

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (MACHINE DESIGN) (09)

MACHINE TOOL DESIGN

SUBJECT CODE: 2720903

SEMESTER: II

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: To make the students understand the concepts & broad principles of machine tool design, regulation of speed and speed regulation, design of machine tool structure, dynamics of machine tools.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
					ESE	OEP	PA	RP		
4	0	2 [#]	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.	04	5%
2	Regulation of Speed and Feed Rates: Aim of Speed and Feed Regulation, Layout of Speed Change Gears, Saw Diagrams for Arithmetic Progression, Geometric Progression, Harmonic Progression and Logarithmic Progression of spindle speeds for Mechanical Stepped Drives for Machine Tools. Establishment of Gear Ratios, Layout of the Intermediate Reduction Gears, Calculation of Transmission Ratios, Pulley Diameter, Gear Wheel Diameters and Number of Teeth. Ray Diagram. Speed Diagram. Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.	11	15%
3	Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength Design for Rigidity, Materials for Machine Tool Structures, Machine Tool , Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.	10	20%
4	Design of Guideways, Power Screws and Spindles: Functions and Types of Guide ways, Design of Guide ways, Design of Aerostatic, Slide ways, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Power Screws.	10	20%
5	Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on, Machining Accuracy, Design of Spindles, Antifriction Bearings.	07	15%

6	Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness, Stability Analysis, Machine Tool Chatter, Damping Characteristics, Damping Methods.	07	15%
7	Control Systems in Machine Tools: Machine tool control systems, Control Systems for Speed and Feed Changing, Adaptive Control Systems.	06	10%

Reference Books:

1. Machine Tool Design and Numerical Control, N K Mehta, McGraw-Hill
2. CMTI Machine Tool Design Handbook, McGraw-Hill
3. Fundamentals of Metal Machining and Machine Tools, G A Knight, G. Boothroyd, CRC Press.
4. Machine Tool Design, S.K. Basu, Oxford and IBH Publishing.
5. Machine tool design by Sen and Bhattacharya , CBS Publications

Course Outcome:

1. Design and analyse kinematic motions in a machine tool.
2. Evaluate strategies for critical mechanical components of a machine tool based on design principles.
3. Design and analyze systems used for achieving required speeds and feeds.
4. Select Slide ways, spindles and lead screws for reducing friction and achieving high product accuracy.
5. Select appropriate quality tests to be performed on the machine tool as a part of quality assurance during machining.

List of Experiments:

1. Structural diagram of a speed gear box
2. Design of a gear box
3. Evaluate machine tool with all geared headstock and Norton gear box.
4. Evaluation of machine tool slideways
5. Design evaluation of machine tool housings, columns and tables
6. Design evaluation of spindle of general purpose and high speed machine tools

Design based Problems (DP)/Open Ended Problem:

1. Design a machine tool for given capacity and capability.

Major Equipment:

1. Design Databook.
2. Computer

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website