

Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech.	Machining of Hard Materials	MEM 522	SM+MT+ET 25+25+50
Semester	Credits	L-T-P	Exam.
II	3	3-0-0	3 Hours

Unit - I

Definitions and Industrial Applications: Introduction: Definition of Hard Machining; Advantages and Limitations; Short Critical Analysis of the Research on Hard Machining; Factors Distinguishing Hard Machining; Cutting Force Reduction with the Cutting Speed; Great Axial (Thrust) Components of the Cutting Force; Great Power Spent in the Formation of New Surfaces; Need for Rigid Machining Systems; Basic Hard-machining Operations; Hard Turning; Hard Boring and Reaming; Hard Milling; Hard Broaching; Hard-gear-manufacturing Operations; Skiving; Hard Machining with a Rotating Cutting Edge. **(08 Hours)**

Unit - II

Advanced Cutting Tools: Materials for Cutting-tool; High-speed Steel; Sintered Carbide (Hardmetal); Ceramics; Extra-hard Materials; Coatings - Historical Introduction to Physical Vapour Deposition Coatings; Industrial Evolution of Different Compositions; Current Trends in Coatings for Hard Machining; Coating Selection and Optimization for Hard Machining; Tool Wear; Tool Wear in Turning; Tool Wear in Milling; Tool Life; Cutting Fluids; Tool Geometry; End milling Tools; The Rake and Clearance Angles; Position Angle; Milling Tools for Several Applications; Hard Machining for Mould and Dies; Ball-end milling for Sculptured Surfaces; Five-axis Ball-end milling; Tool holders and Tool Clamping Systems; Tool holders for Turning Operations; Tool holders for Milling Operations; Tool-Tool holder Clamping Systems; New Techniques for Hard Machining; High-feed Milling; Plunge Milling; Turn Milling and Spinning Tool; Trochoidal Milling; Tools for Multitask Machining; Conclusions, the Future of Tools for Hard Machining.

(09 Hours)

Unit - III

Mechanics of Cutting and Chip Formation: Mechanics of Hard Machining; Cutting Tools for Hard Machining; Mechanical Models of Hard Machining; Cutting Forces; Cutting Energy; Influence of Supply of Minimum Quantity of Lubricant on Mechanical Behaviour of Hard Machining ; Finite-element Modelling of Mechanical Loads; Chip Formation in Hard Machining; Criteria for Crack Initiation and Propagation; Criteria for Shear Instability; Mechanisms of Chip Formation; Chip Morphology in Typical Machining Operations; Material Side Flow Effect; Finite-element-based Modelling of Chip Formation. **(08 Hours)**

Unit - IV

Surface Integrity: Geometric Irregularities; Surface Finish; Dimensional and Geometric Deviations; Surface Alterations- Microstructural Alterations; Hardness Alterations; Residual-stress Distribution; Fatigue Strength; Conclusion. **(06 Hours)**

Unit - V

Finite Element Modeling and Simulation: Introduction; Finite-element Modeling; Commercial Software; State of the Art in Finite-element Models of Hard Turning; Finite-element Modeling of Hard Turning; Two-dimensional Finite-element Analysis of Hard Turning; Two-dimensional Finite-element Analysis of Hard Turning: Results and Discussion; Three-dimensional Finite-element Analysis of Hard Turning; Three-dimensional Finite-element Analysis of Hard Turning: Results and Discussion; Conclusions. **(07 Hours)**

Unit - VI

Computational Methods and Optimization: Introduction; Computational Tools for Hard-machining Modelling; Hard-machining Modelling Purposes; Conventional Computational Tools; Intelligent Techniques; Optimization of Hard Machining; Importance of Hard-machining Optimization; Problem Definition - Objective Function - Decision Variables -Constraints -Optimization Techniques; Case Study; Case Description; Statistical Modelling; Neural-network-based Modelling; Multi-objective Optimization; Future Trends. **(07 Hours)**

Recommended Books:

1. Machining of Hard Materials, J Paulo Davim; Springer 2011.
2. High Speed Machining; Bert P. Erdel; Society of Manufacturing Engineers; Technology & Engineering; 2003.