

**B.E Semester: V Mechanical Engineering**

**Subject Name: Machine Design - I**

**A. Course Objective**

- To develop a solution oriented approach by in depth knowledge of Design of Machine Component(s).
- To address the underlying concepts and methods to analyze different Machine Component(s).

**B. Teaching / Examination Scheme**

| SUBJECT |                    | Teaching Scheme |     |     |       | Total Credit | Evaluation Scheme |       |       |       |            | Total Marks |
|---------|--------------------|-----------------|-----|-----|-------|--------------|-------------------|-------|-------|-------|------------|-------------|
| CODE    | NAME               | L               | T   | P   | Total |              | THEORY            |       | IE    | CIA   | PR. / VIVO |             |
|         |                    | Hrs             | Hrs | Hrs | Hrs   |              | Hrs               | Marks | Marks | Marks | Marks      |             |
| ME502   | Machine Design - I | 4               | 0   | 2   | 6     | 5            | 3                 | 70    | 30    | 20    | 30         | 150         |

**C. Detailed Syllabus**

**1 Design Considerations**

Manufacturing and assembly considerations, Design of components for casting, welding, forging, hot and cold working, machining, welding etc. assembly considerations in design. Design for creep – thermal considerations – wear considerations in design, Contact Stresses ,stress concentration in machine elements

**2 Selection of Materials for Various Applications**

**3 Application of Standardization**

Machine design preferred numbers – preferred series – derived series- limits fits and tolerances and their applications in design.

**4 Design of Welded Joints**

Weld design for fillet joints – lap joints - butt joints and eccentrically loaded welded joints.

**5 Design of Sliding and Journal Bearing**

Method of lubrication, Hydrodynamic, Hydrostatic, boundary, etc., Minimum film thickness and thermal equilibrium, Selection of anti-friction bearings for different loads and load cycles, Design of thrust bearing, Rolling contact bearing, Ball bearing, Rolling contact bearing under variable loading, Mounting of the bearings, Method of lubrication, Selection of oil seals.

**6 Fatigue Loading**

Completely reversed or cyclic stresses – stress – cycle (S-N) curves – fatigue and endurance limit – effect of surface finish, size and loading etc. on endurance strength, Finite and infinite life – design for finite and infinite life, stress concentration, notch sensitivity and fatigue stress concentration factor – factor of safety for fatigue loading – Gerber, Goodman and Soderberg criteria for design of parts subjected to variable loading. Combined variable normal and shear stresses – applications of fatigue loading for design of shafts, axles etc. Bolts with initial lightening under static and fatigue loading.

**7 Design of Pressure Vessels**

Classification of pressure vessels – design of thin cylindrical and spherical shells subjected to internal pressure design of thick cylindrical shell subjected to internal and external pressure – compound cylinders subjected to internal and external pressure. Design of interference joints – press / shrink fitted assemblies – Design of cylinder covers, cover plates, pipes – pipe flanges for pipe joints.

8 **Belt and Chain Drives**

Types of belt drives – selection of belt drives – type of belts, materials for belt and their properties – velocity ratio, center distance and length of belt for various types of belt drives – power transmitted by flat and V belts drivers – design of belt drivers – selection of flat and V belts using manufacturers catalogues. Design flat and V belt pulleys. Types of chains used for power transmission – selection of standard roller – bush chains and sprockets for power transmission by chain drive using standard data. Stresses in the elements of chain drive.

9 **Design of Clutches**

Positive clutches, friction clutches, design of cone, single and multiple and centrifugal clutches, application of friction clutches in automotive and industrial machinery .

10 **Design of Brakes**

Design of band brake, external and internal shoe brakes internal expanding shoe brakes – design of disc brakes, application in automotive and industrial machinery.

**D. Lesson planning**

| <b><u>SR.NO</u></b> | <b><u>DATE/WEEK</u></b>                                | <b><u>UNIT NO</u></b> | <b><u>%WEIGHTAGE</u></b> | <b><u>TOPIC NO</u></b> |
|---------------------|--------------------------------------------------------|-----------------------|--------------------------|------------------------|
| 1                   | 1 <sup>ST</sup> , 2 <sup>ND</sup> , 3 <sup>RD</sup>    | 1,2                   | 20                       | 1,2                    |
| 2                   | 4 <sup>TH</sup> , 5 <sup>TH</sup> , 6 <sup>TH</sup>    | 3                     | 20                       | 3                      |
| 3                   | 7 <sup>TH</sup> , 8 <sup>TH</sup> , 9 <sup>TH</sup>    | 4,5                   | 20                       | 4,5                    |
| 4                   | 10 <sup>TH</sup> , 11 <sup>TH</sup> , 12 <sup>TH</sup> | 6                     | 20                       | 6                      |
| 5                   | 13 <sup>TH</sup> , 14 <sup>TH</sup> , 15 <sup>TH</sup> | 7                     | 20                       | 7                      |

**E. Instructional Method & Pedagogy**

1. At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
3. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4. One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7. The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.
8. Term Work should be as per below with maximum 5 students in one group:
  1. Exercise on material selection of various machine elements.
  2. Preparation of design report consisting of one of the following problems along with Auto CAD drawing (parts and assembly).
    - Spring loaded safety valve.
    - Brakes – external shoe brake, internal expanding shoe brakes, band brake.
    - Clutches – cone, disc, single plate. Multiple and centrifugal clutches.
    - Belt drive for industrial applications.
    - Hydraulic cylinders.
    - Hydraulic press.
    - Power screw applications – such as fly press, screw press etc.
    - Another topic covered in above topics.

3. Preparation of design report for at least six minor problems out of which at least one problem may be solved by computer program.

**9. Practical / Oral:** The candidate shall be examined on the basis of term-work.

**F. Students Learning Outcomes**

- The student can identify different areas of Manual & Computer Aided Design.
- Can find the applications of all the areas in day to day life.

**G. Recommended Demonstrate Materials**

1. Design Of Machine Elements by V B Bhandari., Tata McGraw Hill Pub
2. Machine Design by Sharma & Agrawal., S.K.Kataria Pub.
3. Mechanical Engineering Design by Dr. Sadhusingh., Khanna Pub.
4. Machine Design by Joseph Shighley, Mc-Graw Hill
5. Elements Of Machine Design by Pandya and Shah, Charotar Publishing House
6. Machine Design Vol. I & II by Patel, Pandya, Sikh & Rajput., C.Jamnadas & Co
7. Machine Design by R K Jain, Khanna Pub.
8. Design Of Machine Elements Vol. I, II& III by Farazdak Haideri, Nirali Prakashan, Pune
9. P S G Design Data Book.