MACHINE DESIGN II

ENME 415

Lecture	**: 3**	**Year : IV**
Tutorial	**: 1**	**Part : I**
Practical	**: 3/2**	

Course Objectives:

The objective of this course is to provide fundamental knowledge and skills for designing machine elements and selecting mechanical components with emphasis on safety, reliability, efficiency and economy, while developing engineering judgment and problem-solving ability.

1 Modelling and Optimization (4 hours)

- 1.1 Modelling
  - 1.1.1 Models: Types, role in engineering design, mathematical modeling, similitude and scale models
  - 1.1.2 Finite element modeling and analysis
- 1.2 Optimization techniques
  - 1.2.1 Optimization: Differential calculus, search methods, multivariable search methods
  - 1.2.2 Linear and geometric programming, multifactor objective functions

2 Product Design Considerations (6 hours)

- 2.1 Design for Manufacture and Assembly
- 2.2 Design for Reliability and Safety
- 2.3 Design for Quality and Robustness
- 2.4 Design for Testing
- 2.5 Design for Sustainability
- 2.6 Risk, reliability and safety
  - 2.6.1 Risk and society
  - 2.6.2 Probabilistic approach to design
  - 2.6.3 Reliability theory, failure rates, system reliability
  - 2.6.4 Hazard analysis and fault tree analysis

3 Design of springs (8 hours)

- 3.1 Stresses in a helical spring
- 3.2 Deflection of a helical spring
- 3.3 Extension and compression springs
- 3.4 Spring materials: Estimation of tensile strength and torsional yield strength
- 3.5 Design of helical spring: Critical frequency
- 3.6 Fatigue loading

3.7 Belleville spring
3.8 Helical torsion spring
3.9 Leaf spring
3.10 Energy storing capacity of a spring

4 Design of Spur and Helical Gears (12 hours)

4.1 Lewis's bending equation
4.2 Surface durability
4.3 AGMA stress and strength equations
4.4 Geometry factors, elastic coefficient and various factors affecting gear performance, such as dynamic factors, overload factors, surface condition, size, load distribution, hardness ratio, stress-cycle, reliability, temperature and rim-thickness factors
4.5 Safety factors
4.6 Design of gear mesh

5 Design of Clutches and Brakes (10 hours)

5.1 Internal expanding rim clutches and brakes
5.2 External expanding rim clutches and brakes
5.3 Band-type clutches and brakes
5.4 Frictional contact axial clutches
5.5 Cone clutches and brakes
5.6 Energy consideration and temperature rise
5.7 Frictional material

6 Design of Power Screws (5 hours)

6.1 Power screws, forms of threads, multiple threaded screws, terminology
6.2 Torque requirement for lifting and lowering loads, self-locking of screws
6.3 Efficiency of power screws, collar friction torque, overall efficiency and coefficient of friction

Tutorial (15 hours)

1. Design calculations of springs
2. Design calculations of spur and helical gears
3. Design calculations of clutches and brakes
4. Design calculations of power screws

Practical (22.5 hours)

1. Solving problems related to the design of springs using any computational tools
2. Computing problems related to the design of gear mesh (Spur and Helical) using any computational tools
3. Computing problem related to the design of clutches and brakes using any computational tools

4. Computing problems related to the design of power screws using any computational tools

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1, 2	10	14
3	8	10
4	12	16
5	10	14
6	5	6
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Budynas, R. G., Nisbett, J. K. (2020). Shigley's mechanical engineering design. McGraw-Hill Education.
2. Bhandari, V. B. (2017). Design of machine elements. McGraw-Hill Education.
3. Dieter, G. E., Schmidt, L. C. (2021). Engineering design. McGraw-Hill Education.