Second Edition

Design of Machine Elements II DME II

is written in accordance with the syllabus of Visvesvaraya Technological University (VTU) for sixth semester students of mechanical engineering course. It also covers the syllabi of KTU, Kerala, and similar Indian Technological Universities, Institutions, and State Boards of Technical Education. The book is concise and concepts can be easily understood. Different approaches have been discussed in detail to solve similar problems.

At the end of each chapter, more than 50 VTU question papers are given for the students as exercise problems; some of these problems are solved. Another popular CBS source book *Design Data Handbook for Mechanical Engineers,* fourth edition by K Mahadevan | K Balaveera Reddy has been used as reference in preparing the material of this book.

Salient features:

- Follows a simple approach.
- Presents a collection of more than 50 VTU question papers at the end of each chapter as exercise problems.
- Structured and designed as per VTU syllabus.

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He started his teaching career as Lecturer in VVS Polytechnic, Ballari, followed as Lecturer at RYME College, Ballari, before joining as Assistant Professor at BITM, Ballari. He has also worked as a CAD designer for civil works.

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Design of

Machine Elements II (DME II)

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Design of
Machine Elements II (DME II)

Second Edition

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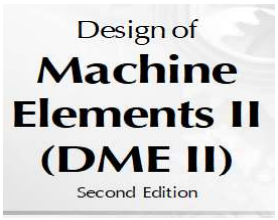

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In loving memory
of
my father
Late Sri K Sivaramulu

Preface to the Second Edition

This edition of *Design of Machine Elements II (DME II)*, is presented after thorough revision. I am thankful to the readers who have adopted this book as a textbook | reference book.

The book has been organized into 13 chapters. Additional topics relevant to the subject within the scope of the syllabus have been added wherever applicable. A number of problems have been solved covering the basic concepts to various methods.

The book is structured as per latest VTU syllabus. Old chapters from various schemes have been retained in the book. A detailed comparison of the syllabus across various schemes is provided for ease of reference. At the end of each chapter, 50+ question from VTU question papers are given as exercise problems.

In this edition, the entire book has been updated as per 4th edition of *Design Data Handbook for Mechanical Engineers*, by Prof K Balaveera Reddy and Prof K Mahadevan.

I am thankful to my family members for their continuous support and encouragement in preparing this book.

Salient Features

- Standardized chapter organization according to the choice based credit system (CBCS)
- Detailed explanation using different methods with relevant illustration
- New examples have been added throughout the book
- Numerous practice problems at the end of each chapter
- VTU questions as exercise problems for self-study and practice at the end of each chapter.
- Use of Design Data Handbook (4/e)

K Raghavendra

Preface to the First Edition

It gives me a great satisfaction in presenting this book titled *Design of Machine Elements II (DME II)*, written according to the syllabus prescribed by VTU, Belagavi, for VIth semester students of Mechanical Engineering and Industrial Production Engineering

The manuscript is based on the lectures delivered by the author with reference to the fourth edition of *Design Data Handbook for Mechanical Engineers* by Prof K Mahadevan and Prof K Balaveera Reddy. The concepts are presented in simple and lucid language to explain the subject within the scope of the topics given in the syllabus.

I owe my gratitude to my mother Smt B Susheela, whose blessings inspired me in bringing out this book. I am thankful to my wife Smt V Radhika, son Chi K Naga Ganesh for their continuous support and encouragement in preparing this book.

I would like to express my sincere thanks to Dr Kori Nagaraj, Professor and Head, Department of Mechanical Engineering, RYME College, Ballari; Dr Yadavalli Basavaraj, Professor and Head, Department of Mechanical Engineering, BITM, Ballari, for their support and cooperation while preparing the manuscript.

Last but not the least, I would like to thank the entire team of CBS Publishers & Distributors, New Delhi for making all possible efforts in the publication of this book.

K Raghavendra

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Syllabus

DME–2
SYLLABUS COMPARISON (2021)

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1	Curved Beams§	**	M1	M1
2	Cylinders & Cylinder Heads§	**		
3	Belts, Ropes and Chain drives	M1	M2	M2
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10	Design of Brakes			
11	Lubrication and Bearings	M5	M5	M5
12	Antifriction bearing			
13	IC Engine §	OLD SCHEME (**10ME62**)		

§ indicates the chapter from old syllabus for reference.
** Not applicable

DESIGN OF MACHINE ELEMENTS II (DME II)

Sub Code: 18ME62 **6th Semester**

MODULE 1

Springs: Types of springs, spring materials, stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, concentric springs; springs under fluctuating loads.

Leaf Springs: Stresses in leaf springs, equalized stresses, and nipping of leaf springs. Introduction to torsion and Belleville springs.

Belts: Materials of construction of flat and V belts, power rating of belts, concept of slip and creep, initial tension, effect of centrifugal tension, maximum power condition. Selection of flat and V belts- length & cross section from manufacturers' catalogues. Construction and application of timing belts.

Wire ropes: Construction of wire ropes, stresses in wire ropes, and selection of wire ropes.

MODULE 2

Gear drives: Classification of gears, materials for gears, standard systems of gear tooth, lubrication of gears, and gear tooth failure modes.

Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear.

Helical Gears: Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear.

MODULE 3

Bevel Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear.

Worm Gears: Definitions, types of worm and worm gears, and materials for worm and worm wheel. Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

MODULE 4

Design of Clutches: Necessity of a clutch in an automobile, types of clutch, friction materials and its properties. Design of single plate, multi-plate and cone clutches based on uniform pressure and uniform wear theories.

Design of Brakes: Different types of brakes, Concept of self-energizing and self-locking of brakes. Practical examples, Design of band brakes, block brakes and internal expanding brakes.

MODULE 5

Lubrication and Bearings: Lubricants and their properties, bearing materials and properties, mechanisms of lubrication, hydrodynamic lubrication, pressure development in oil film, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated. Numerical examples on hydrodynamic journal and thrust bearing design.

Antifriction bearings: Types of rolling contact bearings and their applications, static and dynamic load carrying capacities, equivalent bearing load, load life relationship; selection of deep grove ball bearings from the manufacturers' catalogue; selection of bearings subjected to cyclic loads and speeds. Probability of survival.

DESIGN OF MACHINE ELEMENTS II (DME II)

Sub Code: 17ME64 **6th Semester**

MODULE I

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links.

Cylinders & Cylinder Heads: Review of Lame's equations; compound cylinders, stresses due to different types of fit on cylinders; cylinder heads and flats.

MODULE 2

Belts: Materials of construction of flat and V belts, power rating of belts, concept of slip and creep, initial tension, effect of centrifugal tension, maximum power condition.

Selection of flat and V belts-length & cross section from manufacturers' catalogues. Construction and application of timing belts.

Wire ropes: Construction of wire ropes, stresses in wire ropes, and selection of wire ropes. *(Only theoretical treatment)*

Chain drive: Types of power transmission chains, modes of failure for chain, and lubrication of chains. *(Only theoretical treatment)*

Springs: Types of springs, spring materials, stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, concentric springs; springs under fluctuating loads. Leaf Springs: Stresses in leaf springs, equalized stresses, and nipping of leaf springs. Introduction to torsion and Belleville springs.

MODULE 3

Gear drives: Classification of gears, materials for gears, standard systems of gear tooth, gear tooth failure modes and lubrication of gears.

Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear.

Helical Gears: Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear.

Bevel Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear.

MODULE 4

Worm Gears: Definitions, types of worm and worm gears, and materials for worm and worm wheel. Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

Design of Clutches: Types of clutches and their applications, single plate and multi-plate clutches. (Numerical examples only on single and multi-plate clutches)

Design of Brakes: Types of Brakes, Block and Band brakes, self locking of brakes, and heat generation in brakes.

MODULE 5

Lubrication and Bearings: Lubricants and their properties, bearing materials and properties; mechanisms of lubrication, hydrodynamic lubrication, pressure development in oil film, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated. Numerical examples on hydrodynamic journal and thrust bearing design.

Anti friction bearings: Types of rolling contact bearings and their applications, static and dynamic load carrying capacities, equivalent bearing load, load life relationship; selection of deep grove ball bearings from the manufacturers' catalogue; selection of bearings subjected to cyclic loads and speeds; probability of survival.

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