UNIVERSITY OF MUMBAI

Bachelor of Engineering

Automobile Engineering

Third Year (Sem. V & VI) and Final Year (Sem. VII & VIII)

Revised Syllabus (REV- 2012) w.e.f. Academic Year 2014 - 15 and 2015-2016 respectively

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)
Deans Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO’s) and give freedom to affiliated Institutes to add few (PEO’s) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner’s learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner’s performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai
Chairman Preamble

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and to excel in their Postgraduate studies.
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner’s thought process.

In addition to the above, 2 to3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from the point of view of a learner are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

Dr. S. M. Khot
Chairman, Board of Studies in Mechanical Engineering, University of Mumbai
### B. E. Automobile-(Semester VII)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Teaching Scheme (Contact Hours)</th>
<th>Credits Assigned</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
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<tr>
<td>AEC701</td>
<td>Chassis Body Engineering</td>
<td>3</td>
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<tr>
<td>AEC702</td>
<td>CAD/CAM/CAE*</td>
<td>4</td>
<td>2</td>
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<tr>
<td>AEC703</td>
<td>Automotive Design</td>
<td>4</td>
<td>2</td>
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<tr>
<td>AEC704</td>
<td>Product Design and Development</td>
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<td>AEE701X</td>
<td>Elective I</td>
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<td>Project I</td>
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<tr>
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<tbody>
<tr>
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<td>Internal Assessment</td>
<td>Term Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test1</td>
<td>Test2</td>
</tr>
<tr>
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<td>Chassis Body Engineering</td>
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<td>AEC702</td>
<td>CAD/CAM/CAE*</td>
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<td>AEC703</td>
<td>Automotive Design</td>
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<td>AEC704</td>
<td>Product Design and Development</td>
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<td><strong>Total</strong></td>
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</tbody>
</table>

* Common with Mechanical Engineering  
* Only ORAL examination based on term work and syllabus

### B. E. Automobile-(Semester VIII)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Teaching Scheme (Contact Hours)</th>
<th>Credits Assigned</th>
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<td>Theory</td>
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<td>Autotronics</td>
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<td>AEC802</td>
<td>Vehicle Dynamics</td>
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<td>AEC803</td>
<td>Vehicle Maintenance</td>
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<th>Course Name</th>
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<td>Internal Assessment</td>
<td>Term Work</td>
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<tr>
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<td>Test1</td>
<td>Test 2</td>
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<td>Vehicle Maintenance</td>
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<td>Elective II</td>
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<td><strong>Total</strong></td>
<td></td>
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</tr>
</tbody>
</table>

* Only ORAL examination based on term work and syllabus

# indicates work load of Learner (Not faculty) in VII and VIII semester for Project

Project I and II: Students groups and load of faculty per week
Project Groups: Students can form groups with minimum 2 (Two) and not more than 4 (Four)
Faculty Load: In semester VII – ½ an hour per week per project group
   In semester VIII - 1 hour per week per project group
   Each faculty is permitted to take (guide) maximum 4 (Four) project groups.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Elective I</th>
<th>Course Code</th>
<th>Elective II</th>
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</thead>
<tbody>
<tr>
<td>AEE7011</td>
<td>Power Plant Engineering</td>
<td>AEE8021</td>
<td>Noise Vibrations &amp; Harshness</td>
</tr>
<tr>
<td>AEE7012</td>
<td>Supply Chain Management</td>
<td>AEE8022</td>
<td>Vehicle Safety</td>
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<tr>
<td>AEE7013</td>
<td>Tribology</td>
<td>AEE8023</td>
<td>World Class Manufacturing</td>
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<td>AEE7014</td>
<td>Computational Fluid Dynamics</td>
<td>AEE8024</td>
<td>Knowledge Management</td>
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<td>AEE7015</td>
<td>Automotive Embedded Systems</td>
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<td>Project Management</td>
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<td>Artificial Intelligence</td>
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<td>AEE7017</td>
<td>Transportation Management</td>
<td>AEE8027</td>
<td>Virtual Reality</td>
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<td></td>
<td>Motor Industry</td>
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</table>

*Common with Mechanical Engineering*
Objectives
1. Understand fundamentals of Vehicle Body design
2. Study different vehicle structural design and their requirements.
4. Design vehicle body structures

Outcomes: Learner will be able to……
1. Design and implement knowledge practically of Vehicle structures.
2. Develop efficient and safe designs with consideration of all constraints.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Fundamental aspects of Vehicle Bodies</strong>&lt;br&gt;1.1 Chassis and structure types: Open, Semi integral and Integral bus structure. Frames: functions and types of frames, Loads on frames, Load distribution of structure.&lt;br&gt;1.2 Classification of motor vehicle, Location of power plant, Location of different chassis components,&lt;br&gt;1.3 Terminology and overview of structural surface types, history and Overview of structural types. Basic concept of design.&lt;br&gt;1.4 Vehicle body materials and their selection: Detail study of materials used in vehicle body building (Steel sheet, timber, plastics, FRP, GRP etc, properties of materials-Corrosion anticorrosion methods, scalation of paint and painting process )</td>
<td>8</td>
</tr>
<tr>
<td>02</td>
<td><strong>Vehicle body styles</strong>&lt;br&gt;2.1 Car Body Details: Types: Saloon, Convertibles, Limousine, Estate van, racing and sports car.&lt;br&gt;Visibility: regulations, driver’s visibility, test for visibility, Methods of improving visibility and space in cars.&lt;br&gt;Safety: safety design, safety equipments for car.&lt;br&gt;Car body construction, Front assembly, Roof Assembly, Under floor, bonnet etc.&lt;br&gt;2.2 Bus Body Details: Types, mini bus, single Decker, double Decker, two levels, split level and articulated bus.&lt;br&gt;Bus Body Lay Out: Floor height, engine location, entrance and exit location, seating dimensions.&lt;br&gt;Constructional details: Frame construction, Double skin construction-Types of metal section used-Regulations-Conventional and Integral type construction.&lt;br&gt;2.3Commercial Vehicle Body Details: Types of bodies, flat platform, drop side, fixed side, tipper body, tanker body, light construction vehicle body types, Dimensions of driver seat in relation to control, Driver cabin design.</td>
<td>8</td>
</tr>
<tr>
<td>03</td>
<td><strong>Vehicle Aerodynamics:</strong> Objectives, Vehicle drag and types, various types of forces and moments, Effects of forces and moments, side wind effects on forces and moments, various body optimization techniques for minimum drag .Calculation of drag.</td>
<td>6</td>
</tr>
</tbody>
</table>
### Ergonomics and Preliminary Design

| 3.1 | Design and requirement of Driver, Passenger and child seat. |
| 3.2 | Drawing of the preliminary design-Vehicle Body Weight Analysis, Calculation of C.G for Vehicle, Vehicle Weight Distribution and Master Model. |
| 3.3 | Overall Criteria for Vehicle Comparison: Design, Running costs, Overall Design Efficiency. |

### Body Loads

| 5.1 | Loads on Vehicles: Bending, Torsion, Lateral and Braking and Acceleration Load Cases, Shear Panel Method |
| 5.2 | Calculation of loading cases Static loading case, Asymmetric loading case, Longitudinal loads, Side Loads, Calculation of different cases. |

### Strength of Vehicle Body Elements

| 6.1 | Thin Walled Structures-General Principle, Torsion, Torsion centre, Forces in End Load Carrying Members. Effect of Holes, Spot welded joints. |

| 04 | Ergonomics and Preliminary Design | 6 |
| 05 | Body Loads | 4 |
| 06 | Strength of Vehicle Body Elements | 4 |

**List of Experiments**

1. Structural Analysis of Chassis Frame using CAD Software for different sections (C-section, I-section, L-section, O-section, Hat section, Tubular section etc)
2. Mini Project: Containing a 3D Model of Chassis or Body or combination of both (Min 2 Max 4 Students per Group)
3. Industrial Visit

**Term Work**

Term work shall consist of experiments from the list, 6 assignments based on complete syllabus, industrial visit report and a mini project report

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments) : 05 marks
- Mini project : 05 marks
- Assignment: 05 marks
- Industrial visit report: 05 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Internal Assessment**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.
Practical/Oral examination

1. Practical examination duration is 2 hours.
2. Practical examination shall be based structural analysis and mini project mentioned in the term work.
3. The distribution of marks for practical/oral examination shall be as follows:
   i. Practical performance: 15 marks
   ii. Oral: 10 marks
4. Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
5. Students work along with evaluation report to be preserved till the next examination

Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

Objectives
1. To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.

Outcome: A learner will be able to…
1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects and store and manage data.
3. Prepare part programming applicable to CNC machines.
4. Use rapid prototyping and tooling concepts in any real life applications.
5. Identify the tools for Analysis of a complex engineering component.

<table>
<thead>
<tr>
<th>Modules</th>
<th>Details</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Computer Graphics and Techniques for Geometric Modeling</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Computer Graphics: Two dimensional computer graphics, vector generation, the windowing transformation, Three dimensional Computer graphics, viewing transformation, Homogeneous coordinates, Perspective projection, Hidden line removal &amp; hidden surface removal algorithm, light &amp; shade ray tracing. The parametric representation of geometry, Bezier curves, Cubic Spline curve, B-Spline curve, parametric representation of line, circle, ellipse &amp; parabola. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature based modeling, Feature recognition, Design by feature.</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Transformation, Manipulation &amp; Data Storage</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>2D &amp; 3D Transformations (Translation, Rotation, &amp; Scaling &amp; Magnification), Concatenations, Matrix representation, Problems &amp; object oriented programming on Transformations. Object transformation, mirror transformation, Artificial Intelligence in Design &amp; Manufacturing, Representation of Knowledge, and Knowledge base Engineering.</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>NC &amp; CNC Technology</td>
<td>08</td>
</tr>
<tr>
<td>04</td>
<td>Computer Aided Engineering (CAE)</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Fundamentals of computer aided engineering, CAE includes mass property calculations, kinematic analysis and animation (movement, visualization, simulation and FEA). Case study based on modeling and analysis of structural, thermal/fluid, and dynamic (vibration analysis) system. Parameter optimization.</td>
<td></td>
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</tbody>
</table>
List of Exercises
1. Programming for transformations,
2. Solid modeling using any 3D modeling software
3. Part programming and part fabrication on CNC trainer (Turning / Milling)
5. Development of physical 3D mechanical structure using any one of the rapid prototyping processes.
6. Rapid tooling for any one of the engineering or medical applications.

Term Work
Term work shall consist of any three exercises from the above list and a course project in a group of not more than three (3) students on either computer aided engineering or rapid prototyping and tooling.

The distribution of marks for term work shall be as follows:
- Exercises : 15 marks
- Course Project : 05 marks
- Attendance (Theory & Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems.
Practical / Oral Examination
Practical examination of 2 hours duration based on any one of the following.
1) Programming for Algorithms, transformations.
2) Part Programming and machining of components.
3) 3D Modeling on software.
4) Analysis of component for optimization

The distribution of marks for practical/oral examination shall be as follows:

i. Practical performance: 15 marks
ii. Oral: 10 marks

Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
Students work along with evaluation report to be preserved till the next examination

Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

4. “CAD/CAM Principles, Practice and Manufacturing Management” by Chris McMahon, Jimmie Browne, Pearson Education
5. “CAD/CAM/CIM” by P. Radhakrishan, S. Subramanyan, V. Raju, New Age International Publishers
8. David L. Goetsch, Fundamental of CIM technology ,Delmar publication
18. “Rapid Prototyping” Chee Kai Chua World Scientific Publishing
Course Code | Course /Subject | Credits
--|---|---
AEC703 | Automotive Design | 4+1

Objective

1. Provide students with the fundamental knowledge in the field of automotive design.
2. Develop analytical abilities to give solutions to Automotive design problems

Outcome: Learner will be able to…

1. Design automotive component to meet desired needs
2. Apply the fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machine for actual design problems

<table>
<thead>
<tr>
<th>Modules</th>
<th>Details</th>
<th>Hrs.</th>
</tr>
</thead>
</table>
| 01 | Design of Principal parts of I.C. Engines
   1. Cylinder and cylinder liner- Material Selection, Design of cylinder
   2. Piston, piston rings and piston pin or gudgeon pin- Material Selection, Design considerations, Design calculations
   3. Connecting rod with small and big end bearing-forces acting on connecting rod, Design considerations, Design calculations | 12 |
| 02 | Design of Principal parts of I.C. Engines
   1. Crank, crankshaft and crank pin
   2. Cam shaft and Valve Operating mechanism. | 08 |
| 03 | Design of Clutches and Gear Boxes: single plate, multiple plates, centrifugal clutch, lining material, lever design, sliding mesh, constant mesh, synchromesh gear box, gear ratio and gear shifting lever, sliding mechanism | 08 |
| 04 | Design of Drive train: Design of propeller shaft and U-joints, Design of propeller shaft, criteria, failure theories-joint design, Design of Final drive and differential | 08 |
| 05 | Brakes and Suspension: internal expanding shoe brake, friction lining material, leaf spring, coil spring, materials, suspension system and linkages, independent suspension | 06 |
| 06 | Advanced automotive Body Structures: Emphasis is on body concept for design. Material selection and manufacturing constraints | 06 |

Term Work

Term work shall consists of exercises on the above topics in the form of design calculations with sketches and/or drawings, Complete design and preparation of drawings for at least four components using CAD Software and Analysis software, Class Assignments and course project where a group of 3 or 4 students shall perform Stress analysis of any machine element using any analysis software like ANSYS/MSC, NASTRAN etc. and submit report as term work.

The distribution of marks for term work shall be as follows:

- Exercises/Assignment : 10 Marks
- Course Project : 10 Marks
- Attendance (Theory & Practical) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.
Note
Use of standard design data books like PSG data book, Mahadevan book is permitted at the examination and shall be supplied by the college.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems.

Oral examination
1. Oral examination shall be conducted based on term work and syllabus content
2. Examiners are expected to give small task or ask questions either to evaluate understanding of basic fundamentals or to evaluate their capability of applying basic theory to practical applications.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
1) Machine Design – Khurmi Gupta. S.Chand pub..
3) Design of machine elements—Sharma, Purohit, Prentice Hall India publication
4) Machine Design by Pandya & shah, Charolar Publishing
5) Mechanical Engineering Design – J.E.Shiegly- Mcgraw hill
6) Recommended Design Data Books- PSG, Kalaikathir Achchagam Publishing
7) Recommended Design Data Books -Mahadevan,
8) Design of machine element – Spotts.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course/Subject Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AEC704</td>
<td>Product Design &amp; Development</td>
<td>4+1</td>
</tr>
</tbody>
</table>

**Objectives**

1. To understand fundamental product design concepts
2. To understand product design methodologies
3. To understand product design needs and issues in industry

**Outcomes:** Learner will be able to……

1. To design the products as per the customer/industry requirements
2. To apply product design tools and techniques

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<tr>
<th>Module</th>
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<th>Hrs.</th>
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<tbody>
<tr>
<td>01</td>
<td><strong>1. INTRODUCTION</strong>&lt;br&gt;1.1 Introduction to product design.&lt;br&gt;1.2 Classification/ Specifications of products.&lt;br&gt;1.3 Product life cycle &amp; Product mix.&lt;br&gt;1.4 Modern product development process.&lt;br&gt;1.5 Innovative thinking.&lt;br&gt;1.6 Morphology of design (7 phases)</td>
<td>08</td>
</tr>
<tr>
<td>02</td>
<td><strong>2. CONCEPTUAL DESIGN</strong>&lt;br&gt;2.1 Generation, selection &amp; embodiment of concept.&lt;br&gt;2.2 Product architecture.&lt;br&gt;2.3 Significance of Industrial design process.&lt;br&gt;2.4 Introduction to Design Of Experiments (DOE) for Robust Design, Taguchi Designs.</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>3. DESIGN FOR MANUFACTURING AND ASSEMBLY</strong>&lt;br&gt;3.1 Methods of designing for manufacturing &amp; assembly.&lt;br&gt;3.2 Designs for maintainability.&lt;br&gt;3.3 Designs for environment.&lt;br&gt;3.4 Product costing.</td>
<td>10</td>
</tr>
<tr>
<td>04</td>
<td><strong>4. DESIGN METHODOLOGIES</strong>&lt;br&gt;4.1 Value engineering and Value analysis.&lt;br&gt;4.2 Failure Mode Effect Analysis (FMEA)&lt;br&gt;4.3 Concurrent engineering&lt;br&gt;4.4 Quality Function Deployment (QFD)&lt;br&gt;4.5 Reverse engineering</td>
<td>10</td>
</tr>
<tr>
<td>05</td>
<td><strong>5. DESIGN FACTORS</strong>&lt;br&gt;5.1 Ergonomics and Aesthetics.&lt;br&gt;5.2 Anthropometry.&lt;br&gt;5.3 Man-Machine interaction.&lt;br&gt;5.4 Concepts of size and texture, color&lt;br&gt;5.5 Comfort criteria.&lt;br&gt;5.6 Psychological &amp; Physiological considerations.&lt;br&gt;5.7 Economic factors.</td>
<td>06</td>
</tr>
<tr>
<td>06</td>
<td><strong>6. PRODUCT DESIGN NEEDS AND ISSUES IN INDUSTRY</strong>&lt;br&gt;6.1 Customer needs: types, models and collection of customer needs information, analysis of information, Rapid prototyping, Tools for product design – Drafting / Modeling software, CAM interface.&lt;br&gt;6.2 Creativity Techniques: Creative thinking, conceptualization, Brain storming, primary design, drawing, simulation, detail design.&lt;br&gt;6.3 Legal and social issues. Engineering ethics and issues of society related to design of products, Patents &amp; IP Acts. Overview, Disclosure preparation.</td>
<td>06</td>
</tr>
</tbody>
</table>
Term Work

Term work shall consist of minimum six assignments one from each module and Case studies on product design and development

The distribution of marks for term work shall be as follows:

- Exercises/Assignment : 10 Marks
- Case studies : 10 Marks
- Attendance (Theory & Practical) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

Course Code | Course/Subject Name | Credits
---|---|---
AEE7011 | Power Plant Engineering & | 3+1

& Common with Mechanical Engineering

**Objectives**
1. Study basic working principles of different power plants
2. Study power plant economics

**Outcomes:** Learner will be able to…
1. Comprehend various equipments/systems utilized in power plants
2. Discuss types of reactors, waste disposal issues in nuclear power plants
3. Illustrate power plant economics

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td>Hydro Electric Power Plants: Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.</td>
<td>06</td>
</tr>
<tr>
<td>03</td>
<td>Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.</td>
<td>08</td>
</tr>
<tr>
<td>04</td>
<td>Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam &amp; gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.</td>
<td>06</td>
</tr>
<tr>
<td>05</td>
<td>Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors- PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.</td>
<td>06</td>
</tr>
<tr>
<td>06</td>
<td>Power Plant Economics: Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance &amp; operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing. Problems.</td>
<td>06</td>
</tr>
</tbody>
</table>

**List of Experiments**
1. Case study report on at least two types of power plants
2. Group presentation (Group shall not be more than 3 students) on topics relevant to syllabus
3. Industrial visit to any power plant
Term Work
Term work shall consist of one case study report and 5 assignments covering maximum syllabus
The distribution of marks for term work shall be as follows:

- Case study: 05 marks
- Industrial visit report: 05 marks
- Presentation: 05 marks
- Assignments: 05 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
1. Power Plant Engineering, A K Raja, Amit Praksh Shrivastava, Manish Dwivedi, New Age International Publishers
8. Power Plant Engineering, G.R. Nagpal, Khanna Publishers
11. Power Plant Engineering, Manoj Kumar Gupta, PHI Learning
12. Nuclear Power Plant Engineering, James Rust, Haralson Publishing Company
   Nuclear Power Plants, Geotge Petridis and DimitriosNicolau, NOVA Publishers
Course Code | Course/Subject Name | Credits
---|---|---
AEE7012 | Supply Chain Management* | 3+1

* Common with Mechanical Engineering

Objectives
1. To develop an understanding of key drivers of supply chain performance and their inter-relationships with strategy.
2. To impart analytical and problem solving skills necessary to develop solutions for a variety of supply chain management & design problems.
3. To understand the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

Outcomes: Learner will be able to…..
1. Illustrate the role & functions of supply chain management and its processes.
2. Analyze the flows of material, information and funds in an integrated manner.
3. Evaluate various performance measures of supply chain management.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
</tr>
</thead>
</table>
| 01 | **Building a Strategic Frame Work to Analyse Supply Chains**  
Supply chain stages and decision phases, Process view of supply chain: Supply chain flows, Examples of supply chains, Competitive and supply chain strategies, Achieving strategic fit: Expanding strategic scope, Drivers of supply chain performance. Framework for structuring drivers: inventory, transportation facilities, information obstacles to achieving fit. | 04 |
| 02 | **Designing the Supply Chain Network**  
Distribution Networking: Role, Design, Supply Chain Network(SCN):Role, Factors, Framework for design decisions. | 05 |
| 03 | **Materials Management**  
Scope, Importance, Classification of materials, Procurement, Purchasing policies, Vendor development and evaluation. Inventory control systems of stock replenishment, Cost elements, EOQ and its derivative modules. | 06 |
| 04 | **Dimensions of Logistics**  
Introduction: A Macro and Micro Dimensions, Logistics interfaces with other areas, Approach to analyzing logistics system, Logistics and systems analyzing: Techniques of logistics system analysis, factors affecting the cost and Importance of logistics. | 06 |
| 05 | **Warehouse and Transport Management**  
Concept of strategic storage, Warehouse functionality, Warehouse operating principles, Developing warehouse resources, Material handling and packaging in warehouses, Transportation Management, Transport functionality and principles, Transport infrastructure, transport economics and Pricing. Transport decision making. | 07 |
| 06 | **IT in Supply Chain**  
6.1 IT framework, Customer Relationship Management(CRM),internal Supply chain management, Supplier Relationship Management (SRM) and Transaction Management,Coordination in a Supply Chain  
6.2 Lack of supply chain coordination and the Bullwhip effect, Obstacle to Coordination, Managerial levers, Building partnerships and trust. Emerging Trends and Issues  
6.3 Vendor managed inventory-3PL-4PL, Reverse logistics: Reasons, Role, Activities; RFID systems: Components, Applications, Implementation; Lean supply chain, Implementation of Six Sigma in supply chain, Green supply chain. | 08 |
Term Work

Term work shall consist of,
1. Assignments: On topics drawn from syllabus [At least 1 assignment per module].
2. Seminar / case study on the modules / trending scenario (current) in industry.

The distribution of marks for term work shall be as follows;
Seminar / Case study Presentation & report: 10 marks
Assignments: 10 marks
Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. Supply Chain Management Strategy, Planning, and operations, Sunil Chopra and Peter Meindl
5. The Management of Business Logistics: A Supply Chain Perspective, Coyle, Bardi, Langley
**Course Code**: AEE 7013  
**Course/Subject Name**: Tribology  
**Credits**: 3+1

### Objectives
1. To provide students with the fundamental knowledge in the field of Industrial tribology.
2. To provide basic concepts in the design of automotive lubrication system.
3. To provide knowledge of friction and wear mechanism in automotive system.

### Outcome:
Lerner will be able to:
1. apply knowledge of tribology for industrial component design
2. apply design concepts practically for automotive lubrication systems

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
</tr>
</thead>
</table>
| 1      | Introduction to Tribology  
Introduction to Tribology, Tribology in design, Tribology in industry, economic aspects of Tribology, lubrication, basic modes of lubrication, lubricants, properties of lubricants-physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion. Types of sliding contact bearings, comparison of sliding and rolling contact bearings | 06 |
| 2      | Friction and Wear  
Wear: Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear. | 06 |
| 3      | Hydrodynamic lubrication  
Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, two-dimensional Reynold's, equation, infinitely long journal bearing, infinitely short journal bearing, finite bearing  
Hydrodynamic thrust bearing: Introduction, flat plate thrust bearing, pressure equation, load, center of pressure, friction in tilting pad thrust bearing. | 06 |
| 4      | Hydrostatic Lubrication  
Hydrostatic lubrication: Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses, optimum design of step bearing. Compensators and their actions.  
Squeeze film lubrication: Introduction, circular and rectangular plates approaching a plane. | 06 |
| 5      | Elasto-hydrodynamic Lubrication and Gas Lubrication  
Elastohydrodynamic Lubrication: Principle and application, pressure-viscosity term in Reynolds equation, Hertz theory. Ertel- Grubin Equation  
Gas lubrication: Introduction, merits and demerits, applications.  
Lubrication in metal working: Rolling, forging, drawing and extrusion.  
Bearing materials, bearing constructions, oil seals, shields and gaskets | 06 |
| 6      | Surface Engineering  
Introduction to surface engineering, concept and scope of surface engineering, manufacturing of surface layers, solid surface geometrical, mechanical and physic chemical concepts, superficial -layer, development of concept, structure of superficial layer, general characteristics of superficial layer, obtained by machining, strengthening and weakening of superficial layer. | 06 |
**Term Work**

Term work shall consist of at least one (1) assignment from each module and a case study or seminar by each student.

The distribution of marks for term work shall be as follows:

- Assignments: 10 marks
- Seminar / Case study Presentation & report: 10 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Internal Assessment**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

**Theory Examination**

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

**References**

2. Shizhu Wen, “Principles of Tribology”, Wiley
3. Majumdar, “Introduction to Tribology and Bearings“, S.Chand and Company Ltd. New Delhi
6.  
Course Code: AEE 7014  
Course/Subject Name: Computational Fluid Dynamics  
Credits: 3+1

& Common with Mechanical Engineering

Objectives
1. Study basic principles of modeling a system using software
2. Study grid generation and discretization methods

Outcomes: Learner will be able to…
1. Demonstrate & explain geometrical model of a fluid flow
2. Describe specific boundary conditions and solution parameters

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction:</strong> What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Softwares, Solution methodology-Preprocessing, Solver, Post processing.</td>
<td>04</td>
</tr>
<tr>
<td>04</td>
<td><strong>Heat Conduction, Convection and Diffusion:</strong> Steady One-dimensional Conduction, Unsteady One-dimensional Conduction, Two and Three-dimensional Situations, Over relaxation and Under relaxation, Steady One-dimensional and Two Dimensional Convection-Diffusion, Unsteady One-dimensional Convection</td>
<td>06</td>
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<tr>
<td>06</td>
<td><strong>Finite Volume Methods:</strong> FVM solutions to steady one, two and three dimensional diffusion problems and unsteady one and two dimensional diffusionproblems, FVM solutions to convection-diffusion problems - one and twodimensional, steady and unsteady; Advection schemes; Pressure velocity coupling</td>
<td>06</td>
</tr>
</tbody>
</table>

List of Experiments
1. Simulate and solve, two problems, each 2-d and 3-d steady and unsteady flows using any commercial CFD package like Ansys-FLUENT, STAR CCM, FLUIDYNE, Ansys-CFX, etc.
2. Write codes for, at least one each, 1-d and 2-d steady conduction with and without source and do the post processing to verify with analytical results
3. Write codes, at least one, for steady, 2-d conduction-advection problems and do the post processing to verify with analytical results
Term Work
Term work shall consist of experiments from the list, 3 assignments covering maximum portion of the syllabus.

The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments): 15 marks
- Assignments: 05 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
AEE 7015  Automotive Embedded Systems  3+1

Objectives
1. To provide broad introduction to automotive embedded systems
2. To provide a comprehensive overview about existing and future automotive electronic systems.
3. To enable undergraduates to be able to design and apply embedded systems.

Outcomes: Learner will be able to…
1. Ability to design automotive component to meet desired needs.
3. Develop analytical abilities to give solutions to automotive design problems.

Module | Detailed Contents | Hrs.
--- | --- | ---
01 | **Introduction**  
Body and convenience electronics, Vehicle power supply controllers and lighting modules, Door control modules  
Safety electronics: Active safety systems such as ABS, ASR& ESP etc., Passive safety systems such as restrained systems and their associated sensor in an automobile.  
Power train electronics :Petrol Engine Management, Infotainment electronics: Dashboard /Instrument cluster, car audio, telematics system, navigation system, multimedia systems etc.  
Cross application technologies:42 volt vehicle power supply system | 06
02 | **Embedded Communications**  
A Review of Embedded Automotive Protocols, Dependable Automotive CAN Networks, Flex Ray Protocol | 08
03 | **Drive By Wire**  
Challenges and opportunities of X by Wire: System and design requirements steer by wire, brake by wire, suspension by wire, gas by wire, power by wire, and shift by wire.  
Future of automotive Electronics | 06
04 | **Hardware Modules**  
MC9S12XD family features  
Modes of operation: functional block diagram overview, Programming model Map Overview Pulse width Modulator(PWM)  
On chip ADC serial communication protocol: SCI,SPI,IIC,CAN | 06
05 | **Software Developments Tools**  
Introduction to HCS12XDT512 Student learning kit & PBMCU(Project board), Introduction to code warrior IDE: editing, debugging simulating simple programs. Flashing code into HCS12XDT512 SLK board and testing | 06
06 | **Integration of Software and Hardware**  
Downloading the software from Host Machine to target Machine, Implementing Application Prototype: Power windows and automotive lighting system | 04
Term Work
Term work shall consist of 6 assignments (One on each module) covering maximum portion of the syllabus.

The distribution of marks for term work shall be as follows:
- Assignments : 20 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
1. Automotive Electronics By Tom H. Denton
2. Automotive Electrical and Electronic Systems by John F. Kershaw, James D. Halderman / Pearson Education
3. Automotive Embeded System Handbook by Nicolas NavetCRC PRESS
4. Distributed Automotive Embeded System
5. Embeded System Handbook by Richard Zurawski
Objective
1. To understand basic needs and requirements of robotics in industry.
2. To learn basic kinematics required in designing of robots.
3. To write and embed programs in robots.

Outcomes: Learner will be able to…
1. Appreciate the significance of robot in industry.
2. Design and make the robot for particular industrial problem.

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<tr>
<th>Module</th>
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<th>Hrs.</th>
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<tr>
<td>01</td>
<td>Fundamentals of Robotics</td>
<td>08</td>
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<tr>
<td></td>
<td>Introduction, Fundamentals of Robot Technology, Programming, and Applications</td>
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<tr>
<td></td>
<td>Robot Technology: The Robot and its Peripherals</td>
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<td></td>
<td>Control Systems and Components, Robot Motion Analysis and Control, Robot End Effectors, Sensors in Robotics, Machine Vision</td>
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<tr>
<td>02</td>
<td>Kinematics of Robotics</td>
<td>06</td>
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<tr>
<td></td>
<td>Types of joints and motion, Basic of kinematics in robotics, Inverse kinematics, Balancing of robots</td>
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<tr>
<td>03</td>
<td>Robot Programming and Languages</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>Robot Programming on microcontrollers, Robot Languages, Artificial Intelligence</td>
<td></td>
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<tr>
<td>04</td>
<td>Robot Applications in Manufacturing</td>
<td>06</td>
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<tr>
<td></td>
<td>Application of robot in processing, assembly and inspection. ASRS(Automatic storage and retrieval system), AGV(Automated guided Vehicles)</td>
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<tr>
<td>05</td>
<td>Implementation Principles and Issues</td>
<td>06</td>
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<tr>
<td></td>
<td>Technical issues involved in implementing Robotics, its Safety, Training, Maintenance and Quality</td>
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<tr>
<td>06</td>
<td>Social Issues and the Future of Robotics</td>
<td>06</td>
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<tr>
<td></td>
<td>Social and Labor Issues, Robotics Technology of the Future</td>
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</tbody>
</table>

Term Work
Term work shall consist of 6 assignments (one on each module) covering maximum portion of the syllabus.

The distribution of marks for term work shall be as follows:
- Assignments : 20 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.
**Theory Examination**

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus.
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3).
4. Total four questions need to be solved.

**References**

2. J.J, Craig, Introduction to Robotics, Pearson Education
3. Fu, Gonzales and Lee, Robotics, McGraw Hill
5. Staughard, Robotics and AI, Prentice Hall of India
7. Walfram Stdder, Robotics and Mechatronics,
8. Niku, Introduction to Robotics, Pearson Education
9. Klafter, Chmielewski, Negin, Robot Engineering, Prentice Hall of India
10. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications
<table>
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<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>1. Motor Vehicle Act</strong>&lt;br&gt;1.1 Short titles &amp; definitions&lt;br&gt;1.2 Laws governing to use of motor vehicle &amp; vehicle transport&lt;br&gt;1.3 Licensing of drivers &amp; conductors&lt;br&gt;1.4 Registration of vehicle&lt;br&gt;1.5 State &amp; interstate permits&lt;br&gt;1.6 Traffic rules, Signals &amp; controls&lt;br&gt;1.7 Accidents, Causes &amp; analysis&lt;br&gt;1.8 Liabilities &amp; preventive measures&lt;br&gt;1.9 Rules &amp; regulations&lt;br&gt;1.10 Responsibility of driver&lt;br&gt;1.11 Public &amp; public authorities&lt;br&gt;1.12 Offences, penalties &amp; procedures&lt;br&gt;1.13 Different types of forms&lt;br&gt;1.14 Government administration structure&lt;br&gt;1.15 Personnel, Authorities &amp; duties&lt;br&gt;1.16 Rules regarding construction of motor vehicles</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td><strong>2. Taxation</strong>&lt;br&gt;2.1 Objectives&lt;br&gt;2.2 Structure &amp; methods of levying taxation&lt;br&gt;2.3 One time tax&lt;br&gt;2.4 Tax exemption &amp; tax renewal</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>3. Insurance</strong>&lt;br&gt;3.1 Insurance types &amp; significance&lt;br&gt;3.1.1 Comprehensive&lt;br&gt;3.1.2 Third party insurance&lt;br&gt;3.2 Furnishing of particulars of vehicles involved in accident&lt;br&gt;3.3 MACT (Motor Accident Claims Tribunal)&lt;br&gt;3.4 Solatium Fund&lt;br&gt;3.5 Hit &amp; Run case&lt;br&gt;3.6 Duty of driver in case of accident&lt;br&gt;3.7 Surveyor &amp; Loss Assessor, Surveyor's report</td>
<td>04</td>
</tr>
<tr>
<td>04</td>
<td><strong>4. Passenger Transport Operation</strong>&lt;br&gt;4.1 Structure of passenger transport organizations&lt;br&gt;4.2 Typical depot layouts&lt;br&gt;4.3 Requirements and Problems on fleet management&lt;br&gt;4.4 Fleet maintenance&lt;br&gt;4.5 Planning - Scheduling operation &amp; control&lt;br&gt;4.6 Personal &amp; training-training for drivers &amp; conductors&lt;br&gt;4.7 Public relations, Propaganda, publicity and passenger amenities&lt;br&gt;4.8 Parcel traffic.</td>
<td>08</td>
</tr>
</tbody>
</table>
4.9 Theory of fares - Basic principles of fare charging
4.10 Differential rates for different types of services
4.11 Depreciation & debt charges
4.12 Operation cost and Revenues
4.13 Economics & records

5. Goods Transport Operation
5.1 Structure of goods transport organizations
5.2 Scheduling of goods transport
5.3 Management Information System (MIS) in passenger / goods transport operation
5.4 Storage & transportation of petroleum products

6. Advance Techniques in Traffic Management
6.1 Traffic navigation
6.2 Global positioning system

List of Experiments
1. Organization & Management of Motor Vehicle Department
2. Collection & study of different types of RTO forms.
3. Central Motor Vehicle rules
4. Taxation, Insurance & Permits
5. Study of accidents claims & survey report including post accident procedure
6. Study of depot layouts (passenger & goods transport)
7. Case study of MIS in passenger / goods transports organization
9. Study of vehicle navigation system
10. Advanced traffic control devices

Term Work
Term work shall consist of 8 experiments from the list, 6 assignments (One on each module) covering maximum portion of the syllabus.

The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) : 10 marks
- Assignments : 10 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.
Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

2. Economics of Transport, S.K. Shrivastava
Objectives
1. To study basic and advance Automotive Electronics systems.
2. To study working of different Automotive Electronics systems and subsystems.
3. To study basic and advance electronics technologies like Battery, Fuel Cell, ECM etc.
4. To have basic idea about how automotive electrical systems are developed.

Course Outcomes: Learner will be able to……
1. Practically identify different automotive Electronics systems and subsystems.
2. Practically identify and demonstrate Systems like Battery, Alternator, Dynamo, Starter Motors, and Sensors etc.

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<td>1.4 Working of Lead acid, alkaline, Zebra, Sodium Sulphur, Swing batteries,</td>
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<td>1.5 Ratings,</td>
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<td>1.6 Charging.</td>
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<td>1.7 Maintenance &amp; testing of Lead acid battery.</td>
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<td><strong>Fuel Cells</strong></td>
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<td>2.2 Constructions and Operation of proton Exchange membrane</td>
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<td>2.3 Alkaline Fuel Cell.</td>
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<td>2.5 Reformers.</td>
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<td>02</td>
<td><strong>42-volt technology</strong></td>
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<td>3.2 Transition from 12V to 42V electrical system,</td>
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<td>3.3 Need of 42V automotive electrical system.</td>
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<td>3.4 42V automotive power system,</td>
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<td>3.5 Method of controlling 12V system in 42V architecture,</td>
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<td>3.6 Present developments in 42 volt technology.</td>
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<tr>
<td>01</td>
<td><strong>Charging System</strong></td>
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<td>1.1 Requirements of charging system</td>
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<td>1.2 Dynamo</td>
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<td>1.2.1 Principle of operation</td>
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<td>1.2.2 Construction</td>
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<tr>
<td></td>
<td>1.2.3 Working</td>
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<tr>
<td></td>
<td>1.2.4 Regulators, Combined current &amp; voltage regulator etc.</td>
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<td></td>
<td>1.3 Alternator</td>
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<tr>
<td></td>
<td>1.3.1 Principle of operation</td>
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<td>1.3.2 Construction</td>
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<td></td>
<td>1.3.4 Rectification from AC to DC</td>
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<td></td>
<td><strong>Starting system</strong></td>
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<td></td>
<td>2.1 Requirements of starting system</td>
<td></td>
</tr>
</tbody>
</table>
## 2.2 Various torque terms used

### 2.3 Starter motors drives

- 2.3.1 Bendix
- 2.3.2 Folo through Barrel
- 2.3.3 Rubber compression
- 2.3.4 Compression spring
- 2.3.5 Friction clutch
- 2.3.6 Overrunning clutch
- 2.3.7 Dyer

### 2.4 Starter motor solenoids & switches

### 2.5 Glow plugs

## 3. Integrated Starter and Alternator

### 1. Electronic Ignition System

- 1.1 Capacitor Discharge Ignition system
- 1.2 Distributer less Ignition System
- 1.3 Direct Ignition System,
- 1.4 Hall Effect pulse generator
- 1.5 Inductive pulse generator
- 1.6 Constant dwell system
- 1.7 Constant energy system

### 2. Electronic Engine controls

- 2.1 Electronic control module (ECM)
- 2.2 Operating modes of ECM (closed loop & open loop)
- 2.3 Inputs required & output signals from ECM
- 2.4 Electronic spark timing
- 2.5 Electronic spark control
- 2.6 Air management system
- 2.7 idle speed control

## 1. Sensors & Actuators

### 1.1 Automotive Sensors,

- 1.1.1 Thermisters,
- 1.1.2 Inductive Sensors,
- 1.1.3 Position Sensors (Rotary, Linear)
- 1.1.4 Pressure Sensors,
- 1.1.5 Knock Sensor,
- 1.1.6 Optical Sensor
- 1.1.7 Hot wire & thin film air flow sensor,
- 1.1.8 Turbine fluid flow sensors
- 1.1.9 Light sensor,
- 1.1.10 Methanol sensor
- 1.1.11 Rain sensor operating principles
- 1.1.12 Oxygen sensor
- 1.1.13 Application & new developments in sensor technology

### 1.2 Automotive Actuators

- 1.2.1 Introduction,
- 1.2.2 Function & operating principle
- 1.2.3 Construction & working of solenoid actuators,
- 1.2.4 Relays
- 1.2.5 Motorized actuators,
- 1.2.6 Thermal Actuators
- 1.2.7 Electro hydraulic & Electrochemical Valve actuators,
- 1.2.8 Application & new developments in the actuators technology.
- 1.2.9 Stepper motors.
1. Automotive Lighting and wiring harness systems.

1.1 Lighting
1.1.1 Energy demand of lighting system
1.1.2 Types of Lamps
   i. Head lamp: Construction & types. Setting & control
   ii. Fog Lamp
   iii. Side Lamp
   iv. Tail lamp
   v. Parking lamp
   vi. Brake warning light
   vii. Trafficators
   viii. Blinkers
   ix. Flashers
   x. Electronic flasher circuit
   xi. Instrument panel lights
   xii. Body interior illumination
   xiii. Adaptive lighting system.
1.1.3 Reflectors: Parabolic, Bifocal, Homifocal, poly-ellipsoidal
1.1.4 Gauges: Fuel, Temperature, Oil pressure etc.
1.1.5 Accessories: Electric horn, wipers, Fuel pump, Power operated windows.

1.2 Wiring
1.2.1 Cables
1.2.2 Sizes
1.2.3 Colors & color codes
1.2.4 Connectors
1.2.3 Multiplex wiring system

Introduction to Automotive embedded system and Intelligent vehicle system. Telematics, X by wire, GPS etc.

List of Experiments
1. Study of Lead Acid Battery.
2. Study of Fuel Cells.
5. Measurement of Temperature using sensor.
9. Study of Air Management System under different operating conditions.
10. Study of effect of operating variables on injector’s activating Pulses.
11. Study of functioning/working of Idle speed control system.
13. Study of Idle Speed Control.
Term Work
Term work shall consist of minimum 8 experiments from the list, 6 assignments covering maximum portion of the syllabus (one on each module).

The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) : 10 marks
- Assignments : 10 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Practical/oral examination
1. Practical examination is based on list of experiments proposed.
2. Demonstration of automobile electronic systems like Battery, Alternator, Dynamo, Starter Motors, Sensors etc
3. Distribution of marks for practical/oral examination shall be as follows:
   i. Practical performance: 15 marks
   ii. Oral: 10 marks
4. Evaluation of practical examination to be done based on the experiment performed
5. Students work along with evaluation report to be preserved till the next examination

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
1. Understanding Automotive Electronics by William B. Ribbens
2. Automobile Electrical & Electronics by Tom Denton.
3. Intelligent Vehicle Technologies by Michel Parent
4. Light weight Electric/Hybrid vehicle design by John Fenton & Ron Hodkinson
5. Computerized engine control by Dick King
6. Automotive electrical equipments by P.L.Kohli
Objective
1. To provide students with the fundamental knowledge in the field of automotive dynamics.

Outcome: Learner will be able to…..
1. Ability to design automotive component to meet desired needs.
3. Develop analytical abilities to give solutions to automotive design problems.

<table>
<thead>
<tr>
<th>Module</th>
<th>Details</th>
<th>Hrs</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Fundamentals of vehicle dynamics</strong>&lt;br&gt;Road loads, Aerodynamics - Drag, side force, Lift force, Rolling resistance, Total road loads, Ride, Vehicle response properties, Perception of ride.&lt;br&gt;<strong>Tyres</strong>&lt;br&gt;Tyre construction, Tractive properties, Cornering properties, Camber thrust, Aligning moment, Combined braking and cornering, Conicity and ply steer, Tire vibrations, Tyre properties affecting vehicle rollover</td>
<td>10</td>
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<tr>
<td>2</td>
<td><strong>Suspension systems</strong>&lt;br&gt;Fundamental approach to vehicle modeling, Single mass system with two degree of freedom, Theory and problems of double Conjugate points, Motion after the hump, Acceleration for stepped input, Solid axles, Independent suspensions, Anti- Squat and anti- pitch suspension geometry, Equalizing type of suspension, Active suspension, Semi Active.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Roll Center of suspension linkages, Roll axes and roll angles, Non- Roll layout, No Roll suspensions, <strong>Vehicle Rollover</strong>&lt;br&gt;Characteristics of on road rollover, Rollover résistance, Anti rollover Braking, Anti- roll bar and its effects&lt;br&gt;<strong>Equation of Motion</strong>&lt;br&gt;Euler’s equation of motion, Inertia tensor axes</td>
<td>08</td>
</tr>
<tr>
<td>4</td>
<td><strong>Steering Systems</strong>&lt;br&gt;Steering geometry, Front wheel geometry, Steering system forces and, moments, Steering system effects, Influence of front wheel drive, Four wheel steering, Steering oscillations, Shimmy &amp; wheel wobble, Jack Knifing of articulated vehicles</td>
<td>07</td>
</tr>
<tr>
<td>5</td>
<td><strong>Handling characteristics</strong>&lt;br&gt;Steady state cornering, Low speed turning, High speed cornering, Stability derivatives ( Derivation and problems ), Suspension effect of cornering, Steady state and Transient behavior</td>
<td>07</td>
</tr>
<tr>
<td>6</td>
<td><strong>Recent trends in vehicle dynamics</strong>&lt;br&gt;Stability Control systems, Introduction of vehicle sensors, Central tyre, inflation systems, Influence of parameters at vehicle rollover, Vehicle dynamics simulations</td>
<td>06</td>
</tr>
</tbody>
</table>
List of Experiments
1. Mathematical modeling of suspension system (Quarter suspension model and half vehicle).
2. Live problem on suspension design of modern vehicle in passenger car segment, heavy vehicle segment etc

Term Work
Term work shall consist of experiments from the list, and minimum 6 assignments covering maximum portion of the syllabus (one on each module).

The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) : 10 marks
- Assignments : 10 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus.
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
3. Mechanics of Road vehicle By Steeds.
5. Automobile suspension and Handling By Colin Campell.
6. Car suspension By Bastow.
## Objectives

1. To study basics of vehicle maintenance
2. To study maintenance of vehicle systems and subsystems
3. To study different automotive diagnostic tools

## Outcomes:
Learner will be able to……

1. Effectively use automotive diagnostic tools in industries.
2. Improve existing vehicle maintenance practices in industries.

<table>
<thead>
<tr>
<th>Module</th>
<th>Details</th>
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<tr>
<td>1</td>
<td><strong>Types of Maintenance</strong>&lt;br&gt;<strong>Automotive Engine Diagnosis:</strong> Lower End Theory and Service, Upper End Theory and Service, Engine Lubrication Diagnosis and Service, Cooling System Diagnosis</td>
<td>06</td>
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<tr>
<td>2</td>
<td><strong>Electrical System Diagnostic and Service</strong>&lt;br&gt;Batteries: Theory Diagnosis, and Service&lt;br&gt;Starting System Diagnosis, and Service&lt;br&gt;Charging Systems&lt;br&gt;Basic Lighting System Diagnosis</td>
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<tr>
<td>4</td>
<td><strong>Restraint Systems: Theory, Diagnosis, and Service</strong>&lt;br&gt;Seat Belts, Seat Belt Service, Air Bags, Electrical System Components Diagnosis, Servicing the Air Bag System, Other Protection Systems</td>
<td>06</td>
</tr>
<tr>
<td>5</td>
<td><strong>Manual transmissions and transaxles</strong>&lt;br&gt;Clutch Problem Diagnosis and Service, Diagnosis of Drive Shaft and U-Joint Problems, Transmission/Transaxle Problem Diagnosis and Service, Servicing the Final Drive Assembly and Diagnosing Differential Noises</td>
<td>08</td>
</tr>
<tr>
<td>6</td>
<td><strong>Suspension And Steering Systems</strong>&lt;br&gt;Tire/Wheel Run out, Tire Replacement, Tire Repair, Installation of Tire/ Wheel Assembly on the Vehicle, Basic Front-Suspension Diagnosis and Service, Manual-Steering Systems and Power-Steering System Diagnosis and service, Alignment Geometry Performing an Alignment on Two wheel drive Four-Wheel-Drive Vehicle Alignment&lt;br&gt;<strong>Brakes</strong>&lt;br&gt;Drum Brake Inspection, Brake Shoes and Linings, Wheel Cylinder Inspection and Servicing, Drum Parking Brakes.&lt;br&gt;Disc Brake Diagnosis and Service, General Caliper Inspection and Servicing, Rear Disc Brake Calipers, Anti-lock Brake System Diagnosis and Service</td>
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</table>
List of Experiments

1. To perform engine analysis of petrol & diesel engines using a computerized engine analyzer or Auto Master.
2. To perform wheel balancing on a computerized wheel balancer.
3. To find the steering geometry of a vehicle using a computerized wheel aligner.
4. Removing and refitting of tyre using an automatic tyre changer.
5. Dismantling, inspection and repairing and assembly of engine components.
6. Experiment on calibration of the fuel injection pump.
7. Study of body repairing and reconditioning methods.

Term Work
Term work shall consist of 7 experiments from the list, and minimum 6 assignments covering maximum portion of the syllabus (one on each module).

The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments): 10 marks
- Assignments: 10 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Practical/Oral examination
1. Practical examination duration is 2 hours.
2. Examination is based on experiments performed during the semester.
3. Distribution of marks for practical/oral examination shall be as follows:
   i. Practical performance: 15 marks
   ii. Oral: 10 marks
4. Evaluation of practical examination to be done based on the experiment performed.
5. Students work along with evaluation report to be preserved till the next examination.
Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

2. Automotive Mechanics, William Crouse and Donald Anglin /TATA Mc Graw-hill
3. Automotive Technology, Joseph Heitner
4. Automotive Electrical and Electronic Systems by John F. Kershaw, James D. Halderman
5. Automotive Engines: Theory and Servicing by J.D.Halderman & Mitchell/Pearson Education.
**Course Code** | **Course/Subject Name** | **Credits**
---|---|---
AEE 8021 | Noise, Vibrations and Harshness | 3+1

**Objectives**
1. To study basic concepts of noise, vibration and harshness and their effects
2. To study various methods of vibration control
3. To study and analyze sounds and detection of noise from automobiles.

**Outcomes:** Learner will be able to…
1. Identify and analyze vibrations and noise coming out of automobiles
2. Investigate level of harm caused by noise and harshness and to provide measures to control it.

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<tr>
<th>Module</th>
<th>Detailed Contents</th>
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| 01 | 1. **Basics of Vibrations:**  
1.1 Basic Concepts  
1.2 Mathematical Models  
1.3 System characteristics and response  
1.4 Single and Multi DOF systems | 06 |
| 02 | 2. **Vibration control:**  
2.1 Isolators  
2.2 Tuned absorbers  
2.3 Untuned viscous dampers  
2.4 Applications: single cylinder engines, multi cylinder engine  
2.5 Simple rubber engine mounts  
2.6 Hydro elastic mounts  
2.7 Semi active mounts and active mounts  
2.8 Mass elastic models and measurements  
2.9 Limits for passenger comforts | 08 |
| 03 | 3. **Sound & sound measurement:**  
3.1 Fundamentals of acoustics  
3.1.1 General sound propagation  
3.1.2 Plane wave propagation  
3.1.3 Spherical wave propagation  
3.2 Human response to sound – the audible range  
3.3 Sound measurement  
3.3.1 Instrumentation  
3.3.2 Sound level meters  
3.3.3 Frequency intensity analyzers  
3.3.4 Real time measurements | 08 |
| 04 | 4. **Automotive noise:**  
4.1 Automotive noise criteria  
4.1.1 Drive by noise test  
4.1.2 Noise from stationary vehicles  
4.1.3 Interior noise in vehicles  
4.2 Automotive noise  
4.2.1 Sources and control methods  
i) Engine noise  
ii) Transmission noise  
iii) Intake and exhaust noise  
iv) Aerodynamic noise  
v) Tyre noise  
vi) Brake noise | 06 |
5. General noise control principles
   5.1 Sound in enclosures
   5.2 Sound energy absorption
   5.3 Sound transmission through barriers

6. Harshness
   6.1 Causes
   6.2 Frequency limits

Term Work
Term work shall consist of at the list 6 assignments (one on each module) covering maximum portion of the syllabus.

The distribution of marks for term work shall be as follows:

- Assignments: 20 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
Course Code | Course/Subject | Credits
---|---|---
AEE 8022 | Vehicle Safety | 3+1

Objectives
1. To study basic concepts of vehicle safety
2. To study accident reconstruction analysis methods
3. To study different issues in vehicle safety

Outcomes: Learner will be able to……
1. Understand vehicle design from safety point of view
2. Apply the concepts of accident reconstruction analysis in real world

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<tr>
<th>Module</th>
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<tr>
<td>01</td>
<td><strong>Introduction:</strong> Introduction to vehicle safety, Basic concepts of vehicle safety, Risk evaluation and communication, Human error control, Universal design The distracted driver, Special design problems (Design for children, handicap, etc)</td>
<td>06</td>
</tr>
<tr>
<td>02</td>
<td><strong>Safety Regulations and testing:</strong> Vehicle Safety Regulations, Accident Data, Accident Avoidance, Biomechanics and Occupant Simulation, Crash Testing, Vehicle Body Testing, Dynamic Vehicle Simulation Tests, Occupant Protection Pedestrian Protection, Compatibility, Interrelationship among Occupants, Restraint Systems, and Vehicle in Accidents</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>Rear Crash Safety:</strong> Head Restraint Position during Normal Driving, Study of procedure to evaluate Occupant Interaction with seat in rear crashes, Role of seat in Rear crash safety, Performance criteria for different seats, Ultra high Retention seats, Human and dummy responses for Pendulum impacts to the Back Effectiveness of Self –Aligning Head Restraints in preventing whiplash, Energy absorptions properties of Head Restraints, Introduction to RUPD (Rear under rum protection device)</td>
<td>08</td>
</tr>
<tr>
<td>04</td>
<td><strong>Accident Reconstruction Analysis:</strong> Uncertainty in Measurement and cautions, Tire forces, Straight-line Motion Critical speed from Tire Yaw marks, Reconstruction of Vehicular Rollover Accidents, Analysis of Collisions , Impulse – Momentum Theory, Reconstruction Applications , Impulse Momentum Theory, Crush Energy Frontal Vehicle –Pedestrian Collusion, Photogrammetry for accident constructions</td>
<td>08</td>
</tr>
<tr>
<td>05</td>
<td>Working of different Automotive safety systems Recent trends in Automotive safety systems</td>
<td>04</td>
</tr>
<tr>
<td>06</td>
<td>Key issues in vehicle safety in India and Abroad</td>
<td>02</td>
</tr>
</tbody>
</table>

List of Experiments:
1. Measurement of Windscreen wiping area for different vehicles.
2. Study of Crash test dummies.
5. Study of Tell Tale Symbols in Indian Cars
6. Industrial Visit
**Term Work**

Term work shall consist of 5 experiments from the list, 6 assignments covering maximum portion of the syllabus (One on each module).

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments) : 10 marks
- Assignments : 05 marks
- Industrial visit report: 05 marks
- Attendance (Theory and Practical) : 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Internal Assessment**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

**Theory Examination**

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

**References**

Course Code: AEE 8023  Course/Subject Name: World Class Manufacturing  Credits: 3+1

Common with Mechanical Engineering

Objectives
1. To familiarize the students with the concepts of Business excellence and competitiveness.
2. To apprise the students with the need to meet the current and future business challenges.
3. To prepare the students to understand the current global manufacturing scenario.

Outcomes: Learner will be able to..
1. Demonstrate the relevance and basics of World Class Manufacturing.
2. Identify the factors of competitiveness and performance measures based on which, global manufacturing success is benchmarked.
3. Draw current Status of Indian Manufacturing scenario and design and develop a roadmap to achieve world class manufacturing status.

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<tr>
<th>Module</th>
<th>Details</th>
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<tr>
<td>01</td>
<td>Historical Perspective</td>
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<tr>
<td>02</td>
<td>Benchmark, Bottlenecks and Best Practices</td>
<td>07</td>
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<tr>
<td>03</td>
<td>System and Tools for World Class Manufacturing</td>
<td>07</td>
</tr>
<tr>
<td>04</td>
<td>HR Dimensions in WCM – WCM Strategy Formulation</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>4.1 Adding value to the organization: Organizational learning, techniques of removing Root cause of problems, People as problem solvers, New organizational structures. 4.2 Associates: Facilitators, Teams man ship, Motivation and reward in the age of continuous improvement.</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Characteristics of WCM Companies</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>Performance indicators like POP, TOPP and AMBITE systems. Other features of WCM : Supply Chain Management &amp; key issues in SCM, Agile Manufacturing, Green Manufacturing, Role of Information system in WCM, Introduction to Knowledge management, Study of various performance measures in world class organization.</td>
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<tr>
<td>06</td>
<td>Total Quality Management (TQM)</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>Definition, Understanding quality, Evolution of TQM, Framework for TQM, Commitment and leadership, Customer satisfaction, Employee involvement, Continuous process improvement, Supplier partnership, Performance measures, Formulation and implementation of TQM: Case Study.</td>
<td></td>
</tr>
</tbody>
</table>
Term Work
Term work shall consist of at least six assignments on topics drawn from the syllabus [1 assignment per module] and at least 3 case studies and analysis based on the topics mentioned above.

The distribution of marks for term work shall be as follows.
- Assignments: 10 marks
- Lab work (Case Studies: at least 3, with inferences): 10 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
2. World Class Manufacturing - The Lesson of Simplicity, Schonberger R. J, Free Press, 1986
Objectives
1. To study basic concepts of knowledge management
2. To understand knowledge management tools and techniques

Outcomes: Learner will be able to…
1. Effectively implement knowledge management in organizations
2. Improve existing knowledge management practices in organizations

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
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<tbody>
<tr>
<td>01</td>
<td>Introduction to Knowledge Management: What is Knowledge Management? Data, Information and Knowledge, Types of Knowledge, Forces Driving Knowledge Management, Knowledge Management Systems, Knowledge Management Systems and existing technology</td>
<td>02</td>
</tr>
</tbody>
</table>
| 02     | Principles of Knowledge Management  
  2.1 Knowledge Management Foundations: Infrastructure, Mechanisms, and Technologies: Knowledge Management Foundations, Knowledge Management Infrastructure, Knowledge Management Mechanisms, Knowledge Management Technologies, Management of Knowledge Management Foundations  
  2.2 Knowledge Management Solutions: Processes and Systems: Knowledge Management Processes, Knowledge Management Systems, Managing Knowledge Management Solutions  
  2.3 Organizational Impacts of Knowledge Management: Impact on People, Impact on Processes, Impact on Products, Impact on Organizational Performance | 06 |
| 03     | Knowledge Management Technologies and Systems  
  3.1 Knowledge Application Systems: Systems that Utilize Knowledge: Technologies for Applying Knowledge, Developing Knowledge Application Systems, Types of Knowledge Application Systems, Limitations of Knowledge Application Systems  
  3.4 Knowledge Discovery Systems: Systems that Create Knowledge: Mechanisms to Discover Knowledge: Using Socialization to Create, New Tacit Knowledge, Technologies to Discover Knowledge: Using Data Mining to Create, New Explicit Knowledge, Designing the Knowledge Discovery System, Barriers to the Use of Knowledge Discovery Systems | 10 |
4.1 Emergent Knowledge Management Practices


4.3 Leadership and Assessment of Knowledge Management: Leadership of Knowledge Management, Importance of Knowledge Management Assessment, Types of Knowledge Management Assessment, Assessment of Knowledge Management Solutions, Assessment of Knowledge, Assessment of Impacts

The Future of Knowledge Management: Using Knowledge Management as a Decision-Making Paradigm to Address Wicked Problems, Promoting Knowledge Sharing While Protecting Intellectual Property, Involving Internal and External Knowledge Creators, Addressing Barriers to Knowledge Sharing and Creation, KM for innovation

List of Experiments
1. Case studies on knowledge management
2. Group seminar (Group shall not be of more than 3 members)

Term Work
Term work shall consist of a case study, report of group seminar, 6 assignments covering maximum portion of the syllabus (one on each module).

The distribution of marks for term work shall be as follows:
- Case study: 10 marks
- Seminar: 05 marks
- Assignments: 05 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.
References
1. Encyclopedia of knowledge management by David Schwartz, publisher: Idea Group Reference
3. KM tools and techniques: practitioners and experts evaluate KM solutions / Madanmohan Rao, publisher Elsevier Butterworth–Heinemann
4. Knowledge management strategies for business development / Meir Russ, editor. Published by Business Science Reference
5. The Knowledge-Creating Company by Ikujiro Nonaka by Harvard Business Review.
6. The complete guide to knowledge management: a strategic plan to leverage your company’s intellectual capital / Edna Pasher and Tuvya Ronen.
7. The Knowledge management Toolkit: Practical Techniques for building a Knowledge management System by Amrit Tiwana/ Pearson Education
Course Code | Course/Subject Name | Credits
---|---|---
AEE 8025 | Project Management & | 3+1

*Common with Mechanical Engineering*

**Objectives**
1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To apprise the students with the project management lifecycle and make them knowledgeable about the various phases from project initiation through closure.

**Outcomes:** Learner will be able to..
1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference.

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<tr>
<td>01</td>
<td><strong>Project Management Foundations</strong>&lt;br&gt;Definition of project management, project manager and project. Project types, project phases and knowledge areas.</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td><strong>Initiating Projects</strong>&lt;br&gt;How to get a project started; Your project sponsor and creating charter; The project team and team dynamics; running meetings</td>
<td>06</td>
</tr>
<tr>
<td>03</td>
<td><strong>Planning Projects</strong>&lt;br&gt;Project estimating and scheduling techniques. PERT, CPM, GANTT chart. Introduction to any one project scheduling software.</td>
<td>08</td>
</tr>
<tr>
<td>04</td>
<td><strong>Planning Projects</strong>&lt;br&gt;Risk planning methods; Cost planning; Communication plan and Final project plan.</td>
<td>04</td>
</tr>
<tr>
<td>05</td>
<td><strong>Executing Projects</strong>&lt;br&gt;5.1 Team management; communicating and engaging with all stakeholders of the projects. <strong>Controlling Projects</strong>&lt;br&gt;5.2 Earned Value Management techniques for measuring your work completed; Using milestones for measurement; change requests and scope creep. Keeping up with the project, Updating the project, Project Issues management and Dealing with troubled projects.</td>
<td>08</td>
</tr>
<tr>
<td>06</td>
<td><strong>Closing the Project</strong>&lt;br&gt;Customer acceptance; completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.</td>
<td>06</td>
</tr>
</tbody>
</table>
Term Work

Term work shall consist of,

1. Assignments: On topics drawn from syllabus [At least 1 assignment per module].
2. One scheduling exercise on any project management software where writing WBS and Scheduling on PMIS software for a simple project or a Case Study on project selection/ risk management.
3. Case Studies (at least 2 with inferences).

The distribution of marks for term work shall be as follows:

- Assignments: 10 marks
- Scheduling on PMIS software: 10 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. Project Management and Control, Narendra Singh; Himalaya Publishing House
2. Preparation, Appraisal, Budgeting, Implementing and Review, Prasanna Chandra TMGH
3. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, Wiley India, 7th Ed.
6. Project Management, Gopalan, Wiley India
7. Projects- Planning, Analysis, Selection, Financing, Implementation and Review, Prasanna Chandra, TMGH
<table>
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<tr>
<th>Course Code</th>
<th>Course/Subject Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AEE 8026</td>
<td>Artificial Intelligence</td>
<td>3+1</td>
</tr>
</tbody>
</table>

Objectives
1. Introduction to the basic concepts of Artificial Intelligence.
2. To develop the design and programming skills.
3. Implement, evaluate, and compare the performance of various AI Techniques.

Course Outcomes: Learner will be able to ..... 
1. Apply the concept in Automobile industry

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
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</thead>
</table>
| 01     | **AI and Internal Representation**  
Artificial Intelligence and the World, Representation in AI, Properties of Internal Representation, The Predicate Calculus  
**Intelligent Agents:** Concept of Rational Agent, Structure of Intelligent agents, Agent Environments.  
**Problem Solving :** Solving problems by searching, Problem Formulation, Search Strategies, Uninformed Search Techniques, DFS, BFS, Uniform cost search, Iterative Deepening, Comparing different Techniques, Informed search methods – Best First Search, heuristic functions, Hill Climbing, A*,IDA*, Crypt Arithmetic, Backtracking for CSP | 06   |
| 02     | **Programming in LISP or PROLOG**  
Lisps, Typing at Lisp, Defining Programs, Basic Flow of Control in Lisp, Lisp Style, Atoms and Lists, Basic Debugging, Building Up List Structure, More on Predicates, Properties, Pointers, Cell Notation and the Internals (Almost) of Lisp, Destructive Modification of Lists, The for Function, Recursion, Scope of Variables Input/Output, Macros | 06   |
| 03     | **Fundamentals Concepts and Models of Artificial Neural Systems**  
Biological Neuron and their Artificial Models, Models of ANN, Learning and Adaptation, Neural Networking Learning Rules. Single-layer Perception Classifiers  
**Multilayer Feed forward Networks :** Linearly Nonseparable Pattern Classification, Delta Learning Rule, Feed forward Recall and Error Back-Propagation Training, Learning Factor | 06   |
| 04     | **Fuzzy Systems**  
**Fuzzy Sets:** Fuzzy Relations, Fuzzy Function, Fuzzy Measures, probabilities possibilities. Fuzzy Modeling and applications of Fuzzy Control. Neural and fuzzy machine Intelligence | 06   |
| 05     | **Generic Algorithm:** Simple generic algorithm, Simulation by hands, similarity templates (Schemata), Mathematical foundations, Schema processing at work, Two armed and k armed Bandit Problem, Building blocks hypothesis, Minimal Deceptive Problem,  
Computer implementation of generic algorithm, Data structures, Reproduction, Cross over and mutation. Time to response and time to cross mapping objective function to fitness from fitness scaling. Application of generic algorithm. De Jong and Function Optimization. Improvement in basic techniques, Improvement to genetics based machine learning, application of genetic based machine learning | 06   |
Data Mining & Information Retrieval
Data warehousing & Data Mining. Online Analytic Processing [OLAP]: its architecture and its use. Java implementations, classification trees and exploratory data analysis [EDA].
EDA Vs Hypothesis Testing, Computational EDA Techniques, Graphical [Data Visualization], EDA techniques for function fitting, data smoothing, layering, tessellations, contour projections, Verification of results of EDA. Applications & trends in data mining.
Case Studies

Term Work
Term work shall consist of, Assignments on each module [At least 1 assignment per module]. The distribution of marks for term work shall be as follows:

1. Assignments: 20 marks
2. Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal Assessment
Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Theory Examination
In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References
1. Introduction to Artificial intelligence By Eugene Charniak, Drew McDermott Addison Wesley
4. Data Mining by Pieter Adriaans and Dolt Zantinge - Pearson Education Asia
5. Data Warehousing in the Real World by Sam Anahory and Dennis Murray.
9. Introduction to Data Mining & Knowledge Discovery – Edelstein, Herbert A.
**Course Code** | **Course/Subject Name** | **Credits**
---|---|---
AEE8027 | Virtual Reality | 3+1

### Objectives
1. Introduction to the basic concepts of Virtual Reality.
2. To develop the design and programming skills.
3. Implement, evaluate, and compare the performance of various Virtual Reality Techniques

### Outcomes:
Learner will be able to….
1. Apply the concept in Automobile industry

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs.</th>
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</table>
| **01** | **Introduction:** A short history of early virtual reality, early commercial VR Technology, VR becomes an Industry, The five classical components of VR Systems.  
**Input Devices: Trackers, Navigations and Gesture Interfaces.**  
Three Dimensional Position Trackers: Tracker performance parameters, Mechanical trackers, Magnetic trackers, Ultrasonic trackers, Optical Trackers and Hybrid Inertial Trackers Navigation and Manipulation Interfaces: Tracker based Navigation/Manipulation Interfaces, Trackballs, and three Dimensional Probes Gesture Interfaces: The Pinch Glove, the 5DT Data Glove, the Didjiglove, the Cyberglove | 06 |
| **02** | **Output Devices: Graphical, Three Dimensional Sound and Haptic Displays:** Graphical Display: The human visual system, personal graphics displays, large volume displays. Sound displays: the human auditory system, the convolvotron, Speaker based three dimensional sound. Haptic Feedback: The human haptic system, Tactile Feedback Interfaces, Force Feedback Interfaces. | 06 |
| **03** | **Computing Architectures for Virtual Reality:** The Rendering Pipeline: The graphical rendering pipeline, The haptics rendering pipeline.  
| **04** | **Modeling:** Geometric Modeling: Virtual Object Shape, Object Visual Appearance.  
Kinematics Modeling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, viewing the three dimensional words.  
Behavior Modeling and Model Management: Level of Detail Management, Cell Segmentation. | 06 |
| **05** | **Virtual Reality Programming:** Toolkits and Scene Graphs. World Toolkit: Model Geometry and Appearance, The WTK Scene Graph, Sensors and Action Functions, WTK Networking, JAVA 3D: Model Geometry and Appearance, Java 3D Scene graph, Sensors and Behaviors, Java 3D Networking, WTK and Java 3D Performance Comparison. General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptic Scene Graph, Collision Detection and response, Graphics and PHANToM | 06 |
Calibration.


|---|---|

**Term Work**

Term work shall consist of, at least one (1) assignments on each module

The distribution of marks for term work shall be as follows:

- Assignments: 20 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Internal Assessment**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

**Theory Examination**

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

**References**

Course Code | Course/Subject Name | Credits
--- | --- | ---
AEP701 / AEP802 | Project I/ II | 3 / 6

**Objective**
1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
2. To familiarize the process of solving the problem in a group
3. To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
4. To inculcate the process of research

**Outcome:** Learner will be able to…
1. Do literature survey/industrial visit and identify the problem
2. Apply basic engineering fundamental in the domain of practical applications
3. Cultivate the habit of working in a team
4. Attempt a problem solution in a right approach
5. Correlate the theoretical and experimental/simulations results and draw the proper inferences
6. Prepare report as per the standard guidelines.

**Guidelines for Project**
- Students should do literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem.
- Students should attempt solution to the problem by experimental/simulation methods.
- The solution to be validated with proper justification and report to be compiled in standard format.

**Guidelines for Assessment of Project I**
- Project I should be assessed based on following points
  - Quality of problem selected
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
  - Breadth and depth of literature survey
- Project I should be assessed through a presentation by the student project group to a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

**Guidelines for Assessment of Project II**
- Project II should be assessed based on following points
  - Quality of problem selected
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiners approved by the University of Mumbai
- Students should be motivated to publish a paper based on the work in Conferences/students competitions