Course No: **TMM-103 TRIBO-MATERIALS C L P [3 3 0]**

TRIBO-MATERIALS (TMM-103)	**Dr. Mukund Dutt Sharma**	**CO1:**	**Understand the tribological processes and relevant properties of materials. Know the process of selection of materials for tribological applications.**
		CO2:	**Identify the role of ferrous, non ferrous and composite materials for tribological applications.**
		CO3:	**Analyze the surface treatment techniques to enhance the life of Tribo-pair.**
		CO4:	**Analyze the surface coating techniques to enhance the life of Tribo-pair.**

Course topics:

UNIT I

Introduction to tribological processes and tribological relevant properties of material. An overview of engineer materials having potential for tribological application. Selection of materials for tribological applications at design stage.

UNIT II

Characterization and evaluation of Ferrous material for tribological requirements/application, Selection of ferrous material for rolling element bearings, gears, crank shafts, piston rings, cylinder liners, etc. Non-ferrous materials and their applications such e-sliding bearing, piston rings, cylinder liners, etc., materials for dry friction materials. Composite materials (PM, CMC and MMC) for tribological application.

UNIT III

Surface treatment techniques with applications such as carburizing, nitriding, induction hardening, hard facing, laser surface treatments, etc. Surface coating techniques such as electrochemical deposition, anodizing, thermal spraying, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), etc. and their applications.

Text Books:

1. Ashby, M.F., "Materials selection in mechanical design", 4th Edition, Butterworth Heinemann, London, 2010.
2. Glaeser,W. A., "Tribology series - Vol. 20," Elsevier Publications, 1992.
3. Neale, MJ., "The Tribology Hand Book," Butterworth Heinemann, London, 1995.

Reference Books:

1. Peterson, M. B., Winer, W.O., "Wear Control Handbook," ASME, NY 1980.

1. Mapping of CO's with PO's and PEO's

Session 2018-2019														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	--	3	--	--	--	--	--	3	3	3	2
CO2	3	3	3	1	--	3	--	--	--	--	--	2	3	3	2
CO3	3	3	3	2	1	3	--	--	--	--	--	3	3	3	2
CO4	3	2	3	2	1	3	1	--	--	--	--	2	3	3	2

Session 2017-2018															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	--	3	--	--	--	--	--	3	2	3	2
CO2	3	3	3	1	--	3	--	--	--	--	--	2	3	3	2
CO3	3	3	3	2	1	3	--	--	--	--	--	3	2	3	2
CO4	3	2	3	2	1	3	1	--	--	--	--	2	3	3	2
Session 2016-2017															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	--	3	--	--	--	--	--	2	2	3	2
CO2	3	3	3	1	--	3	--	--	--	--	--	2	3	3	2
CO3	3	3	3	2	1	3	--	--	--	--	--	3	2	3	2
CO4	3	2	3	2	1	3	1	--	--	--	--	2	3	3	2

Appendix A

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

1. Mechanical engineering graduates will be able to function in the area of design, modeling, simulation and analysis to realize physical systems /processes by creating knowledge base and facilities.

2. Mechanical Engineering Graduates will be able to apply knowledge of materials, testing and advanced manufacturing to Realize Physical Systems /Processes leading to Research and Consultancy Capabilities.

3. Mechanical Engineering Graduates will imbibe holistic approach for lifelong learning to achieve, deliver and occupy positions of excellence in their chosen areas.