SOLVED PROBLEMS

MACHINE ELEMENTS

VOLUME 1

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PREFACE

This book has been prepared for mechanical engineering students as a complementary book to be used in the course of "Mechanical Engineering Design or Design of Machine Elements. It is not the author's intention to use this book as a text book but it may be considered as a complementary book especially for the solution of problems in the area of Mechanical Engineering Design. Methodic approaches developed for the solutions are provided in order to improve the efficiency of teaching Machine Elements course. Most of the problems are selected from previous years' examinations sheets. Short explanations of some subjects have been included for a beter understanding of the solution of the problems.

The Author's previous book " Problems on the Design of Machine Elements" is rearranged, introductory sections of the Chapters have been extended, different types of problems are added and an effort is made to make the examples more practical. Owing to an increased volume of the contents, it was considered to be more practical and usable to present the book in two parts, especially for students of Mechanical Engineering.

This first part is devoted to the subjects : stress analysis, deflection analysis, design for static strength, design for fatigue strength, tolerances and fits, design of power screws, design of bolted joints, design of riveted joints and design of welded joints.

Second part is devoted to the subjects: design of mechanical springs, selection of anti-friction bearings, design of journal bearings, gearing and kinematic analysis of gear trains, design of spur gears, design of helical gears, design of worm gears, design of bevel gears, design of brakes and design and selection of flexible mechanical elements such as belts and chains.

The subjects are treated in seperate sections and they are incorporated with introductory sections in which a brief summary of design and/or selection principles of

the respective elements are given. At the end of each section some selected problems are included to be solved by the students themselves.

SI units are used in this book. Material selection process is not included, but material properties are stated in the problems. Some design factors used in the solution of the problems may be found in the figures and tables given in the Appendix. They are adopted from some of the references given at the end of the book. The reasons of including the tables and figures are first, to give the students the opportunity to find the numerical values of some of the design factors without needing any other source and second, to be consistent with the text used in Machine Elements Courses.

I would like to thank to my previous years' undergraduate students for their criticism and suggestions on the contents of the book. Mr. Haci Çelik, in preparing the title page and the help in the printing stage of the book is very much appreciated.

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Dr. I. Hüseyin Filiz

LIST OF SYMBOLS

A	Area; constant
a	constant; dimension
B	constant
b	constant; fatigue strength exponent
C	coefficient; spring index; column-end condition constant; center distance
c	clearance; distance
D,d	Diameter
E	Modulus of elasticity
e	Eccentricity; efficiency; strain value;
F	Force; face width
f	Frequency; coefficient of friction
G	Shear modulus of elasticity
g	Gravitational constant
H	Hardness number; power
h	thickness; nut height
I	Moment of inertia
J	Polar moment of inertia
K	Stress concentration factor;
k	Spring scale; endurance limit modifying factor; radius of gyration; stiffness
L	Length; life; lead
l	Length

M	Moment
m	Mass; margin of safety; speed ratio
N	Number
n	Rotational speed; number of start; factor of safety
P	Force; unit load
p	Pressure; circular pitch
q	Notch sensitivity factor
R	Reaction forces; radius
r	Radius
S	Strength;
T	Torque
t	Thickness
U	Energy
u	Unit energy
V	Shear force; velocity
W	Weight; width; load; force
x	Distance
y	Distance; Lewis form factor
α	Angle; axial fatigue stress concentration factor
γ	shear strain
δ	Deformation; deflection
ε	Unit strain; efficiency
θ	angle of rotation, angle
λ	Lead angle, helix angle
μ	Poisson's ratio; coefficient of friction
ρ	Radius of curvature
σ	Normal stress
τ	Shear stress

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