AUTOMOBILE COMPONENT DESIGN I
ENAM 352

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
The objective of this course is to introduce fundamental principles of automobile component design by integrating theoretical concepts with industrial specifications. It focuses on material selection, failure theories, fatigue analysis, and the design of components such as fasteners, shafts, and bearings. Upon completion, students will be able to apply engineering standards to practical component design and analysis.

1 Introduction (3 hours)

1.1 Scope and phases of design
1.2 Design tools and resources
1.3 Design factor and factor of safety
1.4 Reliability and probability of failure
1.5 Design topic interdependencies

2 Material Selection (3 hours)

2.1 Material performance index
2.2 Material selection using Ashby chart
2.3 Dimensions, tolerance and numbering systems
2.4 Materials for automobiles: Alloy steel, corrosion resistant steel, casting steel, nonferrous metals, plastics and composite

3 Failure Theories (9 hours)

3.1 Theory for ductile materials
  3.1.1 Maximum-shear-stress theory
  3.1.2 Distortion-energy theory
  3.1.3 Coulomb-Mohr theory
3.2 Theory for brittle materials
  3.2.1 Maximum-normal-stress theory
  3.2.2 Modification of the Mohr theory
3.3 Selection of failure criteria

4 Fatigue Failure (6 hours)

4.1 Fatigue life method

4.2 Endurance limit
4.3 Fatigue strength
4.4 Endurance limit modifying factors
4.5 Stress concentration and notch sensitivity
4.6 Fluctuating stresses
4.7 Fatigue failure criteria for fluctuating stress
4.8 Combination of loading modes

5 Screws, Fasteners and Design of Joints (12 hours)

5.1 Screw and fasteners
- 5.1.1 Thread standards
- 5.1.2 Mechanics of power screws
- 5.1.3 Threaded fasteners
- 5.1.4 Joints: Fastener stiffness, member stiffness
- 5.1.5 Bolt strength
- 5.1.6 Tension joints, gasketed joints
- 5.1.7 Fatigue loading of tension joints
- 5.1.8 Bolt and riveted joints loaded in shear

5.2 Welding
- 5.2.1 Welding symbols
- 5.2.2 Butt and fillet welds
- 5.2.3 Stress in welded joints in torsion and bending
- 5.2.4 Strength of welded joints
- 5.2.5 Static, fatigue and resistance loading

6 Shaft Design and Rolling Contact Bearings (9 hours)

6.1 Shaft design
- 6.1.1 Shaft materials and layout
- 6.1.2 Shaft design for stress
- 6.1.3 Deflection considerations

6.2 Rolling contact bearings
- 6.2.1 Types, bearing life, bearing load
- 6.2.2 Selection of ball and cylindrical roller bearing
- 6.2.3 Selection of tapered roller bearings

7 Component of Steering system (3 hours)

7.1 Steering gear box: Steering mechanism and linkage design
7.2 Design criterion for mechanical and power steering
7.3 Steering geometry for Ackerman’s steering

Tutorial (15 hours)

1. Solving numerical problems related to material selection
2. Calculation of parameters related to failure theories

3. Determination of fatigue failure through numerical problems
4. Solving problems related to screws, fasteners and design of joints
5. Calculation of shaft design parameters and rolling contact bearing selection
6. Determination of specifications for steering system components

Practical **(22.5 hours)**

1. Collection of technical specifications, including power, speed and gear ratios, through industrial site visits and sketching of a general shaft layout and performance of force analysis for the chosen transmission system
2. Determination of critical diameters using maximum-shear-stress and distortion-energy theories
3. Calculation of fatigue failure limits using two specific criteria and assessment of shaft deflections
4. Preparation of specification of appropriate square keys for gear mounting based on calculated loads
5. Calculation of C10 basic load ratings for the selected shaft bearings
6. Performing task of technical selection of specific bearings using online catalogs to satisfy geometric and rating requirements
7. Assessment of technical specifications of power screws with data collected from workshops or industrial facilities
8. Calculation of lifting torque, lowering torque and efficiency for the industrial power screw
9. Performance of design assessments for bolted or riveted joints in steel vessels and structures and mapping of feasible and infeasible design domains using fastener spacing entries
10. Preparation of final specifications and performance of a comprehensive adequacy assessment for the joint design

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	3	4
2	3	4
3	9	12
4	6	8
5	12	16
6	9	12
7	3	4
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Budynas, R. G., Nisbett, J. K. (2011). Shigley's mechanical engineering design. McGraw-Hill Education.
2. Bhandari, V. B. (2020). Design of machine elements. McGraw-Hill Education.
3. Mott, R. L., Vavrek, E. M., Wang, J. (2017). Machine elements in mechanical design. Pearson.
4. Dieter, G. E., Schmidt, L. C. (2013). Engineering design. McGraw-Hill Education.
5. Spotts, M. F. (2003). Design of machine elements. Pearson.