
AEN 3208 Design of Machine Elements

Course Code:

Course Level: Level 3

Course Credit: 3 CU

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Teaching Assistant

Brief Course Description

This course introduces students to the factors influencing the proportioning of machine elements as well as their choice for a particular application- stresses, deformation, failure criteria and their application to the design of joints, shafts, springs, belts, bearings, gears, etc.

Course Objective

- Students shall be able to select a particular material for a given task
- Students should be able to design various machine elements at a minimal cost while achieving its intended purpose for a reasonable period of time
- Students should be able to anticipate failure in various machine elements and come up with appropriate recommendations to the manufacturer.

Course content

Lecture	Topic	Content	Methods	Tools/ equipment
1.	Introduction to engineering design	Design process, Theories of parts failure, Codes and standards, Design considerations, Factor of safety	Interactive lecture (2 hrs)	Chalk/ Blackboard, LCD
2.	Introduction to engineering design	Strength and stress considerations, Reliability, Economics, Safety and product liability, Statistical considerations, Ergonomics, safety and aesthetic considerations, steady and variable loading	Interactive lecture (2 hrs)	Chalk/ Blackboard, LCD
3.	Design of threaded fasteners and connections	Bolts and nuts Power screws	Lecture (2 hrs)	Chalk/ Blackboard, LCD
4.	Design of threaded fasteners and connections	Set screws, Keys and pins, rivets	Lecture (2 hrs)	Chalk/ Blackboard, LCD
5	Welded, brazed and bonded joints	Welding symbols, Torsion in welded	Lecture (2 hrs)	Chalk/ Blackboard, LCD

		joints		
6	Welded, brazed and bonded joints	Resistance welding and Bonded joint	Lecture (2 hrs)	Chalk/ Blackboard, LCD
7	Mechanical springs	Stresses in helical springs, Deflection of helical springs, Extension and compression springs and Spring materials	Lecture (2 hrs)	Chalk/ Blackboard, LCD
8	Mechanical springs	Design of helical springs, Critical efficiency of helical springs, Fatigue loading Helical torsion springs	Lecture (2 hrs)	Chalk/ Blackboard, LCD
9.	Bearings(Rolling contact bearings)	Bearing type, Bearing life, Bearing survival, Reliability goal and Load cycle analysis	Lecture (2 hrs)	Chalk/ Blackboard, LCD
10.	Bearings(Rolling contact bearings)	Mounting and enclosure, Selection of straight roller bearings and ball bearings, Selection of roller tapered bearings and lubrication	Lecture (2 hrs)	Chalk/ Blackboard, LCD
11.	Lubrication and journal bearings	Types of lubrication, Viscosity, Petroff's law, Stable lubrication, Clearance, Pressure fed bearings, Heat balance and Thick film lubrication	Lecture (2 hrs)	Chalk/ Blackboard, LCD
12.	Lubrication and journal bearings	Hydrodynamic theory, Design considerations, Temperature and viscosity considerations,	Lecture (2 hrs)	Chalk/ Blackboard, LCD

		Loads and materials, Bearing types, Thrust bearings and Boundary lubricated bearings		
13.	Gearing	Types of gears, Conjugate action, Involute properties, Fundamentals, Contact ratio, Interference, Forming of gear teeth, Straight bevel gears, Parallel helical gears, Tooth systems	Lecture (2 hrs)	Chalk/ Blackboard, LCD
14.	Gearing	Force analysis on spur gears, Force analysis on bevel gears, Worm gears and Gear trains	Lecture (2 hrs)	Chalk/ Blackboard, LCD
15.	Gearing	Force analysis on helical gears, Force analysis on worm gears, Bevel gearing (general), Bevel gear stresses and Worm gearing	Lecture (2 hrs)	Chalk/ Blackboard, LCD
16.	Flexible mechanical elements	Belts, Flat and round belt drives, V-belts and Timing belts	Lecture (2 hrs)	Chalk/ Blackboard, LCD
17.	Flexible mechanical elements	Roller chains, Wire rope and Flexible shafts	Lecture (2 hrs)	Chalk/ Blackboard, LCD
18.	Shafts, axles and spindles	Determination of shaft geometry, Static loading, Bending and torsion and Fatigue	Lecture (2 hrs)	Chalk/ Blackboard, LCD
19.	Shafts, axles and spindles	Fatigue analysis, Stiffness considerations and Estimating reliability	Lecture (2 hrs)	Chalk/ Blackboard, LCD

20.	Clutches, brakes, flywheels and couplings	Statics, Internal expanding rims and clutches, External contracting rims and clutches and Band type clutches and brakes	Lecture (2 hrs)	Chalk/ Blackboard, LCD
21.	Clutches, brakes, flywheels and couplings	Frictional contact axial clutches, Disk brakes, Cone clutches and brakes and Energy considerations	Lecture (2 hrs)	Chalk/ Blackboard, LCD
22.	Clutches, brakes, flywheels and couplings	Temperature rise, Friction materials, Miscellaneous clutches and couplings and Flywheels	Lecture (2 hrs)	Chalk/ Blackboard, LCD

Assessment:

- Assignments (10%)
- Projects (10%)
- Tests (20%)
- Final university examination (60%)

References

- Shigley J.E and Mischke C.R (1989). "Mechanical Engineering Design". 5th Edition. McGraw Hill Book Company. New York, USA
- Krutz G.W, Scheller J.K and Claar P.W (1999). Machine Design for Mobile and Industrial Applications. Second Edition. SAE Publications Group, USA.
- Movnin M and Goltziker D (1975). "Machine Design". Mir Publishers, Moscow, Russia.
- Spotts MF (1971). "Design of Machine Elements". Fourth Edition. Prentice Hall International, London, UK.
- Black P.H and Adams O.E (1968). "Machine Design". Third Edition. McGraw Hill Book Company, London, UK.

Other Resources

- Computer laboratory connected to internet
 - University library
 - Faculty and department book banks
 - Materials testing laboratory
 - Solid Edge and unigraphics laboratory
 - Mechanical workshop
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