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Design of Machine Elements — Complete Syllabus

BTEUP Diploma in Mechanical Engineering • 5th Semester • Session 2026–27
Subject 5.3 (Theory) • Total 100 Marks • 4 Credits

About this document: Design of Machine Elements is subject 5.3 of the 5th semester of the Diploma in Mechanical Engineering. It is a theory subject common to the Mechanical Engineering (Production) and Mechanical Engineering (Automobile) sub-branches. This document gives the complete unit-wise syllabus, the examination scheme and the reference books from the official curriculum.

Examination Scheme

Code	Paper	Type	L – P	Credits	Internal	External	Total
5.3	Design of Machine Elements	Theory	4 – 0	4	Theory 40	Theory 60 (3 hrs)	100
Design of Machine Elements Total				**4**	**40**	**60**	**100**

What This Subject Aims To Do

To equip diploma students with the knowledge and skills needed to create and improve machine components: the principles of designing bearings, gears, springs and fasteners, and the analysis of real-world engineering problems, so that failures are prevented, performance is optimised and mechanical solutions are reliable and cost-effective.

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Unit-Wise Complete Topic List

Unit	Topic	Periods	Marks
1	Introduction to Design	10	12
2	Design of Simple Machine Parts; Bearings; Springs	12	12
3	Design of Shafts, Keys, Couplings	10	12
4	Design of Spur Gear	12	12
5	Design of Power Screws and Fasteners	12	12

Total: 56 periods, 60 marks (external theory). Each unit carries 12 marks in the external theory paper, as per the suggested distribution of marks in the official syllabus.

Unit 1 — Introduction to Design (10 Periods, 12 Marks)

Topics: Procedure of Design, General considerations in Machine Design, Use of standards in design and preferred numbers series; Stresses; Bearing pressure Intensity; Crushing; Creep Curve; Fatigue, S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes and Remedies; selection criteria of materials; Introduction to Theories of Failures; Ergonomics and Aesthetic consideration in design.

In simple words: How a design is done step by step, what a factor of safety covers, why parts fail by fatigue and stress concentration, and how materials are chosen.

Unit 2 — Design of Simple Machine Parts; Bearings; Springs (12 Periods, 12 Marks)

Topics: Design of simple machine parts: Cotter Joint; Knuckle Joint; Design of Levers: Hand/Foot Lever and Bell Crank Lever; Design of C-Clamp; Overhang Crank. Bearings: Introduction, Types of bearing and terminology of bearings, Life Load relationship, Selection of bearings using manufacturer's catalogue. Springs: Classification and Applications of Springs; Spring terminology; Materials and Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application.

In simple words: Designing joints, levers, clamps and cranks; choosing a bearing from its life and load; and designing helical and leaf springs for valves, balances, buffers and governors.

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Unit 3 — Design of Shafts, Keys, Couplings (10 Periods, 12 Marks)

Topics: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; determination of shaft diameter (Hollow and Solid), ASME code of design for shafts. Design of Sunk Keys; Effect of Keyways on strength of shaft. Introduction and function of keys, types, material and failure of keys. Design of keys (Sunk key only). Necessity, advantages and types of Couplings, Design of couplings: Muff Coupling and Flange Coupling (Protected and unprotected).

In simple words: Sizing solid and hollow shafts for strength and rigidity under the ASME code, designing a sunk key for shear and crushing, and joining shafts with muff and flange couplings.

Unit 4 — Design of Spur Gear (12 Periods, 12 Marks)

Topics: Mechanical drive, classification of gears, selection of gear, involute and cycloidal profile of teeth, terminology of spur gear, standard system of gear teeth, Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; design procedure of spur gear (module determination). Power transmission capacity of spur gears in bending.

In simple words: How spur gears are named and sized: module, pitch and tooth proportions, the Lewis equation for tooth strength, and how the module is chosen. (The syllabus prints 'cyloidal', a misprint for cycloidal.)

Unit 5 — Design of Power Screws and Fasteners (12 Periods, 12 Marks)

Topics: Introduction of power screw, terms used in screw threads, Thread Profiles used for power Screws; Torque required to overcome thread friction; Self-locking and overhauling property; Efficiency of power screws; Design of Screw Jack. Introduction of Fasteners, Types of Fasteners, Bolts of uniform strength, design of bolted joints, design of parallel and transverse welded joints, design of riveted joints, failure and efficiency of riveted joints, leak proofing of riveted joints: caulking and fullering.

In simple words: Power screws that lift loads (the screw jack), bolts that hold parts together, welds that join them permanently, and rivets that join them with a measurable efficiency.

Course Outcomes

- CO1: Explain the fundamentals of machine design.
- CO2: Design simple machine elements such as cotter joints, knuckle joints, levers, C-clamps, and overhang cranks.
- CO3: Design bearings and springs based on load and deflection requirements.

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- CO4: Design shafts, keys, and couplings for strength, rigidity, and standardization.
- CO5: Design spur gears, including tooth profile and module selection.
- CO6: Design power screws and fasteners, including screw jacks, bolts, riveted and welded joints, considering efficiency and load requirements.

Reference Books (as listed in the syllabus)

- Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575).
- Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-513).
- Introduction to Machine Design – V. B. Bhandari, Tata Mc-Graw Hill, New Delhi.
- Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc-Graw Hill, New Delhi.
- Machine design – Pandya and Shah, Dhanpat Rai and Son, New Delhi.
- Machine design – R. K. Jain, Khanna Publication, New Delhi.
- Design Data Book – PSG Coimbatore, PSG Coimbatore.
- Hand Book of Properties of Engineering Materials and Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai and Sons, New Delhi.

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Source: IRDT Kanpur NEP-2020 curriculum for the Diploma in Mechanical Engineering (Production), effective session 2026-27, approved by the Board of Technical Education, U.P. Lucknow in the C.D.C. meeting held on 16.07.2026. Topic lists follow the official syllabus; short explanations are the author's own plain-English summaries, not syllabus text. Please confirm with your own polytechnic for any local changes.

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