. Course Exit Survey |
| 2. End-Semester Examination | |
| 3. Project Evaluation | |

### INTRODUCTION **8 Hours**

Application areas of CFD, Basic concepts of fluid flow - Governing equations, conservation of mass, momentum and energy – Navier-stokes and energy equation for Newtonian fluid, Mathematical classification of flow - Hyperbolic, parabolic, elliptic and mixed flow types.

### DISCRETISATION **13 Hours**

Finite difference method - Forward, backward and central difference schemes, explicit and implicit methods - Numerical solution for heat transfer and fluid flow problems for steady state and transient conditions, stability analysis and error estimation. Grid generation - Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements.



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## CFD TECHNIQUES **9 Hours**

Lax - Wendroff technique, MacCormack's technique, relaxation technique. ADI technique, pressure correction technique, SIMPLE algorithm. Fluid flow and convection problems - Upwind scheme and stability criteria.

## TURBULENCE MODELING **9 Hours**

Turbulence energy equation - One-equation model, k-ω model and k- ε model.

## CASE STUDIES **5 Hours**

Modelling and analysis of heat transfer, fluid flow and automobile components using CFD packages

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. John D Anderson, " Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 1995.
2. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
3. Chung T.J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
4. David C Wilcox, "Turbulence Modeling for CFD", DCW Industries, Inc, 1993.


**Other references:**


1. Versteeg H.K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method', Longman, 1995.




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**U14AU*T*E03** **VEHICLE CONCEPT DESIGN AND STYLING**

| L | T | P | c |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the difference between geometric versus naturalistic drawing

**CO2:** Ability to create and innovate different Automotive shapes and to validate them

**CO3:** Able to visually present by using different colors, sketches and to increase the aesthetic sense of vehicles.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | M | | | | | M | | M |
| CO2 | S | M | M | W | M | | | | | M | | M |
| CO3 | | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar | |
| 3. Semester Exam | |

## INTRODUCTION **9 Hours**

Drawing in product design, drawing by hand, drawing by computer, mass production, geometric versus naturalistic drawing, modernist design. Basic drawing skills - Perspectives, metric projections, spherical projections, orthographic projections, sections and scrap views. Tools and materials - Pencils, pens, erasers, markers, paints, ink, airbrush, drawing instruments, paper and aboard.

## COMPUTER SYSTEMS **9 Hours**

The computer processor, system software, the central processing unit, memory, frame buffers, display, input devices, hardcopy output, 3D output devices, networking, health and safety. Concept design - Satisfying the client, sketch, schematic, evaluating the design, 3D modelling concepts, hybrid approach, commercial computer solutions, drawing in space, creating organic forms.

## PRESENTATION DRAWING AND VISUALS **9 Hours**

From water colour washes to markers, painting by numbers, the art of design, visual tricks, making marker drawing, 2D computer programs: paint and vector, 3D computer aided styling (CAS),



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creating virtual reality, shading a computer model, ray tracing and radiosity, adding texture, fractals and commercial modelers.

**FROM GENERAL ARRANGEMENTS DRAWING TO PRODUCTION** **9 Hours**

Technical production documentation, the general arrangement drawing, drafting standards, computer aided drafting, geometric constructions, controlling curves, parametric design, CAD data - Exchange standards and all change in the CAD market.

**TECHNICAL ILLUSTRATION** **9 Hours**

Art of technical illustration, techniques of technical illustration, thick and thin lines, sections, cutaways and ghosting, photo-tracing, annotation and labeling, computer aided illustration, interactive technical illustration and commercial solutions.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Alan Pipes, "Drawing for Designers", Laurence King Publishing, 2007
2. Erik Olofsson, Klara Sjölén, "Design Sketching", Keeos Design Books AB, 2005
3. Tony Lewin, Ryan Borroff, "How to Design Cars Like a Pro", MotorBooks International, 2010.

Other references:

1. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray , "H-Point: The Fundamentals of Car Design & Packaging", Design Studio Press, 2009.




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**U14AU*T*E04** **DESIGN FOR MANUFACTURE AND ASSEMBLY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the basic background of DFM and related concepts
**CO2:** Understand the fundamentals of GD &T
**CO3:** Understand tolerance charting
**CO4:** Apply the concept of DFM
**CO5:** Understand the concept of selective assembly

**Pre-requisite:**

1. Manufacturing Technology

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | |
| CO2 | S | S | | | | | | | | | | |
| CO3 | S | S | M | | | | | | | S | | |
| CO4 | M | | | S | | | | | | | | |
| CO5 | S | | | | | | | | | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment | |
| 3. Semester Exam | |

## DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY **9 Hours**

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on Cost basis.

## GEOMETRIC DIMENSIONING & TOLERANCE INTRODUCTION **9 Hours**

Process capability, process capability metrics, Cp, Cpk , Cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, 6σ concept.

## TOLERANCE CHARTING TECHNIQUE **9 Hours**

Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.



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## DESIGN FOR MANUFACTURE **9 Hours**

Design features to facilitate machining, datum features - Functional and manufacturing, component design-machining considerations, redesign for manufacture, examples Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – Case studies.

## SELECTIVE ASSEMBLY **9 Hours**

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983.
2. Krulikowski A, “Fundamentals of Geometric Dimensioning and Tolerancing, Delmar Publishers, New York, 1991
3. Spotts M. F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 1983.
4. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
5. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, 1987.


**Other references:**


1. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 1967.
2. Creveling C. M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley Longman Inc.,USA, 1997.
3. Pahl.G and Beitz .W, "Engineering Design-Systematic Approach", Springer Verlag Publications, 1996.




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**U14AU*T*E05**

# COMPUTER SIMULATION OF IC ENGINE PROCESSES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand simulating IC engine combustion processes.
**CO2:** Apply the simulation techniques for modification of combustion chamber
**CO3:** Apply the simulation techniques to develop new engines

**Pre-requisite:**

1. Thermodynamics and Thermal Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | M | M | M | M | | | | M | W | M | |
| CO2 | M | S | W | M | S | | | | M | W | M | |
| CO3 | M | S | W | M | S | | | | M | W | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## INTRODUCTION **9 Hours**

Introduction to Simulation, Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models – Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylinder models. Step by step approach in SI & CI engine simulation.

## COMBUSTION AND STOICHIOMETERY **9 Hours**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

## ADIABATIC FLAME TEMPERATURE **9 Hours**

Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle



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## SIMULATION OF IC ENGINES 9 Hours

SI and CI engine simulation – Air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – Part throttle, full throttle and supercharged conditions

## SIMULATION OF NEW ENGINE CONCEPT 9 Hours

Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine and controlled auto ignition engine.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Ganesan,V., Computer Simulation of spark ignition engine process, Universities Press (I) Ltd., Hyderabad, 1996.
2. Ganesan V, “Computer Simulation of Compression-Ignition Engine Processes”, University Press (I) Ltd, Hyderabad, 2000
3. Ramoss,A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.
4. Benson,R.S., Whitehouse,N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.


**Other references:**


1. Ashley Campbel, Thermodynamics analysis of combustion engines, John Wiley & Sons, New York, 1986.




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**U14AU*T*E06**

# NOISE, VIBRATION AND HARSHNESS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the theory of sound.
**CO2:** Analyze various sources of vibration and methods of damping
**CO3:** Apply the concept of design of interiors to maintain NVH levels.

**Pre-requisite:**

1. Engineering Mechanics

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | W | | | | | | | | | | M |
| CO2 | S | M | W | | | | | | | | | M |
| CO3 | S | M | M | W | | | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## FUNDAMENTALS OF ACOUSTICS, NOISE AND VIBRATION — 8 Hours

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

## EFFECT OF NOISE, BLAST, VIBRATION AND SHOCK ON PEOPLE — 7 Hours

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.



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**TRANSPORTATION NOISE AND VIBRATION – SOURCES, PREDICTION AND CONTROL** **10 Hours**

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

**INTERIOR TRANSPORTATION NOISE AND VIBRATION – PREDICTION AND CONTROL** **10 Hours**

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors—Prediction and Control.

**NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT, SIGNAL PROCESSING AND MEASURING TECHNIQUES** **9 Hours**

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Allan G. Piersol ,Thomas L. Paez “Harris’ shock and vibration hand book” , McGraw-Hill , New Delhi, 2010
2. Clarence W. de Silva , “Vibration Monitoring, Testing, and Instrumentation”, CRC Press, 2007
3. David A.Bies and Colin H.Hansen “Engineering Noise Control: Theory and Practice” Spon Press , London . 2009


**Other references:**


1. Colin H Hansen “Understanding Active Noise Cancellation” , Spon Press , London. 2003
2. Matthew Harrison “Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles”, Elsevier Butterworth-Heinemann, Burlington, 2004
3. Xu Wang, “Vehicle Noise and Vibration Refinement”, CRC Press, 2010




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**U14AU*TE*07** **AUTOMOTIVE HVAC**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Design and implement refrigeration and air conditioning systems using standards
**CO2:** Apply the concept of psychometry to estimate the heating and cooling load for automobiles
**CO3:** Check the operation of automatic HVAC control systems and diagnose it.

**Pre-requisite:**

1. Thermodynamics and Thermal Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | M | | W | | | | W | | | M |
| CO2 | S | M | M | | W | | | | M | | | M |
| CO3 | S | S | W | M | S | | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End semester exam | |

## REFRIGERATION **9 Hours**

Introduction - Methods of refrigeration - Air Refrigeration System and its applications – Vapour compression refrigeration system - Vapour absorption refrigeration system - Applications of refrigeration & air conditioning -Automobile air conditioning -Air conditioning for passengers, isolated vehicles, transport vehicles-Applications related with very low temperatures Classification, properties and selection criteria - Commonly used refrigerants – Alternative refrigerants - Eco-friendly refrigerants - Applications of refrigerants -Refrigerants used in automobile air conditioning

## PSYCHOMETRY **9 Hours**

Psychometric properties, tables, charts - Psychometric processes - Comfort charts – Factor affecting comfort - Effective temperature - Ventilation requirements.

## AIR CONDITIONING SYSTEMS AND LOAD ANALYSIS **9 Hours**

Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc. Load Analysis: Outside & inside design consideration - Factors forming the load on refrigeration



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& air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance.

## AIR DISTRIBUTION SYSTEMS **9 Hours**

Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations. Air Routine & Temperature Control: Objectives - evaporator care air flow - Through the dash re-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems.

## AIR CONDITIONING SERVICE AND CONTROL **9 Hours**

Air conditioner maintenance & service - servicing heater system - Removing & replacing components - Trouble shooting of air conditioning system -Compressor service, methods of dehydration, charging & testing.

Air Conditioning Control: Common control such as thermostats- Humidistat us – Control dampers - Pressure cutouts and relays.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Mark Schnubel, “Automotive Heating and Air Conditioning”, Today’s Technician, 5th edn, 2013
2. Steven Daly, “Automotive Air Conditioning and Climate Control Systems”, Butterworth-Heinemann; 1 edition (2006)
3. R.J. Dossat, “Principles of Refrigeration”, Prentice Hall, 5th ed, 2001.


**Other references:**


1. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)
2. W.F. Stoecker and J.W. Jones, “Refrigeration and Air-Conditioning”, Tata McGraw Hill Pub, 1982




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## U14AU*TE*08 COMBUSTION ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand Types and properties of fuel
**CO2:** Understand basic thermodynamics and kinetics of combustion
**CO3:** Understand Combustion theory of solid, liquid and gaseous fuel.

**Pre-requisite:**

1. Engineering Chemistry
2. Thermodynamics and Thermal Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | W | | | | W | | | | | | M |
| CO2 | S | M | W | | | W | | | | | | M |
| CO3 | S | W | M | | | W | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Presentations | |
| 3. End-Semester Examination | |

### INTRODUCTION **9 Hours**

Historical perspective of combustion science – perspective of fuels and combustion technology. Types and general characteristics of fuels – proximate and ultimate analysis of fuels. ROM, DMMF, DAF and bone dry basis. Moisture and heating value determination – gross and net hearting values – claorimetry, DuLong's formula for HV estimation, Flue gas analysis – Orsat apparatus.

### FUEL TYPES **9 Hours**

**Solid Fuels:** Peat – coal – biomass – wood waste – agro fuels – refuse derived solid fuel – testing of solid fuels. Bulk and apparent density – storage – washability – coking and caking coals. Liquefaction of solid fuels.

**Liquid Fuels:** Refining – molecular structure – liquid fuel types and their characteristics – fuel quality.

**Gaseous Fuels:** Classification and characterization.



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## THERMODYNAMICS AND KINETICS OF COMBUSTION **9 Hours**

Properties of mixture – combustion stoichiometry – chemical energy – chemical equilibrium and criteria – properties of combustion products. First law combustion calculations – adiabatic flame temperature (analytical and graphical methods) – simple second law analysis. Elementary reactions – chain reactions – pre-ignition kinetics – global reactions – kinectics – reaction at solid surface.

## COMBUSTION OF SOLID FUELS **8 Hours**

Drying - devolatilization - char combustion. Fixed bed combustion - suspension burning - fluidized bed combustion.

## COMBUSTION OF LIQUID AND GASEOUS FUELS **10 Hours**

Spray formation and droplet behaviour - oil fired furnace combustion - gas turbine spray combustion – direct and indirect Injection combustion in IC engines. Energy balance and furnace efficiency – gas burner types - pulse combustion furnace. Premixed charge engine combustion. Detonation of gaseous mixtures.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Kuo, K.K., Principles of Combustion, 2nd Edition, John Wiley and Sons, Inc., 2005.
2. Annamalai, K and Puri, I.K, Combustion science and Engineering, CRC Press, 2007
3. Borman, G.L. and Ragland, K.W., Combustion Enginnering, McGrawHill International Editions, 1998.
4. Samir Sarkar, Fuels and Combustion, 2nd Edition, Orient Longman, 1990


**Other references:**


1. Sharma SP and Mohan Chander, Fuels and Combustion, Tata Mcgraw Hill, 1984.
2. Bhatt, B.I and Vora, S.M., Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1996
3. Clive Davis, Calculations in Furnace Technology, Pergamon Press, Oxford, 1970.




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**U14AU*T*E09** **ALTERNATE FUELS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand and identify the alternatives to conventional gasoline and diesel fuels
**CO2:** Performance investigation and comparison of alternate fuels
**CO3:** Understand the working of multi fuel engine

**Pre-requisite:**

1. Fuels and Lubricants

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | S | | M | S | S | | | | | S |
| CO2 | S | S | S | | | | | | | | | |
| CO3 | S | | M | | M | S | S | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

## GASEOUS FUELS **10 Hours**

Properties, composition, production, storage, engine modifications, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of compressed natural gas (CNG), liquefied petroleum gas (LPG), hydrogen and ammonia.

## ALCOHOL FUELS **10 Hours**

Properties, composition, production, storage, engine modifications, blends, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of methanol ethanol and butanol.

## BIO-FUELS **9 Hours**

Properties, composition, production, engine modifications, treatment, blends, performance and emission characteristics, advantages and disadvantages of straightvegetable oils, bio-diesel and biogas.

## SYNTHETIC FUELS **8 Hours**

Properties, composition, material compatibility, engine modifications, performance and emission characteristics, advantages and disadvantages of hydrogen with CNG, dimethyl ether (DME), diethyl ether (DEE), syngas, producer gas and plastic fuel.



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**DUAL-FUEL AND MULTI-FUEL ENGINES** **8 Hours**

Technology, working principle, conversion of engine, operation, combustion, performance and emission characteristics, advantages and disadvantages.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Thipse S.S., "Alternate Fuels – Concepts, Technologies and Developments", Jaico Publishing House, Delhi, 2010.
2. Richard L. Bechfold, "Alternative Fuels Guide Book", SAE International, Warrendale, 1997.
3. Ganesan V. "Internal Combustion Engines", Tata Mc-graw Hill Publishing Co. Ltd., New Delhi, 2012.
4. Mathur L and Sharma R.P, "Internal Combustion Engines", DhanpatRai Publications (P), Ltd, New Delhi, 2002.


**Other references:**


1. "Alcohols as motor fuels progress in technology", Series No.19, SAE Publication, USA, 1980.




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# AUTOMOTIVE TECHNOLOGY & MANUFACTURING



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|---|
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**U14AU*T*E10**

# HYDRAULIC AND PNEUMATIC SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the graphical representation, construction and working of the components of the pneumatic and hydraulic systems

**CO2:** Understand and build pneumatic and hydraulic circuits

**CO3:** Understand the working of Automotive pneumatic and hydraulic systems

**CO4:** Analyze and correlate the circuits and programming

**Pre-requisite:**

1. Fluid Mechanics and Machinery

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | M | | | | | | | | S | | |
| CO2 | | | S | | | | | | | | | |
| CO3 | | | S | | | | | | | | | |
| CO4 | | | | | S | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal tests | |
| 3. End semester exam | |

## INTRODUCTION TO FLUID POWER & PRINCIPLE **9 Hours**

Introduction to fluid power control- Hydraulic and pneumatics- Selection criteria, application of fluid power, application of Pascal's law, equation, Transmission and multiplication of force pressure losses- fluids, selection and properties- ISO symbols

## FLUID POWER DRIVES **12 Hours**

Fluid power drives- Pumps- working principle and construction details of gear, vane and piston pumps, hydraulic motor, Hydrostatic transmission drives and characteristics- Hydraulic supply components- Pneumatic power supply- Compressor, air distribution, air motors. Case study related to automotive application

## FLUID POWER ELEMENTS **12 Hours**

Control valves- pressure, flow direction- working principles and construction- Special type valves- cartridge, modular, proportional and servo- Selection and actuation methods.

Actuators- Selection and specification, cylinders- mounting, cushioning, pipe fittings- Fluid conditioning elements- Accumulators. Case study related to automotive application.



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## HYDRAULICS AND PNEUMATICS CIRCUITS DESIGN **9 Hours**

Design of Hydraulic and Pneumatic circuits for automation, Selection and specification of circuit components, sequencing circuits, cascade and Karnaugh- Veitch map method- Regenerative, speed control, Synchronizing circuits. Case study related to automotive application.

## AUTOMOTIVE APPLICATIONS **9 Hours**

Use of electrical timers, switches, solenoid, relay, proximity sensors etc. Electro pneumatic sequencing Ladder diagram- PLC: – elements, function and selection- PLC programming- Ladder and different programming methods- Sequencing circuits. Case study related to automotive application.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Anthony Esposito, “Fluid power with applications” , 5th Edition, Pearson Education 2003.
2. Majumdar, “ Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004
3. Majumdar, “Pneumatic system: Prinicples and maintenance”, Tata McGraw Hill,2004
4. Andrew Parr, “ Hydraulics & Pneumatics” Jaico Publishing House,2004


**Other references:**


1. William W.Reaves, “Technology of Fluid Power”, Delmer Publishers,1997
2. Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006.
3. Peter Rohner,” Fluid Power Logic circuit Design” MacMillion Press Ltd., 1990.
4. Micheal J, Pinches and Ashby, J.G., “Power Hydraulics”, Prentice Hall, 1989.
5. Dudelyt, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.




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**U14AUTE11** **ROBOTICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Familiarize with the history, concept development and key components of robotics technologies.

**CO2:** understand basic mathematic manipulations of spatial coordinate representation and transformation

**CO3:** understand and able to solve basic robot forward and inverse kinematics problems

**Pre-requisite:**

1. Mechanics of Machines
2. Engineering Mechanics

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(Pos) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | | | | W |
| CO2 | S | | | | | | | | | | | |
| CO3 | M | | | | | W | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. Assignment/Presentation/Seminar | |
| 3. Semester Exam | |

## FUNDAMENTALS OF ROBOT **7 Hours**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications

## ROBOT DRIVE SYSTEMS AND END EFFECTORS **10 Hours**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

## SENSORS AND MACHINE VISION **10 Hours**

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors),



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Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors),Wrist Sensors, Compliance Sensors, Slip Sensors

Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

## ROBOT KINEMATICS AND ROBOT PROGRAMMING **9 Hours**

Forward Kinematics, Inverse Kinematics and Differences –Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – DH matrices - Deviations and Problems.

Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

## IMPLEMENTATION AND ROBOT ECONOMICS **8 Hours**

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2001.
2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987


**Other references:**


1. Yoram Koren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992




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**U14AU*T*E12** **VEHICLE TROUBLESHOOTING AND MAINTENANCE**

| L | T | P | c |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Become familiar with Need for Vehicle Maintenance
**CO2:** Apply the concepts of scheduling
**CO3:** Trouble shoot and Repair

**Pre-requisite:**

1. Automotive Chassis
2. Automotive Transmission

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | S | | M | | | | M | | | M |
| CO2 | M | | | M | | | | | | | S | |
| CO3 | | | S | | M | S | M | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1.Continuous assessment tests | 1. Course Exit Survey |
| 2.Assignment | |
| 3. End semester exam | |

## MAINTENANCE OF RECORDS AND SCHEDULES **9 Hours**

Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. service schedule (Manufacture Km service ) and service history maintenance

## ENGINE MAINTENANCE REPAIR AND OVERHAULING **9 Hours**

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.- Need for overhauling- Preparation of Cost sheets ( estimation )- Engine performance analysis-Troubleshoot and Remedies

## CHASSIS MAINTENANCE REPAIR AND OVERHAULING **9 Hours**

Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake



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systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing. How to diagnose troubles and Remedies.- Road Test

**ELECTRICAL SYSTEM MAINTENANCE SERVICING AND REPAIRS** **9 Hours**

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instrument- Diagnose troubles and Remedies

**MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY** **9 Hours**

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance. Manufacture recommended fluids- Kaizen method on schedule services, how to increase productivity and efficiency- Case studies. Field surveys.- Latest technologies in servicing

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. John Doke, "Fleet management ", McGraw Hill Co, 1984.
2. James D Halderman - Advanced Engine Performance Diagnosis PHI - 1998.
3. Judge A N, “Motor vehicle engine servicing, 3rd, Edition ", Pitman Paper pack, London, 1969.


**Other references:**


1. Service Manuals from Different Vehicle Manufacturers.




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**U14AUTE13**

# COMPOSITE MATERIALS AND STRUCTURES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Advantages and Properties of Composite Materials.
**CO2:** Apply the composite materials in Automotive Application.
**CO3:** Analyze the Material properties and Failure criteria for Composites
**CO4:** Select the Materials and Design the Sandwich Construction
**CO5:** Understand the fabrication of fibers

**Pre-requisite:**

1. Materials Science

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | | S | | | | | | | | | |
| CO2 | S | | S | | | | W | | | | | |
| CO3 | S | S | S | | | | | | | | | |
| CO4 | S | S | S | | | | W | | | | | |
| CO5 | W | | S | | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## STRESS STRAIN RELATION — 6 Hours

Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalized Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

## METHODS OF ANALYSIS — 12 Hours

Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties. Experimental characterization of lamina.

## LAMINATED PLATES — 12 Hours

Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.



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## SANDWICH CONSTRUCTIONS **8 Hours**

Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

## FABRICATION PROCESS **7 Hours**

Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
3. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.


**Other references:**


1. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.




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**U14AUTE14**

# AUTOMOTIVE COMPONENTS MANUFACTURING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Automotive Engine and Transmission system components Manufacturing Process

**CO2:** Understand the Heat Treatment and surface treatment process used for Engine and Transmission system Components Manufacturing

**CO3:** Understand the Automotive vehicle Body and Electrical system Components Manufacturing Process

**CO4:** Understand the surface Coating Process used in Automotive Industry

**Pre-requisite:**

1. Materials Science
2. Automotive Manufacturing Technology

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | | S | | | M | | | | | | |
| CO2 | W | | S | | | M | S | | | | | |
| CO3 | W | | S | | | M | | | | | | |
| CO4 | W | | S | | | M | S | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## ENGINE COMPONENTS **10 Hours**

Casting of engine block - conventional and expendable pattern, machining of engine blocks in machining center. Preparation of casting for cylinder heads, forging of crank shaft, connecting rod and gudgeon pins, machining and heat treatment, casting of piston by gravity casting, squeeze casting, machining and finishing, upset forging of valves, heat treatment and surface improvement, cylinder liners and piston ring manufacturing. Engine bearing manufacturing.

## TRANSMISSION COMPONENTS-I **8 Hours**

Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing.



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**TRANSMISSION COMPONENTS-II** **8 Hours**

Continuous casting of propeller shaft, extrusion of propeller shaft, extrusion dies, heat treatment and surface hardening of propeller shaft, composite propeller shaft manufacturing. Forging of rear axles, casting of rear axle casing, wheels, brake drum, tyre manufacturing

**BODY COMPONENTS** **10 Hours**

Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance welding and other welding processes. Introduction, principle of injection moulding, injection moulding of instrument panel, moulding of bumpers, reinforced reaction injection moluding, tooling and tooling requirements, manufacture of metal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs.

**SURFACE COATINGS AND ELECTRICAL COMPONENTS** **9 Hours**

Chemical vapour deposition, physical vapour deposition, sol-gel processing, spraying, plating, paining in paint booth.

Starter motor, alternator, regulator, battery, lamps, control switches, electronic gauges.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Philip F. Ostwald & Jairo Munuz, "Manufacturing Processes and Systems", John Wiley & Sons, New York, 1998.
2. Degarmo E.P., "Materials and process in Manufacturing", Macmillan Publishing Co., 1997.
3. Heldt P.M., "High Speed Combustion Engines", Oxford IBH publishing Co., Calcutta, 1996.


**Other references:**


1. Kalpakjian, "Manufacturing and Engineering and Technology", Addison Wesloy, Publishing Company, 1995.
2. Sanjay K Mazumdar, "Composites Manufacturing", CRC Press, NY, 2003.




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**U14AU*T*E15** **TYRE TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Basics of tyres and its Components
**CO2:** Understand the Fabric preparation & Calendaring process
**CO3:** Understand the Thread Extrusion & Bead Construction
**CO4:** Understand the building & curing of tyres.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | | S | | | | S | | | | | |
| CO2 | W | | S | | | | S | | | | | M |
| CO3 | W | | S | | | M | S | | | | | M |
| CO4 | W | | S | | | M | S | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## INTRODUCTION TO BASICS OF TYRES **5 Hours**

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres - Major departments of a Tyre Industry – An explanation of their function and relation to other departments. Factors influencing the performance of tyre: Compound design, degree of mixing: (open mill & internal mixing), parameters (temperature, time, speed), degree of vulcanization - Testing and Despatch of mixes, Basic quality control and mill room control Laboratory.

## FABRIC PREPARATION **8 Hours**

Fabrics of the Tyre Industry: Cotton, Rayon, Nylon & steel cords – manufacture, construction – styles and presentations. Bonding methods – Fabric bonding necessities of stronger fabrics leading to bonding methods developments. Wet & dry bonding systems – dip and hot stretch process for Nylon. REL-VP latex systems – and parameters for dip & hot stretch process for Nylon. Modified surface treatment needed for polyesters & glass fabric - Metal coating for steel cord. Recent developments in Radical Tyre fabrics – Aromatic Nylon (Kevlar) and other special fabric reinforcement systems and their use - Testing of dipped fabrics ‘U’, ‘H’ and other tests. Dip pick up and the relation to adhesion etc.



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## CALENDERING 8 Hours

Calendering process: 3 and 4 roll calenders. Skimming & frictioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calenders. Topping process on calendar - Limitation of 3 roll calenders and advantages of 4 roll calenders-process control aspects – economics - Relation between ends per inch and calendering process. Inner, outer and breaker fabrics. Compound fabric ratios and compound design consideration for different styles of fabrics - Defects of calendered fabrics and their remedies. Parameters for scrap control in fabric processes in the tyre industry requirement of total quality control involving fabric supplier's dipping, calendering and bias cutting operations. Economics of fabric usage.

## THREAD EXTRUSION AND BEAD CONSTRUCTION 8 Hours

Basic concepts of Extrusion. Die swell & shrinkage phenomenon – effect of compounding parameters on this phenomenon. Die design and theoretical calculation of tread weight. Effect of viscosity & temperature on extrusion. Dimensions and weight control extusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile – critical dimensions. Duel extruder – Cap & base concept relation to tyre wear parameters like tread wear heat buildup etc.

Cross head extruder wire coating process - Bias cutting and pocket making: Bias angle specification and the significance Horizontal and vertical laying of coated wore. Apex preparation on extruder and profile calender Bead wrapping and flipping operations. Single and double bead concept and preliminary calculation of bead safety factors. Width and angle adjustments splicing and identification. Bias plies pocket 3-3-2 4-4-2 ply constructions Defects of pockets wrong identification over splicing wrinkles, parallel plies etc.

## TYRE BUILDING 8 Hours

Tyre building inputs: Inner liners, plies, beads, tread, side wall and gum strips – their inspection Drum inspection for drumset, drum circumference Significance of parameters for tyre building. Size making on finished tyre and the relation to building specifications. Tyre building specifications sequence of building. Intermitant consolidation use of various cements and gum strips. Importance of the state of the Art Technology. Appraisal of Tyre building as most crucial operation correlation of some of the cured tyre & service returned tyres to the lack of building skill. Green tyre inspection procedures weight tolerance techno-commercial importance of green tyre weight. Green tyre storage considerations.

## GREEN TYRE PREPARATION & CURING 8 Hours

Internal and External painting – Awling – Bagging in case of Air bag cure Bag-omatic and Air bag curing – mold lubrication- Bladder assembly bead curing rings – Dimension criticality Services to the Bag-o-matic presses Curing cycle – shaping – HPS, and hot water circulation. Dome steam cold water & vacuum cycles. Determination of optimum cure of tyres by thermocouple built tyres. Economics of curing post cure inflation of Nylon tyres cured tyre inspection. Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fastwear, poor retreading Bead/casing failures. Hot and cold process retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

**Theory :45 Hr** **Total Hours: 45**



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**References:**


1. Tom French, Tyre technology, The University of Michigan, 1989.
2. Blow. C. M, Rubber Technology and Manufacture, Butterworth- Heinemann, London, 1982.
3. Maurice Morton, “Rubber Technology”, Springer, 3rd edition, 1987.
4. Claude Hepburn, “Rubber Technology and Manufacture”, Third Edition, 2005.


**Other references:**


1. Kovac. F. J, “Tyre Technology”, Good Year Tire & Rubber Company, 1973.
2. Different tyre manufacturer’s websites.




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**U14AUTE16** **UNCONVENTIONAL MACHINING PROCESSES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the need for the processes and classification
**CO2:** Understand the processes that use Mechanical energy
**CO3:** Understand the processes that use Electrical energy
**CO4:** Understand the processes that use chemical and Electro- chemical energy
**CO5:** Understand the processes that use Thermal energy

**Pre-requisite:**

1. Manufacturing Technology

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | |
| CO2 | | | S | | M | M | | | | | | S |
| CO3 | | | S | | M | M | | | | | | S |
| CO4 | | | S | | M | M | | | | | | S |
| CO5 | | | S | | M | M | | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

**INTRODUCTION** **5 Hours**

Unconventional machining Process – Need – classification – Brief overview.

**MECHANICAL ENERGY BASED PROCESSES** **10 Hours**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications

**ELECTRICAL ENERGY BASED PROCESSES** **8 Hours**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.



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## CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **12 Hours**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskant-techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-equipments-Surface Roughness and MRR-Electrical circuit-Process Parameters-ECG and ECH - Applications.

## THERMAL ENERGY BASED PROCESSES **10 Hours**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi (2007).


**Other references:**


1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition, 2001.




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**U14AU*T*E17**

# RAPID PROTOTYPING TOOLING AND MANUFACTURING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the stages of product development

**CO2:** Understanding the concepts of STEREO LITHOGRAPHY AND DIRECT METAL LASER SINTERING processes

**CO3:** Understanding the concepts of FUSION DEPOSITION MODELING AND LAMINATED OBJECT MANUFACTURING and the machine details

**CO4:** Understanding the concepts of SOLID GROUND CURING and 3D printing processes and the machine details

**CO5:** Understanding the concepts of Rapid Tooling and the medical applications of RPT

**Pre-requisite:**

1. Manufacturing Technology

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | M | |
| CO2 | | | S | | S | | M | | | | | |
| CO3 | | | S | | S | | M | | | | | |
| CO4 | | | S | | S | | M | | | | | |
| CO5 | | | S | | S | | M | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal tests | |
| 3. End semester exam | |

**PRODUCT DEVELOPMENT STAGES** **9 Hours**

Introduction: Need for time compression in product development, Product development - conceptual design - development - detail design - prototype - tooling.

**STEREO LITHOGRAPHY AND DIRECT METAL LASER SINTERING** **9 Hours**

Classification of RP systems, Stereo lithography systems - Principle - process parameters - process details - machine details, Applications. Direct Metal Laser Sintering (DMLS) system - Principle - process parameters - process details - machine details, Applications.



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**FUSION DEPOSITION MODELING AND LAMINATED OBJECT MANUFACTURING** **9 Hours**

Fusion Deposition Modeling - Principle - process parameters - process details - machine details, Applications. Laminated Object Manufacturing - Principle - process parameters - process details - machine details, Applications.

**SOLID GROUND CURING** **9 Hours**

Solid Ground Curing - Principle - process parameters - process details - machine details, Applications. 3-Dimensional printers - Principle - process parameters - process details – machine details, Applications, and other concept modelers like thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

**RAPID TOOLING** **9 Hours**

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) - Principle. Introduction to rapid tooling - direct and indirect method, software for RP - STL files, Magics, Mimics. Application of Rapid prototyping in Medical field.

**Theory :45 Hr** **Total Hours: 45**

**References:**

1. Pham, D.T&Dimov.S.S, 2001, Rapid manufacturing, Springer-Verlag, London.

**Other references:**

1. Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA.



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**U14AUTE18**

# DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

**(Approved Design Data Book is Permitted)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understanding the jigs and fixtures and need for them
**CO2:** Understand and design the different types of jigs
**CO3:** Understand and design the different types of Fixtures
**CO4:** Understand the different types of presses and their elements
**CO5:** Design of different types of dies

**Pre-requisite:**

1. Manufacturing Technology

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | S | | M | | | | | | | | |
| CO2 | S | | S | | | | | | | | M | |
| CO3 | S | | S | | | | | | | | M | |
| CO4 | | M | S | | | | | | | | | |
| CO5 | S | | S | | | | | | | | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal tests | |
| 3. End semester exam | |

## PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES — 8 Hours

Tool design objectives - Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

## JIGS — 9 Hours

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

## FIXTURES — 9 Hours

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given component



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**PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT** **10 Hours**

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers –knockouts-stops –pilots-Selection f standard die sets strip lay out-strip lay out calculations

**DESIGN AND DEVELOPMENT OF DIES** **9 Hours**

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Edward G Hoffman, Jigs & Fixture Design, Thomson – Delmar Learning, Singapore 2004
2. Donaldson. C, Tool Design, Tata McGraw-Hill, 1986
3. Kempster, "Jigs & Fixtures Design, The English Language Book Society", 1978
4. Joshi, P.H., "Jigs & Fixtures, Second Edition", Tata McGraw-Hill Publishing Company Limited, New Delhi 2004


**Other references:**


1. Hiram E Grant, ' Jigs and Fixture' Tata McGraw-Hill, New Delhi, 2003
2. Fundamentals of Tool Design, CEEE Edition, ASTME, 1983
3. PSG College of Technology, Coimbatore - Design Data Handbook.




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# AUTOMOTIVE ELECTRONICS & SYSTEMS



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**U14AU*T*E19** **EMBEDDED COMMUNICATION SYSTEM PROTOCOLS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the different communication protocols used in automobiles

**CO2:** Make use of communication protocols for interfacing sensors and automotive subsystems with that of microcontrollers.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | | | | |
| CO2 | | | | | | | | | M | | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal tests | |
| 3. End semester exam | |

## EMBEDDED NETWORKING **9 Hours**

Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming -ISA/PCI Bus protocols - Firewire USB bus – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types – Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs –CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN

## CONTROLLER AREA NETWORK (CAN) PROTOCOL **9 Hours**

History and foundation of CAN, CAN Applications, Main characteristics of CAN, CAN in OSI Reference Model, CAN Data Link Layer, Principles of data exchange in CAN, Arbitration, Data Frame, Remote Frame, Error detection and management in CAN, CAN physical Layer, Bit encoding, Bit timing and synchronization, Relationship between data rate and bus length, Single wire and twin wire media, CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), Comparison with other IVN protocols, CAN based applications development



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## LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL **9 Hours**

Introduction to LIN, LIN consortium, LIN specification, LIN features, Technical overview, Work flow concept, LIN operation, LIN frame format, Scheduling table, Network management of LIN cluster, LIN Transport Layer, LIN node configuration and identification, LIN diagnostics, LIN physical layer, Comparison with other IVN protocols and Case Study

## FLEXRAY PROTOCOL **9 Hours**

Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, Flex Ray Features, Application requirements, Working of FlexRay, Network topologies, ECU architecture, Segment Configuration, Communication Cycles, FlexRay frame format, Timing of configuration protocol, Error control, and FlexRay core mechanisms, Coding and Decoding, Medium Access Control, Frame and Symbol Processing, Clock Synchronization, FlexRay Components, Comparison with other IVN protocols and Case Study

## IN VEHICLE NETWORK DIAGNOSTICS **9 Hours**

Process of Automotive Fault Diagnostics, Fault Codes, Vehicle Systems (open-loop and closed-loop), On- and Off- Board Diagnostics, OBD-I, OBD-II, Engine Analyzers, Steps taken to diagnose a fault, Diagnostics Protocol-KWP2000, SAE-J1587, SAE-J1708 and Case Study

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Muhammad Ali Mazidi, Danny Causey and Janice Mazidi. (2008) HCS12 Microcontrollers and Embedded Systems, Prentice Hall.
2. Frank Vahid, Givargis ‘Embedded Systems Design: A Unified Hardware/Software Introduction’, Wiley Publications


**Other references:**


1. Jan Axelson, ‘Parallel Port Complete’ , Penram publications




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## U14AU*TE*20 VIRTUAL INSTRUMENTATION

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Labview programming and its interfacing

**CO2:** Model Automotive systems

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | M | | | | | | |
| CO2 | M | | | | S | | | | | | S | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Lab Experiments | 1. Course Exit Survey |
| 2. Projects | |

### INTRODUCTION 9 Hours

Virtual Instrumentation-Definition and flexibility-Block diagram and Architecture of Virtual Instrumentation- Virtual instruments versus Traditional Instruments- Review of software in virtual Instrumentation- VI programming techniques- VI, sub VI, Loops and charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, string and File Input / Output.

### DATA ACQUISITION IN VI 9 Hours

A/D and D/A Converters, plug-in Analog input / Output cards- Digital Input and Output cards, Organization of the DAQ VI system- Opto Isolation- Performing analog input and analog output- Scanning multiple analog channels- issues involved in selection of data acquisition cards- Data acquisition modules with serial communication- Design of digital voltmeter with transducer input- Timers and Counters.

### COMMUNICATION NETWORKED MODULES 9 Hours

Introduction to PC buses-Local buses:-ISA,PCI,RS232,RS422 and RS 485- Interface buses:- USB,PCMCIA,VXI,SCXI and PXI – Instrumentation Buses:- Modbus and GPIB- Networked buses- ISO/OSI reference model, Ethernet and TCP/IP Protocols.

### REAL TIME CONTROL IN VI 9 Hours

Design of ON/OFF controller and proportional controller for a mathematically described processes using VI software- Modeling and basic control of level and Reactor Processes- Case Studies on development of HMI, SCADA in VI.



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## AUTOMOTIVE APPLICATIONS **9 Hours**

PC based digital storage oscilloscope- Sensor technology and signal processing- virtual laboratory-spectrum analyzer- wave form generator- Data visualization and multiple locations:- Distributed monitoring and control-Vision and motion control. Case study related to automotive applications.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Nadovich, C., "Synthetic Instruments Concepts and Applications". Elsevier,2005
2. Bitter, R., Mohiuddin, T. and Nawricki, M., "Labview Advanced programming Techniques", CRC Press, 2nd Edition, 2007
3. Gupta, S. and Gupta J. P., "PC Interfacing for Data Acquisition and Process Control", 2nd Edition, Instrument Society of America, 1994
4. Jamal, R. and Picklik, H., "Labview-Applications and Solutions ", National Instrument Release


**Other references:**


1. Johnson, G.," Labview Graphical programming " , McGraw-Hill, Newyork,1997
2. Wells, L.K and Travis, J., " Labview for Everyone", Prentice Hall, New Jersey, 1997
3. Buchanan, W., "Computer Busses ", CRC Press, 2000




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## U14AU*T*E21 FUEL CELL TECHNOLOGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concept of fuel cells in automobiles
**CO2:** Understand the various characteristic components of fuel cell
**CO3:** Analyze the Performance of fuel cell in automobile application.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | |
| CO2 | | S | S | | | | | | | | | |
| CO3 | M | S | | | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End-semester examinations | |

### INTRODUCTION TO FUEL CELLS **9 Hours**

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.

### FUEL CELLS FOR AUTOMOTIVE APPLICATIONS **9 Hours**

Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.

### FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE **9 Hours**

Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects – membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.



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## FUELING 9 Hours

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.

## FUEL CYCLE ANALYSIS 9 Hours

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

**Theory :45 Hr** **Total Hours: 45**

**References:**

1. Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1-86058 4233, 2004.

**Other references:**

1. Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.



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**U14AU*T*E22** **AUTOMOTIVE SAFETY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand and remember the fundamentals of safety during body design
**CO2:** Applying the knowledge for selecting the suitable active & passive systems
**CO3:** Applying the knowledge for selecting the suitable safety equipments for designing a vehicle
**CO4:** Creating the advanced system for increasing the safety in special purpose vehicles

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | M | | | M | | | | | | |
| CO2 | M | | | | | M | | | | | | |
| CO3 | | | | | | M | | | | | | |
| CO4 | | | S | | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Presentation | |
| 3. End-semester examinations | |

## INTRODUCTION **9 Hours**

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

## SAFETY CONCEPTS **9 Hours**

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

## SAFETY EQUIPMENTS **9 Hours**

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



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## COLLISION WARNING AND AVOIDANCE 9 Hours

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

## COMFORT AND CONVENIENCE SYSTEM 9 Hours

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

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.
2. Vivek D. "*Ergonomics in the Automotive Design Process"* Bhise publisher CRC press, Taylor and Francis group.
3. Ronald K Jurgen, "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.
4. Jullian Happian, "Smith An Introduction to Modern Vehicle Design", SAE, 2002.


**Other references:**


1. Johnson W and Mamalis A.G, "Crashworthiness of Vehicles", MEP, London.
2. Richard Bishop, "Intelligent Vehicle Technology and Trends" – 2005.
3. George A. Peters , Barbara J. Peters, "Automotive Vehicle Safety" – 2002.




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## U14AU*TE*23 ELECTRIC AND HYBRID VEHICLES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Differentiate electric and hybrid vehicles

**CO2:** Understand the subsystems and components used in electric and hybrid vehicles

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | | | | |
| CO2 | M | | | | | | | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Internal Test | 1. Course Exit Survey |
| 2. End semester Examination | |

### INTRODUCTION TO ELECTRIC VEHICLES **9 Hours**

Layout of an electric vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

### HYBRID VEHICLES **8 Hours**

Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

### ELECTRIC PROPULSION SYSTEMS, GENERATORS, MOTOR CONTROLLERS AND CONTROL SYSTEMS **10 Hours**

DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics, regenerative braking.

DC generators, AC generators, voltage and frequency regulations.

Control system principles, speed and torque control – DC motors and AC motors.

### ENERGY STORAGES **9 Hours**

Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultracapacitors.



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## FUEL CELLS & SOLAR CARS **9 Hours**

Fuel cell, construction, working, equations, possible fuel sources, fuel reformer, design. Solar cars-photovoltaic cells, tracking, efficiency and Cost comparison

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. MehrdadEhsani, YiminGao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRS Press, 2004.
2. James Larminie and John Loury, "Electric Vehicle Technology-Explained", John Wiley & Sons Ltd., 2003.
3. Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth –Heinemann, 2002.
4. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.


**Other references:**


1. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth-Heinemann, 2001.




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## U14AU*TE*24 VEHICLE TESTING AND VALIDATION

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

CO1: Understand the concept of vehicle and engine performance evaluation
CO2: Understand about the Laboratory and On road testing of vehicles
CO3: Understand the various mechanical measurement devices used in vehicle testing

**Pre-requisite:**

1. Measurements & Metrology

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | S | S | S | M | | | | | | |
| CO2 | S | | S | S | S | M | | | | | | |
| CO3 | S | | S | S | S | M | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignments | 1. Course Exit Survey |
| 2. Continuous assessment tests | |
| 3. End-semester examination | |

**MEASUREMENT SYSTEMS** **9 Hours**

Introduction to Measurement systems-static and dynamic measurement –closed and open loop system - Requirements and characteristics – Analysis of experimental detail. Error analysis

**TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES** **9 Hours**

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays –Signal Analyzing

**MECHANICAL MEASUREMENT** **9 Hours**

Instrumentation for measuring Weight, Force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion

**ENGINE EXPERIMENTAL TECHNIQUES** **9 Hours**

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements



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**VEHICLE EXPERIMENTAL TECHNIQUES** **9 Hours**

Laboratory tests- test tracks - Endurance Tests- crash tests- Vehicle performance test – Brake tests.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. A.W. JUDGE, Engineering Precision Measurement, Chapman and Hall Ltd, Essex Street W.C.,1951,
2. T.G. Beckwith and Buck, Mechanical Measurements, Oxford and IBH Publishing House, New Delhi, 1995
3. D.Patambis, Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co, New Delhi, 1990.
4. Rangan, Sharma and Mani, Instrumentation Devices and systems, Tata McGraw Hill Publishing Co., Ltd., 1990


**Other references:**


1. J.G. Giles, Engine and Vehicle Testing, Illiffe books Ltd., London,1968.




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**U14AU*T*E25**

# MODERN AUTOMOBILE ACCESSORIES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the Engine & Chassis Management system
**CO2:** Understand the Heating and Air-Conditioning
**CO3:** Understand the Comfort , Convenience, Safety & Security Systems

**Pre-requisite:**

1. Automotive Chassis
2. Automotive Engine Systems

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | W | S | | | | S | | | | | | M |
| CO2 | W | S | | | | S | | | | | | M |
| CO3 | W | S | | | | S | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## ENGINE MANAGEMENT SYSTEMS **9 Hours**

Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed loop ignition system. Catalytic converters and particulate traps.

## CHASSIS **9 Hours**

Active suspension control, Pneumatic suspensions, Power train monitoring, safety views-Modern development in Chassis management of vehicles.

## HEATING AND AIR CONDITIONING **9 Hours**

Principles of vehicle air conditioning and heating-Automatic climate control system-Modern trends in thermal management of vehicles-Influence of Electronics in thermal management of vehicles.

## COMFORT AND CONVENIENCE **9 Hours**

Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering.



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**SAFETY AND SECURITY SYSTEMS** **9 Hours**

Airbags, seat belt tightening system, collapsible and tiltable steering column, Anti-theft system, anti-lock braking system, electronic stability control system/traction control system, roll over protection system.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Tom Denton - "Automobile Electrical and Electronic Systems" - Edward Arnold, London - 1995.
2. Eric Chowanietz - 'Automotive Electronics' - SAE International USA - 1995.


**Other references:**


1. Bosch Automotive Hand Book - 5th Edition - SAE Publication, USA - 2000.




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# GENERAL & MANAGEMENT



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**U14AUTE26**

# ENTREPRENEURSHIP DEVELOPMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Analyze himself on entrepreneurial traits
**CO2:** Analyze various business opportunities
**CO3:** Prepare a project report on a project idea

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | S | S | S | S | | S | S |
| CO2 | | | | | | S | S | S | S | | S | S |
| CO3 | | | | | | S | S | S | S | | S | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End semester exam | |

## ENTREPRENEURSHIP — 9 Hours

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Multiprener, Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

## MOTIVATION — 9 Hours

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

## BUSINESS — 9 Hours

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – e-business –Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies



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## FINANCING AND ACCOUNTING **9 Hours**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax

## SUPPORT TO ENTREPRENEURS **9 Hours**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Khanka. S.S, "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
3. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013
4. Mathew J Manimala, Enterprenuership theory at cross roads: paradigms and praxis", 2nd Edition, Dream tech, 2005


**Other references:**


1. Rajeev Roy, 'Entrepreneurship', 2nd Edition, Oxford University Press, 2011
2. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers:Entrepreneurship Development", Institute of India, Ahmadabad, 1986




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**U14AU*T*E27** **PROJECT MANAGEMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concepts of project definition, life cycle, and systems approach

**CO2:** Develop competency in project planning, scheduling and related activities.

**CO3:** Handle the complex tasks of time estimation and project scheduling, including PERT and CPM.

**CO4:** Develop competencies in project Costing, budgeting, and financial appraisal

**CO5:** Gain exposure to project control and management, using standard tools of Cost and schedule variance analysis.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | M | M | S | S | S | S | M |
| CO2 | | | | | | M | M | S | S | S | S | M |
| CO3 | | | | | | M | M | S | S | S | S | M |
| CO4 | | | | | | M | M | S | S | S | S | M |
| CO5 | | | | | | M | M | S | S | S | S | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment /Case Study | 1. Course Exit Survey |
| 2. Internal Examination | |
| 3. End Semester Examination | |

## PROJECT MANAGEMENT CONCEPTS **9 Hours**

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction.

## PROJECT ORGANIZATION & PROJECT CONTRACTS **9 Hours**

Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.



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## PROJECT APPRAISAL & COST ESTIMATION **9 Hours**

Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social Cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital Cost of a project, modern approach to project performance analysis

## PROJECT PLANNING & SCHEDULING **9 Hours**

Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM Cost accounting systems, lowest Cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique

## MODIFICATION & EXTENSIONS OF NETWORK MODELS **9 Hours**

Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Nagarajan. K, “Project “Management, New Age International, 2012.
2. Harvey Maylor, “Project Management”, Prentice Hall, 2010.


**Other references:**


1. Erik W. Larson, “Project Management”: The Managerial Process (Special Indian Edition), Tata McGraw-Hill Education, 2006




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**U14AUTE28**

# QUALITY CONTROL AND RELIABILITY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand statistical quality control techniques
**CO2:** Predict the life of components based on their reliability
**CO3:** Analyze the failure data using various methods

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | W | | | | | | | | S | M |
| CO2 | S | | W | | | | | | | | S | M |
| CO3 | M | | W | | | | | | | | S | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## STATISTICAL PROCESS CONTROL — 9 Hours

Quality control – Definition – Quality Assurance Variation in process – Factors – control charts – variables XR and XÃ, - Attributes P, C and U-Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

## ACCEPTANCE SAMPLING — 9 Hours

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts Design of single sampling plan – standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan

## EXPERIMENTAL DESIGN & TAGUCHI METHOD — 9 Hours

Fundamentals – factorial experiments – meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques – Pareto analysis



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## RELAIBILITY AND ITS PREDICTION **9 Hours**

Life testing – Failure characteristics – MTBA MTTF – System reliability – OC curve Availability and Maintainability – Reliability Improvement techniques

## FAILURE DATA ANALYSIS **9 Hours**

Real time distribution, exponential, normal, log normal, gamma and weibull – reliability data requirements – Graphical evaluation

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. AmitaMitra "Fundamentals of Quality Control and Improvement" Pearson Education, 2002
2. Modares: Reliability & Risk Analysis Marcel Decker Inc. 1993.
3. Bester field D.H., "Quality Control" Prentice Hall, 7th edition 2003


**Other references:**


1. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publications, 2004




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**U14AU*T*E29** **ENERGY STUDIES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the need for global energy demand
**CO2:** Apply energy conservation techniques
**CO3:** Understand energy police and energy Cost.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | S | M | M | | | | |
| CO2 | | | | | | S | M | M | | | | |
| CO3 | | | | | | S | M | M | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1.Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End semester exam | |

## ENERGY SOURCES **9 Hours**

Fossil fuels, Nuclear fuels, hydel, solar, wind and bio fuels in India, Energy conservation, Nuclear energy through fission and fusion processes.

## ENERGY CONVERSION **9 Hours**

Energy conversion from source to utility, Solar, Nuclear, Geothermal, Tide and Wind Energies.

## GLOBAL ENERGY SCENARIO **9 Hours**

Role of energy in economic development and social transformation, Overall energy demand, availability and consumption, Depletion of energy resources and its impact on economy, Non proliferation of nuclear energy. International energy policies of G-8, G-20, OPEC and European union countries.

## INDIAN ENERGY SCENARIO **9 Hours**

Commercial and noncommercial forms of energy, Utilization pattern in the past, present and also future prediction, Sector wise energy consumption.



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## ENERGY POLICY **9 Hours**

Energy policy issues at global level, national level and state level, Energy conservation act 2001, Electricity act 2003, Energy pricing and its impact on global variations.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Jose Goldenberg, Thomas Johanson, and Reddy, A.K.N., Energy for Sustainable World, WileyEastern, 2005.
2. Charles E. Brown, World Energy Resources, Springer Publication, New York, 2002.
3. Culp, A.W., Principles of Energy Conversion, McGraw Hill New York, 2004.


**Other references:**


1. Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi, 2003.




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**U14AU*T*E30**

# VEHICLE DEALERSHIP MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the basic concepts of dealership.
**CO2:** Apply a strategic perspective of the retailing industry
**CO3:** Apply the concept of management in parts ordering, servicing.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | M | | | M |
| CO2 | M | | | | | | | | M | | | M |
| CO3 | M | | | | | | | | M | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous assessment tests | 1. Course Exit Survey |
| 2. Assignment | |
| 3. End semester exam | |

## DEALERSHIP **9 Hours**

Understanding Dealership Infrastructure requirements. Furnishing dealership. Preparing dealer manual.

## SHOWROOM MANAGEMENT **9 Hours**

Contemporary showroom management. Institutionalising, structuring and monitoring the sales process, managing the showroom floor and the sales team. Retail developments and industry trends

## SERVICE MANAGEMENT **9 Hours**

Service management, process and fundamentals, repair order analysis, productivity and efficiency, scheduling, loading, warranties and service retention.

## PARTS MANAGEMENT **9 Hours**

Parts management, inventory control, staffing and productivity, ordering parameters, parts marketing, merchandising, retailing and trade activities.



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**CASE STUDY** **9 Hours**

Applying theory in practice working case study of an actual dealership, group presentations and action planning.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. A.Sivakumar (1997), Retail Management, Excel Books, New Delhi.
2. Kapil Sharma (2009), Marketing Management, Global India Publication Pvt.Ltd., New Delhi.
3. KVS Madaan (2009), Fundamentals of Retailing, Tata McGraw Hill, New Delhi


**Other references:**


1. Gibson G.Vedamani (2003), Retail Management, Jaico Publishing House, New Delhi




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**U14AUTE31**

# VEHICLE TRANSPORT MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concept of personal Management and selection process
**CO2:** Understand the Passenger and Good Transport management Systems
**CO3:** Understand the Motor Vehicle Act
**CO4:** Understand the Automobile vehicle Maintenance.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | S | | | S | | S | S | S | S | M |
| CO2 | | | S | | | S | | S | S | | S | M |
| CO3 | | | S | | | S | | S | | | S | |
| CO4 | | | S | | | S | | S | | | S | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Continuous Assessment Test | 1. Course Exit Survey |
| 2. Assignments | |
| 3. End Semester Examination | |

## INTRODUCTION **9 Hours**

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

## PASSENGERTRANSPORTOPERATION **9 Hours**

Structure of passenger transport organizations- Typical depot layouts- Requirements and Problems on fleet management- Fleet maintenance- Planning -Scheduling operation & control- Personal & training-training for drivers & conductors- Public relations, Propaganda, publicity and passenger amenities-

Parcel traffic.- Theory of fares-Basic principles of fare charging- Differential rates for different types of services- Depreciation & debt charges- Operation Cost and Revenues- Economics & records



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## GOODS TRANSPORT OPERATION **9 Hours**

Structure of goods transport organizations- Scheduling of goods transport- Management Information System (MIS) in passenger / goods transport operation- Storage & transportation of petroleum products- Advance Techniques in Traffic Management- Traffic navigation- Global positioning system.

## MOTOR VEHICLE ACT **9 Hours**

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

## MAINTENANCE **9 Hours**

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. John Duke - Fleet Management – McGraw-Hill Co, USA -1984.
2. Government Motor Vehicle Act – Eastern Book Company, Lucknow – 1989
3. Kitchin.L.D., - Bus Operation - Illiffee and Sons Co., London, III edition – 1992


**Other references:**


1. The motor vehicle Act 1939 - Ejaz Ahemad, Ashok law house, India - 1989.




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**U14AU*T*E32** **MICROPROCESSOR BASED SYSTEM DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the basics about microprocessors and its programming
Understand the microprocessor based system design

**Pre-requisite:**

1. Basics of Electrical and Electronics Engineering

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | | | | | | | | | | |
| | | | | | | S | | | | | | W |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | 1. Course Exit Survey |
| 2. Projects | |

## INTRODUCTION **9 Hours**

Need for microprocessor based system design – Design cycle – dimensions of the design problem – Hardware design and software design – System integration.

## INPUT AND OUTPUT ALGORITHMIC PROCESSES **9 Hours**

I/O control – I/O timing – Data buffering with FIFOS – Keyboards and switches – Remote instrument control –Self test hardware. Keyboard parsing – Real time programming – Self test algorithm. Multiplication and division algorithms.

## TROUBLESHOOTING SYSTEMS – LOGIC ANALYSERS **9 Hours**

Logic state analysers, Logic timing analysers, Display modes, Logic analysers features – Signature analysis, Error detection using signature analysis. Development systems: Basic features – software development aids –Development system architecture – Emulators, system software – Assembler, linker, loader.

## 8086 /8088 BASED MULTIPROCESSING SYSTEM **9 Hours**

Review of Architecture and Instruction Set of 8086 Processor Coprocessor configuration, closely coupled configurations, loosely coupled configurations – 8087 coprocessor: Architecture, Instruction set – 8089 I/O processor.



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**SYSTEM DESIGN APPLICATIONS** **9 Hours**

LCR meter – PID controller – DC motor speed control – Digital weighing machine – Temperature control – Controller for a washing machine.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. John B. Peatman, Microcomputer Based Interfacing, McGraw Hill, 1988.
2. Douglass V. Hall, Microprocessor and Interfacing, McGraw Hill, 1987.
3. Williams, G.B., Troubleshooting on Microprocessor Based Systems, Pergamon Press 1984.


**Other references:**


1. Yu-Cheng Liu and Glenn A. Gibson, Microcomputer systems, The 8086/8088 family, Second edition, Prentice Hall of India, 1990.




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**U14AU*T*E33**

# TECHNICAL TEXTILES FOR AUTOMOBILES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the role of textiles and fabrics used in Automotive
**CO2:** Understand the developments of composites for Automotive interior
**CO3:** Apply the knowledge of special fabrics to be used in Automotives

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | S | | | | | | | | | |
| CO2 | M | | S | | | | | | | | | |
| CO3 | M | | S | | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## AUTOMOTIVE TEXTILES **9 Hours**

Requirements for automotive textiles, design demands, woven & knitted ,non-woven fabrics used in automotive interiors, Recycling of automotive textiles –Future trends

## SMART TEXTILES IN AUTOMOTIVE INTERIORS **9 Hours**

Car seats- Types of materials used as cushions. Technology for replacing polyurethane foams in car seats. Smart textiles: definition, textile sensors, textile actuators- heating fabrics for car interior, Shape memory alloys for car seats.

## TRANSPORTATION TEXTILES **9 Hours**

Materials used in automobiles – tire cord, filter, air bag- future applications , belt, seat cover, acoustic textiles for noise insulation; Design and development of textile reinforced composites in automobile industry

## AUTOMOTIVE TEXTILE STRUCTURES & COMPOSITES **9 Hours**

2D and 3D textile structures for load bearing applications in automobiles, future trends in applications of textile structures in automobiles, composite structural components



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**SAFETY APPLICATIONS & FUTURE TRENDS** **9 Hours**

Recent developments in fibre/textile reinforcements used in tyres,fibre-rubber adhesion in tyres resent advances in tyre design.

**Theory :45 Hr** **Total Hours: 45**

**References:**

1. R.Shishoo, Textile advances in the automotive industry, Wood head Publishing Limited, Cambridge, England- 2008



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## U14GS*T*002 TOTAL QUALITY MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand quality concepts and philosophies of TQM
**CO2:** Apply TQM principles and concepts of continuous improvement
**CO3:** Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality
**CO4:** Understand the TQM tools as a means to improve quality
**CO5:** Remember and understand the quality systems and procedures adopted

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | | | | | S | | | |
| CO2 | | | | M | | M | | | | | | |
| CO3 | M | M | | | W | | | | | | S | |
| CO4 | | | M | | | | | | | | | M |
| CO5 | | | | | | | | | | | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

### INTRODUCTION 9 Hours

Definition of Quality, Dimensions of Quality, Quality Costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

### TQM PRINCIPLES 9 Hours

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS



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## STATISTICAL PROCESS CONTROL **9 Hours**

The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma

## TQM TOOLS **9 Hours**

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

## QUALITY SYSTEMS **9 Hours**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Dale H.Besterfiled, "Total Quality Management", Pearson Education
2. James R.Evans& William M.Lidsay, "The Management and Control of Quality", South-Western (Thomson Learning), 2008.
3. Feigenbaum.A.V. "Total Quality Management", McGraw Hill
4. Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd., Oxford


**Other references:**


1. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 2007
2. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers.




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## U14GS*T*003 PRINCIPLES OF MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the concepts of management, administration and the evolution of management thoughts.

**CO2:** Understand and apply the planning concepts

**CO3:** Analyze the different organizational structures and understand the staffing process.

**CO4:** Analyze the various motivational and leadership theories and understand the communication and controlling processes.

**CO5:** Understand the various international approaches to management

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | | W | | | | | M | S | |
| CO2 | | | | | | | | | | | S | |
| CO3 | | | S | | | | | | | | | |
| CO4 | | | | | | | | | S | | | |
| CO5 | | | | | | | | | | | M | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

**MANAGEMENT CONTEXT** **9 Hours**

Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration. Evolution of Classical, Behavioral and Contemporary management thoughts.

**PLANNING** **9 Hours**

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making



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## ORGANISING 9 Hours

Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority – Benefits and Limitations. Centralisation Vs De-Centralization and Delegation of Authority.Staffing – Manpower Planning – Recruitment – Selection – Placement – Induction.

## DIRECTING & CONTROLLING 9 Hours

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation. Leadership – Styles and theories of Leadership.
Communication – Process – Types – Barriers – Improving effectiveness in Communication. Controlling – Nature – Significance – Tools and Techniques

## CONTEMPORARY ISSUES IN MANAGEMENT 9 Hours

Corporate Governance Social responsibilities – Ethics in business – Recent issues.
American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. DinkarPagare, "Principles of Management", Sultan Chand & Sons, 2000.
2. Tripathy PC And Reddy PN, "Principles of Management", Tata McGraw-Hill, 4th Edition, 2008.
3. Kanagasapapathi. P (2008) Indian Models of Economy, Business and Management, Prentice Hall of India, New Delhi, ISBN: 978-81-203-3423-6
4. G.K.Vijayaraghavan and M.Sivakumar, "Principles of Management", Lakshmi Publications, 5th Edition, 2009


**Other references:**


1. Harold Koontz & Heinz Weihrich, "Essentials of Management – An International perspective", 8th edition. Tata McGraw-Hill, 2009
2. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata McGraw-Hill, 2009.




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**U14GS*T*004** **OPERATIONS RESEARCH**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Apply linear programming model and assignment model to domain specific situations

**CO2:** Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

**CO3:** Apply the concepts of PERT and CPM for decision making and optimally managing projects

**CO4:** Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

**CO5:** Analyze the inventory and queuing theories and apply them in domain specific situations.

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | S | M | | | | | | | | |
| CO2 | S | S | S | S | | | | | | | | |
| CO3 | S | S | M | M | | | | | | | | |
| CO4 | S | M | S | M | | | | | | | | |
| CO5 | S | S | S | M | | | | | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## LINEAR MODEL **9 Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex

## TRANSPORTATION AND ASSIGNMENT PROBLEM **9 Hours**

Transportation model – Initial solution by North West corner method – least Cost method – VAM. Optimality test – MODI method and stepping stone method.

Assignment model – formulation – balanced and unbalanced assignment problems



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## PROJECT MANAGEMENT BY PERT & CPM **9 Hours**

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT Cost

## REPLACEMENT AND SEQUENCING MODELS **9 Hours**

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).
Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem

## INVENTORY AND QUEUING THEORY **9 Hours**

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.
Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Taha H.A., "Operation Research", Pearson Education
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2002
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co.2008
4. Wagner, "Operations Research", Prentice Hall of India, 2000


**Other references:**


1. S.Bhaskar, "Operations Research", Anuradha Agencies, Second Edition, 2004




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**U14GS*T*005** **ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Evaluate the economic theories, Cost concepts and pricing policies
**CO2:** Understand the market structures and integration concepts
**CO3:** Understand the measures of national income, the functions of banks and concepts of globalization
**CO4:** Apply the concepts of financial management for project appraisal
**CO5:** Understand accounting systems and analyze financial statements using ratio analysis

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | | M | | | | | | M | | |
| CO2 | | | | | | W | | | | | | |
| CO3 | S | | | | | | | | | | | |
| CO4 | | S | | | | | | | | | | |
| CO5 | | | | S | | | | | | M | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## ECONOMICS, COST AND PRICING CONCEPTS **9 Hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods .

## CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES **9 Hours**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.



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**NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT** **9 Hours**

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

**CONCEPTS OF FINANCIAL MANAGEMENT** **9 Hours**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

**ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS** **9 Hours**

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Prasanna Chandra, " Financial Management (Theory & Practice) TMH
2. Weston & Brigham, " Essentials of Managerial Finance"
3. Pandey, I. M., "Financial Management"
4. Fundamentals of Financial Management- James C. Van Horne.
5. Financial Management & Policy -James C. Van Horne


**Other references:**


1. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
2. Management Accounting Principles & Practice -P. Saravanavel




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| U14GS*T*006 | PRODUCT DESIGN AND DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Understand the process to plan and develop products
**CO2:** Understand the process of collecting information and developing product specifications
**CO3:** Understand the concept generation, selection and testing processes
**CO4:** Understand the concepts of product architecture, industrial design and design for manufacture
**CO5:** Understand the basics of prototyping, economic analysis and project planning and execution processes

**Pre-requisite:**

1. Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | M | | | | | | | | S | |
| CO2 | | | M | | | | | | | | M | |
| CO3 | | | S | | | | | | | | | |
| CO4 | | | M | | | | | | | | | |
| CO5 | | | S | | | | | | M | M | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS - PRODUCT PLANNING — 9 Hours

Characteristics of successful product development to Design and develop products, duration and Cost of product development, the challenges of product development.

A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization.

The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.



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**IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS** **9 Hours**

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process.

Specifications, establish specifications, establishing target specifications setting the final specifications.

**CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING** **9 Hours**

The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process.

Overview of methodology, concept screening, concept scoring, caveats.

Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

**PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING** **9 Hours**

Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design.

Definition, estimation of manufacturing Cost, reducing the Cost of components, assembly, supporting production, impact of DFM on other factors.

**PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGING PROJECTS** **9 Hours**

Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Elements of economic analysis, base case financial mode, Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Understanding and representing task, baseline project planning, accelerating projects, project execution, and postmortem project evaluation.

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Product Design and Development: Karl. T. Ulrich, Steven D Eppinger,. Irwin McGrawHill.
2. Product Design and Manufacturing: A C Chitale and R C Gupta, PHI
3. New Product Development: Timjones. Butterworth Heinmann,, Oxford. UCI.


**Other references:**


1. Product Design for Manufacture and Assembly: Geoffery Boothroyd, Peter Dewhurst and Winston Knight.




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**U14GS*T*008** **FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT (FSIPD)**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Outcomes**

After successful completion of this course, the students should be able to:

**CO1:** Analyze various global trends and decide on the scope of a new product [K4]

**CO2:** Outline the product development methodologies and management.[K2]

**CO3:** Develop product management plan for a new product based on the type of the new product and development methodology.[K3]

**CO4:** Summarize requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.[K2]

**CO5:** Conceptualize new product integrating the hardware, software, controls, electronics and mechanical systems.[K6]

**CO6:** Develop test specifications and coordinate the respective activities with testing group, validate the product and confirm its performance as per design specification. [K3]

**CO7:** Develop product documentation as required.[K3]

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | M | W | S | | | | M | | | |
| CO2 | | | W | | | | | | | | S | |
| CO3 | | | S | | | | | | | | S | |
| CO4 | | | M | | S | | | | | | | |
| CO5 | | | | | S | | | | | | | |
| CO6 | | | S | | | | | | M | | | |
| CO7 | | | | | | | | | M | S | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Assignment | 1. Course Exit Survey |
| 2. Internal Test | |
| 3. End Semester Examination | |

## FUNDAMENTALS OF PRODUCT DEVELOPMENT **9 Hours**

**Global Trends Analysis and Product decision:** Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern,



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target Cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis

**Introduction to Product Development Methodologies and Management:** Overview of Products and Services (Consumer product, Industrial product, Specialty products etc); Types of Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements)/ Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall/ Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S-Curve, Reverse Bathtub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management).

## REQUIREMENTS AND SYSTEM DESIGN 9 Hours

**Requirement Engineering:** Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management .**System Design & Modeling:** Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design.

## DESIGN AND TESTING 15 Hours

**Conceptualization:** Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.

**Detailed Design:** Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing. **Prototyping:** Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing. **System Integration, Testing, Certification and Documentation:** Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).

## SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 6 Hours

**Sustenance:** Maintenance and Repair; Enhancements. **Product EoL:** Obsolescence Management; Configuration Management; EoL Disposal.

## BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 6 Hours

**The Industry:** Engineering Services Industry – Overview; Product development in Industry versus Academia.

**The IPD Essentials:** Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and Configuration

**Theory :45 Hr** **Total Hours: 45**

**References:**


1. Foundation Skills in Integrated Product Development (FSIPD), I st Edition, 2013, Published by NASSCOM.
2. Ulrich, Karl T. and Eppinger, Steven D (2004) Product Design and Development, 5th Edition, McGraw-Hill, 2012.


**Other references:**


1. Kevin N. Otto, “Product design – Techniques in Reverse Engineering and New Product Development”, PEARSON, New Delhi, 2011




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# ONE CREDIT COURSES



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**U14AU*I*N01** **OVERVIEW OF MOTORSPORTS ENGINEERING**

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the various events of motorsport engineering

**CO2:** Understanding the rules and regulation for the different motor sports events

**CO3:** Understanding the career opportunities in motor sports engineering

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | | S | | | S | | | | | | |
| CO2 | | | S | | | | S | S | | M | S | |
| CO3 | | | | | | | S | | | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | |
| 2. Seminar | |

**INTRODUCTION TO MOTORSPORT ENGINEERING** **2 Hours**

The history of motorsport engineering-Review of motorsport engineering-Pioneers of Motorsport engineering -Motorsport technology evolution review.

**LIST OF MOTORSPORT COMPETITIONS FOR STUDENTS** **3 Hours**

A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage.

**PROFESSIONAL MOTORSPORT EVENTS** **4 Hours**

The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – MotoGP, Superbike, Endurance, Motocross, Supermoto, Freestyle, Trials, Cross-country rallies, Speedway, Board track, drag racing

**RULES AND REGULATIONS OF MOTORSPORTS** **3 Hours**

Introduction about the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races

**CAREER IN MOTORSPORTS ENGINEERING** **3 Hours**

Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician -Aerodynamics Engineer - Race official / steward

**Total Hours: 15**



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## U14AU*I*N02 AUTOMOTIVE STYLING

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the design trends of concept cars

**CO2:** Apply the concept of ergonomics in designing concept cars

**Pre-requisite:**

1. Nil

| CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | W | | | | | | | | | | |
| CO2 | | M | | | | | | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | |
| 2. Seminar | |

### DESIGN EXPRESSIONS **4 Hours**

Design methodology, Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles and product aesthetics

### INTRODUCTION TO CONCEPT CARS **4 Hours**

Importance of concept cars, Blending technology, Form in concept cars

### CAR DESIGN **4 Hours**

Art and colour, Product styling, Introduction to human factors engineering, Digital design, Concept to reality, Auto show vehicles

### VISUAL FACTORS IN DESIGN **3 Hours**

Colour harmony, Colour in design, Artist's spectrum, Basic color schemes

**Total Hours: 15**



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**U14AU*I*N03**

# ELECTRONIC ENGINE MANAGEMENT SYSTEMS

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Familiarize the importance of ECU for better performance of engines.

**Pre-requisite:**

1. Nil

| **CO/PO Mapping** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | | S | | | | | | | | | W | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | |
| 2. Seminar | |

**Topics covered**

- An overview of Engine Management System
- Current trends in automotive electronic engine management system
- Control of SI & CI engines for better performance and low emissions
- Closed loop control of engine parameters of fuel injection and ignition.
- Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation.
- Electronics emission control techniques

**Total Hours 15**



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## U14AU*I*N04 VEHICLE SERVICE MANAGEMENT

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the Automotive vehicle servicing

**CO2:** Understand the parts Ordering management

**Pre-requisite:**

1. Nil

| CO/PO Mapping<br>(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes(POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | W | S | | | M | S | | | M | | W |
| CO2 | M | W | S | | | M | S | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | |
| 2. Quiz | |
| 3. Assignment / Case study | |

**SERVICE MARKETING** **4 Hours**

Services economy– evolution and growth of service sector, service quality, Focus on Customers - customer expectations, building service customer relationship, Service market segmentation

**SERVICE DESIGN AND DELIVERY** **4 Hours**

Service life cycle, service core process – distributing service direct distribution, channel functions, channels selection, impact of information technology, service recovery, Repair order analysis.

**PARTS MANAGEMENT** **4 Hours**

Parts management, inventory control, staffing and productivity, ordering parameters, parts marketing, merchandising, retailing and trade activities.

**BUSINESS PLANNING** **3 Hours**

Audits- for performance Management

SoP's for process compliance

How to conduct Daily Management meeting for service.

**Total Hours: 15**

**References:**


1. Kenneth E Clow, et. al "Services Marketing Operation Management and Strategy" Biztantra, New Delhi, 2004.
2. ChiristropherH.Lovelock, JochenWirtz, "Services Marketing", Pearson Education, New Delhi, 2004.
3 Halen Woodroffe, "Services Marketing", McMilan Publishing Co, New Delhi 2003.




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## U14AU*I*N05 VEHICLE MAINTENANCE

**Course Outcomes**

On successful completion of the course the learner would be able to:

**CO1:** Understand the Basics of maintenance & workshop statements preparation

**CO2:** Understand the Engine, Chassis, Electrical Maintenance systems

**Pre-requisite:**

1. Nil

**CO/PO Mapping**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes(POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | | S | | | M | S | | | M | | W |
| CO2 | M | | S | | | M | S | | | | | M |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | |
| 2. Quiz | |
| 3. Assignment / Case study | |

**MAINTENANCE OF RECORDS AND SCHEDULES** **2 Hours**

Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets.

**ENGINE MAINTENANCE** **4 Hours**

List of Engine components and cleaning methods, visual and Inspections, minor reconditioning of various components, Reconditioning methods, special tools used for maintenance.

**CHASSIS MAINTENANCE** **6 Hours**

Maintenance of Automobile clutch, gear box, drive, suspension, Brake and Steering systems.

**ELECTRICAL SYSTEM MAINTENANCE** **3 Hours**

Testing methods battery, starter motor, charging, Ignition and lighting Systems. Checking and servicing of dash board instruments.

**Total Hours: 15**

**References:**


1. John Doke, “Fleet Management”, McGraw Hill Co. 1984.
2. James D Halderman, “Advanced Engine Performance Diagnosis”, PHI, 1998.
3. Service Manuals from Different Vehicle Manufacturers.




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