# KUMARAGURU COLLEGE OF TECHNOLOGY

(An autonomous Institution affiliated to Anna University, Chennai)

## COIMBATORE – 641 049

## B.E., AUTOMOBILE ENGINEERING

## REGULATION 2017

## CURRICULUM AND SYLLABUS

## III to VIII Semesters

## DEPARTMENT OF AUTOMOBILE ENGINEERING

# DEPARTMENT OF AUTOMOBILE ENGINEERING

## Vision

To be a renowned Learning Centre in the field of Automobile Engineering contributing towards development of the society.

## Mission

- Develop students for successful careers in Industry, and Academia.
- Provide required learning environment and processes to become socially responsible Engineering Professionals.
- Establish Industry-Institute interaction.
- Inculcate the entrepreneurial mind set among the students.

## Program Educational Objectives (PEO's)

**Graduates will be able to**

1. Design and develop products, utilize their knowledge and skills as engineer / start their own ventures as entrepreneurs
2. Practice managerial leadership roles with values and social responsibility.
3. Pursue higher studies and research in core, allied fields and management.

## Program Outcomes (PO's)

**The following are the program outcomes:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSO's)

**Graduates will be able to**

**PSO 1:** provide solutions for designing safe and affordable automotive and mobile equipment.

**PSO 2:** explore the Automotive Manufacturing, Automotive Electrical & Electronics, vehicle maintenance and service domains.

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# DEPARTMENT OF AUTOMOBILE ENGINEERING

## B.E., AUTOMOBILE ENGINEERING

## CURRICULUM- REGULATION- 2017

### SEMESTER 3

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17MAT3101 | Partial Differential Equations and Transforms | Theory | BS | 3 | 1 | 0 | 0 | 4 | Nil |
| 2 | U17AUI3201 | Automotive Chassis and Transmission | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | Nil |
| 3 | U17AUI3202 | Strength of Materials | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | Nil |
| 4 | U17AUI3203 | Manufacturing Technology | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | Nil |
| 5 | U17AUT3104 | Thermodynamics and Thermal Engineering | Theory | ES | 3 | 1 | 0 | 0 | 4 | Nil |
| 6 | U17INI3600 | Engineering Clinic I | Embedded - Practical & Project | ES | 0 | 0 | 4 | 2 | 3 | Nil |
| | | | | | | | | **Total Credits** | **23** | |
| | | | | | | | | **Total Contact Hours/week** | **29** | |

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**SEMESTER 4**

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17MAT4101 | Numerical Methods and Probability | Theory | BS | 3 | 1 | 0 | 0 | **4** | Nil |
| 2 | U17AUI4201 | Automotive Engines and Systems | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | U17AUT3104 |
| 3 | U17AUI4202 | Fluid Mechanics and Machinery | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | Nil |
| 4 | U17AUI4203 | Machine Drawing | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | Nil |
| 5 | U17AUT4004 | Vehicle Body Engineering | Theory | PC | 3 | 0 | 0 | 0 | **3** | Nil |
| 6 | U17INI4600 | Engineering Clinic II | Embedded - Practical & Project | ES | 0 | 0 | 4 | 2 | **3** | U17INI3600 |
| | | | | | | | | **Total Credits** | **22** | |
| | | | | | | | | **Total Contact Hours/week** | **28** | |

**SEMESTER 5**

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUI5201 | Automotive Electrical and Electronics Engineering | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | Nil |
| 2 | U17AUI5202 | Finite Element Analysis | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | U17MAT4101 |
| 3 | U17AUT5103 | Design of Machine Elements | Theory | PC | 3 | 1 | 0 | 0 | **4** | U17AUI3202 |
| 4 | U17AUT5104 | Mechanics of Machines | Theory | PC | 3 | 1 | 0 | 0 | **4** | Nil |
| 5 | U17____ | Open Elective I | Theory | OE | 3 | 0 | 0 | 0 | **3** | Nil |
| 6 | U17INI5600 | Engineering Clinic III | Embedded - Practical & Project | ES | 0 | 0 | 4 | 2 | **3** | U17INI4600 |
| | | | | | | | | **Total Credits** | **22** | |
| | | | | | | | | **Total Contact Hours/week** | **27** | |

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**SEMESTER 6**

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUI6201 | Automotive Embedded Systems | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | U17AUI5201 |
| 2 | U17AUI6202 | Vehicle Dynamics | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | **4** | U17AUT5104 |
| 3 | U17AUT6003 | Hybrid and Electric Vehicles | Theory | PC | 3 | 0 | 0 | 0 | **3** | U17AUI5201 |
| 4 | U17AUT6004 | Total Quality Management and Project Management | Theory | HS | 3 | 0 | 0 | 0 | **3** | Nil |
| 5 | U17AUE__ | Professional Elective - I | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 6 | U17___ | Open Elective - II | Theory | OE | 3 | 0 | 0 | 0 | **3** | Nil |
| 7 | U17INI6600 | Engineering Clinic IV | Embedded - Practical & Project | ES | 0 | 0 | 4 | 2 | **3** | U17INI5600 |
| | | | | | | | | | **Total Credits** | **23** |
| | | | | | | | | | **Total Contact Hours/week** | **29** |

**SEMESTER 7**

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUI7201 | Vehicle Maintenance and Reconditioning | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | **3** | U17AUI3201 |
| 2 | U17AUT7002 | Automotive Emissions | Theory | PC | 3 | 0 | 0 | 0 | **3** | U17AUI5201, U17AUI4201 |
| 3 | U17AUE__ | Professional Elective - II | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 4 | U17AUE__ | Professional Elective - III | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 5 | U17AUE__ | Professional Elective - IV | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 6 | U17AUP7703 | Project Work - Phase I | Project only Course | PW | 0 | 0 | 0 | 6 | **3** | -- |
| | | | | | | | | | **Total Credits** | **18** |
| | | | | | | | | | **Total Contact Hours/week** | **23** |

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**SEMESTER 8**

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUP8701 | Project Work - Phase II | Project only Course | PW | 0 | 0 | 0 | 24 | 12 | -- |
| | | | | | | | | **Total Credits** | **12** | |
| | | | | | | | | **Total Contact Hours/week** | **24** | |

| | |
|---|---|
| **Total Credits** | **166** |

| List of mandatory courses | | | | | |
|---|---|---|---|---|---|
| **S.No** | **Couse Code** | **Course Title** | **Course Mode** | **CT** | **Semester** |
| 1 | U17VEP3503 | Family Values | Lab | HS | 3 |
| 2 | U17CHT3000 | Environmental Science and Engineering | Theory | MC | 3 |
| 3 | U17VEP4504 | Professional Values | Lab | HS | 4 |
| 4 | U17INT4000 | Constitution of India | Theory | MC | 4 |
| 5 | U17VEP5505 | Social Values | Lab | HS | 5 |
| 6 | U17VEP6506 | National Values | Lab | HS | 6 |
| 7 | U17VEP7507 | Global Values | Lab | HS | 7 |

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## PROFESSIONAL ELECTIVES

### Automotive Design

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUE0001 | Design of Engine Components | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI3202<br>U17AUI4201<br>U17AUT5103 |
| 2 | U17AUE0002 | Design of Chassis Components | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI3201<br>U17AUI3202 |
| 3 | U17AUE0003 | Computational Fluid Dynamics | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI4202 |
| 4 | U17AUE0004 | Computer Simulation of IC Engine Processes | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI4201<br>U17AUT3104 |

### Automotive Manufacturing

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUE0005 | Automotive Components Manufacturing | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI3203 |
| 2 | U17AUE0006 | Design for Manufacture and Assembly | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI3203 |
| 3 | U17AUE0007 | Composite Materials and Structures | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 4 | U17AUE0008 | Additive Manufacturing and Tooling | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |

### Automotive Electrical and Electronics

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUE0009 | Automotive Control System | Theory | PE | 2 | 0 | 2 | 0 | **3** | U17AUI6201 |
| 2 | U17AUE0010 | Auxiliary Vehicle Systems | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 3 | U17AUE0011 | Fuel Cell Technology | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 4 | U17AUE0012 | Automotive Communication Protocols | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 5 | U17AUE0013 | Intelligent Vehicle Technology | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |

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## Automotive Technology and Management

| S.No | Course Code | Course Name | Course Mode | CT | L | T | P | J | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U17AUE0014 | Off Road Vehicles | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 2 | U17AUE0015 | Tyre Technology | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 3 | U17AUE0016 | Vehicle Testing and Validation | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 4 | U17AUE0017 | Entrepreneurship Development | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 5 | U17AUE0018 | Vehicle Transport Management | Theory | PE | 3 | 0 | 0 | 0 | **3** | Nil |
| 6 | U17AUE0019 | Applied Hydraulics and Pneumatics | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI4202 |
| 7 | U17AUE0020 | Automotive Aerodynamics | Theory | PE | 3 | 0 | 0 | 0 | **3** | U17AUI4202 |

## ONE CREDIT COURSES

| S.No | Course Code | Course Name |
|---|---|---|
| 1 | U17AUC0001 | Motorsports Engineering |
| 2 | U17AUC0002 | Automotive Styling |
| 3 | U17AUC0003 | Electronic Engine Management Systems |
| 4 | U17AUC0004 | Intellectual Property Rights |
| 5 | U17AUC0005 | Vehicle Maintenance |
| 6 | U17AUC0006 | Lean Manufacturing |

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# SEMESTER 3

**U17MAT3101 PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**

**(Common to AE/AUE/CE/ME/MEC/EEE)**

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

**Course Outcomes (COs):**

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

**CO1:** Form partial differential equations and solve certain types of partial differential equations.

**CO2:** Know how to find the Fourier Series and half range Fourier Series of a function

**CO3:** To know how to solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.

**CO4**: Apply Fourier series to solve the steady state equation of two dimensional heat equation in Cartesian coordinates.

**CO5**: Apply the Fourier transform, Fourier sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals..

**CO6:** Evaluate Z – transform for certain functions. Estimate Inverse Z – transform of certain functions and to solve difference equations using them.

**Pre-requisite: 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 | M | | S |
| CO2 | S | M | | M | | | | | | | | |
| CO3 | S | S | S | | S | | | | M | M | | S |
| CO4 | S | M | M | | | | | | | | | M |
| CO5 | S | M | M | | S | | | | | | | |
| CO6 | S | S | | | S | | | | M | M | | S |

## Course Assessment methods:

| **Direct** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)<br>3. End Semester Examination |
| **Indirect** |
| 1. Course-end survey |

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**PARTIAL DIFFERENTIAL EQUATIONS** **9+3 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

**FOURIER SERIES** **9+3 Hours**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

**BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS** **5+2 Hours**

Classification of second order quasi linear partial differential equations – Formulation of wave and heat equations using physical laws - Solutions of one dimensional wave equation – One dimensional heat equation (excluding insulated ends)

**BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS** **4+1 Hours**

Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

**FOURIER TRANSFORM** **9+3 Hours**

Fourier Integral Theorem – Representation of Functions – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

**Z –TRANSFORM** **9+3 Hours**

Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform (by using partial fractions, residue methods and convolution theorem) – Solution of difference equations using Z - transform.

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

**References:**


1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition. 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company ltd., New Delhi, 2006.
4. Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2009.


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**U17AUI3201** **AUTOMOTIVE CHASSIS AND TRANSMISSION**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | 4 |

**Course Outcomes**

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

| | | |
|---|---|---|
| CO1: | Understand the construction details of various types of automotive Frames and basic chassis layouts. | [$K_2$] |
| CO2: | Understand the basic function steering system and steering components | [$K_2$] |
| CO3: | Select the appropriate transmission system for various automobiles | [$K_3$] |
| CO4: | Infer the final drive system of a vehicle | [$K_2$] |
| CO5: | Apply the knowledge for selection of suitable axles, wheels and tyres for a vehicle. | [$K_3$] |
| CO6: | Distinguish various types of suspension system, brake system. | [$K_2$] |

**Pre-requisite: 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 | PSO1 | PSO2 |
| CO1 | M | M | M | | | M | | M | M | | | | S | |
| CO2 | S | S | S | W | | | | M | M | W | | | S | |
| CO3 | S | S | S | M | | | M | M | M | M | | | S | |
| CO4 | S | S | S | M | | | | | | | | | M | |
| CO5 | S | S | M | W | | M | S | S | M | W | | | S | |
| CO6 | M | M | M | | | M | S | S | M | | | | S | |

**Course Assessment methods:**

**Direct**
1. Assignments/Mini Projects
2. Internal Test
3. End semester Examination

**Indirect**
1. Course Exit Survey

## Frames and Steering System

| L |
|---|
| 12 Hrs |

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, , Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Ackerman's Steering Mechanisms, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

## Transmission and Drive Line

| L |
|---|
| 12 Hrs |

Requirement of transmission system, Different types of gearboxes - Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox. Automatic transmission - Types and Operations. Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube



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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.

## Axles, Wheels and Tyres

| L |
|---|
| 6 Hrs |

Types of Front Axles and Stub Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings. Wheels and Rims – Types and constructional details, Tyres – Types and constructional details.

## Suspension System

| L |
|---|
| 6 Hrs |

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

## Braking System

| L |
|---|
| 9 Hrs |

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading 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.

## List of Experiments

| **P** |
|---|
| **30 Hrs** |

1. Measurement of the automotive frames
2. Measurement of steering angle
3. Assessment of Automotive chassis
4. Performance test on suspension test Rig
5. Assessment of wheels and tyres
6. Study of final drive assembly
7. Study of different gearboxes
8. Study of different types of brake systems

**Theory :45 Hrs Tutorial: --- Hrs Practical : 30 Hrs Total Hours: 75**

**References:**


1. Tim Gilles, “Automotive Chassis-Brakes, Steering and Suspension”, Thomson Delmer Learning, 2005.
2. Jornsen Reimpell, Helmut Stoll, “Automotive Chassis: Engineering Principles”, Elsevier, 2nd edition, 2001.
3. Newton Steeds and Garret, “Motor Vehicles” 13th Edition, Butterworth, London, 2005.
4. Heinz Hazler, “Modern Vehicle Technology”, Butterworth, London, 2005.
5. Kripal Singh, “Automobile Engineering” ,Standard Publishers,2011
6. R.K. Rajput, “A Text–Book of Automobile Engineering”, Laxmi Publications Pvt.Ltd, 2007.
7. Heldt.P.M, “Automotive Chassis”, Chilton Co., New York,1990.
8. Giles.J.G, “Steering Suspension and tyres”, Iliffe Book Co.,London,1988


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**U17AUI3202** **STRENGTH OF MATERIALS**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | 4 |

**Course Outcomes**

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

| | | |
|---|---|---|
| CO1: | Understand the basic concepts of stress and strain | [$K_2$] |
| CO2: | Compare the beams of different cross sections for shear force, bending moment & bending stress | [$K_4$] |
| CO3: | Understand and apply the different approaches for calculating slope and deflection for various types of beams | [$K_3$] |
| CO4: | Analyze the shafts and columns with different edge conditions by using different theories | [$K_4$] |
| CO5: | Understand the concepts and theories necessary to design the structural elements and pressure vessels | [$K_2$] |
| CO6: | Apply concepts of strength of materials to obtain solutions to real time Engineering problems | [$K_6$] |

**Pre-requisite:**

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 | PSO1 | PSO2 |
| CO1 | S | S | M | | | | | | | S | | | S | |
| CO2 | S | S | M | M | | | | | | S | | | S | |
| CO3 | S | S | M | M | | | | | | S | | | S | |
| CO4 | S | S | M | M | | | | | | S | | | S | |
| CO5 | S | S | M | M | | | | | | S | | | S | |
| CO6 | S | S | M | S | | | | S | | S | | S | S | |

**Course Assessment methods:**

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

## CONCEPT OF STRESSES AND STRAINS

| L |
|---|
| 10 Hrs |

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

| L |
|---|
| 9 Hrs |

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.

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## DEFLECTION OF BEAMS

| L |
|---|
| 9 Hrs |

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

## TORSION OF SHAFTS

| L |
|---|
| 8 Hrs |

Theory of pure torsion, derivation of shear stress produced in terms of torque in a circular shaft. Strength, stiffness of shaft and Torsional rigidity & power transmitted – Expression for torque in terms of polar moment of inertia in a circular shaft subjected to torsion – Circular shafts in series and parallel – Circular shaft subjected to combined bending and torsion – Circular shaft subjected to combined bending and torsion – Composite Shaft.

## COLUMNS AND CYLINDERS

| L |
|---|
| 9 Hrs |

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.

## List of Experiments

| **P** |
|---|
| **30 Hrs** |

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. Deflection Test on Beams

**Theory: 45 Hrs Tutorial: 0 Hrs Practical: 30 Hrs Total Hours: 75**

**References:**


1. Bansal R.K, "*A Text Book of Strength of Materials*", Lakshmi Publications Pvt. Limited, New Delhi, 2010.
2. William Nash, '*Strength of Materials'*, Tata McGraw Hill, 2004
3. S. Ramamrutham and R. Narayanan, (2011), *Strength of Materials*, Dhanpat Rai Publications, 16th edition.
4. Kazmi, S. M. A., "*Solid Mechanics*" TMH, Delhi, India.
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Egor P. Popov, *"Engineering Mechanics of Solids*", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
7. Ferdinand P. Beer, and RusellJohnston.E, *"Mechanics of Materials"*, SI Metric Edition, McGraw Hill, 2011(Hard cover).
8. Timoshenko, S.P. and Young, D.H., (2011), *Strength of Materials*, East West Press Ltd. 5th edition


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**U17AUI3203** **MANUFACTURING TECHNOLOGY**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | 4 |

**Course Outcomes**

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

**CO1:** Understand the Casting processes used for components manufacturing

**CO2:** Understand the Forming and Powder metallurgy processes used for manufacturing bulk and Sheet metal components

**CO3:** Understand the principles of Welding Processes used in manufacturing practices

**CO4:** Understand the Conventional Machining and Machine tools used for components manufacturing

**CO5:** Understand the Principles behind the Unconventional machining processes used for components manufacturing

**CO6:** Understand the Principles behind Forming of Plastics

**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 | PSO1 | PSO2 |
| CO1 | W | | S | | M | | | | | | | | | |
| CO2 | W | | S | | M | | | | | | | | | |
| CO3 | S | | S | | M | | | | | | | | | |
| CO4 | S | | S | | M | | | | | | | | | |
| CO5 | S | | S | | M | | | | | | | | | |
| CO6 | S | | S | | M | | | | | | | | | |

**Course Assessment methods:**

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

## CASTING **9 Hours**

Casting types, procedure to make sand mould, types of core, moulding tools, machines used for 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 **9 Hours**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning - Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy - Forming and Shaping of Plastics –Types of plastics and Molding Types - Principles of Hydro forming process, its advantages and limitations.

## WELDING **9 Hours**

Classification of welding processes. Principles of gas welding- Oxy-acetylene- A.C metal arc welding, Resistance welding, Submerged arc welding, Tungsten inert gas welding, Metal inert gas



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welding, Plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding - defects in welding - Soldering and brazing- Application of Welding in Automobile.

**MACHINE TOOLS FOR MACHINING** **9 Hours**

Introduction to the Lathe, Shaper, Planer, Milling machines, Drilling machines, Cylindrical grinding machine, Capstan and Turret lathe - CNC machines.

**UNCONVENTIONAL MACHINING PROCESSES** **9 Hours**

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.

**List of Exercises: Machining exercises using Machine Tools**

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
6. FOUNDRY
   6.1 Moulding using single and Split Pattern
7. SMITHY (Hand Forging exercises)
   7.1 Making of a Square rod from a round rod
   7.2 Making of a Square and Hexagonal head in a round rod

**Theory :45 Hrs** **Practical : 15 Hrs** **Total Hours: 60**

**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.

5 "H.M.T. Production Technology – Handbook", Tata McGraw-Hill, 2000.
6 Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
7 M. Adithan and A.B. Gupta, "Manufacturing Technology", New Age, 2006
8 Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja, G.S.Sekhon, Nitin Seth, New Age International (P) Limited ,Publishers, 2005
9 Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw-Hill Education, 1980
10 Nontraditional Manufacturing Processes, Gary F. Benedict, Marcel and Decker,2017


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**U17AUT3104** **THERMODYNAMICS AND THERMAL ENGINEERING**

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

(Use of standard Steam tables with mollier chart, HMT Data book and Refrigerant tables are permitted)

**Course Outcomes**

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

CO1: Understand Thermodynamic laws and their applications. [$K_2$]

CO2: Apply energy balance to systems and control volumes, in situations involving heat and work interactions [$K_4$]

CO3: Differentiate between high grade and low grade energies [$K_2$]

CO4: Understand Properties of steam. [$K_2$]

CO5: Integrate the basic concepts into various thermal applications like air compressor, refrigeration and air conditioning. [$K_5$]

CO6: Enlighten the various mode of heat transfer and their engineering application [$K_3$]

**Pre-requisite: 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 | PSO1 | PSO2 |
| CO1 | S | S | | | | | | | | | | | S | |
| CO2 | S | S | | S | | | | | | | | | S | |
| CO3 | S | S | | | | | | | | | | | | |
| CO4 | S | S | | | | | | | | | | | | |
| CO5 | S | S | | | | | | | | | | | S | |
| CO6 | S | S | | | | | | | | | | | S | |

**Course Assessment methods:**

**Direct**

1. Assignments
2. Internal Test
3. Group Presentation
4. End semester Examination

**Indirect**

1. Course Exit Survey

**FIRST LAW OF THERMODYNAMICS**

| L | T |
|---|---|
| 8 Hrs | 3 Hrs |

System, thermodynamic equilibrium, state, property, process, cycle, energy, work, heat, first law of thermodynamics, PMM I, ideal gases, steady flow energy equation and application of first law of thermodynamics to closed and open systems. Simple Problems.

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**SECOND LAW OF THERMODYNAMICS**

| L | T |
|---|---|
| 7 Hrs | 2 Hrs |

Statements of second law of thermodynamics, heat engine, heat pump, refrigerator, carnot cycle, carnot theorem, entropy and entropy changes for a closed system.

**AIR STANDARD CYCLE AND COMPRESSOR**

| L | T |
|---|---|
| 8 Hrs | 2 Hrs |

Otto, Diesel, and Brayton cycles - Concepts and applications, simple problems. Compressors, Classifications of compressors, Single stage and multi stage, intercooler in multi stage compressor.

**PROPERTIES OF STEAM AND VAPOUR POWER CYCLE**

| L | T |
|---|---|
| 6 Hrs | 2 Hrs |

Steam formation, properties of steam. Use of steam tables and Mollier chart, Ideal Rankine cycle, Reheat and regenerative cycle Rankine cycle. Simple problems.

**PSYCHROMETRY, REFRIGERATION AND AIR CONDITIONING**

| L | T |
|---|---|
| 8 Hrs | 3 Hrs |

Properties of atmospheric air, Psychrometric relations, Psychrometric Processes and chart. Principles of refrigeration, Types - Vapour compression and Vapour absorption types – Coefficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning. Introduction to Automotive air conditioning systems. Simple Problems.

**HEAT TRANSFER**

| L | T |
|---|---|
| 8 Hrs | 3 Hrs |

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Basics of Convective heat transfer. Fundamentals of Radiation heat transfer. Flow through heat exchangers, Types and Performance evaluation – Parallel and counter flow. Simple Problems.

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

**References:**


1. Nag .P.K, "*Engineering Thermodynamics"*, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. Yunus A Cengel, "Heat and Mass Transfer – A Practical Approach", Tata McGraw Hill, New Delhi, 2007.
3. Rajput R.K, "*Thermal Engineering"*, Laxmi Publications, 10 th Edition, New Delhi, 2015.
4. Yunus.N.J, Cengel.A, and Michael Boles, "A., Thermodynamics – An Engineering Approach, 8th Edition", Tata McGraw Hill- Education, 2015
5. Kothandaraman.C.P, Domkundwar.S, Anand Domkundwar, "A Course in Thermal Engineering", Dhanpat Rai & Co. (P) Ltd., 2010.
6. Mahesh M. Rathore, "Thermal Engineering", Tata Mc Graw Hill Education private limited, Reprint 2012.


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**U17INI3600** **ENGINEERING CLINIC - I**

| L | T | P | J | C |
|---|---|---|---|---|
| 0 | 0 | 4 | 2 | 3 |

**Course objectives**

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

**Course Outcomes**

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

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

**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 | PSO1 | PSO2 |
| CO1 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews | 1. Course Exit Survey |
| 2. Workbook report | |
| 3. Demonstration & Viva-voce | |

**Content:**

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the third semester, students will focus primarily on IOT with C programming using Audino.

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**GUIDELINES:**

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

**Total Hours: 90**

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| U17VEP3503 | FAMILY VALUES (Mandatory) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 0 |

**Course Outcomes**

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

**CO 1:** Develop skills in maintaining the harmony in the family.
**CO 2:** Create impulsive activities for healthy family
**CO 3:** Be receptive to troubled Individuals
**CO 4:** Gain healthy life by practicing Kundalini Yoga & Kayakalpa
**CO 5:** Possess Empathy among family members.
**CO 6:** Reason the life and its significance

**Pre-requisites :**

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES

**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 | | | | | |
| CO3 | | | | | | | | | | M | | |
| CO4 | | | | | | | | | | | | S |
| CO5 | | | | | | S | | | | | | |
| CO6 | | | | | | | | M | | | | |

**Course Assessment methods**

| **Direct** |
|---|
| 1.Group Activity / Individual performance and assignment<br>2.Assessment on Value work sheet / Test |
| **Indirect** |
| 1. Mini project on values / Goodwill Recognition |

**Values through Practical activities:**

**1. Family system:** Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
**2. Peace in Family :**Family members and their responsibility - Roles of parents, children, grant parents -. Respectable women hood
**3. Core value: Empathy:** Unconditional love - Respect - Compassion - sacrifice–Care &share - helping – emotional support- hospitality – cleanliness
**4. Blessing:** Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.

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**5. Healthy Family:** Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

| **Workshop mode** |
|---|

**REFERENCES**


1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf

2. FRAMEWORK FOR ACTION ON VALUES EDUCATION IN EARLY CHILDHOOD – UNESCO – PDF – www.unesdoc.unesco.org/images/0012/001287/128712e.pdf

3. TRUE FAMILY VALUES Third Edition - Tparents Home www.tparents.org/Library/Unification/Books/TFV3/_TFV3.pdf

4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf

5. PROBLEMS OF INDIA'S CHANGING FAMILY AND STATE ... - the United Nations - www.un.org/esa/socdev/family/docs/egm09/Singh.pdf


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| U17CHT3000 | ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All branches) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 |

**Course Outcomes**

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

CO 1: Analyze the impact of engineering solutions in a global and societal context.

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.

CO 3: Highlight the importance of ecosystem and biodiversity.

CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play an important role in transferring a healthy environment for future generations.

**CO/PO Mapping**

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

| COs | Programme Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
| CO 1 | | M | | | | | S | | M | | | |
| CO 2 | | | | | | M | | | | M | | |
| CO 3 | | | | | | | M | | | | | |
| CO 4 | | | | | | M | S | | | | | |
| CO 5 | | | | | | | S | | | | | |
| CO 6 | | | W | | | | S | | | | | M |

**Course Assessment methods**

| Direct | Indirect |
|---|---|
| 1. Internal Test I<br>2. Internal Test II<br>3. Assignment<br>4. Group presentation<br>5. End Semester Exam | Course end survey |

**INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES** **14 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, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, 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, case studies.

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Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

**ECOSYSTEMS AND BIODIVERSITY** **9 Hours**

**ECOSYSTEM:** Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem 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 – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – 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 – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

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

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production 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 – Human Rights.

**HUMAN POPULATION AND THE ENVIRONMENT** **7 Hours**

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

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

**REFERENCES**


1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.


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3. Bharucha Erach, ‘The Biodiversity of India’, Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, ‘Introduction to Air Pollution’, Techno-Science Publications, 2003.
5. Trivedi R.K., ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’, Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, ‘Environmental Encyclopedia’, Jaico Publication House, Mumbai, 2001.
7. Wager K.D., ‘Environmental Management’, W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, ‘Essentials of Ecology’, Third Edition, Blackwell Publishing, 2008.

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# SEMESTER 4

**U17MAT4101**

# NUMERICAL METHODS AND PROBABILITY

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

**(Common to AE/AUE/CE/ME/MCE/EEE)**

## COURSE OUTCOMES

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

**CO1:** Apply various numerical techniques for solving non-linear equations and systems of linear equations.

**CO2:** Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.

**CO3:** Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.

**CO4:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

**CO5:** Apply the concepts of probability to random variables.

**CO6:** Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

**Pre-requisite: 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 | PSO1 | PSO2 |
| CO1 | S | S | | | | | | | | | | | | |
| CO2 | S | S | | | | | | | | | | | | |
| CO3 | S | S | | | | | | | M | | | | | |
| CO4 | S | S | | | | | | | | | | | | |
| CO5 | S | S | | | | | | | M | | | | | |
| CO6 | S | S | | | | | | | | | | | | |

## COURSE ASSESSMENT METHODS

**Direct**

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

**Indirect**

1. Course-end survey

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**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3 Hours**

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigenvalues of a matrix by Power method.

**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours**

Single step methods: Taylor's series method – Euler and Improved Euler methods for solving a first order equations – Fourth order Runge-Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

**BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours**

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain–Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

**PROBABILITY AND RANDOM VARIABLES 9+3 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function- Probability density function – moments - Binomial, Poisson and Normal distributions – Properties.

**Theory: 45 Hours Tutorials: 15 Hours Total: 60 Hours**

**REFERENCES**


1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 2007.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 7th Edition, Tata McGraw-Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition, 2017.
6. Gupta S.C, and Kapur V.K "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4th Edition, 2014.




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**U17AUI4201** **AUTOMOTIVE ENGINES AND SYSTEMS**

| L | T | P | J | **C** |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
Impart knowledge on IC engines and its subsystems for understanding their role in automobiles.
**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the various components of the engine and its functions.
CO2: Examine the combustion process in SI and CI Engine for understanding the performance and emission characteristics.
CO3: Summarize various fuel supply and injection system used in IC engines.
CO4: Identify the suitable lubrication and cooling system to be used in IC Engines.
CO5: Explain the concepts of Supercharging and Turbocharging.
CO6: Analyze the various properties of fuels used in I.C engines.

**Pre-requisite:**
1 U17AUT3104 - Thermodynamics and Thermal Engineering

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | S | | | S | S | M | | M | | | | S |
| CO2: | S | | S | | | S | S | S | M | S | | | | S |
| CO3: | S | | S | | | M | | M | | M | | | | M |
| CO4: | M | | S | | | M | | M | | M | | | | S |
| CO5: | S | | S | | | S | M | M | | M | | | | M |
| CO6: | S | | S | | | S | 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 ITS COMPONENT** **L: 9 Hrs**
Four stroke SI and CI engines – Working principle- Constructional details of engine components, function, materials, 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.

**COMBUSTION IN SI ENGINES** **L: 12 Hrs**
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 and design variables on combustion, Combustion chambers – types, factors controlling combustion chamber design. Gasoline injection Systems

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**COMBUSTION IN CI ENGINES** **L: 12 Hrs**

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, Diesel injection system.

**LUBRICATION AND COOLING SYSTEM** **L: 3 Hrs**

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 TURBOCHARGING** **L: 9 Hrs**

Objectives – Effects on engine performance – engine modification required – Thermodynamics of supercharging and Turbocharging – Turbo lag-Windage losses- Turbo charging methods – Engine exhaust manifold arrangements.

**Practical**

**List of Exercises :** **P: 30 Hrs**

1. Dismantling and Assembly of Engine components.
2. Experimental investigation on performance and emission characteristics of Twin cylinder C.I engines
3. Experimental Investigation on Performance, combustion and emission characteristics of Single cylinder D.I Diesel engines
4. Heat Balance Test on Automotive Engine
5. Experimental investigation on performance and emission characteristics of Multi cylinder S.I engines
6. Study on CRDI and MPFI fuel injection system.
7. Flash and fire point of fuels
8. Cloud and pour point test
9. Calorific value of liquid and gaseous fuel
10. Viscosity of fuels, Lubricants
11. Drop point of grease and mechanical penetration in grease.

| | | |
|---|---|---|
| Theory : 45 Hrs | Practical: 30 Hrs | **Total Hours: 75** |

**References:**


1. "*Internal combustion engines*", Ganesan V, 4th edition, Tata McGraw Hill Education, 2017.
2. IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
3. "A textbook of Internal Combustion Engines - Rajput R. K, 2nd edition, Laxmi Publications (P) Ltd, 2017.
4. "*Internal Combustion Engine Fundamentals*", John. B, Heywood, McGraw Hill Publishing Co., New York, 2017.
5. *Internal Combustion Engines and Air Pollution* Edward F, Obert,*"*, Intext Education Publishers, 1980.
6. Mathur and Sharma, "*A course on Internal combustion Engines*", Dhanpat Rai & Sons, 2015.


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**U17AUI4202** **FLUID MECHANICS AND MACHINERY**

| L | T | P | J | **C** |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
To understand the fundamental concepts of fluid flow and its application in flow measurement devices, pipes and hydraulic machines.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Understand the properties of the fluid, flow concepts and measuring devices
CO2: Apply the fluid flow concepts and solve the problems
CO3: Analyse the practical flow problems using mathematical techniques
CO4: Apply the laws of conservation in flow through pipes
CO5: Illustrate the working principles of hydraulic machines
CO6: Correlate the Fluid Mechanics principles by performing laboratory experiments.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | M | | | | | | | | | M | | |
| CO2: | S | M | M | | | | | | | | | M | M | |
| CO3: | S | M | M | | | | | | | | | M | M | |
| CO4: | S | M | M | | | | | | | | | M | M | |
| CO5: | M | | | | | | | | | | | M | | |
| CO6: | S | M | M | | | | | | M | | | M | M | |

**Course Assessment methods:**

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

**PROPERTIES OF FLUIDS AND FLUID STATICS** **L: 9 Hrs**
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** **L: 12 Hrs**
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.

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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.

**DIMENSIONAL AND MODEL ANALYSIS** **L: 9 Hrs**

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** **L: 9 Hrs**

Laminar and turbulent flow characteristics, laminar flow through circular pipes – Hagen Poiseuille law, Turbulent flow – development of Darcy – Weisbach equation, major and minor losses in pipes, Flow through pipes in series and parallel.

**HYDRAULIC MACHINES** **L: 6 Hrs**

Hydraulic turbine: Classification, difference between impulse and reaction turbine. Construction and working of Pelton turbine, Francis turbine and Kaplan turbine.
Pumps: classification, difference between positive and non-positive displacement pumps. Construction and working of reciprocating pump and Centrifugal pump.

**Practical**

**List of Exercises :** **P: 30 Hrs**

1. Verification of Bernoulli's theorem
2. Determination of Darcy's friction factor
3. Determination of coefficient of discharge of Venturimeter
4. Determination of coefficient of discharge of Orificemeter
5. Determination of coefficient of discharge of notches
6. Determination of coefficient of discharge of mouthpiece/Orifice
7. Performance study on centrifugal pump
8. Performance study on gear oil pump/Reciprocating Pump
9. Load test on Pelton wheel turbine
10. Load test on Francis tubine
11. Load test on Kaplan turbine

| | | |
|---|---|---|
| Theory : 45 Hrs | Practical: 30 Hrs | **Total Hours: 75** |

**References:**


1. "Fluid mechanics and hydraulic machines", R.K. Bansal, Laxmi Publications (P) Ltd, Tenth edition, 2018.
2. "Hydraulics and Fluid Mechanics", Modi P.N. and Seth S.M., Standard Book House, New Delhi, 21 edition, 2018.
3. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Introduction to Fluid Mechanics", Wiley, 8th Edition, 2013.
4. Frank M.White, "Fluid Mechanics", McGraw-Hill, 7th Edition, New Delhi, 2011.
5. Irving H. Shames, "Mechanics of Fluids", McGraw Hill, 3rd Edition, 2013.


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**U17AUI4203** **MACHINE DRAWING**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
To make the students to understand the concepts of I.S. conventions, methods of dimensioning and sectioning, to draw part and assemble drawings using drawing instruments and software tools.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Interpret the conventional representation of components
CO2: Construct part drawings with required views and dimensions
CO3: Apply the knowledge of Limits, Fits and Tolerances in the drawings.
CO4: Build part and assembly drawings according to BIS with Bill of Materials
CO5: Identify and draw the different types of Screwed Fastenings.
CO6: Make use of CAD software to model and draft components and assemblies.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | M | | S | | | M | M | S | | M | S | |
| CO2: | S | M | S | M | S | | | M | S | S | | M | S | |
| CO3: | S | M | S | M | S | W | | S | | S | | | M | S |
| CO4: | M | S | S | | S | | | M | S | S | | | S | |
| CO5: | M | M | M | | S | | | M | M | S | | | S | |
| CO6: | M | S | S | | S | | | M | S | S | | | S | |

**Course Assessment methods:**

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

**Introduction** **L: 3 Hrs**
Need of Graphical Language, Importance Machine Drawing
Classification of Machine Drawings:
Part Drawing and Assembly Drawing
**Sectioning** **L: 3 Hrs**
**Conventional Representations** **L: 7 Hrs**
Standard parts and Screwed Fastenings.
**Limits, Fits, Dimensional and Form Tolerances** **L: 9 Hrs**
Definitions, Classifications of Fits, System of Fits, Selection of Fits, Method of Indicating Fits on Drawings, Tolerance Grade, Positions of Tolerance, Form Tolerance, Fundamental of Deviations, Shaft and Hole Basis systems, Method of Placing Limit Dimensions
**Part and Assembly Drawings** **L: 8 Hrs**
Introduction, BOM and its Importance, Assembly procedures

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## Practical

**List of Exercises : (Any Five to be practiced)** **P: 30 Hrs**

1. Part and Assembly Drawing of Screw Jack
2. Part and Assembly Drawing of Knuckle Joints
3. Part and Assembly Drawing of Universal coupling
4. Part and Assembly Drawing of Lathe Tail Stock
5. Part and Assembly Drawing of Gear Pump
6. Part and Assembly Drawing of Crankshaft with connecting road and piston
7. Part and Assembly Drawing of Single Plate Clutch

| | | |
|---|---|---|
| Theory : 30 Hrs | Practical: 30 Hrs | **Total Hours: 60** |

**References:**


1. Machine Drawing Textbook By ND Bhatt – 53rd Edition 2016
2. Machine Drawing- P.S. Gill, S.K. Kataria & Sons, 17 th Edition, 2012.
3. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers, 4 th Edition, 2012.
4. "Machine Drawing", Gopalakrishnan.K.R, Subash Publishers, Bangalore, 2000.
5. N. D. Junnarkar , "Machine Drawing", Pearson India, 2006
6. Technical Graphics Communication (IRWIN Graphic Series), Bertoline, Wiebe, Miller, Nasma., Richard D Irwin; 2nd edition (June 1997)


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**U17AUT4004** **VEHICLE BODY ENGINEERING**

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

**Course Objective:**
Impart knowledge for the construction of vehicle with light weight, improved aerodynamics and body trims in accordance with safety regulations.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Classify the vehicles and define basic terminologies.
CO2: Select appropriate body material for automobiles.
CO3: Calculate various aerodynamic forces and moments acting on vehicle.
CO4: Examine the various loads distribution in vehicle frames.
CO5: Familiarize the ergonomics concepts related to the vehicles.
CO6: Apply various safety aspects as per the norms.

**Pre-requisite:**
1 U17AUI3201 - Automotive Chassis and Transmission

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | W | | | | M | | | | | | M | M | |
| CO2: | S | M | M | | | M | M | M | | M | | M | S | |
| CO3: | S | S | S | M | | | M | M | M | M | | | S | |
| CO4: | S | S | S | S | | | | M | M | M | | | S | |
| CO5: | M | W | W | | | S | | M | | | | | M | |
| CO6: | M | W | S | | | S | | M | M | M | | M | S | |

**Course Assessment methods:**

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

**VEHICLE BODY DETAILS** **L: 7 Hrs**
Body Terminologies, Vehicle body construction techniques, BIW, Regulations, Drivers visibility - Methods for improving visibility and space in cars, Seat – dimensions & parameters, Types of loads, Frame design and bending - Idealized structure, surface, crash worthiness, vehicle safety - Crash and Roll Test.

**VEHICLE AERODYNAMICS** **L: 8 Hrs**
Aerodynamics – concept, objectives, Forces and Moments – types and effects on vehicle body, Body optimization techniques for minimum drag and lift. Wind tunnel testing – concept – types - test setup - testing process - Flow visualization techniques - Scale model testing - Component balance to measure aerodynamic forces

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**CAR BODY DETAILS** **L: 8 Hrs**

Classifications – Hatchback, Saloon, Convertibles, Limousine, Estate Van, SUV, Racing and Sports Car – Car body construction Driver seat design – Car body panels, windows, doors, locks – remote and central locking - Safety aspect of car body.

**BUS BODY DETAILS** **L: 8 Hrs**

Types: Mini bus, single decker & double decker, two level, split level and articulated bus, bus body layout, floor height, engine location, entrance and exit locations, passenger seating dimensions, seat layout for RTO registration, constructional details, frame construction, double skin construction, conventional and integral coach type construction. Bus body Code Regulations (ARAI). Pneumatic equipment for passenger door opening & closing. Air conditioning equipment selection and mounting.

**COMMERCIAL BODY DETAILS** **L: 7 Hrs**

Types of body, flat platform, drop side, fixed side, tanker body, tipper body - designs, volume/weight considerations, pay load and related regulations, light commercial vehicle body types. Dimensions of driver's seat in relation to controls, drivers cab design.

**BODY MATERIALS AND MECHANISMS** **L: 7 Hrs**

Types of materials used in body construction - steel sheet, timber, plastics, GRP, FRP - properties of materials. Body trim items - body mechanisms. body repair - body fillers - passenger compartment service – corrosion – types, anticorrosion methods, modern painting process procedure - paint problems, dash board - instrument panel, audio – visual systems.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Body Engineering Design and Construction of Motor Vehicle Bodywork - Sydney F page., Chapman & Hall Ltd, London, 1967
2 Vehicle Body Engineering - Giles J Pawlowsky., Business books limited, 1989
3 Vehicle Body Layout and Analysis - John Fenton., Mechanical Engg. Publication ltd, London, 1980
4 Vehicle Body Building and Drawing - Braithwaite, J.B., Heinemann Educational Books Ltd., London, 1997
5 The Passenger Car Body - Dieler Anselm., SAE International and Vogel Verlag, 2000
6 Materials for Automobile Bodies - Geoff Davies., Butterworth-Heinemann, 2012
7 The Repair of Vehicle Bodies - A. Robinson, W. A. Livesey., Butterworth-Heinemann Ltd, 2018
8 Aerodynamics of Road Vehicles - Wolf-Heinrich Hucho., Published by SAE International, USA, 1998
9 Vehicle Aerodynamics - Dr. V. Sumantran and Dr. Gino Sovram., SAE International, USA, 1994
10 Automotive Chassis & Body - P. L. Kohli., Papyrus Publishing House, New Delhi.
11 Automotive Chassis - Crouse W. H. &Anglin D. L., McGraw-Hill Int. Book Co.


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**U17INI4600** **ENGINEERING CLINIC - II**

| L | T | P | J | C |
|---|---|---|---|---|
| 0 | 0 | 4 | 2 | 3 |

**Course objectives**

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

**Course Outcomes**

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

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

**Pre-requisite:**

1. U17INI3600 - Engineering Clinic - I

**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 | PSO1 | PSO2 |
| CO1 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews | 1. Course Exit Survey |
| 2. Workbook report | |
| 3. Demonstration & Viva-voce | |

**Content:**

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on solid modelling and Python programming.

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**GUIDELINES:**

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

**Total Hours: 90**

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| U17VEP4504 | PROFESSIONAL VALUES (Mandatory) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 0 |

**Course Outcomes**

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

**CO 1:** Develop the ethical values in both professional and personal life
**CO 2**: Develop ability to take decision to reinforce professional life
**CO 3**: Rational in professional skills required for diverse society
**CO 4**: Excel in ingenious attitude to congregate professional life
**CO 5**: Research into the professional stand
**CO 6**: Spruce an Individual with decorum to achieve professional life

**Pre-requisites :**

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES

**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 | | | | | | | | |
| CO3 | | | S | | | | | | | | | |
| CO4 | | | | | | | | | | | | S |
| CO5 | | | | | | | | M | | | | |
| CO6 | | | | | | | | | | M | | |

**Course Assessment methods**

| **Direct** |
|---|
| 1.Group Activity / Individual performance and assignment<br>2.Assessment on Value work sheet / Test |
| **Indirect** |
| 1. Mini project on values / Goodwill Recognition |

**Values through Practical activities:**

**1.Professional skills With Values:** Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence

**2.Building Innovative work cultures:** Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making

**3.Professional Work Ethics:** Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility

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**4.Engineering Ethics:** Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures

**5.Case studies in engineering ethics:** Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

| **Workshop mode** |
|---|

**REFERENCES**


1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
   www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS
   www.garda.ie/Documents/User/declarationvalues.pdf

3. KARMA YOGA - SWAMI VIVEKANANDA
   www.vivekananda.net/PDFBooks/KarmaYoga.pdf

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering
   www.sasurieengg.com/.../GE2025%20Professional%20Ethics%20in%20Engineering.

5. ENGINEERING ETHICS CASE STUDY; Challenger
   www.ucc.ie/en/processeng/staff/academic/ebyrne/.../PE1006PptNotesLect7.pdf


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**U17INT4000** **CONSTITUTION OF INDIA**
**(Mandatory course)**

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

## Course Outcomes:

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

**CO 1:** Gain Knowledge about the Constitutional Law of India
**CO 2:** Understand the Fundamental Rights and Duties of a citizen
**CO 3:** Apply the concept of Federal structure of Indian Government
**CO 4:** Analyze the Amendments and Emergency provisions in the Constitution
**CO 5:** Develop a holistic approach in their life as a Citizen of India

**Pre-requisites : 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 |
| CO2 | | | | | | S | | S | | | | M |
| CO3 | | | | | | | | | M | S | | W |
| CO4 | | | | | | | | W | M | | | M |
| CO5 | | | | | | M | | M | | | | S |
| CO6 | | | | | | | | | | | | |

**Course Assessment methods**

| **Direct** |
|---|
| 1. Group Activity / Quiz/ Debate / Case studies<br>2. Class test / Assignment |
| **Indirect** |
| Surveys |

**THEORY COMPONENT:**

**Module.1: Introduction to Indian Constitution** **4 hours**
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

**Module.2: Fundamental Rights** **8 hours**
Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

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**Module.3: Federal Structure** **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

**Module.4: Amendment to Constitution** **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

**Module.5: Emergency Provisions** **4 hours**

National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India

**Total** **30 hours**

| | | | | |
|---|---|---|---|---|
| **Theory: 30** | **Tutorial: 0** | **Practical: 0** | **Project: 0** | **Total: 30 hours** |

**REFERENCES**


1. Constitution of India - Ministry of Law & Justice – PDF format
   awmin.nic.in/coi/coiason29july08.pdf

2. **Introduction to the Constitution of India by Durgadas Basu**

3. The Constitution of India – Google free material -
   www.constitution.org/cons/india/const.html

4. Parliament of India – PDF format
   *download.nos.org/srsec317newE/317EL11.pdf*

5. The Role of the President of India – By Prof.Balkrishna

6. Local Government in India – E Book - Pradeep Sachdeva
   https://books.google.com/books/.../Local_Government_in_In..


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# SEMESTER 5

**U17AUI5201**

## AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems.

**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: Select a battery, starter motor, lamps etc for a suitable application
CO3: Recognize and understand the different wiring diagrams used in automobile manuals.
CO4: Build a simple automobile electrical systems.
CO5: Perform simple programs with the 8085 microprocessor.
CO6: Apply the fundamental concepts of electronics for designing a 9/12V power supply.

**Pre-requisite:**
1 Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | | | | | | | | | | M | | M |
| CO2: | | | | | M | | | | | | | M | | S |
| CO3: | | | M | | | | | | | | | W | | |
| CO4: | | | M | | | | | | | | | | | S |
| CO5: | S | | | | W | | | | | | | W | | M |
| CO6: | S | M | S | | | | | | M | | | | | S |

**Course Assessment methods:**

| Direct | | Indirect | |
|---|---|---|---|
| 1 | Assignments | 1 | Course Exit Survey |
| 2 | Model Practical Examinations | | |
| 3 | Continuous Assessment Tests | | |
| 4 | End-Semester Examination | | |

**TYPES OF BATTERIES** **L: 9 Hrs**

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** **L: 9 Hrs**

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

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**IGNITION SYSTEM** **L: 9 Hrs**

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

**FUEL INJECTION SYSTEM** **L: 9 Hrs**

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** **L: 9 Hrs**

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

**Practical**

**List of Exercises :** **P: 30 Hrs**

Automotive Electrical Laboratory

1. Testing of Batteries and Battery maintenance
2. Load Test on Starter motors and Alternators
3. Diagnosis of Ignition system
4. Study of Automotive Electrical Wiring
5. Study of Power Window

Automotive Electronics Laboratory

6. Study of rectifiers
7. Study of 555 timer
8. Study of Logic gates
9. Micro Processor programming and interfacing
10. Design of power supply

| | | |
|---|---|---|
| Theory :45 Hrs | Tutorial: 30 Hrs | **Total Hours: 75** |

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


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**U17AUI5202** **FINITE ELEMENT ANALYSIS**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**

This course focuses on the fundamentals concepts and formulation of the finite element method for solving engineering problems arising in structural mechanics & heat transfer.

**Course Outcomes:**

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

CO1: Recognize the concepts of finite element method.
CO2: Formulate finite element techniques for design problems
CO3: Devise equations in finite element analysis for 1D, 2D and 3D problems.
CO4: Analyze and solve problems in heat transfer and structural mechanics
CO5: Familiarise a CAE software, to simulate engineering problems in heat transfer and structural mechanics
CO6: Apply finite element techniques for Non Linear Analysis.

**Pre-requisite:**

1 U17MAT4101- Numerical Methods and Probability

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | M | M | S | | | | | | | M | S | |
| CO2: | S | M | M | M | S | | | | | | | M | M | |
| CO3: | S | M | S | M | S | | | | | | | M | | |
| CO4: | S | M | | M | S | | | | | | | M | M | |
| CO5: | M | | M | M | S | | | | | | | M | S | |
| CO6: | S | M | M | M | S | | | | | | | M | S | |

**Course Assessment methods:**

| Direct | | Indirect | |
|---|---|---|---|
| 1 | Assignments | 1 | Course Exit Survey |
| 2 | Continuous Assessment Tests | | |
| 3 | End-Semester Examination | | |
| 4 | Model Practical Examination | | |

**FINITE ELEMENT METHODS** **L: 9 Hrs**

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

**ONE DIMENSIONAL PROBLEMS** **L: 9 Hrs**

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 – Solution to problems– Examples.

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**TWO DIMENSIONAL PROBLEMS** **L: 9 Hrs**

Finite element modeling – CST element, Shell – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer – Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solution examples

**HEAT TRANSFER ANALYSIS** **L: 9 Hrs**

Basic differential equations of heat transfer, one dimensional and two dimensional finite element formulation using variational method, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples

**ISOPARAMETRIC FORMULATION** **L: 5 Hrs**

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems.

**NON LINEAR ANALYSIS** **L: 4 Hrs**

Introduction, Non-linear differential equation, Solution procedures for non-linear problems Material non-linearity-analysis of axially loaded bars. Introduction to geometric nonlinearity.

**Practical**

**List of Exercises :** **P: 30 Hrs**

1 Structural analysis of frames using Truss Elements
2 Static Structural Analysis using 2D Elements
3 Heat Transfer Analysis using 1D Elements
4 Heat Transfer Analysis using 2D Elements
5 Buckling Analysis of Connecting rod
6 Torsional Analysis of bar using 3D Analysis
7 Dynamic Analysis of Leaf and Coil springs
8 Material Non linearity of Axially loaded bars

| | | |
|---|---|---|
| Theory : 45 Hrs | Practical: 30 Hrs | **Total Hours: 75** |

**References:**


1 "Introduction to Finite Elements in Engineering", Chandrupatla T R and Belegundu A D , Pearson Education, New Delhi, 2015
2 "A First Course in the Finite Element Method", Logan D L, Thomson Learning, 2012.
3 "A Text book on Finite Element Analysis", Seshu P, Prentice Hall of India, New Delhi, 2003.
4 JN Reddy
5 "The Finite Element Method in Engineering", Rao S S, Elsevier, 2005.
6 "Finite Element Analysis in Engineering Design", Rajasekaran S, S Chand, 2008


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**U17AUT5103** **DESIGN OF MACHINE ELEMENTS**

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

**( Use of PSG design data book is allowed )**

**Course Objective:**
To impart knowledge on theory and design of machine elements and train them in solving design problems involving common machine elements.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Familiarize and apply the design morphology in designing various machine element
CO2: Selecting suitable material for the machine elements
CO3: Calculate and analyze the forces acting on the Machine element
CO4: Choosing the appropriate machine element for the required function
CO5: Designing a machine element from the given data
CO6: Justify the design and present it in an effective manner

**Pre-requisite:**
1 U17AUI3202- Strength of Materials

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | M | | | | | | M | M | | | M | |
| CO2: | S | S | S | | | | | | | M | | | S | |
| CO3: | S | S | | | | | | | | | | | | |
| CO4: | S | S | | | | | | | | M | | M | S | |
| CO5: | S | S | S | | | | | | M | M | | M | S | |
| CO6: | S | S | S | | | | | | M | M | | M | S | |

**Course Assessment methods:**

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

**L: 9 Hrs T: 3 Hrs**

**INTRODUCTION**
Introduction to design and machine elements and, Classification of design – Selection of materials – Factors of safety in design – Endurance limit of materials – Determination of endurance limit for ductile materials.

**DESIGN OF SHAFTS AND SPRINGS** **L: 9 Hrs T: 3 Hrs**
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.

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**GEAR DESIGN** **L: 9 Hrs T: 3 Hrs**

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.

**DESIGN OF BEARINGS** **L: 9 Hrs T: 3 Hrs**

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.

**FLYWHEELS** **L: 9 Hrs T: 3 Hrs**

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.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 15 Hrs | **Total Hours: 60** |

**References:**


1 " Fundamentals of Machine Elements", Bernard J Hamrock, Tata McGraw Hill, 2004
2 " Design of Machine Elements " Bhandari V B , Tata McGraw Hill, 1990
3 "Material selection in mechanical design" Michael F ashby, Butterworth-Heinemann,2001
4 "Machine Design", U C Jindal, Pearson,2010.
5 " A textbook of Machine Design" , R S Khurumi, Eurasia Publishing House.2005
6 "Mechanical Engineering Design" Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, 9th Edition, Tata McGraw-Hill, 2011.
7 "Machine Design", Sundararajamoorthy T. V. Shanmugam .N, Anuradha Publications, Chennai, 2015.


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**U17AUT5104** **MECHANICS OF MACHINES**

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

**Course Objective:**
Understand the mechanisms of mechanical systems and analyze the forces and motions.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Calculate the velocity and acceleration of simple mechanisms.
CO2: Create the cam profile for different follower motions.
CO3: Identify the different gear trains and calculate the gear ratio.
CO4: Solve and draw the plots for the static and dynamic balancing of various mechanical systems.
CO5: Evaluate the free and forced vibrations for different applications.
CO6: Summarise the kinematic aspect of the mechanisms in automotive applications

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | | | | | | | S | | | S | |
| CO2: | S | S | M | M | | | | M | M | S | | | S | |
| CO3: | S | S | S | M | | | | | | | | | M | |
| CO4: | S | S | M | | | | | M | | S | | | M | |
| CO5: | S | S | S | M | | W | W | M | | | | | S | |
| CO6: | S | S | M | W | | | | M | | M | | S | M | |

**Course Assessment methods:**

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

**BASICS OF MECHANISMS** **T: 9 Hrs T: 3 Hrs**
Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Kinematic analysis of simple mechanisms –Four bar mechanisms Slider crank and crank rocker mechanisms - Inversions –Applications– Velocity and Acceleration diagram – Calculation of simple four bar and slider crank mechanism using relative velocity method.

**DESIGN OF CAM PROFILE** **T: 9 Hrs T: 3 Hrs**
Types of cams, Types of followers, Radial cam, Terminology of radial cam, Types of follower motions: uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, Cam profile for knife edge, Roller and flat faced follower – Graphical method (Mushroom)

**KINEMATICS OF GEAR TRAINS** **T: 9 Hrs T: 3 Hrs**
Gear profile and geometry – Nomenclature of spur and helical gears, Classification of gear trains, Calculation of Gear ratio, Number of teeth for the gears in the gear trains, Velocities of the gears in gear



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trains such as Simple, Compound, Reverted and Epicyclic (using tabulation method) gear trains, Differential gear train.

**BALANCING** **T: 9 Hrs T: 3 Hrs**

Static and dynamic balancing – Single and several masses in different planes - Whirling of shafts– Critical speed of shafts - 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

**VIBRATIONS** **T: 9 Hrs T: 3 Hrs**

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 Hrs | Tutorial: 15 Hrs | **Total Hours: 60** |

**References:**


1 Theory of Machines and Mechanisms - Shigley J.E., Pennock G.R., Uicker J.J., 5th Edition, Oxford University Press, 2017.
2 Theory of Machines - Rattan S.S., Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2014.
3 Kinematics and Dynamics of Machinery - Robert L. Norton, Tata McGraw-Hill, 2009.
4 Theory of Machines - Khurmi R.S and Gupta J.K. 14th Revised Edition, S. Chand and Company Ltd., New Delhi, 2005.
5 Theory of Machines - Ballaney P.L., 3rd Edition, Khanna Publishers, New Delhi, 2004.


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**U17INI5600** **ENGINEERING CLINIC - III**

| L | T | P | J | C |
|---|---|---|---|---|
| 0 | 0 | 4 | 2 | 3 |

**Course objectives**

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

**Course Outcomes**

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

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

**Pre-requisite:**

1. U17INI4600 - Engineering Clinic - II

**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 | PSO1 | PSO2 |
| CO1 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO3 | S | S | S | S | S | M | M | S | S | S | S | S | S | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews | 1. Course Exit Survey |
| 2. Workbook report | |
| 3. Demonstration & Viva-voce | |

**Content:**

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fifth semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II.

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**GUIDELINES:**

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

**Total Hours: 90**

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**U17VEP5505** **SOCIAL VALUES**
(Mandatory)

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

**Course Outcomes**

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

**CO 1**: Understand the transformation from self to society
**CO 2:** Acquire knowledge about disparity among Human Beings
**CO 3**: Realize the new ethics in creating a more sustainable Society
**CO 4**: Develop skills to manage challenges in social issues
**CO 5**: Acquire the skills for Management of Social work & Holistic Society
**CO 6:** Validate the social liabilities at dissimilar situations

**Pre-requisites :**

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES

**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 | | | | | |
| CO3 | | | | | | | | M | | | | |
| CO4 | | | | | | | | | | | S | |
| CO5 | | | | | | | | | | | | S |
| CO6 | | | | | | | | | M | | | |

**Course Assessment methods**

| **Direct** |
|---|
| 1.Group Activity / Individual performance and assignment<br>2.Assessment on Value work sheet / Test |
| **Indirect** |
| 1. Mini project on values / Goodwill Recognition |

**Values through Practical activities:**

**1. Self and Society:** Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society
**2. Social Values:** Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace-nonviolence - right conduct- Unity – forgive – dedication – Honest
**3. Social issues :**Disparity among Human beings- Poverty-Sanitation -corruption- un employment-superstition – religious intolerance & castes – terrorism.

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**4. Emerging Ethics for Sustainable Society:** Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society

**5. Social Welfare**: Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

**Workshop mode**

**REFERENCES**


1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF
   discuss.forumias.com/uploads/File
   upload/.../711b18f321d406be9c79980b179932.pd...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...
   www.un.org/en/events/culturaldiversityday/pdf/Investing_in_cultural_diversity.pdf

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut
   www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E- class
   www.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU
   www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf


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# SEMESTER 6

**U17AUI6201** **AUTOMOTIVE EMBEDDED SYSTEMS**

| L | T | P | J | C |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
To give insight on the concepts of automotive embedded systems and to impart skills in developing models.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Select suitable sensors for measuring parameters in automotive systems
CO2: Choose the appropriate actuator and driver for automotive applications
CO3: Outline the concepts of embedded systems
CO4: Design of hardware model for automotive system using microcontroller
CO5: Build codes for automotive embedded applications
CO6: Compare the wired and wireless communication protocols

**Pre-requisite:**
1 U17AUT5201 - Automotive Electrical and Electronics Engineering

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | | | S | | S | | | | | S | | S |
| CO2: | S | | | | S | | | | | | | M | | S |
| CO3: | M | | | | S | | | | | | | | | S |
| CO4: | | S | S | | S | | | | | | | | M | S |
| CO5: | | S | S | | S | | | | M | | | | M | S |
| CO6: | | | | | S | | | | | | | M | | S |

**Course Assessment methods:**

| Direct | | Indirect | |
|---|---|---|---|
| 1 | Assignments | 1 | Course Exit Survey |
| 2 | Quiz | | |
| 3 | Continuous Assessment Tests | | |
| 4 | End-Semester Examination | | |

**SENSORS** **L: 9 Hrs**
Introduction to automotive sensors ,Proximity sensors- inductive, capacitive, magnetic, Photoelectric, Ultrasonic sensors, Thermistor, Thermocouple, Hall effect sensor, Load cell, Optical rain sensor, Liquid level sensor, Lambda sensor, NOX sensor, MAP and MAF, Knock sensor, Angle sensor, Vibration sensor, Acceleration sensor, Pressure sensor, RPM sensor, Torque sensors, Position sensor.

**ACTUATORS** **L: 9 Hrs**
Solenoid –Types , Solenoid Switching, Relays and Optoisolators – Electromechanical relay, driving a relay, solid-state relay, Reed switch , Optoisolator, Operation and application of BLDC motors, Servo and stepper motors, Piezoelectric Actuators, Actuator Driver - H Bridge driver, Door actuator driver, Stepper motor driver, Transistor driver, Signal conditioner - Amplifier, Filter, Data Acquisition.

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**EMBEDDED SYSTEM** **L: 9 Hrs**

Introduction, Embedded system design process, Microcontroller v/s microprocessor, Architecture of 8/32 Bit controller - ADC, DAC, Memory, Timer and interrupts. Software development in IDE - Hardware/ Software configuration, Models of programs - Assembly, linking and loading. Structure of the Program - variables, functions, loops and I/O parameters.

**INTERFACING WITH MICROCONTROLLER** **L: 9 Hrs**

**Sensor Interfacing:** Analog and digital sensor, keyboard interface with 8/32 bit controller.

**Actuator Interfacing:** Motor control applications - Pulse width modulation (PWM), LCD display, relay and solenoid Interfacing with 8/32 bit controller. Serial communication interfacing.

**COMMUNICATION PROTOCOLS** **L: 9 Hrs**

Introduction to Communication protocol in embedded systems, Wired communication protocols – SPI, I2C and USB, CAN. Wireless communication protocols - Bluetooth HC05, Wi-Fi, RF transmitter and receiver, Internet of Things (IoT).

**Practical**

**List of Exercises :** **P: 30 Hrs**

1. Study of 8/32 Bit Microcontroller Architecture
2. LED Blinking using PWM
3. Interfacing Analog sensor
4. Interfacing Digital sensors
5. Interfacing DC Motor speed control with PWM
6. Interfacing Relay and solenoid Control application
7. Interfacing LCD
8. Implementing the Communication protocols – wireless and wired protocols
9. Interface EEPROM for writing and reading the ECU diagnostic code
10. Interrupts and Timers
11. Design and Build CAN communication Network
12. Interfacing Serial communication

| | | |
|---|---|---|
| Theory : 45 Hrs | Practical: 30 Hrs | **Total Hours: 75** |

**References:**


1. Electronic control unit (ECU). In: Reif K. (eds) Gasoline Engine Management. Bosch Professional Automotive Information by Kaiser M. (2015)
2. Sensors and Transducers - Ronald K. Jurgen, —, 2nd Edition, SAE, 2003
3. Automotive Sensors, BOSCH. 2002
4. Automotive Electronics Design Fundamentals 1st ed. 2015 Edition by Najamuz Zaman
5. Comprehensible Guide to Controller Area Network Paperback – 1 Aug 2005 by Wilfried Voss


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**U17AUI6202** **VEHICLE DYNAMICS**

| L | T | P | J | **C** |
|---|---|---|---|---|
| 3 | 0 | 2 | 0 | **4** |

**Course Objective:**
To make the students familiarize over the forces and moments that generated in a vehicle and its influence over performance in acceleration and braking, handling qualities and ride qualities.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Identify the forces acting on vehicle for the given conditions and draw free body diagram
CO2: Infer and explain the phenomena of the forces that acts on the vehicle
CO3: Determine the reaction forces induced in the vehicle
CO4: Develop mathematical model of the vehicle system and elements
CO5: Provide solution by developing model and solving it
CO6: Justify the vehicle response for the forces and moments that acts on the vehicle

**Pre-requisite:**
1 U17AUT5104- Mechanics of Machines

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | | | S | | | | M | M | | | | |
| CO2: | S | S | | M | S | | | | M | M | | M | M | |
| CO3: | S | S | | | S | | | | | | | S | | |
| CO4: | S | S | M | S | S | | | | | | | M | S | |
| CO5: | S | M | M | S | S | | | | | | | S | S | |
| CO6: | S | S | M | S | S | | | | M | M | | S | M | |

**Course Assessment methods:**

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

**LONGITUDINAL DYNAMICS** **L: 9 Hrs**
Introduction: Earth and vehicle coordinate system, Forces and Moments. Vehicle Load Distribution – position of CG - gradability- Acceleration - Free body diagram of accelerating vehicle, maximum transferable tractive force- tractive effort and reactions for different drive, Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance, maximum braking force, Vehicle performance .

**TIRE MECHANICS** **L: 9 Hrs**
Tire mechanics: Introduction -Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Pressure Distribution. Lateral Force Generation - cornering properties - Tire Models – Magic Formula - Classification of Tire Models.

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**RIDE DYNAMICS** **L: 9 Hrs**

Vibration – introduction, types, terminologies, source of vibration, human response, Degrees of freedom-single, two and multi degrees of freedom system, free, forced and damped vibration, magnification factor, transmissibility, vibration absorbers, pitch and bounce motion, oscillation centers, Suspension- types, active and semi active suspension, sprung mass and un-sprung mass, calculation of effective spring rate.

**LATERAL DYNAMICS** **L: 9 Hrs**

Vehicle control-low speed cornering and static steering – Ackerman steering geometry, steady-state cornering- steering factors, vehicle control parameters ( understeer, 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 and constant radius testing and fish hook measurement testing.

**VEHICLE STABILITY AND NOISE** **L: 9 Hrs**

Stability of a vehicle – on slope, on curve and banked road

Noise- Introduction, properties of sound, sound level designation and measurement techniques- sound isolation and absorption- silencer and mufflers.

**Practical**

**List of Exercises :** **P: 30 Hrs**

1. Simulation of a telescopic suspension system
2. Simulation of a Rack and Pinion Steering system
3. Simulation of Mc Phearson strut suspension system
4. Simulation of braking characteristics of a four wheeler passenger car
5. Simulation of Cornering characteristics of a four wheeler passenger car.
6. Simulation test for roll stability of a four wheeler passenger car.
7. Driving Simulation of a passenger car in ISO Lane change and 3D road

| | | |
|---|---|---|
| Theory : 45 Hrs | Practical: 30 Hrs | **Total Hours: 75** |

**References:**


1. Fundamentals of vehicle dynamics, Gillespie T D , SAE USA ,1992
2. Automotive Mechanics, Giri N K, Khanna Publisher, 2007
3. Ground vehicle Dynamics, Karl Popp and Werner O Schiehlen, Springer. 2012.
4. Road Vehicle dynamics – Theory and Application ,Masato Abe, Elsevier ,2009
5. Motor Vehicle dynamics- Modeling and Simulation, Giancarlo Genta, World Scientific,2006
6. Vehicle dynamics- Theory and Application, Reza N Jazzar, Springer,2008
7. Elementary Vehicle Dynamics, Cole D E , Ann Arbor, Michigan, USA,1972.
8. Theory of Ground Vehicles, Wong J Y, John Wiley and Sons, 1978
9. Martin Meywerk , Vehicle Dynamics- Automotive Series,Wiley,2015
10. Dr.R Krishnakumar,Vehicle Dynamics, NPTEL course https://nptel.ac.in/courses/107106080/


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**U17AUT6003** **HYBRID AND ELECTRIC VEHICLES**

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

**Course Objective:**

This course will introduce general aspects of Hybrid and Electric Vehicle (HEV) technologies, including architectures, modeling, sizing, sub-system design and vehicle control. It will cover energy storage sources, electric propulsion systems, power electronics design, and HEV control.

**Course Outcomes:**

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

CO1: Describe the configuration of hybrid and electric vehicles.
CO2: Identify the basic components of hybrid and elective vehicles.
CO3: Assess the characteristics and performance of the electric vehicle
CO4: Select suitable electric propulsion and control systems for HEV.
CO5: Choose proper energy storage systems for vehicle applications
CO6: Describe the operation of fuel cell and solar cell vehicles.

**Pre-requisite:**

1 U17AUT5201- Automotive Electrical and Electronics Engineering

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | M | | | | S | | M | S | | M | | M |
| CO2: | S | S | M | M | | | S | | S | S | | S | | S |
| CO3: | S | S | M | M | | | S | S | S | M | | | | S |
| CO4: | S | S | S | M | | | S | S | S | M | | | | S |
| CO5: | S | S | M | M | | | S | S | S | M | | | | S |
| CO6: | S | M | M | | | | S | | M | S | | M | | M |

**Course Assessment methods:**

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

**ELECTRIC PROPULSION SYSTEMS** **L: 8 Hrs**

Drive systems for EV & HEV, DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives, drive system efficiency - Control System principles, Speed and Torque control, Power electronic converters for HEV, Regenerative Braking.

**ENERGY STORAGE SYSTEMS** **L: 8 Hrs**

Requirements in Hybrid and Electric Vehicles, Types of batteries – lead acid batteries, nickel based batteries, and lithium based batteries - Battery Charging, Battery Characterization - capacity, discharge rate, state of charge, state of discharge, depth of Discharge, Technical characteristics, battery pack design, battery management system, Ultra capacitors.

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**ELECTRIC VEHICLES** **L: 7 Hrs**

History of electric vehicles, social importance of electric mobility, performance of e-vehicles - tractive effort and transmission requirements, vehicle performance, energy consumption, Specifications - System Components, Electric drive-trains topologies, power flow control in electric drive-train, fuel efficiency analysis.

**HYBRID VEHICLES** **L: 7 Hrs**

History of hybrid vehicles, social and environmental importance of hybrid vehicles, impact of modern drive-train on energy supplies. Hybrid Electric Drive-train configurations - basic concept of hybrid traction, architecture - merits and challenges, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**HEV PERFORMANCE** **L: 8 Hrs**

Maximum speed - Acceleration – Gradeability, HEV - mechanics, efficiency, driving cycles, regulations, sizing the propulsion motor and power electronics, Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV), Vehicle Simulation, Comparison of ICEV and HEV, Well-to-Wheel Analysis.

**FUEL CELL AND SOLAR VEHICLES** **L: 7 Hrs**

Operations and Properties of Fuel cells – Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Molten Carbonate Fuel Cell – Characteristics, electrochemical energy conversion – factors affecting electrochemical energy conversion - Solar Vehicles - photovoltaic cells, tracking, efficiency and cost comparison.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "Electric and Hybrid – Electric Vehicles" - Ronald K Jurgen,, SAE International, 2011.
2 "Electric and Hybrid Vehicles- Design Fundamentals" - Iqbal Husain, CRC Press, 2011.
3 "Electric Vehicle Technology Explained" - James Larminie, John Lowry, Wiley, 2012.
4 "Electric Vehicle Battery Systems" - Sandeep Dhameja, Butterworth – Heinemann, 2002.
5 "Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design" - Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, CRC Press, 2018.
6 "Fuel Cells Principles and Applications" - Viswanathan, B. and Aulice Scibioh, M., Universities Press (India) Pvt. Ltd., Hyderabad, 2006.
7 "Light Weight Electric Hybrid Vehicle Design" - Ron Hodkinson and John Fenton, Butterworth – Heinemann, 2009.
8 "Vehicular Electric Power Systems" - Ali Emadi, Mehrdad Ehsani, John M. Muller, , Marcel Dekker,Inc., 2004.
9 "Recent Trends in Fuel cell Science and Technology" - Basu .S, Anamaya Publishers, New Delhi.,2007.
10 "Fuel Cell Technology Handbook", Gregor Hoogers, CRC Press, 2003.


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**U17AUT6004** **TOTAL QUALITY MANAGEMENT AND PROJECT MANAGEMENT**

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

**Course Objective:**
Expose the students to learn how to apply the Total Quality Management Techniques for an industry in turn for the product & To develop their ability in planning and execution of a project effectively.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Relate quality concepts and philosophies of TQM
CO2: Apply TQM tools as a means to improve quality
CO3: Select the lean six sigma tools for improving the productivity
CO4: Categorize the structure of the organization
CO5: Identify competency in project planning, scheduling and related activities
CO6: Develop network models and analyze the cost accounting

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | M | | | | | | | S | S | S | S | | |
| CO2: | M | M | | | S | | | | S | S | S | S | | |
| CO3: | M | M | | | S | | | | S | S | S | S | | |
| CO4: | | M | | | | | | | S | S | S | S | | |
| CO5: | M | M | | | | | | | S | S | S | S | | |
| CO6: | | M | | | S | | | | S | S | S | S | | |

**Course Assessment methods:**

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

**TQM PRINCIPLES** **L: 9 Hrs**
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. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time.

**TQM TOOLS & STATISTICAL TOOLS** **L: 9 Hrs**
The seven tools of quality, New seven Management tools, Statistical Fundamentals .Concept of six sigma. Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function.

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**QUALITY SYSTEMS** **L: 9 Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

**PROJECT ORGANIZATION AND MANAGEMENT** **L: 9 Hrs**

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Organizing human resources, organizing systems & procedures for implementation. Project direction. selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

**PLANNING ,SCHEDULING , NETWORK MODELS, PROJECT APPRAISAL** **L: 9 Hrs**

PERT & CPM Cost accounting systems, lowest Cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique. computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. Cost analysis of the project, components of capital Cost of a project, modern approach to project performance analysis.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education 2011
2 Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
3 D.R. Kiran Total Quality Management: Key Concepts and Case Studies Butterworth-Heinemann, 2016
4 Nagarajan. K, “Project “Management, New Age International, 2012.
5 Harvey Maylor, “Project Management”, Prentice Hall, 2010.
6 Erik W. Larson, “Project Management”: The Managerial Process (Special Indian Edition), Tata McGraw-Hill Education, 2006
7 Joseph Phillips,PMP Project Management Professional Study Guide, Fourth Edition,McGraw Hill Professional, 2013


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**U17INI6600** **ENGINEERING CLINIC - IV**

| L | T | P | J | C |
|---|---|---|---|---|
| 0 | 0 | 4 | 2 | 3 |

**Course objectives**

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

**Course Outcomes**

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

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

**Pre-requisite:**

1. U17INI5600 - Engineering Clinic - III

**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 | PSO1 | PSO2 |
| CO1 | S | S | S | S | S | M | W | | S | | | S | | |
| CO2 | | | | | | | | | | | S | | | |
| CO3 | | | | | | | | | | S | | | | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Project reviews | 1. Course Exit Survey |
| 2. Workbook report | |
| 3. Demonstration & Viva-voce | |

**Content:**

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on Reverse engineering project to improve performance of a product.

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**GUIDELINES:**

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

**Total Hours: 90**

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**U17VEP6506** **NATIONAL VALUES**
(Mandatory)

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

**Course Outcomes**

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

**CO 1:** Acquire knowledge on the Essence of Indian Knowledge Tradition

**CO 2:** Know the great Indian personalities and follow their trail

**CO 3**: Understand the specialty of democracy

**CO 4**: Disseminate our Nation and its values to propagate peace

**CO 5**: Contribute with their energy and effort for a prosperous India

**CO 6**: Propagate the youth and the contribution for development of our Nation

**Pre-requisites :**

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES

**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 | | | |
| CO3 | | | | | | | M | | | | | |
| CO4 | | | | | | | | S | | | | |
| CO5 | | | | | | | | | | | S | |
| CO6 | | | | | | | | | | | | M |

**Course Assessment methods**

| **Direct** |
|---|
| 1.Group Activity / Individual performance and assignment<br>2.Assessment on Value work sheet / Test |
| **Indirect** |
| 1. Mini project on values / Goodwill Recognition |

**Values through Practical activities:**

**1. Essence of Indian Knowledge Tradition:**
Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition - Indian Linguistic Tradition - Indian Artistic Tradition.

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**2. Great Indian Leaders :** Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates -Scientists – Statesman.
**3. Largest Democracy :** Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.
**4. India's Contribution to World peace :** Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.
**5. Emerging India :** World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

**Workshop mode**

**REFERENCES**


1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, *CBSE Publication* ___*cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_6_2.pdf*

2. CULTURAL HERITAGE OF INDIA - SCERT Kerala
www.scert.kerala.gov.in/images/2014/HSC.../35_Gandhian_Studies_unit-01.pdf

3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO
www.unesdoc.unesco.org/images/0014/001480/148021e.pdf

4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick
www2.warwick.ac.uk/fac/arts/history/students/modules/hi297/.../week1.pdf

5. INDIA'S CONTRIBUTION TO THE REST OF THE WORLD - YouSigma
www.yousigma.com/interesting facts/indiasgifttotheworld.pdf

6. INDIA AS AN EMERGING POWER - International Studies Association
web.isanet.org/Web/Conferences/.../11353cac-9e9b-434f-a25b-a2b51dc4af78.pdf


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# SEMESTER 7

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**U17AUI7201** **VEHICLE MAINTENANCE AND RECONDITIONING**

| L | T | P | J | C |
|---|---|---|---|---|
| 2 | 0 | 2 | 0 | **3** |

**Course Objective:**
Impart knowledge and skill on Vehicle Maintenance and Troubleshooting of automotive systems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Familiarise the need and procedures of service records used for vehicle maintenance
CO2: Examine and troubleshoot engine malfunctions
CO3: Identify the conditions of battery and auxiliary electrical systems.
CO4: Describe the repair procedure for vehicle chassis and body components
CO5: Asses and rectify the wheel and tire parameters
CO6: Inspect and troubleshoot the HVAC system

**Pre-requisite:**
1 U17AUI3201- Automotive Chassis and Transmission

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | | | S | | M | S | | | M | | | M | | S |
| CO2: | M | | | M | | S | | | | | S | | | S |
| CO3: | | | S | | M | S | M | | | | | | | S |
| CO4: | S | M | M | | S | S | M | | | | | | | S |
| CO5: | | S | | | M | S | | | | | | | | S |
| CO6: | | | S | | M | S | M | | | | | | | S |

**Course Assessment methods:**

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

**LAYOUT OF AUTOMOTIVE SERVICE STATION - RECORDS AND PROCEDURES** **L: 8 Hrs**

Introduction to vehicle maintenance, Importance and need for maintenance, preventive and breakdown maintenance. Tools and Instruments used in Maintenance shop, Layout of Automotive Repair, Service & Maintenance Shop.
Preparation of check lists, safety. Inspection schedule, maintenance of records, log sheets Trip sheet and Road test report. Service schedule and service history maintenance, Workshop Management, spare parts warranty.

**REPAIR AND MAINTENANCE OF ENGINE AND CHASSIS SYSTEM** **L: 8 Hrs**

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 Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft

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and differential system. Servicing of suspension systems, steering systems, overhauling and maintenance. On Road Vehicle Handling and Testing.

**MAINTENANCE OF ELECTRICAL SYSTEM** **L: 6 Hrs**

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 electronic systems, checking and servicing of instrument cluster.

**REPAIR AND MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY** **L: 8 Hrs**

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

## Practical

**List of Exercises :** **P: 30 Hrs**

1. Lighting System Trouble shooting & Servicing.
2. Fault diagnosis of Air-Conditioning system.
3. Tire maintenance and wheel balancing.
4. Measurement of camber, caster, kingpin inclination and alignment of toe-in and toe-out
5. Braking System Troubleshooting & Servicing
6. Diagnosis of Engine ECU
7. Performance Testing of Two-Wheeler using 2-Wheeler Chassis Dynamometer
8. Experimental Study about Gearbox, Steering, Suspension system Maintenance
9. On-road Braking, Acceleration and Fuel economy test

| | | |
|---|---|---|
| Theory : 30 Hrs | Practical: 30 Hrs | **Total Hours: 60** |

**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.
4. Automotive Trouble shooting and Maintenance by Anderson Ashburn
5. Venk. Spicer, Automotive Maintenance and Trouble shooting.
6. Service Manuals from Different Vehicle Manufacturers
7. Vehicle Maintenance and Garage Practices -Dhruv U. Panchal, Jigar A. Doshi, PHI learning Pvt, Ltd.


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**U17AUT7002** **AUTOMOTIVE EMISSIONS**

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

**Course Objective:**
Impart knowledge on the wastes produced from automobiles and the emission formation mechanisms.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the impact of pollutants on global environment and its climatic change
CO2: Examine the emission formation mechanisms and techniques to minimize emissions formation in I.C. engines.
CO3: Describe automotive emission control technologies.
CO4: Familiarise about emission standard, measurement, test procedure and regulations
CO5: Identify the wastes produced from automobiles.
CO6: Explain the available disposal methods of waste.

**Pre-requisite:**
1 U17AUI4201- Automotive Engines and Systems

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | S | | | S | S | | M | | | | S | |
| CO2: | S | | S | | | S | S | | M | | | | S | |
| CO3: | S | | S | | | S | S | | M | | | | S | |
| CO4: | S | | S | | | S | S | S | M | | | | S | |
| CO5: | | | M | | | S | S | M | M | | | | S | |
| CO6: | S | | S | | | S | S | S | M | | | | S | |

**Course Assessment methods:**

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

**POLLUTANT FORMATION EFFECT ON ENVIRONMENT** **L: 7 Hrs**
Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated –- Emission Standards-Euro, Bharat Stage & Legislative Norms.

**EMISSION FORMATION IN S.I ENGINES** **L: 7 Hrs**
Pollution formation in SI Engines – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating and design variables on emission formation.

**EMISSION FORMATION IN CI ENGINES** **L: 7 Hrs**
Pollutant Formation In CI Engines – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines-– Particulate emission in diesel engines- Effect of operating and design variables on emission formation.

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**EMISSION CONTROL AND MEASUREMENT TECHNIQUES L: 12 Hrs**

Design Of Engine, Optimum Selection Of Operating Variables For Control Of Emissions- EGR, SCR, Lean DeNOx catalyst-Thermal Reactors, Secondary Air Injection, Water Injection.- After Treatment: Catalytic Converters, Catalysts, $CO_2$ Emission Reduction- Diesel Particulate Filter- Fuel Modifications. Emission Standards, Driving Cycles - USA, Japan, Euro And India.– NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph – Smoke meters –SHED test.

**AUTOMOTIVE WASTES L: 6 Hrs**

Introduction-Types of Automobile waste-Electrical waste, Battery waste, Copper elements-Electronic circuit wastes-Tyre wastes-Mechanical wastes, Body panel, Chassis components.

**WASTE DISPOSAL AND MANAGEMENT TECHNIQUES L: 6 Hrs**

Battery disposal procedure, management of battery waste, Steps involved in recycling batteries, Hydrometallurgical process, Hydrometallurgical process, Mercury distillation-Tyre disposal techniques.

| | | |
|---|---|---|
| Theory : 30 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
2 Internal Combustion Engines,Ganesan, V- Tata McGraw-Hill Co.- 2017
3 Robert Bosch, “Emissions-Control Technology for Diesel Engines”, BENTLEY ROBERT Incorporated, 2005.
4 Automobiles and Pollution, Paul Degobert– SAE International ISBN-156091-563-3, 1991.
5 *Internal Combustion Engines and Air Pollution* Edward F, Obert,*”*, Intext Education Publishers, 1980.
6 Mathur and Sharma, “*A course on Internal combustion Engines*”, Dhanpat Rai & Sons, 1985.


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**U17AUP7703** **PROJECT WORK - PHASE – I**

| L | T | P | J | C |
|---|---|---|---|---|
| 0 | 0 | 0 | 6 | **3** |

**Course Outcomes**

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

**CO1:** Identify practical problems and find a solution related to automotive and relative domains

**CO2:** Understand the project management practices

**CO3:** Demonstrate their report writing and presentation skills

**Pre-requisite:**

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**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO2: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO3: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |

**Course Assessment methods:**

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

**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 and allied areas.
2. The project work 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 4 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 90**

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**U17VEP7507** **GLOBAL VALUES**
(Mandatory)

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

**Course Outcomes**

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

**CO 1:** Aware of the concept of Universal Brotherhood and support the organizations which are working for it

**CO 2:** Follow the path of Ahimsa in every aspect of their life

**CO 3:** Uphold the Universal declaration of Human Rights

**CO 4**: Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth

**CO 5:** Sensitize the environmental degradation and work for the sustainable development

**CO 6:** Amalgamate harmony through Non-violence and edify the nation headed for upholding development

**Pre-requisites :**

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES
6. U17VEP6506 / NATIONAL VALUES

**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 | | | | |
| CO3 | | | | | | | | | M | | | |
| CO4 | | | | | | S | | | | | | |
| CO5 | | | | | | | | | | | M | |
| CO6 | | | | | | | | | | | | S |

**Course Assessment methods**

| **Direct** |
|---|
| 1.Group Activity / Individual performance and assignment<br>2.Assessment on Value work sheet / Test |
| **Indirect** |
| 1. Mini project on values / Goodwill Recognition |

**Values through Practical activities:**

**1. Universal Brotherhood :** Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings -Red Cross, UN Office for Humanitarian Affairs

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– Case study on humanitarian problems and intervention - Active role of Students/Individual on Universal Brotherhood.

**2. Global Peace, Harmony and Unity :** Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.

**3. Non-Violence :** Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence– Practicing nonviolence in everyday life.

**4. Humanity and Justice:** Universal declaration of Human Rights - Broad classification - Relevant Constitutional Provisions– Judicial activism on human rights violation - Case study on Human rights violation– Adherence to human rights by Students/Individuals.

**5. Inclusive growth and sustainable development :** Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality – Protection of environment – Case study on inequality and environmental degradation and remedial measures.

**Workshop mode**

**REFERENCES**


1. TEACHING ASIA-PACIFIC CORE VALUES OF PEACE AND HARMONY – UNICEF www.unicef.org/.../pdf/Teaching%20Asia-Pacific%20core%20values.pdf

2. THREE-DIMENSIONAL ACTION FOR WORLD PROSPERITY AND PEACE- IIM Indore - www.iimidr.ac.in/.../Three-Dimensional-Action-for-World-Prosperity-and-Peace-Glo...

3. MY NON-VIOLENCE - MAHATMA GANDHI www.mkgandhi.org/ebks/my_nonviolence.pdf

4. HUMAN RIGHTS AND THE CONSTITUTION OF INDIA 8th ... - India Juris www.indiajuris.com/uploads/.../pdf/l1410776927qHuman%20Rights%20080914.pdf

5. THE ETHICS OF SUSTAINABILITY – Research Gate www.researchgate.net/file.PostFileLoader.html?id...assetKey..


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# SEMESTER 8

**U17AUP8701** **PROJECT WORK - PHASE – II**

| L | T | P | J | **C** |
|---|---|---|---|---|
| 0 | 0 | 0 | 24 | **12** |

**Course Outcomes**

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

**CO1:** Identify and solve practical problems and find a solution related to automotive and relative domains

**CO2:** Understand the project management techniques

**CO3:** Demonstrate their report writing and presentation skills

**Pre-requisite:**

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**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO2: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |
| CO3: | S | S | S | S | S | M | M | S | S | S | S | S | S | S |

**Course Assessment methods:**

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

**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 for the most appropriate problems.
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 execution & contribution, 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 360**

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# PROFESSIONAL ELECTIVE

# AUTOMOTIVE DESIGN

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**U17AUE0001** **DESIGN OF ENGINE COMPONENTS**

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

**Course Objective:**
The course provides basic knowledge on designing of IC engine components.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Understand the design procedure for piston and cylinder
CO2: Apply the design assumption in validating the types of connecting rod used in IC engines.
CO3: Calculate the parameters required for designing the crankshaft
CO4: Understand the steps involved in designing of different types of automotive clutch
CO5: Apply the assumption and design valves and valve train
CO6: Explain design methods for engine components

**Pre-requisite:**
1 U17AUI3202 - Strength of Materials
2 U17AUI4201 - Automotive Engines and Systems
3 U17AUT5103 – Design of Machine Elements

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | M | W | | | | | | W | W | | | S | |
| CO2: | S | S | M | | | | | | M | M | | | M | M |
| CO3: | S | S | M | | | | | W | | | | | S | |
| CO4: | S | S | M | | | | | W | | | | | S | |
| CO5: | S | S | M | | | | | | | | | | S | |
| CO6: | S | S | M | | | | | | | | | | S | |

**Course Assessment methods:**

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

**DESIGN OF CYLINDER AND PISTON** **L: 9 Hrs**
Choice of material for cylinder and piston, design assumptions and procedure for cylinder and piston. Design of cylinder, piston, piston pin, piston rings.

**DESIGN OF CONNECTING ROD** **L: 9 Hrs**
Design of Connecting Rod-determining minimum length of connecting rod, small end design, Big end design, shank design, design of cap bolts.

**DESIGN OF CRANKSHAFT** **L: 9 Hrs**
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.



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**DESIGN OF CLUTCH** **L: 9 Hrs**

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 OF VALVES AND VALVE TRAIN** **L: 9 Hrs**

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

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**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.
4 Vehicular Engine Design – Hoag, Kevin, Springer
5 Internal Combustion Engine Design – John Manning, Ricardo UK Ltd
6 Giri.N.K, Automobile Mechanics, Khanna Publishers, New Delhi, 2007.


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**U17AUE0002** **DESIGN OF CHASSIS COMPONENTS**

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

**Course Objective:**
Build knowledge on design of Automotive Chassis components.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Calculate loads, moments and stresses on frame members and suspensions.
CO2: Design front axle and examine the steering components
CO3: Explain the design concepts of final drive and rear axle
CO4: Determine parameters involved in gear box design.
CO5: Solve problems related to Automotive braking System
CO6: Improve the overall design of chassis.

**Pre-requisite:**
1 U17AUI3201- Automotive Chassis and Transmission
2 U17AUI3202 - Strength of Materials

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | **S** | **S** | M | M | | | | | | | | | **S** | |
| CO2: | **S** | **S** | S | M | | | | | | | | | **S** | |
| CO3: | **S** | **S** | M | S | | | | | | | | | **S** | |
| CO4: | **S** | **S** | M | S | | | | | | | | | **S** | |
| CO5: | **S** | **S** | M | M | | | | | | | | | **S** | |
| CO6: | **S** | **S** | S | S | | | | | | | | | **S** | |

**Course Assessment methods:**

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

**VEHICLE FRAME AND SUSPENSION** **L: 9 Hrs**
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** **L: 9 Hrs**
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 REAR AXLE** **L: 9 Hrs**
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** **L: 9 Hrs**

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

**BRAKING SYSTEM** **L: 9 Hrs**

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 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "Automobile Chassis Design Book", Dean Averns, 2nd edition, Kotelian sky Press, 2009.
2 "Introduction to Modern Vehicle Design", Julian Happian-Smith, SAE International, 2004.
3 Automobile Mechanics, Giri, N.K., Khanna publishers, New Delhi, 2007.
4 Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
5 Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

**U17AUE0003** **COMPUTATIONAL FLUID DYNAMICS**

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

**Course Objective:**
Impart knowledge on various CFD Techniques to solve simple fluid flow and heat transfer problems.

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

CO1: Introduce Governing Equations of viscous fluid flows
CO2: Discretize the governing equations by Finite Difference Method and Finite volume Method.
CO3: Solve basic convection and diffusion equations and understand its role in fluid flow and heat transfer problems..
CO4: Apply the solution algorithms to determine the flow field variables.
CO5: Understand turbulence equations in mathematical form and various types of grids used to solve the flow problem.
CO6: Create confidence to solve flow and heat transfer problems by using commercial software packages.

**Pre-requisite:**
1 U17AUI4202- Fluid Mechanics and Machinery

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | | | | | | | | | | M | | |
| CO2: | S | S | S | M | M | | | | | | | M | M | |
| CO3: | S | S | S | M | M | | | | | | | M | M | |
| CO4: | S | S | S | M | M | | | | | | | M | M | |
| CO5: | S | S | S | M | M | | | | | | | M | M | |
| CO6: | S | S | S | M | M | | | | | | | M | S | |

**Course Assessment methods:**

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

**GOVERNING EQUATIONS AND BOUNDARY CONDITIONS** **L: 8 Hrs**
Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

**FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION** **L: 9 Hrs**
Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three –dimensional diffusion

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problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

**FINITE VOLUME METHOD FOR CONVECTION DIFFUSION L: 10 Hrs**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

**FLOW FIELD ANALYSIS L: 9 Hrs**

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

**TURBULENCE MODELS AND MESH GENERATION L: 6 Hrs**

Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh.

**PRACTICAL ASPECT OF CFD L: 3 Hrs**

Grid generation – Structured and unstructured mesh, Case study using commercial CFD software

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "An Introduction to Computational Fluid Dynamics: The finite volume Method", Versteeg H.K., and Malalasekera W., Pearson Education Ltd., 2nd Edition, 2007.
2 "Numerical Heat Transfer and Fluid Flow", Patankar, S.V., Hemisphere Publishing Corporation (CRC Press), 1st Edition, 1980.
3 "Computer Simulation of flow and heat transfer", Ghoshdastidar, P.S., Tata McGraw Hill Publishing Company Ltd., 1998.
4 "Computational Fluid Dynamics", Chung, T.J., Cambridge University, Press, 2nd Edition, 2010.
5 "Computational Fluid Flow and Heat Transfer", Muralidhar, K., and Sundararajan, T., Alpha Science International Ltd., 2nd Revised edition edition, 2003.
6 "Introduction to Computational Fluid Dynamics", Prodip Niyogi, Chakrabarty, S.K., Laha, M.K., Pearson Education, 1st Edition, 2005.
7 https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules


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**U17AUE0004** **COMPUTER SIMULATION OF IC ENGINE PROCESSES**

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

**Course Objective:**
To Impart Knowledge In Simulating IC Engine Processes.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Understand the significance of various processes in I.C Engines.
CO2: Learn the simulation of engine combustion based on first and second law of thermodynamics.
CO3: Calculate minimum air required for combustion of I.C Engines.
CO4: Write combustion equation for hydrocarbon fuels.
CO5: Apply the simulation techniques for modification of combustion chamber
CO6: Apply the simulation techniques to develop new engine concept

**Pre-requisite:**
1 U17AUI4201 - Automotive Engines and Systems

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | | | | | | | | | | | | |
| CO2: | S | | | | | | | | | | | | | |
| CO3: | S | S | | | | | | | | | | | | |
| CO4: | S | M | | | | | | | | | | | | |
| CO5: | S | S | S | S | | | | | | | | M | S | |
| CO6: | S | S | S | S | | | | | | | | M | S | |

**Course Assessment methods:**

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

## INTRODUCTION **L: 9 Hrs**
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 **L: 9 Hrs**
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 **L: 9 Hrs**
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** **L: 9 Hrs**

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** **L: 9 Hrs**

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 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Ganesan,V., Computer Simulation of spark ignition engine process, Universities Press (I) Ltd., Hyderabad, 2013.
2 Ganesan V, "Computer Simulation of Compression-Ignition Engine Processes", University Press (I) Ltd, Hyderabad, 2013
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.


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# AUTOMOTIVE MANUFACTURING

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**U17AUE0005** **AUTOMOTIVE COMPONENTS MANUFACTURING**

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

**Course Objective:**
Impart knowledge on various processes involved in the manufacturing of automotive components.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Distinguish the various Manufacturing Processes employed in manufacturing Engine components
CO2: Choose the right Manufacturing Process for manufacturing Transmission system components
CO3: Select the relevant Heat and surface treatment methods for Engine and Transmission Components
CO4: Outline the Automotive Body Components Manufacturing methods
CO5: Identify the surface Coating Processes used in Automotive Industry
CO6: Suggest the suitable machining process for Automotive components manufacturing

**Pre requisite:**
1 U17AUI3203-Manufacturing Technology

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | M | | | | M | M | | S | | | M | S |
| CO2: | S | S | M | | | | M | M | | S | | | M | S |
| CO3: | S | S | M | | | M | M | | | | | | | S |
| CO4: | M | S | M | | | M | M | M | | S | | | | S |
| CO5: | S | M | | | | S | S | S | | | | | | S |
| CO6: | S | S | M | | | | | | | S | | | | S |

**Course Assessment methods:**

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

## ENGINE COMPONENTS **L: 10 Hrs**

Casting of Engine block - conventional and expendable pattern, Casting of cylinder heads,Cylinder liners, Crankshaft, Connecting rod and Gudgeon pins-forging and casting, machining and heat treatment.
Casting of Piston - gravity casting, squeeze casting, machining and finishing and piston ring manufacturing.
Upset forging of valves - heat treatment and surface improvement.
Engine bearing manufacturing.

## TRANSMISSION COMPONENTS - I **L: 10 Hrs**

Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining.



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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.

**TRANSMISSION COMPONENTS-II** **L: 10 Hrs**

Propeller shaft – Continuous Casting, extrusion, heat treatment and surface hardening, Composite propeller shaft manufacturing.
Forging of rear axles, casting of rear axle casing,
Manufacturing of wheels and brake drums.

**BODY COMPONENTS** **L: 10 Hrs**

Introduction- Thermoforming and Hydro forming, Press forming of body panels. Welding of body panels - resistance welding, Spot welding, Seam welding.
Injection moulding – Introduction, instrument panel, bumpers, Reinforced Reaction injection moulding.
Manufacture of metal and polymer panels.
Adhesives and sealants
Manufacturing of Springs , Wrap forming of coil springs,leaf springs, Composite leaf springs

**SURFACE COATINGS** **L: 5 Hrs**

Chemical Vapour deposition, Physical Vapour deposition, sol-gel processing
Spraying, Plating, Painting in paint booth.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **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, 2012 .
3 Kalpakjian, “Manufacturing Engineering and Technology”, Publisher: Pearson, 2013

4 Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2003.


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**U17AUE0006** **DESIGN FOR MANUFACTURE AND ASSEMBLY**

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

**Course Objective:**
To learn the design process /aspects and its effect on different manufacturing processes and to acquire knowledge for providing tolerance specification and representation used in assembly.

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

CO1: Outline the design aspects for selection of Materials, Manufacturing processes for economical production.
CO2: Identification of design processes for various machining and metal joining processes.
CO3: Apply a systematic understanding of design knowledge in the areas of metal casting and forging
CO4: Familiarise the knowledge of Geometric Dimensioning and Tolerances
CO5: Identify the details required for mechanical documentation.
CO6: Integrate the knowledge of compliance analysis and interference analysis for assembly.

**Pre-requisite:**
1 U17AUI3203 - Manufacturing Technology

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | S | | | | M | | S | | M | M | |
| CO2: | S | M | M | M | | | | | M | M | | | M | S |
| CO3: | M | M | M | M | | | | | M | | | | M | S |
| CO4: | S | S | S | M | | | | | M | S | | | S | M |
| CO5: | M | | | | M | | | | | M | | | | M |
| CO6: | S | S | S | M | | | | | | M | | | S | M |

**Course Assessment methods:**

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

**DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY** **L: 9 Hrs**
DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on Cost basis.

**GEOMETRIC DIMENSIONING & TOLERANCE INTRODUCTION** **L: 9 Hrs**
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.

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**TOLERANCE CHARTING TECHNIQUE** **L: 9 Hrs**

Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

**DESIGN FOR MANUFACTURE** **L: 9 Hrs**

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, minimizing core requirements, redesigning cast members using weldments, use of welding symbols – Case studies.

**SELECTIVE ASSEMBLY** **L: 9 Hrs**

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 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Design for Manufacturability Handbook, James G. Bralla, Second Edition, McGraw-Hill companies, New York, USA. (1998)
2 Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst and Winston Knight Second Edition, CRC press, Taylor & Francis, Florida, USA (2002)
3 G. E. Dieter and L. C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
4 Design for Manufacturing and assembly, O. Molloy, S. Tilley and E.A. Warman , First Edition, Chapman &Hall, London, UK (1998).
5 "Design for Economic Production", Trucks H E, Society of Manufacturing Engineers, Michigan, 1987.
6 J. J. Shah, An Assessment of Features Technology, Proc. CAM-1 Features Symposium, Boston, MA, August 9-10, 1990, p. 55.
7 J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc.
8 I. Zeid, R. Siva Subramanian (2009) CAD/CAM Theory and Practice, 2nd edition Tata McGraw-Hill education private limited, New Delhi.
9 Port-compatibility and connectability based assembly design, P. Singh, B.Bettig, Journal of Computing and Information Science in Engineering, 4 (2004) pp.197-205.
10 Extended liaison as an interface between product and process model in assembly, A.K. Swain, D Sen, B. Gurumoorthy,Robotics and Computer-Integrated Manufacturing, 30 (5), pp.527-545.


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**U17AUE0007**

## COMPOSITE MATERIALS AND STRUCTURES

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

**Course Objective:**
Provide knowledge on properties, micromechanics, macro mechanics and also the manufacturing of Composite materials.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the types, advantages and properties of Composite Materials
CO2: Apply the knowledge of micro mechanics to calculate the properties of a Lamina
CO3: Calculate the properties of a Laminate
CO4: Analyze the material properties and failure criteria of Composites
CO5: Explain the basic design concepts and materials used for sandwich construction
CO6: Summarize the methods used for fabrication of fiber

**Pre-requisite:**
1 Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | W | | | | | W | | | | | | M | S | |
| CO2: | S | S | M | | | | W | | | | | | S | |
| CO3: | S | S | S | | | | W | | | | | M | S | |
| CO4: | S | S | S | | | | W | | | | | | S | |
| CO5: | M | W | W | | | | | | | | | | S | |
| CO6: | M | | | | | W | W | | | | | M | S | |

**Course Assessment methods:**

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

**STRESS STRAIN RELATION** **L: 8 Hrs**
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** **L: 10 Hrs**
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.

**LAMINATED PLATES** **L: 12 Hrs**
Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.

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**SANDWICH CONSTRUCTIONS** **L: 8 Hrs**

Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

**FABRICATION PROCESS** **L: 7 Hrs**

Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **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.
4 Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989
5 https://nptel.ac.in/courses/101104010/
6 Autar K. Kaw., 'Mechanics of Composite Materials', Taylor & Francis-India; Second Edition edition (2006)


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**U17AUE0008** **ADDITIVE MANUFACTURING AND TOOLING**

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

**Course Objective:**
Expose the students with fundamental and advanced knowledge in the field of Additive manufacturing technology and its industrial applications.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Classify the concepts and terminologies of additive manufacturing
CO2: Apply the reverse engineering concepts for design development
CO3: Identify the variety of additive manufacturing techniques based on end product applications
CO4: Design and develop newer tooling models
CO5: Familiarise with cutting edge technologies in rapid tooling and manufacturing
CO6: Analyse the cases relevant to Additive manufacturing

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | | | | W | M | | | | | M | | M |
| CO2: | S | S | S | M | W | | S | M | | | | M | | S |
| CO3: | S | M | | | | | M | | | | | | | M |
| CO4: | S | S | S | M | W | | S | M | M | | | | | S |
| CO5: | S | M | | | W | | M | | | | | M | | S |
| CO6: | S | S | S | M | | | M | M | | | | | | S |

**Course Assessment methods:**

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

**INTRODUCTION** **L: 9 Hrs**
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits Applications.

**REVERSE ENGINEERING & CAD MODELING** **L: 9 Hrs**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

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**ADDITIVE MANUFACTURING SYSTEMS** **L: 9 Hrs**

Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

**SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS** **L: 9 Hrs**

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies

**TOOLING** **L: 9 Hrs**

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "Rapid prototyping: Principles and applications", Chua, C.K., Leong K.F. and Lim C.S., second edition, World Scientific Publishers, 2010.
2 Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRC press, 2005.
3 "Rapid prototyping", Gebhardt, A., Hanser Gardener Publications, 2003.
4 Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
5 Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.


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# AUTOMOTIVE ELECTRICAL AND ELECTRONICS

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**U17AUE0009** **AUTOMOTIVE CONTROL SYSTEM**

| L | T | P | J | C |
|---|---|---|---|---|
| 2 | 0 | 2 | 0 | **3** |

**Course Objective:**

To impart knowledge in the Model based system design. By the end of the course, it should enable the student

- To obtain the mathematical model of any system/sub system of a vehicle.
- To model and simulate automotive systems with the help of modern simulation tools

To design a suitable controller for any given application.

**Course Outcomes:**

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

CO1: Identify the level of the system that is more suitable for model based system design
CO2: Select appropriate modelling technique according to the available inputs for automobiles.
CO3: Understand and apply the fundamental laws of physics and mathematics to obtain the mathematical model of any system / sub system of a vehicle.
CO4: Create a simulation model of a simple automotive system
CO5: Implement a suitable controller applicable for any automotive system.
CO6: Analyse the performance of the sub-system / system using software tools based on the test inputs given to the system.

**Pre-requisite:**

1 U17AUI6201- Automotive Embedded Systems

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | **S** | | **S** | | | | | | | | | | | M |
| CO2: | | **S** | **S** | | | | | | | | | | | |
| CO3: | S | M | | | | | | | | | | | | S |
| CO4: | | | | S | S | | | | M | M | M | | | |
| CO5: | | | S | S | S | | | | M | M | M | | | M |
| CO6: | | | S | S | S | | | | M | M | M | | | S |

**Course Assessment methods:**

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

**MODEL BASED SYSTEM DESIGN** **L: 6 Hrs**

Introduction to model based design, Model based system design in Functional level, Architectural level, Implementation level, limitations on model based design, Process Design- requirements, mathematical modeling, validation and verification, In-loop testing - SIL, HIL

**MODELING TECHNIQUES** **L: 6 Hrs**

Introduction to Modeling - Graphical modeling, Signal flow modeling, State machines modeling, Transfer function modeling, State space modeling, Event based modeling, Statistical modeling for system identification

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**MATHEMATICAL MODELING OF ELEMENTARY SYSTEMS** **L: 6 Hrs**

System, Control system, Modeling – 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

**INTRODUCTION TO TIME AND FREQUENCY RESPONSE ANALYSIS** **L: 6 Hrs**

Time response, test signals, obtaining dynamic response of first order and second order linear systems for different inputs through simulation – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time

Introduction to Frequency response, frequency domain specifications, Excitation and response signals of systems

**REALTIME SIMULATION OF AUTOMOTIVE SYSTEMS** **L: 6 Hrs**

Introduction to controllers, different types of controllers, tuning of PID controller, Plant and Controller stand alone simulation, Plant and controller implementation on single target, RT simulation by Separating the plant from the controller, Controller and plant on real time target

**Practical**

**P: 30 Hrs**

**List of Exercises:**

**(Note: The Simulation tutorial given in the syllabus is not for the End semester Exam)**

1. Mathematical modelling of elementary systems using simulink
2. Modelling of suspension system using simulink and simscape
3. Determination of time response parameters for an automotive system using simulink.
4. Multibody dynamic simulation of a simple system using Matlab
5. Implementation of controller to a simple automotive system
6. Tuning of PID controller
7. Simulation of a cruise control system using dSPACE

| | | |
|---|---|---|
| Theory : 30 Hrs | Tutorial: 30 Hrs | **Total Hours: 60** |

**References:**


1. Peter Wilson and H.AlanMantooth "Model based Engineering for complex Electronics system" 2013,Newness
2. AgamKumarTyagi "Matlab and simulink for Engineers" Oxford Higher education,2012
3. P.D. Cha, J.J. Rosenberg & C.L. Dym, `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
4. Rao V.Dukkipati, 'MATLAB – An introduction with applications', New age international publishers, 2010.
5. Web course by Zachariah chambers and Marc Herniter –Rose Hulman institute of technology on "Introduction to model based design and Advanced model based design."
6. Reference manual: dSPACE - DS1104 R&D Controller Board, Release 2016-A – May 2016


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**U17AUE0010** **AUXILIARY VEHICLE SYSTEMS**

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

**Course Objective:**
To familiarize the students with the fundamentals of modern auxiliary vehicle systems which includes the construction and operational details of ECUs, engine auxiliaries, safety, security, comfort and driver assistance systems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Apply the concept of embedded systems for automotive applications.
CO2: Outline the importance of stability and safety systems in automobiles.
CO3: Interface automotive sensors and actuators with microcontrollers.
CO4: Obtain an overview of vehicle comfort systems.
CO5: Review the telematics systems in modern vehicles.
CO6: Recognize the various automotive security systems.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | | W | | S | M | M | | | | | S |
| CO2: | S | M | | | | M | S | | W | W | | M | | M |
| CO3: | S | S | S | | W | | | M | M | | | | | S |
| CO4: | S | M | | | | M | S | | M | W | | M | | M |
| CO5: | S | M | | | | M | S | | M | W | | M | | M |
| CO6: | S | M | | | | M | S | | M | W | | M | | M |

**Course Assessment methods:**

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

**DIGITAL VEHICLE CONTROL SYSTEMS** **L: 9 Hrs**
Modern Automotive Systems, need for electronics in automobiles, applications, Microcontroller and Microprocessors in automobiles, Input devices – oxygen sensors, fuel metering, vehicle speed sensors, detonation sensor, flow sensor, throttle position sensors, Output devices – displays, solenoids, stepper motors, and relays, Engine Control Unit.

**ENGINE SYSTEMS** **L: 9 Hrs**
Gasoline injection systems - throttle body injection, advanced GDI and multi point fuel injection system, Electronic ignition systems – distributor less ignition system, solid-state ignition system, electronic spark timing control, Open loop and Close loop control system, engine cooling and warm up control, detonation and idle speed control, exhaust emission control, on-board diagnostics.

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**SAFETY SYSTEMS** **L: 9 Hrs**

Active Safety - vehicle motion control, collision avoidance control, vehicle stabilization system, antilock-braking system, traction control system, anti-slip regulation, electronic stability program, dual circuit brakes, safety glass, bad weather equipment – wiper-washer systems.

Passive Safety - air bags, seat belt pretensioner systems, occupant and passenger safety, driver monitoring systems, pedestrian protection, collapsible steering, rollover bars, head restraints, anti-burst door locks.

**COMFORT SYSTEMS** **L: 9 Hrs**

Power Steering, ePAS, Cruise control, Adaptive cruise control, Transmission - fundamentals, control, types MT, AT, CVT and DCT, hill assist, HVAC – Climate Control, Tyre pressure monitoring systems, Seats, Mirrors, Sun-Roofs, Park assist, Infotainment – Car Stereo and Radio.

**DRIVER ASSISTANCE SYSTEMS** **L: 9 Hrs**

Telematics, global positioning systems, geographical information systems, navigation systems, voice command systems, automotive vision system, lane departure warning system, Security Systems – central lock, vehicle immobilizers, keyless entry, anti-theft technology, smart card system, number plate coding.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "Navigation and Intelligent Transportation Systems" - Ronald K. Jurgen, SAE International, USA, 1998.
2 "Electronic Engine Control Technologies" - Ronald K. Jurgen, SAE International, 2004.
3 "Intelligent Vehicle Technologies: Theory and Applications" - Ljubo Vlacic, Michel Parent & Furnio Harshima, Butterworth-Heinemann publications, 2001
4 "Automotive Electrical and Electronic Systems : Automotive Technology - Vehicle Maintenance and Repair" Tom Denton, Burlington, MA 01803, Elsevier Butterworth - Heinemann, 2012.
5 "Automotive Telematics" – Dennis Foy, Red Hat, 2002.
6 "Understanding Automotive Electronics" - Williams. B. Ribbens, 6th Edition, Elsevier Science, Newnes Publication, 2017.
7 Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive , Robert Bosch GmbH, 2014
8 "Telematics Communication Technologies and Vehicular Networks: Wireless Architectures and Applications: Wireless Architectures and Applications" Huang, Chung-Ming, IGI Global, 2009.
9 "Automotive Electricity and Electronics" - James D. Halderman, PHI Publication, 2016.


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**U17AUE0011** **FUEL CELL TECHNOLOGY**

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

**Course Objective:**

- To create an awareness on the recent developments in Fuel cell technology
- Develop a single cell of PEM fuel cell / Microbial fuel cell

**Course Outcomes:**

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

CO1: Identify the different components and materials used in a fuel cell
CO2: Familiarize with the safety aspects and the recent advancements in field of fuel cells
CO3: Apply the knowledge of thermodynamics and material science to understand the thermodynamic equations and electrochemical kinetics of the fuel cell
CO4: Compare the different types of fuel cells and choose an appropriate fuel cell suitable for specific application
CO5: Develop a single cell of PEM fuel cell / Microbial fuel cell on their own
CO6: Estimate the performance of the fuel cell

**Pre-requisite:**

1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | M | | | | | | | | | | | |
| CO2: | | | S | M | | S | | | | | | | | M |
| CO3: | S | S | | | | | | | | | | | | |
| CO4: | | M | S | M | | | | | | | | | | |
| CO5: | | | S | S | | | | | M | M | M | | | S |
| CO6: | | | S | S | | | | | M | M | M | | | S |

**Course Assessment methods:**

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

**INTRODUCTION TO FUEL CELLS** **L: 9 Hrs**

Introduction – working and types of fuel cell – low, medium and high temperature fuel cells - Proton Exchange Membrane fuel cell, Solid Oxide fuel cell, Alkaline fuel cells, Molten carbonate fuel cell, Phosphoric acid fuel cell, liquid and methanol type fuel cells, Microbial fuel cell

**FUEL CELLS COMPONENTS FOR AUTOMOTIVE APPLICATIONS** **L: 9 Hrs**

Fuel cells for automotive applications, components of fuel cell - Membrane Electrode Assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates, materials for fuel cell- carbon fibre, Fuel cell based vehicle, technological advancements in fuel cell vehicle systems

Signature of BOS chairman, Auto

**FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE L: 9 Hrs**

Thermodynamics and electrochemical kinetics of fuel cells, Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects on membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates

**FUELING - PRODUCTION AND STORAGE OF HYDROGEN L: 9 Hrs**

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, Reformer technology – steam reforming, partial oxidation, auto thermal reforming, Fuel Cell Control Systems and Ancillaries, removal of Biomass and CO

**FUEL CYCLE ANALYSIS L: 9 Hrs**

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fuelled by natural gas and hydrogen and hybrid electric vehicle, road map of fuel cells to market- concern and challenges

**List of Exercises : Assignment (Project)**

Build a Proton Exchange Membrane fuel cell

Performance Analysis of a single cell using manual fuel cell test station

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 "Electric & Hybrid Vehicles – Design Fundamentals" - Iqbal Hussain, CRC Press, Second Edition, , 2011

2 "Electric Vehicle Technology Explained", James Larminie, John Wiley & Sons, 2003

3 "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, theory and design", Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010

4 "Fuel Cell Technology Handbook- SAE International" - Gregor Hoogers, CRC Press ISBN 0-8493-0877-1-2003.

5 "Fuel Cells for automotive applications", professional engineering publishing UK. ISBN 1-86058 4233, 2004.


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**U17AUE0012**

## AUTOMOTIVE COMMUNICATION PROTOCOLS

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

**Course Objective:**
Provide knowledge in concepts of acquiring ECU data, storage and exchange of data for ECU Communication in-vehicle network systems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the concepts of Communication Protocols
CO2: Compare the different communication protocols
CO3: Select suitable communication protocols for Automotive Application
CO4: Develop and understand Embedded C code for CAN Protocol
CO5: Understand the in-vehicle networking protocols in automobile
CO6: Apply the knowledge to In vehicle network diagnostics

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | S | | | | | | | | | | | |
| CO2: | | S | S | | | | | | | | | | | |
| CO3: | S | M | | | | | | | | | | | | S |
| CO4: | | | | S | S | | | | M | M | M | | | M |
| CO5: | | | S | S | S | | | | M | M | M | | | M |
| CO6: | | | S | S | S | | | | M | M | M | | | S |

**Course Assessment methods:**

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

**EMBEDDED NETWORKING** **L: 9 Hrs**
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.

**CONTROLLER AREA NETWORK (CAN) PROTOCOL** **L: 9 Hrs**
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,

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CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), CANoe based applications development.

**LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL** **L: 9 Hrs**

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.

**FLEXRAY PROTOCOL** **L: 9 Hrs**

Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, FlexRay 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.

**IN VEHICLE NETWORK DIAGNOSTICS** **L: 9 Hrs**

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 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Multiplexed Networks for Embedded Systems - by Dominique ParetPublisher: John Wiley & SonsRelease Date: July 2007.

2 Understanding and Using the Controller Area Network Communication Protocol: Theory and Practice -Marco Di Natale(Author), Haibo Zeng(Author), Paolo Giusto(Author), ArkadebGhosal – springer 2012

3 Embedded Networking with CAN and CANopen Paperback – June 28, 2016 by Olaf Pfeiffer (Author), Andrew Ayre (Author), Christian Keydel (Author) -Embedded Systems Academy Inc.; 1 edition (June 28, 2016)


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**U17AUE0013 INTELLIGENT VEHICLE TECHNOLOGIES**

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

**Course Objective:**
This course is to impart knowledge on autonomous vehicle and driver assistant systems and also the architectural overview of IoT

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Gain knowledge on different driver assistant system of autonomous vehicle and their applications
CO2: Understand the Radio communication technologies for Intelligent Vehicle
CO3: Identify different control techniques
CO4: Select the appriporiate architectures for motion autonomy
CO5: Understand the model of autonomous vehicles needed in road applications
CO6: Apply IoT configurations for Intelligent Vehicle

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | | | | S | S | | S | | | | | S | S |
| CO2: | S | M | | | S | S | | S | | | | | S | S |
| CO3: | M | M | | | S | S | | S | | | | | S | S |
| CO4: | M | | | | S | S | | S | | | | | S | S |
| CO5: | M | | | | S | S | | S | | | | | S | S |
| CO6: | S | | | | S | S | | S | | | | | S | S |

**Course Assessment methods:**

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

**AN INTRODUCTION TO AUTONOMOUS DRIVING TECHNOLOGIES L: 9 Hrs**
Levels of Driving Automation - Architecture for Autonomous System – Hardware and Software Architecture - Computer vision – Deep learning - Sensor fusion – localization - path planing – decisdition and Control - System intergration .

**RADIO COMMUNICATION AND INTELLIGENT-TRANSPORTATION-SYSTEMS L: 9 Hrs**
Introduction – ITS communication systems, Multimedia communication in a car, Current ITS communication systems and services - Inter-vehicle communication system - Road-vehicle communication system - Device technologies.

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**INTELLIGENT VEHICLE DECISION AND CONTROL TECHNOLOGIES L: 9 Hrs**

Adaptive control system techniques - Adaptive control - an overview - System models for adaptive control- Design of self tuning controllers - Fuzzy control systems - Fuzzy control of distance and tracking.

**DECISIONAL ARCHITECTURES FOR MOTION AUTONOMY L: 9 Hrs**

Introduction - Robot control architectures and motion autonomy - Sharp control and decisional architecture for autonomous vehicles - Motion planning for vehicles - Trajectory planning and state time space - Nonholonomic path planning.

**IOT – INTERNENT OF THINGS L: 9 Hrs**

Introduction of IoT - IoT – architecture, Basic Components ,Network Protocol Stack - M2M and IoT Technology Fundamentals - Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management - Applications of IoT.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Intelligent Vehicle Technologies - Ljubo Vlacic, Michel Parent and Fumio Harashima,“”, Butterworth-Heinemann publications, Oxford, 2001.

2 Internet of Things: A Hands-On Approach Paperback – 2015 by Arsheep Bahga (Author), Vijay Madisetti (Author) - Orient Blackswan Private Limited - New Delhi; First edition (2015)

# AUTOMOTIVE TECHNOLOGY & MANAGEMENT

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**U17AUE0014** **OFF ROAD VEHICLES**

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

**Course Objective:**
Impart knowledge on different types of special purpose vehicles and their systems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Categorise vehicles based on their specification.
CO2: Infer the different types of subsystem and its functioning used in the construction of special purpose vehicle
CO3: Classify and observe the application of special purpose vehicles in construction activities.
CO4: Explain various safety systems used in Utility and military vehicles.
CO5: Interpret kinematics used in the off-road vehicles to understand its operational stability.
CO6: Identify the design requirements of tracked vehicles.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | M | | | | | | | M | M | | | | |
| CO2: | M | M | | | | | | | M | M | | M | | |
| CO3: | M | M | | | | | | | M | M | | | | |
| CO4: | M | M | M | | | | | | M | M | | M | | |
| CO5: | S | S | M | | | | | | M | M | | | M | |
| CO6: | S | S | M | | | | | | M | M | | | S | |

**Course Assessment methods:**

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

**LAYOUT AND REQUIREMENTS** **L: 9 Hrs**
Requirements of Off Road vehicles- Classification of Off Road vehicles-Construction layout, drive, capacity based on ARAI, Frame, Engine Location, type of wheel, Transmission, Multi-axle vehicles and applications.

**TRACTORS** **L: 9 Hrs**
Classification of tractors-lay out of wheeled tractor- power transmission system- steering system- accessories of wheeled tractors- hydraulic control system- power take off unit and special implements

**EARTH MOVING MACHINES** **L: 9 Hrs**
Earthmovers –Dumpers-types, Body construction and transmission, loaders- types-single bucket, Multi-bucket, rotary and backhoe, Body construction and transmission – dozers- types and utilities. Excavators- scrappers, drag and self-powered types, Power take off, special implements. Bush cutters, stumpers, tree dozer, rippers. – Power -and capacity of earth moving machines



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**MILITARY AND SPECIAL UTILITY VEHICLES** **L: 9 Hrs**

Special features and constructional details of tankers, gun carriers and transport vehicles. Oil tankers-Articulated vehicles, working -features of Ambulance, fire extinguishing vehicle. Mobile Cranes: Basic characteristics of truck cranes, stability & design features, control systems & safety devices

**VEHICLE SYSTEMS** **L: 9 Hrs**

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 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


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




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**U17AUE0015** **TYRE TECHNOLOGY**

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

**Course Objective:**
Provide the fundamental knowledge about the construction, performance and dynamic behaviour of automotive tyres.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the various methods of tyre manufacturing.
CO2: Identify the forces and moments acting on tyres.
CO3: Explain wear possibilities, their causes and measurements
CO4: Estimate the safety of tyres and its failure analysis
CO5: List the types of tyre testing methods
CO6: Summarize Tyre retreading and recycling.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | | | | | | | | | | M | S | |
| CO2: | M | W | | | | | | | | | | | S | |
| CO3: | M | M | | | | S | W | | | | | | S | |
| CO4: | S | W | W | | | S | W | M | | | | S | S | |
| CO5: | M | M | | | | | | | | | | M | S | |
| CO6: | S | S | | | | S | W | | | | | S | S | |

**Course Assessment methods:**

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

## INTRODUCTION TO BASICS OF TYRES **L: 10 Hrs**

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres – Tyre Performance Criteria – Indoor Test and Outdoor Test - Tyre Manufacturing - Compound Preparation - Basic concepts of Tread Extrusion - Effect of viscosity & temperature on extrusion - Die swell & shrinkage phenomenon - Calendering - Tyre Assembly – Curing – Inspection - Quality Control Tests.

## TYRE FORCES AND MOMENTS **L: 8 Hrs**

Forces and Moments – Rolling Resistance – Cornering Properties – Slip Angle and Cornering Force – Performance of Tyre on Wet Surface – Ride Properties of Tyres – Study of Tyre types based on different road conditions and applications.

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**RUBBER ABRASION AND TYRE WEAR** **L: 8 Hrs**

Sliding Abrasion – Tyre Wear – Influence of Road Surface – Driving Influences – Speed and Load Distributions – Road Wear and Force Distribution – Tyre Construction

**TYRE RETREADING, TYRE DURABILITY AND FAILURE ANALYSIS** **L: 10 Hrs**

Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fast wear, poor retreading Bead/casing failures. Hot and cold process.

Service - Maintenance Safety- On Vehicle- In-Service Safety - Fundamentals Of Tyre Durability - Nature Of Tyre Durability- Deflection, Heat, Speed, Tyre Structural Failures - Common In-Service Tyre Failure Modes - Run Low/ Flux Break- Tyre Tread Bead Detachment- Rapid Air Loss - Over Deflection- Intra-Carcass Pressurization- Cuts And Punctures- Improper Repair

**NON-DESTRUCTIVE TESTS AND INSPECTIONS, RECOVERY AND RE-USE** **L: 9 Hrs**

Introduction of Inspection Techniques - X-Ray Examination – Shearography – Ultrasound – Eddy Currents - Recovery and Re-use Reclaiming Technology – Surface Treatment – Grinding and Pulverization technology – Devulcanization Technology Use of Recovered Tyre rubber.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 J. Y. Wong, “Theory of Ground Vehicles”, 4th Edition“2008
2 US Department of Transportation., “The Pneumatic Tire”,February 2006
3 Bireswar Banerjee, “Tyre Retreading” Smithers Information Ltd., 2015
4 V. L. Shulman, “Tyre Recycling” Rapra Review Reports Volume 15, Number 7, 2004
5 Tom French, Tyre technology, The University of Michigan, 1989.




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**U17AUE0016** **VEHICLE TESTING AND VALIDATION**

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

**Course Objective:**
Familiarize the tests to be performed on the vehicle and its subsystems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Outline the basic measurement systems.
CO2: Examine the vehicle body strength using crash tests.
CO3: Explain the various engine performance testing methods.
CO4: Estimate the different vehicle test parameters and its influence on fuel economy.
CO5: Summarize the tests performed on steering, suspension and its impact on driving stability.
CO6: List the tests conducted to analyse the transmission, brakes and wheel performance.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | | | S | | | | | | | W | M | |
| CO2: | S | M | | | S | | M | | | | | M | S | |
| CO3: | M | M | | | S | | M | | | | | W | S | |
| CO4: | M | M | | | S | | M | | | | | W | M | |
| CO5: | M | M | | | S | M | W | | | | | W | M | |
| CO6: | M | M | | | S | | W | | | | | M | S | |

**Course Assessment methods:**

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

**INTRODUCTION TO MEASUREMENT SYSTEMS** **L: 3 Hrs**
Introduction - static and dynamic measurement - closed and open loop system - Requirements and characteristics

**VIBRATION MEASUREMENT AND VEHICLE BODY STRENGTH ANALYSIS** **L: 9 Hrs**
Instrument – Accelerometer and signal conditioning, Graphical presentation. Dynamic simulation sled testing, methodology, Vehicle acceleration measurement and Documentation.
Dolly roll over test, dolly role over fixture, photographic / video coverage, instrumentation. Vehicle roof strength test – test procedure and test measurements. Door system crush test - procedure and measurements.



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**ENGINE TESTING & FUEL ECONOMY** **L: 8 Hrs**

I.S Code for Engine testing – Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers.

Field Testing: Type I & II, test route selection, vehicle test speeds, cargo weights, driver selection, test data form, calculations. Test on rough terrain, pot holes with laden and unladen conditions.

**VEHICLE STEERING, SUSPENSION AND STABILITY TEST** **L: 14 Hrs**

Analysis of constant radius test, constant steer angle test, constant speed variable radius test, constant speed variable steer angle test, response gain test.

Measurement of dimensional and geometric characteristics, measurement of centre of gravity position, measurement of moments and products of inertia, measurement of suspension kinematic characteristics, measurement of suspension elastic and coulomb friction characteristics, measurement of shock absorber characteristics.

**WHEELS AND TRANSMISSION AND BRAKE PERFORMANCE TEST** **L: 11 Hrs**

Friction Clutches - Diagnosing of Slippage, Drag, Binding and Vibration - Performance of Automatic Transmission Systems

Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **Total Hours: 45** |

**References:**


1 Crouse W H and Anglin D L., "Automotive Mechanics"' Tata McGraw Hill Publishing Company, 2004
2 Rangan, Mani and Sharma, "Instrumentation", Tata McGraw Hill Publishers, New Delhi, 2004
3 Stockel M W, "Auto Mechanics Fundamentals", Good Heart-Wilcox Co., Inc., 2000
4 Jain R K "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
5 Martyr A. J, Plint M. A, "Engine Testing Theory and Practice", 3rd edition, Butterworth-Heinemann, 2007.
6 Ken Pickerill, "Automotive Engineering Engine Performance Shop Manual", Cengage Learning, 2010
7 SAE Hand book, Vol. 3, SAE Publications, 2000
8 Tim Gilles, "Automotive Service"' Delmar Publishers, 1998.
9 Beckwith TG and Buck N L, "Mechanical Measurements", Addition Wesley Publishing Company Limited, 1995
10 Giles J. G, "Vehicle Operation & Performance".
11 Crouse. W. H, Anglin. D. L, "Motor Vehicle Inspection", McGraw Hill, 1978.




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**U17AUE0017** **ENTREPRENEURSHIP DEVELOPMENT**

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

**Course Objective:**
Provide knowledge on Entrepreneurship to be become responsible Entrepreneurs.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: List the merits and demerits of entrepreneurial culture
CO2: Develop the entrepreneurial characteristics to understand strength and weakness
CO3: Utilize the opportunity
CO4: Formulate a business plan to solve problems
CO5: Choose the processes involved in setting up a business
CO6: Compare the role of government and banks in promoting entrepreneurship.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | | | | | | | | | | | | | | |
| CO2: | | | | | | | | | | | | | | |
| CO3: | | | | | S | S | S | S | S | S | S | S | | |
| CO4: | | | | | S | S | S | S | S | S | S | S | | |
| CO5: | | | | | S | S | S | S | S | S | S | S | | |
| CO6: | | | | | S | S | S | S | S | S | S | S | | |

**Course Assessment methods:**

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

**ENTREPRENEURSHIP** **L: 9 Hrs**
Entrepreneur - Types of Entrepreneurs, Intrapreneur, Multiprener, Entrepreneurship in Economic Growth of a country, Factors Affecting Entrepreneurial Growth

**ACHIEVEMENT MOTIVATION TRAINING** **L: 9 Hrs**
Factors influencing a person to become on his own. Need to achieve. Training through Activities. Goal setting. Role Play. Awareness programs.

**MARKET RESEARCH & MARKETING** **L: 9 Hrs**
Market potential. Questionnaire for Market survey. Market research. Consumer behavior. Voice of a customer. Scope for new product. Product distribution channels.

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**BUSINESS PLAN** **L: 9 Hrs**

Types of business. Classification based on investment. Detailed Business Plan PPR and DPR. Feasibility study. Technical appraisal of the business. Profitability calculations. Brake-Even analysis, Demand Fore casting and Inventory. Costing and accounting. Taxes. Formalities and processes in setting up a business.

**SUPPORT TO ENTREPRENEURS** **L: 9 Hrs**

Sickness in small Business. Causes and Consequences, Corrective Measures. Technology Business Incubators Government Policy for funding Start Ups & Small Scale Enterprises. Role of MSME State Level. Growth Strategies in small industry. Expansion, Diversification, Joint Venture, Merger and Sub Contracting. Venture capitalists. Patents. Intellectual Property Rights.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **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,Princy Thomas Entrepreneurship Education: Experiments with Curriculum, Pedagogy and Target groups. Springer 2017
5 Rajeev Roy, 'Entrepreneurship', 2nd Edition, Oxford University Press, 2011
6 EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986


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**U17AUE0018** **VEHICLE TRANSPORT MANAGEMENT**

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

**Course Objective:**
Provides knowledge on fleet management methods and Motor vehicle act.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Collect concept of personal Management objectives and functions.
CO2: Explain the Passenger transport operation.
CO3: Explain the Good Transport management Systems.
CO4: Describe the Motor Vehicle Act.
CO5: Outline the process of traffic engineering and its management.
CO6: Extend knowledge of fleet management.

**Pre-requisite:**
1 NIL

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | | | | | | S | | S | M | M | M | M | | S |
| CO2: | | | M | | | S | | S | M | | M | M | | S |
| CO3: | | | | | | S | | S | M | M | M | M | | S |
| CO4: | | | | | | S | S | S | | M | | M | | S |
| CO5: | M | | | | | S | M | S | M | M | S | | | S |
| CO6: | | | | | | S | | S | M | M | M | M | | S |

**Course Assessment methods:**

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

## INTRODUCTION **L: 9 Hrs**
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.

## PASSENGER TRANSPORT OPERATION **L: 9 Hrs**
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 **L: 9 Hrs**

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 **L: 9 Hrs**

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.

## TRAFFIC ENGINEERING & MANAGEMENT **L: 9 Hrs**

Road user characteristics, human and vehicle characteristics, speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams; Traffic volume Measurement, equipment for flow measurement, Density measurement, Travel time measurement, Automotive traffic measurement devises, Traffic signal design, Parking study, accident study, congestion study, toll operation, pedestrian study.

| | | |
|---|---|---|
| Theory : 45 Hrs | Tutorial: 0 Hrs | **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
4 Roess, RP., McShane, WR. and Prassas,ES.(1998), Traffic Engineering,Prentice Hall
5 May,A. D.(1990), Fundamentals of Traffic Flow,Prentice Hall.
6 The motor vehicle Act 1939 - Ejaz Ahemad, Ashok law house, India – 1989.
7 Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna




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**U17AUE0019 APPLIED HYDRAULICS AND PNEUMATICS**

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

**Course Objective:**
Provides knowledge on the application of hydraulic and pneumatic systems.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Identify the graphical representation of all the hydraulic and pneumatic components
CO2: Describe the concept used to design the systems
CO3: Illustrate the working of hydraulic components
CO4: Summarize the working of pneumatic components
CO5: Design and implement simple fluid power systems common in industrial applications using commercial components
CO6: Familiarize the actual fluid power circuits used in Automotive and Industrial Applications

**Pre-requisite:**
1 U17AUI4202 - Fluid Mechanics and Machinery

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | | | | | | | | S | | | S | |
| CO2: | S | | | | M | | | | | | | | S | |
| CO3: | S | | | | | | M | | | | | S | S | |
| CO4: | S | | | | | | M | | | | | S | S | S |
| CO5: | S | M | S | | M | | S | | | | | S | S | S |
| CO6: | S | | M | M | M | | M | | | | | | S | S |

**Course Assessment methods:**

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

## INTRODUCTION TO FLUID POWER & PRINCIPLE **L: 7 Hrs**

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 **L: 11Hrs**

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.

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## FLUID POWER ELEMENTS **L: 9 Hrs**

Control valves - pressure, flow direction - working principles and construction - Special type valves- proportional and servo - Selection and actuation methods.

Actuators - Selection and specification, cylinders - mounting, cushioning - Fluid conditioning elements - Accumulators.

## HYDRAULICS AND PNEUMATICS CIRCUITS DESIGN **L: 9 Hrs**

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

## ELECTRO-PNEUMATICS **L: 9 Hrs**

Use of electrical timers, switches, solenoid, relay, proximity sensors - Electro pneumatic sequencing Ladder diagram.

PLC: – elements, function and selection - PLC programming - Ladder and different programming methods - Sequencing circuits.

Theory : 45 Hrs Tutorial: 0 Hrs **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: Principles and maintenance”, Tata McGraw Hill,2004
4 Andrew Parr, “Hydraulics & Pneumatics” Jaico Publishing House,2004
5 William W. Reaves, “Technology of Fluid Power”, Delmer Publishers,1997
6 Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006.
7 Peter Rohner,” Fluid Power Logic Circuit Design” MacMillion Press Ltd., 1990.
8 Micheal J, Pinches and Ashby, J.G., “Power Hydraulics”, Prentice Hall, 1989.
9 Dudelyt, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.


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**U17AUE0020** **AUTOMOTIVE AERODYNAMICS**

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

**Course Objective:**
Provides knowledge on basic principles of aerodynamics for the design of vehicle body.

**Course Outcomes:**
After successful completion of this course, the students should be able to:
CO1: Understand the fluid flow concepts for aerodynamic studies in vehicle.
CO2: Understand the importance of aerodynamics for automobiles.
CO3: Explain the aerodynamic drag concepts and aerodynamic development strategies for car.
CO4: Analyze various aerodynamic shapes of cars and commercial vehicles.
CO5: Explain the vehicle lateral stability due to side wind, wind noise and occurrence of dirt accumulation on vehicle.
CO6: Apply the concept of wind tunnel and numerical methods for aerodynamic design of automobiles.

**Pre-requisite:**
1 U17AUI4202 - Fluid Mechanics and Machinery

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | M | | | | | | | S | M | | S | S | |
| CO2: | S | M | | | | | | | S | M | | S | S | |
| CO3: | S | M | M | | | | | | S | M | | S | S | |
| CO4: | S | S | S | | | | | | S | M | | S | S | |
| CO5: | S | S | M | | | | | | S | M | | S | S | |
| CO6: | S | S | M | | M | | | | S | M | | S | S | |

**Course Assessment methods:**

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

## INTRODUCTION **L: 9 Hrs**
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 **L: 9 Hrs**
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.

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**SHAPE OPTIMIZATION OF CARS** **L: 9 Hrs**

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.

**VEHICLE HANDLING** **L: 9 Hrs**

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

**WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS** **L: 9 Hrs**

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

Theory : 45 Hrs Tutorial: 0 Hrs **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
4 Vehicle Aerodynamics - SP-1145 - SAE – 1996.


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# ONE CREDIT COURSES

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**U17AUC0001 MOTORSPORTS ENGINEERING**

**Course Outcomes**

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

**CO1:** Classify various motorsport events across the globe

**CO2:** Identify the rules and regulation for the different motor sport events

**CO3:** Recognize the career opportunities in motorsport engineering

**Pre-requisite:**

1. Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | | S | | | S | | | | | | | S | S | S |
| CO2: | | S | | | | S | S | | M | S | | S | S | S |
| CO3: | | | | | | S | | | | | S | | S | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | 1. Exit Survey |
| 2. Seminar / Case Study Report | |

## 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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**U17AUC0002 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/PSO 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 | PSO1 | PSO2 |
| CO1: | S | W | | | | | | | | | | | S | |
| CO2: | | M | | | | | | | | | | M | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | 1. Course Exit Survey |
| 2. Assignment / Case study | |

## 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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**U17AUC0003** **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/PSO 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 | PSO1 | PSO2 |
| CO1: | | S | | | | | | | | | W | | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Quiz | 1. Course Exit Survey |
| 2. Assignment / Case study | |
| 3. Test | |

**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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**Course Outcomes**

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

**CO1:** Understand the IPR and its classification

**CO2:** Understand the Patens for Inventions

**Pre-requisite:**

1. Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | S | | S | S | S | | | S | S | S | S | |
| CO2: | M | | S | | S | S | S | | | S | S | S | S | |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | 1. Course Exit Survey |
| 2. Quiz | |
| 3. Assignment / Case study | |

**Module:**

1.Overview on IPR and its classification **3 Hours**

2.Patents **4 Hours**

3.International Conventions related to IPR **4 Hours**

4.Patens for Inventions in Automotive Engineering - Case Studies **4 Hours**

**Total Hours: 15**

**References:**


1. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000
2. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010


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**U17AUC0005 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:**

2. Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | M | | S | | S | S | S | | | S | S | S | | S |
| CO2: | M | | S | | S | S | S | | | S | S | S | | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | 1. Course Exit Survey |
| 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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**U17AUC0006 LEAN MANUFACTURING**

**Course Outcomes**

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

**CO1:** Understand the Concept of Six Sigma and Value Engineering

**CO2:** Understand the Concept of Reliability Engineering and Learn Manufacturing

**Pre-requisite:**

1. Nil

**CO-PO/PSO 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 | PSO1 | PSO2 |
| CO1: | S | S | S | S | S | W | M | | | | | S | **S** | |
| CO2: | S | S | S | S | S | W | M | | | M | | S | **S** | S |

**Course Assessment methods:**

| Direct | Indirect |
|---|---|
| 1. Test | 1. Course Exit Survey |
| 2. Quiz | |
| 3. Assignment / Case study | |

**Course Description**

Lean Manufacturing is about creating value. The Lean process starts with creating value for the ultimate customer, which requires providing the right product at the right time for the specified price. While all manufacturing attempts to do this, what makes Lean Manufacturing distinct is the relentless pursuit and elimination of waste. Students will learn the concepts and tools of Lean, which include types of waste, visual management, 5S, value stream mapping, A3, & flow.

**Module:**

1. Definition of Lean
2. Importance of Lean
3. Application of Lean Tools
4. Difference between Value-Added and Non-Value-Added
5. Preparing to Work in a Lean Environment
6. Dos and Don’ts for Lean Terms
7. Traditional Manufacturing
8. Introduction to New Advanced Lean Tools
9. Eight Wastes
10. Introduction to Key Terms
11. Visual Controls
12. 5S and Standardized Work

**Total Hours: 15**

**Reference**


1. “The Machine that Changed the World” - J.P. Womack, D.T. Jones, D. Roos, Free Press, 1990 (2007 in paperback). ISBN-13: 978-0-7432-9979-4.
2. “The Toyota Way” J.K. Liker, McGraw Hill, 2004. ISBN 0-007-139231-9
3. “Learning to See” - M. Rother, J. Shook, Lean Enterprise Institute, 2009. ISBN: 9978-0-9667843-0-5


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