

Fundamentals of Machine Design Volume II

Machine design is part of the broader discipline of Engineering Design. *Fundamentals of Machine Design* is compiled in two volumes. Vol. II is a follow-up to the first volume. Unit 1 of this volume begins by discussing fundamental concepts, types and applications of belt drives, pulleys, rope drives, chain and sprocket drive, spur gears, helical gears, bevel gears, worm gears and gear trains using simple and epicyclic gears in detail. Unit 2 discusses construction aspects, classification, material required, design procedures and selection parameters for hydrodynamic and rolling bearings. The design steps are discussed comprehensively, which helps students and teachers in practical classes. Unit 3 discusses different types and construction processes of important parts of an internal combustion engine including cylinder, piston, connecting rod, crank shaft and valve gears. The final unit 4 comprehensively discusses the design procedure, types and construction of flywheels, clutches, brakes and pressure vessels.

Pedagogical features in the book include solved examples, unsolved exercises, design problems and review questions. The text is primarily a follow-up introductory course on machine design, meant for undergraduate students of mechanical engineering. It is accompanied with teaching resources including a solutions manual for instructors.

Ajeet Singh retired as Professor and Head of the Department of Mechanical Engineering from Motilal Nehru National Institute of Technology (MNNIT), Allahabad. In addition to teaching, he worked in many administrative positions like Dean Academic, Dean Research and Consultancy etc. He has about three decades of teaching experience at undergraduate, graduate and doctoral level in India and 15 years abroad. He taught courses in machine drawing, machine design, internal combustion engines, tribology, computer aided design and engineering processes. He has been consultant to industries like BHEL, TEW etc. Besides publishing several papers in national and international journals, he has published three textbooks: *Working with AutoCAD 2000 with updates to AutoCAD 2000i* (2002), *Machine Drawing: Includes AutoCAD 2005* (2005) and *Machine Drawing; Includes AutoCAD 2010* (2012).

Fundamentals of Machine Design

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Ajeet Singh



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Dedicated to my parents, wife,

Daughters: Preety, Diljeet and Maneet

Grandchildren: Gaganjit, Karanjit, Ananya, Neha, Tanvi and Simar

Contents

<i>Preface</i>	<i>xxiii</i>
<i>Acknowledgments</i>	<i>xxv</i>

Unit 1 - Drives

1. Belts and Pulleys

1.1	Introduction	1
1.1.1	Advantages	2
1.1.2	Disadvantages	2
1.2	Types of Belts	2
1.2.1	Flat belts	3
1.2.2	V belts	3
1.2.3	Construction of V belts	4
1.3	Types of Flat Belt Drive	5
1.3.1	Open belts	5
1.3.2	Crossed belts	6
1.3.3	Quarter twist belts	6
1.3.4	Compound belts	6
1.3.5	Serpentine belts	7
1.4	Belt Materials and Construction	7
1.5	Properties of Belt Materials	9
1.6	Flat Belt Specifications	9
1.7	Flat Belt Joints	10

1.8	Angle of Contact	12
1.8.1	Open belt	12
1.8.2	Cross belt	13
1.9	Power through a Belt	14
1.10	Belt Tensions	15
1.11	Belt Tensions Ratio (Capstan Equation)	15
1.11.1	Flat belts	15
1.11.2	V belts	16
1.12	Initial Tension	17
1.13	Centrifugal Tension	19
1.14	Maximum Tension	20
1.15	Condition for Maximum Power	21
1.16	Slip of Belt	22
1.17	Creep of Belt	23
1.18	Length of Belt	23
1.19	Design of Flat Belt Drive	28
1.20	Center Distance	32
1.21	Power Rating of V Belts	32
1.22	Life of Belts	33
1.23	Design of V Belt Drive	36
1.24	Types of Pulleys	43
1.25	Flat Belt Pulleys	44
1.25.1	Solid pulley	45
1.25.2	Webbed pulley	46
1.25.3	Armed pulley	46
1.25.4	Built-up pulley	49
1.25.5	Stepped pulley	50
1.25.6	Fast and loose pulley	51
1.26	Grooved Pulleys	51
1.26.1	Single belt grooved pulley	52
1.26.2	Multibelt grooved pulley	52
1.26.3	Stepped grooved pulley	53
1.27	Toothed Pulley	53
2. Rope Drives		
2.1	Rope Drives	68
2.2	Fibre Rope Drive	69
2.2.1	Advantages	69
2.2.2	Fibre rope materials	69

2.3	Sheave for Fiber Ropes	70
2.4	Design of Rope Drive	70
2.5	Wire Ropes	74
2.5.1	Advantages of wire ropes	74
2.5.2	Wire rope material	74
2.6	Construction of Wire Ropes	75
2.6.1	Core	75
2.6.2	Wires	75
2.6.3	Strands	76
2.7	Lay of Wire Ropes	76
2.7.1	Regular lay	76
2.7.2	Lang lay	76
2.7.3	Ordinary lay	77
2.7.4	Alternate right and left lay	77
2.8	Types of Wire Ropes	77
2.8.1	Spiral ropes	77
2.8.2	Stranded ropes	77
2.9	Designation of Ropes	78
2.10	Classification of Wire Ropes	78
2.10.1	Classification according to usage	79
2.11	Wire Rope Terminations	79
2.12	Selection of Wire Ropes	81
2.12.1	Selecting a type of wire rope center	81
2.13	Stresses in Wire Rope	82
2.14	Drum and Sheave Arrangement	84
2.14.1	Construction of sheave	85
2.14.2	Groove size	86
2.14.3	Groove hardness	86
2.14.4	Throat angle	86
2.14.5	Fleet angle	86
2.14.6	Sheave alignment	87
2.15	Design Procedure for Wire Rope Drive	87

3. Chain Drives

3.1	Introduction	104
3.2	Advantages / Disadvantages	106
3.3	Classification of Chains	106
3.3.1	Hoisting chains	107
3.3.2	Conveyor chains	107

x | Contents

3.3.3	Power transmission chains	107
3.3.4	Roller chains	108
3.3.5	Multiple-strand chains	108
3.4	Pitch and Pitch Circle Diameter	109
3.5	Minimum Number of Teeth	110
3.6	Chordal Action	111
3.7	Length of Chain and Center Distance	112
3.8	Chain Designation	114
3.9	Forces on Chain	117
3.10	Breaking Load and Factor of Safety	117
3.11	Power Capacity of Chains	118
3.12	Design Power and Corrected Power	119
3.12.1	Tooth correction factor	119
3.12.2	Load factor	119
3.12.3	Service factor	120
3.12.4	Lubrication factor	120
3.13	Maximum Number of Teeth	123
3.14	Maximum Chain Speed	123
3.15	Bearing Pressures	123
3.16	Design of Chain Drive	124
3.17	Silent Chains	132
3.17.1	Comparison with roller chains	132
3.17.2	Use of silent chains	132
3.17.3	Construction of silent chains	133
3.17.4	Standard widths	134
3.17.5	Specifying a chain	134
3.17.6	Selection and design tips	134
3.17.7	Chain designation	135
3.17.8	Factor of safety	135
3.17.9	Power capacity	136
3.17.10	Maximum speed of silent chain	136
3.18	Lubrication of Chains	139
3.19	Sprockets	139
3.19.1	Body styles	140
3.19.2	Sprocket mounting	140
3.19.3	Sprocket proportions	141
4.	Gear Fundamentals	
4.1	Introduction	151
4.2	Gear Drives versus Other Drives	152

4.3	Advantages and Disadvantages of Gear Drives	153
4.4	Types of Gear Drives	153
4.4.1	Spur gears	153
4.4.2	Helical gears	154
4.4.3	Bevel gears	154
4.4.4	Worm and worm wheel	155
4.5	Terminology	155
4.6	Types of Pitches	157
4.7	Gear Tooth Proportions and Standard Modules	158
4.8	Tooth Profiles	159
4.8.1	Cycloid profile	159
4.8.2	Involute profile	160
4.8.3	Properties of involute teeth	161
4.8.4	Involute versus cycloid profile	161
4.9	Involute Gear Tooth Systems	162
4.10	Base Circle	163
4.11	Law of Gearing	164
4.12	Velocity Ratio	164
4.13	Path of Contact	165
4.14	Arc of Contact	167
4.15	Contact Ratio	169
4.16	Interference	171
4.16.1	Parameters affecting interference	172
4.17	Maximum Addendum Radius	172
4.18	Minimum Number of Teeth to Avoid Interference	173
4.18.1	Minimum teeth for a pinion	173
4.18.2	Minimum teeth for a gear wheel	174
4.18.3	Minimum teeth for a pinion with a rack	175
4.18.4	Largest gear with a specified pinion	179
4.19	Slide Velocity	179

5. Spur Gears

5.1	Introduction	191
5.2	Gear Materials	192
5.3	Gear Design Considerations	193
5.4	Gear Tooth Strength	193
5.4.1	Loads on gear tooth	193
5.4.2	Lewis equation	195

5.5	Dynamic Loads	199
5.5.1	Velocity factor	199
5.6	Buckingham's Equation for Dynamic Load	200
5.6.1	Dynamic load	200
5.6.2	Beam strength	201
5.6.3	Deformation factor	202
5.6.4	Errors in gears	203
5.6.5	Maximum allowable error	203
5.7	Gear Design for Wear Strength	205
5.7.1	Hertz stresses on tooth surface	205
5.7.2	Buckingham equation for wear	208
5.8	Factors Affecting Gear Design	212
5.8.1	Overload factor	212
5.8.2	Load distribution factor	212
5.8.3	Mounting factor	213
5.8.4	Surface finish factor	213
5.8.5	Rotation factor	213
5.8.6	Reliability factor	213
5.8.7	Size factor	214
5.8.8	Temperature factor	214
5.9	Design Procedure	214
5.9.1	Design procedure with given center distance	215
5.9.2	Design procedure when center distance is not given	219
5.10	Internal Gears	223
5.10.1	Advantages and disadvantages	224
5.10.2	Interference in internal gears	224
5.10.3	Design of internal gears	225
5.11	Non-circular Gears	227

6. Helical Gears

6.1	Introduction to Helical Gears	241
6.2	Terminology for Helical Gears	242
6.3	Types of Helical Gears	243
6.4	Face Width and Overlap	245
6.5	Gear and Tooth Proportions	245
6.6	Equivalent Number of Teeth of Helical Gears	247
6.7	Normal Modules	247
6.8	Forces on Tooth	248
6.9	Design of Helical Gears	249

6.10	Lewis Equation for Helical Gears	250
6.11	Effective Load	251
6.11.1	Service factor	251
6.11.2	Velocity factor	251
6.12	Dynamic Load	253
6.13	Wear Strength of Helical Gears	254

7. Bevel Gears

7.1	Introduction	271
7.2	Terminology	272
7.3	Types of Bevel Gears	273
7.4	Pitch Angle and Gear Ratio	274
7.5	Cone Distance	275
7.6	Proportions of Bevel Gear	276
7.7	Formulative Number of Teeth	276
7.8	Forces on Gear Tooth	277
7.8.1	Forces on tooth of pinion	277
7.8.2	Forces on tooth of bevel gear	279
7.9	Strength of Bevel Gear Tooth	280
7.10	Dynamic Load	283
7.11	Wear Strength	284
7.12	Spiral Bevel Gears	291

8. Worm Gears

8.1	Worm and Worm Wheel	300
8.2	Advantages / Disadvantages of the Drive	301
8.3	Applications	302
8.4	Terminology	302
8.5	Diameter Quotient	304
8.6	Pressure Angle	304
8.7	Types of Worms and Worm Wheels	305
8.7.1	Types of worms	305
8.7.2	Types of worm gears	305
8.8	Material Selection	306
8.8.1	Materials for worm	306
8.8.2	Materials for worm gear	307
8.9	Drive Proportions	308
8.9.1	Worm proportions	308
8.9.2	Worm gear proportions	309

8.10	Drive Designation	310
8.11	Center Distance	310
8.12	Force Analysis	314
8.13	Strength of Worm Gear Tooth	317
	8.13.1 Strength in bending	317
	8.13.2 Endurance strength	318
	8.13.3 Strength in wear	321
8.14	Friction in Worm Drives	322
8.15	Efficiency of Worm Drive	322
8.16	Heat Generated	324
	8.16.1 Heat transfer coefficient	326
	8.16.2 Use of oil cooler	326
8.17	Design of Worm and Worm Wheel Drive	328
	8.17.1 Approximate center distance given	328
	8.17.2 Center distance not given	333

9. Gear Trains and Gear Boxes

9.1	Function of a Gear Box	345
9.2	Applications	346
9.3	Construction	346
9.4	Gear Trains	346
	9.4.1 Simple gear train	347
	9.4.2 Compound gear train	347
9.5	Pitch Line Velocity	348
9.6	Epicyclic Gear Trains	351
9.7	Speed Ratio of Epicyclic Gear Trains	353
	9.7.1 Translation method	353
	9.7.2 Formula method 1	355
	9.7.3 Formula method 2	356
	9.7.4 Compound epicyclic gear trains	359
9.8	Torque Ratios of Epicyclic Gears	361
9.9	Classification of Gear Boxes	362
9.10	Selection of Type of Gear Box	364
9.11	Speed Ratios in Geometric Progression	365
9.12	Kinematic Diagram	367
9.13	Structural Formula	368
9.14	Structural Diagram	368
9.15	Number of Speeds and Stages	369
9.16	Alternate Structural Formulas	369

9.17	Transmission Ratio of a Stage	371
9.18	Optimum Structural Formula	372
9.19	Ray Diagram	373
9.20	Two-stage Gear Box with Fixed Ratio	384
9.21	Sliding Mesh Gear Box	384
9.22	Constant Mesh Gear Box	385
9.23	Synchromesh Gear Box	386
9.24	Gear Box Housing	387
9.25	Power Losses in Gear Box	388
9.26	Fluid Couplings	390
9.27	Torque Converters	392

Unit 2– Bearings

10. Hydrodynamic Bearings

10.1	Introduction	406
10.2	Construction of Bearings	407
10.3	Classification of Bearings	407
10.4	Properties of Bearing Material	411
10.5	Bearing Materials	411
10.6	Properties of Lubricants	412
	10.6.1 Viscosity	413
	10.6.2 Units of viscosity	414
	10.6.3 SAE designation of oils	414
	10.6.4 Viscosity index	415
10.7	Hydrodynamic Lubrication	415
	10.7.1 Terminology	415
	10.7.2 Working principle	416
	10.7.3 Reynolds equation	417
	10.7.4 Long bearings	417
	10.7.5 Short bearings	418
10.8	Finite Bearings	418
	10.8.1 Eccentricity ratio and Sommerfeld number	418
	10.8.2 Critical pressure	420
	10.8.3 Unit load	420
	10.8.4 Maximum pressure	421
10.9	Oil Flow through Bearings	423

10.10 Energy Loss due to Friction	426
10.11 Heat Generated and Temperature Rise	428
10.12 Heat Dissipated	431
10.13 Selection of Parameters for Design of Bearings	433
10.13.1 Length to diameter ratio (L/D)	434
10.13.2 Radial clearance	434
10.13.3 Minimum oil film thickness	435
10.13.4 Clearance ratio	435
10.13.5 Minimum oil thickness to clearance ratio	435
10.13.6 Bearing pressure	435
10.13.7 Temperature rise	435
10.13.8 Oil viscosity	435
10.13.9 Bearing modulus	436
10.14 Design Procedure	437
10.15 Thrust Bearings	441
10.15.1 Foot step bearing	441
10.15.2 Collar bearing	442
10.15.3 Hydrodynamic thrust bearing	443
10.16 Squeeze Film Journal Bearings	444

11. Rolling Bearings

11.1 Introduction	457
11.2 Construction and Nomenclature	459
11.3 Classification of Rolling Bearings	460
11.3.1 Ball bearings	460
11.3.2 Roller bearings	461
11.4 Bearing Designation	462
11.4.1 ISO designation	462
11.4.2 AFBMA designation	463
11.5 Size of Bearings	463
11.5.1 Ball bearings	464
11.5.2 Roller bearings	464
11.6 Static Load Capacity	465
11.7 Static Equivalent Load	468
11.8 Basic Dynamic Load Capacity	469
11.9 Dynamic Equivalent Load	471
11.10 Rated Life of a Bearing	472
11.11 Reliability of Bearings	474
11.12 Life with Varying Loads	477

11.13 Cyclic Loads	479
11.14 Load Factor	481
11.15 Design Procedure for Rolling Bearings	481
11.16 Bearing Lubrication	486
11.17 Mounting of Rolling Bearings	487
11.18 Failure of Rolling Element Bearings	488

Unit 3 - Design of I.C. Engine Parts

12. Cylinder of an I.C. Engine

12.1 Introduction to I.C. Engines	500
12.2 Types of Cylinders	501
12.3 Cylinder	502
12.4 Mean Effective Pressure	503
12.5 Size of Cylinder and Power Developed	503
12.6 Design of Cylinder	505
12.6.1 Stresses in cylinder	505
12.6.2 Wall thickness of cylinder	506
12.6.3 Flange size	508
12.6.4 Studs / Bolts	508
12.7 Cylinder Head	509

13. Pistons

13.1 Definition and Function	518
13.2 Desirable Characteristics of Piston	518
13.3 Piston Materials	519
13.4 Types of Pistons	519
13.5 Construction of Pistons	520
13.6 Piston Design	521
13.6.1 Piston head	521
13.6.2 Ring grooves	523
13.6.3 Barrel	524
13.6.4 Bosses	524
13.6.5 Skirt	524
13.7 Piston Rings	525
13.7.1 Compression rings	525
13.7.2 Oil rings	526

13.8	Gudgeon Pin	526
13.8.1	Fixing of gudgeon pin	527
13.8.2	Design of gudgeon pin	527
14.	Connecting Rod	
14.1	Introduction	539
14.2	Construction	540
14.3	Forces on Connecting Rod	541
14.3.1	Axial force due to gas pressure	541
14.3.2	Axial force due to inertia of reciprocating parts	541
14.3.3	Bending force due to inertia of reciprocating parts	542
14.3.4	Frictional forces due to friction between piston rings and cylinder	543
14.3.5	Frictional forces due to friction between gudgeon pin and crank pin	544
14.4	Design of Connecting Rod	544
14.4.1	Small end of the rod	544
14.4.2	Cross section of connecting rod	545
14.4.3	Big end of the rod	548
14.4.4	Cap bolts	548
14.4.5	Strap thickness	549
15.	Crank Shaft	
15.1	Introduction	560
15.2	Types of Crank Shafts	561
15.3	Crank Materials	561
15.4	Forces on Crank Shaft	562
15.5	Design of Crank Shaft	562
15.5.1	Design of crank at dead center position	562
15.5.2	Design of crank at position of maximum torque	565
15.6	Design of Side Crank	575
16.	Valve Gears	
16.1	Valve Gear Mechanism	593
16.2	Ports	594
16.3	Valves	596
16.3.1	Valve temperatures	598
16.3.2	Valve materials	598
16.3.3	Size of valves	599
16.3.4	Lift of valves	600
16.3.5	Thickness of valve	600
16.3.6	Size of valve stem	601

16.3.7 Valve Timings	601
16.3.8 Forces on valves	602
16.4 Valve Spring	607
16.5 Rocker Arm	611
16.6 Rocker Shaft	615
16.7 Push Rod	616
16.7.1 Materials	616
16.7.2 Design of push rod	617
16.8 Cam Shaft	619
16.9 Cams	619
16.9.1 Followers	620
16.9.2 Lift diagrams	621
16.10 Drawing Cam Profile	622
16.10.1 Cam profile with a roller follower	623
16.10.2 Cam profile with a flat follower	624

17. Fly Wheels

17.1 Function	641
17.2 Construction of a Flywheel	642
17.3 Design of Shaft, Hub, and Key	642
17.4 Fluctuation in Energy and Speed	643
17.5 Rim Velocity	648
17.6 Stresses in Flywheel	649
17.6.1 Tensile stresses due to centrifugal force	649
17.6.2 Bending stresses due to constrained arms	650
17.7 Mass and Energy Stored in Flywheel	651
17.7.1 Solid flywheel	651
17.7.2 Flywheel with web	654
17.7.3 Flywheel with arms	655
17.7.4 Split flywheel	659
17.8 Flywheels for Engines	661
17.9 Flywheels for Punches	666

Unit 4 – Design of Miscellaneous Parts

18. Clutches

18.1 Definition and Function	681
18.2 Types of Clutches	682

18.3	Positive Drive Clutch	683
18.4	Friction Clutch	683
18.4.1	Friction materials	684
18.4.2	Coefficient of friction	684
18.4.3	Variation of bearing pressure	685
18.4.4	Torque transmitting capacity	685
18.4.5	Maximum torque transmitting capacity	690
18.5	Design of a Single Plate Clutch	690
18.6	Time for Clutch Engagement	692
18.7	Heat Generated during Clutching	694
18.8	Multi-plate Clutch	699
18.9	Cone Clutch	701
18.9.1	Design of a cone clutch	702
18.10	Centrifugal Clutch	704
18.10.1	Construction and working	704
18.10.2	Design of a centrifugal clutch	705

19. Brakes

19.1	Definition and Functions	719
19.2	Types of Brakes	720
19.3	Materials for Brake Lining	720
19.4	Energy Absorbed by Brakes	721
19.4.1	Pure rotation	721
19.4.2	Pure translation	722
19.4.3	Combined rotation and translation	722
19.5	Heat Dissipated	723
19.6	Lining Wear (pv Value)	724
19.7	Block Shoe Brakes	726
19.7.1	Fixed block shoe brakes	726
19.7.2	Self-energizing brakes	729
19.7.3	Self-locking	729
19.7.4	Small / long shoe brake	730
19.7.5	Pivoted block brakes	733
19.7.6	Double block shoe brakes	734
19.8	Design Procedure for Block Shoe Brakes	737
19.9	Band Brakes	738
19.9.1	Simple band brakes	738
19.9.2	Differential band brakes	741
19.9.3	Band and block brakes	743

19.10 Internally Expanding Shoe	746
19.10.1 Analysis of internal shoe brakes	747
19.10.2 Shoe actuation	749
19.10.3 Shoe and brake factor	750
19.10.4 Maximum normal force for retarding wheel	751
19.11 Externally Contracting Brakes	754
19.12 Disc Brakes	755
19.12.1 Arctual pads	755
19.12.2 Disc brakes with circular pads	757

20. Pressure Vessels

20.1 Introduction and Applications	772
20.2 Classification	773
20.3 Materials and Allowable Stresses	773
20.4 Corrosion Allowance	774
20.5 Class of Pressure Vessels	774
20.6 Stresses due to Internal Pressure	774
20.6.1 Circumferential stresses	774
20.6.2 Longitudinal stresses	775
20.6.3 Effect of pressure on size	777
20.7 Thick Cylinders	778
20.7.1 Lamé's equation	779
20.7.2 Clavarino's equation	781
20.7.3 Birnie's equation	782
20.7.4 Barlow's equation	783
20.8 Thin Spherical Vessels	784
20.8.1 Plate thickness	784
20.8.2 Change in size of spherical pressure vessel with internal pressure	785
20.9 End Covers	787
20.9.1 Flat circular	787
20.9.2 Flat rectangular	788
20.9.3 Elliptical plate	789
20.9.4 Hemispherical	790
20.9.5 Dished	792
20.9.6 Semi-ellipsoid	793
20.9.7 Tori-spherical end cover	793
20.9.8 Conical end covers	794
20.10 Fixing of End Covers	795
20.10.1 Integral	796
20.10.2 Bolted	796

xxii | Contents

20.11 Welded Joints	797
20.12 Opening in Pressure Vessels	798
20.13 Boiler Code	798
<i>References</i>	811
<i>Index</i>	813

Preface

Fundamentals of machine design considers the concepts of design for each element separately such as shaft, bearing, pulley and gears. Since the number of parts is very large, the book is divided into two volumes. The language is direct and simple, so that every student can understand easily. *Volume 1* of the book describes the basic knowledge needed for designing a part. Various types of stresses that appear due to load and the analysis to calculate the size of a part, which will work satisfactorily, are given. Designs of various types of permanent and temporary joints like riveted, welded, threaded, cotter etc. and some important parts such as shafts, keys, couplings, and springs are described.

Volume 2 has four units; covering design of drives, bearings, I.C. engine parts, and miscellaneous parts such as clutches, brakes, and pressure vessels.

Unit 1 describes different types of drives. Chapter 1 gives the design of belts and pulleys of various types. Chapter 2 is on the design of ropes used for large power transmission and hoisting applications. Chapter 3 describes the design of chain drives. One of the important methods of transmitting power is using gears and is discussed in detail. Chapter 4 describes the fundamentals of the gear design. Various types of gears such as spur, helical, bevel, and worm are described separately in chapters 5 to 8. Design of gear boxes using gear trains and epicyclic gears is explained in Chapter 9.

Unit 2 gives the design of two important types of bearings used in many applications. Design of slide bearings is given in Chapter 10 and rolling element bearings in Chapter 11.

Unit 3 is on the design of I.C. engine parts. Each important part is described as a separate chapter. Chapter 12 is on the design of cylinder, Chapter 13 on piston, Chapter 14 on connecting rod, and Chapter 15 on crank shaft. These engines require valves to control flow of air and exhaust. All parts in valve gear mechanism such as cam, its follower, push rod, rocker arm, and valves are described in Chapter 16. There is large variation in torque in these engines

and hence to reduce the fluctuations in speed, flywheels are required, which are described in Chapter 17.

Unit 4 describes miscellaneous parts in three chapters. Chapter 18 is on the design of various types of clutches, Chapter 19 on the design of various types of brakes, and the last Chapter 20 is on the design of pressure vessels.

Pedagogical features of the book are excellent. At the beginning of each chapter *outcomes* are given, which gives an idea as to what a student is going to learn in that chapter. Every effort has been made to explain the theory with figures. This volume contains 289 figures. To make the book more illustrative, 122 *license-free pictures* are given from the internet. Students face a lot of difficulty in solving design problems; hence a large number of 158 *solved examples* are given.

At the end of each chapter a *summary* is given for quick revision of the course and formulas at the time of examination. Each chapter is followed by *theory questions*. To practice for quiz type questions, 216 *multiple choice* questions have been given. To practice the design problems, 180 *unsolved problems* with the answers are given. Solution to the unsolved examples shall be put in the *solution manual* on the internet in due course of time.

Competition examinations questions of past 3–4 years from Engineering services examinations and *GATE* examinations are given at the end of the chapters to help students preparing for such examinations.

After successful completion of the course, the student shall be able to understand the design process with all stresses on it and shall be able to find a size for its satisfactory working. The mastering of the course is a precondition for a successful design.

Audience: This book can be easily recommended as a *textbook* on the subject of Machine Design for undergraduate students. The book can also be used by practising engineers, students appearing for competition examinations, and for graduate admission tests.

Although every effort is made to minimize the errors, but still a human being is likely to commit mistakes. Also, there is always a possibility of improving the book. Any errors, omissions, or suggestions for the improvement of the book may please be written to the publisher or email to the email address of the author at ajeet41@yahoo.com.

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Many books on the subject of machine design have been consulted and the author would like to thank the publishers and authors of the books referred given in the references at the end of the book.