S.No.	Topic	No. of Lectures
8.	Fatigue loads and mathematical models. Fatigue testing and presentation of fatigue data, Influence of stress conditions on fatigue strength/endurance limit of metals.	3
9.	Total life and damage tolerant approaches to life prediction. Fatigue failure models and their considerations in design of machine elements. Cumulative fatigue damage and Designing for finite and infinite life	2
10.	Methods to improve fatigue resistance of machine elements. Improvement of fatigue strength by chemical/metallurgical processes such as nitriding, flame hardening, case carburizing. Fatigue strength enhancement by mechanical work, cold rolling, peening, shot peening.	3
11.	Environmental Assisted Cracking: Stress corrosion cracking, Hydrogen embrittlement, Corrosion fatigue. Creep: Creep curves, Mechanisms of creep, Stress rapture test, Life prediction, High temperature alloys.	3
	Total	**32**

VIII. List of Practicals

S.No.	Topic	No. of Practicals
1.	Load measurement using Load indicator, Load Cells	1
2.	Strain measurement using Strain Gauge	1
3.	Stress measurement using strain rosette	1
4.	Determination of Fatigue strength measurement of S45C or alike material under same loading condition for different stress concentrations factors (like holes, notches, sharp corners for at least 5 different samples). Comparison to be listed.	5
5.	Study to improvement Fatigue Design based on at least 5 different processes like flame hardening, case carburizing, nitriding, shot peening, peening etc or alike processes.	5
6.	Determination of correlation between fatigue limit and ultimate strength of commercially available S45C material for three different samples	3
	Total	**16**

IX. Suggested Reading

- Lessells, J.M. 1955. *Strength and resistance of metals*. John Wiley & sons, Michigan.
- T.L. Anderson. 2005. *Fracture Mechanics Fundamentals and Applications*. CRC press, Boca Raton.
- Bhandari V.B.2019. *Design of Machine Elements*. Mcgraw Hill Education Pvt Ltd, New Delhi
- Peterson, R.E. 1953 *Stress Concentration Design Factors*. John Wiley & Sons, New York.
- Meguid, S.A.1989 Engineering *Fracture Mechanics*. John Wiley & Sons, New York
- Kare Hellan.1985. *Introduction to Fracture Mechanics*. Mc Graw Hill Book Co, New York.

I. Course Title : **Computer Aided Design**

II. Course Code : **ME 515**

III. Credit Hours : **2+1**

IV. Aim of the course

The **course** provides an understanding on computer aided design. It provides in depth knowledge about 2-d drawing, 3-D Modeling and finite element analysis for optimum product design.

V. Theory

Unit I

Introduction to computer aided design, scope of computer aided machine design, design process and design environments. Geometric modeling and interactive graphic, engineering analysis, design review and automated drafting, modeling, viewing,

Unit II

3-D solid modeling, boundary representation, constructive solid geometry, feature based modeling. Computer aided analysis and synthesis of common mechanical components, a bar, a beam and a shaft, comparison with analytical results.

Unit III

Application of numerical methods and optimization techniques to machine design problems, Computer aided selection of standard mechanical components. Introduction to FEM. FEA using two dimensional and three dimensional elements; plain strain and plain stress problems, finite element mesh, automatic meshing techniques, limitations of FEM.

Practical Computer aided design problems for machine components, use of standard software, CAD models for other applications. Development of FEM models for analysis of a bar, beam and a shaft. Practice in using an FEM software on other real life problems like spanners, connecting rods.

VI. Learning outcome

The students can design a product having better accuracy, less errors, increased productivity and shorter lead times with the help of CAD.

VII. Lecture Schedule

S.No.	Topic	No. of Lectures
1	Introduction to Engineering Design, design steps and computer aided design.	2
2	Software and workstation selection for CAD. Design process with and without CAD	3
3	Input and output devices, Display devices; GKS, IGES and STEP; Modeling and viewing, Application areas of CAD.	3
4	Wireframe model, solid modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).	3
5	Mass, volumetric properties calculations; surface modeling, concepts of hidden-line removal and shading: Mechanical Assembly Kinematics analysis and simulation	3
6	Parametric Modeling Technique. Non-parametric and parametric representation of curves.	2
7	Parametric representation of Hermite Cubic, Beizer and B-spline curves; Surface and its analysis. Representation of Analytical and synthetic surfaces.	2
8	Numerical methods and optimization techniques to engineering design problems	3
9	Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM	3
10	Analyzing simple machine elements and comparing with analytical results of simple machine elements like bar, beam and a shaft.	4

S.No.	Topic	No. of Lectures
11	Simple Project. Mathematical modelling and design calculations of machines.	4
	Total	**32**

VIII. List of Practicals

S.No.	Topic	No. of Practicals
1.	Introduction to 2-D drawing. Use of any relevant software	2
2.	Study of drawings in First angle and third angle projections	1
3.	2-D assembly drawing and generation of BOM	1
4.	3-D Modeling. GKS, IGES and STEP; Modeling and viewing. Use of relevant software	3
5.	Assembly Design	2
6.	Introduction to FEA software. Mesh generation (Nodes and elements). Use of any other relevant software for FEA	3
7.	Practice on Boundary conditions like loads and constraints.	2
8.	Study of static and dynamic loading conditions. Study of Machine elements like bars, beams and shafts or other machine elements.	2
	Total	**16**

IX. Suggested Reading

- Mikell P. Groover, Emory W. Zimmers.2000 *CAD/CAM Computer Aided Design and Manufacturing*, PHI,
- Zeid Ibraham.1991. *CAD/CAM - Theory and Practice*, Tata McGraw Hill, New Delhi
- Chandandeep Grewal & Kuldeep Sareen.2007. *CAD/CAM Theory and Concepts*. S.Chand, New Delhi
- P.N Rao.2010. *CAD/CAM*. Tata McGraw Hill, New Delhi