Course Material

Course Title	NON-TRADITIONAL MACHINING PROCESSES	Credits	L T P C
Course Code			3 0 0 3
Course Category	PEC-IV		
Name of the Unit	Introduction - Non-Traditional Machining Processes		
Name of the Topic :	Need and classification of NTMP		
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- Objectives: To develop ideas on non-traditional machining

1. Outcomes: **Upon successful completion, the student should be able to understand the basic mechanism of different NTMP.**

2. Pre-requisites: **To have a basic knowledge of Traditional Machining Processes**

Why metal removal process is costly?

a) more energy is required
b) some of the material is wasted
c) **both more energy is required and some of the material is wasted**
d) none of the mentioned

In which machining process, removed metal is negligible?
a) **surface finishing**
b) metal removal
c) none of the mentioned
d) both surface finishing and metal removal

Dimension accuracy is not affected in metal removal process?
a) true
b) **false**

Which of the following process is not grouped under metal removal process?
a) boring
b) milling
c) **tumbling**
d) rolling
5. Which of the following is not groped under the surface finishing process?
a) **sawing**

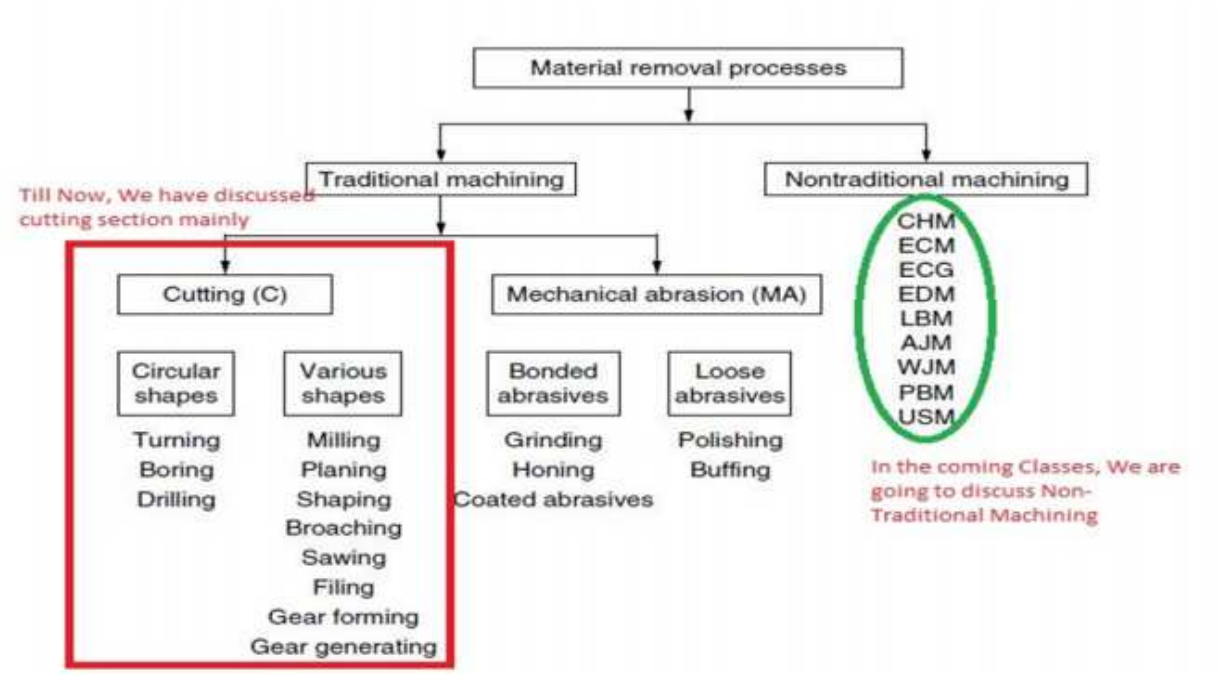
b) tapping
c) buffing
d) polishing
6. Metal removal process gives poor contour on the compound.
a) true
b) **false**
7. In how many groups, metal removal process can be classified?
a) 2
b) **3**
c) 4
d) 5
8. In which type of metal removal process, grinding is included?
a) conventional machining
b**) abrasive process**
c) non-traditional machining
d) none of the mentioned
9. _____ metal removal process includes milling.
a) **conventional machining**
b) abrasive process
c) non-traditional machining
d) none of the mentioned
10. In which type of metal removal process, thermal energy is included?
a) conventional machining
b) abrasive process
c) **non-traditional machining**
d) none of the mentioned

3. Need for NTMP

- Increased workpiece hardness:
- decreased economic cutting speed. Hence, lower productivity. I
- Rapid improvements in the properties of materials (hardness, strength, etc.)
- Requires much superior quality of tool materials. I
- Tool material hardness should be greater than workpiece hardness
- Many Engineering materials are having much superior properties such as ultra high strength , hardness, very high temperature resistance difficult to machine by convenventional machining methods. Ex :Tungsten Carbide, Stainless Steel, Titanium and its alloys etc

- If work piece material hardness is greater than the tool material hardness. How are we going to machine such a work piece material ?

4. Classification of NTMP



5. Terminology used other than normal known scientific / engg. terms and their fundamental explanations / relations: **different Kind of Energy used in NTMP like mechanical. Thermoelectric, electrochemical and chemical**

Mechanism involved

- Mechanical: Erosion of the work material by a high velocity stream of abrasives or fluids (or both)

- Thermal: The thermal energy is applied to a very small portion of the work surface, causing that portion to be removed by fusion and/or vaporization of the material. The thermal energy is generated by conversion of electrical energy. Electrochemical: Mechanism is reverse of electroplating.
- Chemical: Most materials (metals particularly) are susceptible to chemical attack by certain acids or other etchants. In chemical machining, chemicals selectively remove material from portions of the work part, while other portions of the surface are protected by a mask

Application of NTMP

- Complex shapes
- Machining in inaccessible areas
- Low tolerances (say, 0.01 mm)
- Better surface integrity (no surface defects, etc.)
- High surface finish (Nano-level Ra value)
- Miniaturization of products (examples: landline phone & mobile, old computers & laptop, etc.)
- High MRR I High production rate while processing difficult to machine.
- Low cost of production.
- Precision and ultraprecision machining
- Requires material removal in the form of atoms and / or molecules


ELECTROCHEMICAL MACHINING
Contoured Hole and Finished by AFF Drilled In Inconel Using ECM
HOLE NORMAL TO THE WALL
Turbine Blade with cooling Holes
MALE
FEMALE
PART OF A HELICOPTER TURBINE " HOLES DRILLED BY EDM"
AFF MEDIM ACTS AS A SELF-DEFORMABLE STONE
WORK
Media
Abrasive
WORK

Test after completion

1. Non-Traditional machining is recommended when we need which of the following
   features?
   a) Complex shapes
   b) High surface quality
   c) Low-rigidity structures
   d) **All of the mentioned**

2. Non-Traditional machining can also be called as _____

   a) Contact Machining
   b) **Non-contact machining**
   c) Partial contact machining
   d) Half contact machining

3. In which of the following industries, Non-traditional machining methods play an important role?

   a) Automobile
   b) Aerospace
   c) Medical
   d) **All of the mentioned**

4. Different classifications of Non-traditional machining based on source of energy are _____

   a) Mechanical
   b) Thermal
   c) Chemical and electro-chemical.
   d) **All of the mentioned**

5. In mechanical machining, material is removed by _____
   a) Erosion
   b) Corrosion
   c) Abrasion
   d) **Vaporization**

Conclusion

- Traditional machining is mostly based on removal of materials using tools that are harder than the materials themselves.
- New and novel materials because of their greatly improved chemical, mechanical and thermal properties are sometimes impossible to machine using traditional machining processes.
- Traditional machining methods are often ineffective in machining hard materials like ceramics and composites or machining under very tight tolerances as in micromachined components.
- The need to a avoid surface damage that often accompanies the stresses created by conventional machining.
- Acquire the knowledge on the various types of non-traditional machining techniques

Demo Videos

https://www.youtube.com/watch?v=L1D5DLWWMp8

References

Amithaba Bhattacharyya , "New Technology", The Institution of Engineers , (India) "Production Technology", HMT Bangalore, Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.
Hassan El – Hofy "Advanced machining Processes" Tata MC Graw-Hill, 2005

Answers to the assignments with full explanation

Assignment 1

1. Non-traditional abrasive machining methods include a. Ultrasonic machining and Laser beam machining b. Abrasive jet machining but not water jet machining c. Ultrasonic machining and Electrical discharge machining d. None of the others

2. Conventional or traditional machining methods include a. Milling b. Casting c. Electrical discharge machining d. None of the others

3. One of the advantages of non-traditional machining over traditional or conventional machining is that a. Instead of being cut, the workpiece is deformed into required shape b. Instead of being cut, the workpiece is cast into required shape c. The machining forces in most of the non-traditional machining methods is much lower than those in conventional machining methods d. None of the others

4. In ultrasonic machining, abrasive grits of the following material is used frequently for machining purpose a. Iron filings b. CdTe (Cadmium Telluride) c. B4C (Boron carbide) d. None of the others

5. It is intended to machine a hole in a glass part to a depth of 7.5 mm by USM. Halfway down, the abrasive grits are exhausted. New abrasives are supplied, but they are 20 percent larger in size. The percentage reduction or increase in total machining time for the hole is nearest to a. Increase by 20 percent b. Decrease by 15 percent c. Decrease by 8.33 percent d. Increase by 12 percent e. None of the others.