



DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE & Affiliated to Anna University, Chennai)

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P23CCT22 - FINITE ELEMENT METHODS IN MECHANICAL

DESIGN

Syllabus:

UNIT I SURFACE TREATMENT	No. of Periods: 9
Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.	
UNIT II NON-TRADITIONAL MACHINING	No. of Periods: 9
Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM	
UNIT III LASER BEAM MACHINING	No. of Periods: 9
Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.	
UNIT IV PROCESSING OF CERAMICS	No. of Periods: 9
Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application , finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites	
UNIT V FABRICATION OF MICROELECTRONIC DEVICES	No. of Periods: 9
Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining	

Objective:

1. To analyze and determine material fabrication processes.
2. To use laboratory instrument doing routine metrological measurements
3. To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc
5. To recognize engine machine tool requirements and be selective in the choice of tools.
6. To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
8. 6. To identify with numerical control machining and computer programming

Text Book:

- T1.** Boothroyd,G,1997 Design for Assembly Automation and Product Design. New York, Marcel Dekker
- T2.** Boothroyd, G, Hartz and Nike, Product Design for Manufacture, MarcelDekker, 2nd Edition 2002.
- T3.** Bralla, Design for Manufacture handbook, McGrawhill,1999

Reference Book:

1. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
2. Fixel, J. Design for the Environment McGrawHill.1996
3. Graede IT. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. ReasonPub.,1996.
4. Harry Peck, Designing for manufacture,Pitman–1973
5. Kevin Otto and Kristin Wood, Product Design. Pearson Publication, (Fourth Impression) 2009.

UNIT I – SURFACE TREATMENT

10 Short Questions (with Answers)

1. **What is surface treatment?**
Improving surface properties like wear resistance and corrosion resistance.
2. **Why is cleaning important before coating?**
Removes contaminants to ensure proper adhesion.
3. **Name two cleaning methods.**
Mechanical cleaning and chemical cleaning.
4. **What is electroforming?**
Metal deposition using electrolysis on a mold.
5. **Define CVD.**
A coating process where material is deposited from vapor through chemical reactions.
6. **What is thermal spraying?**
Spraying molten material onto a surface to form coating.
7. **What is ion implantation?**
Bombarding surface with ions to modify properties.
8. **What is cladding?**
Bonding a layer of metal over another.
9. **What is diffusion coating?**
Coating formed by diffusion of atoms into base material.
10. **What factors affect coating economics?**
Material cost, process cost, durability, maintenance.

10 Long Questions

1. Explain various **cleaning methods** in surface treatment.

2. Discuss **types of surface coatings** with examples.
 3. Explain the **CVD process with diagram and applications**.
 4. Describe **thermal spraying process and its advantages**.
 5. Explain **electroforming process in detail**.
 6. Discuss **ion implantation process and applications**.
 7. Explain **diffusion coating methods**.
 8. Write in detail about **diamond coating and cladding**.
 9. Compare **ceramic and organic coatings**.
 10. Discuss the **economics of coating processes**.
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UNIT II – NON-TRADITIONAL MACHINING

10 Short Questions (with Answers)

1. **What is non-traditional machining?**
Machining without direct mechanical contact.
 2. **Why is NTM required?**
To machine hard, brittle, and complex materials.
 3. **What is AJM?**
Machining using high-speed abrasive particles.
 4. **What is USM?**
Machining using ultrasonic vibrations.
 5. **Define WJM.**
Machining using high-pressure water jet.
 6. **What is EDM?**
Material removal using electrical sparks.
 7. **What is WEDM?**
EDM using a wire electrode.
 8. **What is MRR?**
Material Removal Rate.
 9. **What affects MRR in EDM?**
Current, voltage, pulse duration.
 10. **What is tool wear in EDM?**
Erosion of tool due to sparks.
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10 Long Questions

1. Explain **AJM process with parametric analysis**.
2. Describe **USM mechanism and models**.
3. Explain **WJM principle, equipment, and applications**.
4. Discuss **EDM process and equipment**.
5. Derive **MRR in EDM**.
6. Explain **R-C circuit in EDM generators**.
7. Compare **AJM and USM**.
8. Discuss **process capabilities of NTM methods**.
9. Explain **WEDM process with advantages**.
10. Compare **EDM and WEDM**.

UNIT III – ADVANCED MACHINING PROCESSES

10 Short Questions (with Answers)

1. **What is LBM?**
Machining using laser beam.
2. **What is PAM?**
Machining using plasma arc.
3. **What is EBM?**
Machining using electron beam.
4. **What is ECM?**
Machining using electrochemical dissolution.
5. **What is MRR?**
Rate of material removal.
6. **What is plasma?**
Ionized gas with high temperature.
7. **What is vacuum required in EBM?**
To prevent electron scattering.
8. **What is tool wear in ECM?**
No tool wear occurs.
9. **What affects LBM performance?**
Power density and focus.
10. **What is electrolyte in ECM?**
Conductive fluid used for material removal.

10 Long Questions

1. Explain **LBM process with diagram and applications.**
2. Discuss **PAM process and parameters.**
3. Explain **EBM process and equipment.**
4. Describe **ECM process and working principle.**
5. Derive **MRR in ECM.**
6. Compare **LBM, EBM, and PAM.**
7. Explain **process parameters affecting LBM.**
8. Discuss **advantages and limitations of ECM.**
9. Explain **performance characteristics of PAM.**
10. Compare **thermal and electrochemical machining processes.**

UNIT IV – PROCESSING OF CERAMICS & COMPOSITES

Short Questions (with Answers)

1. **What are ceramics?**
Inorganic, non-metallic materials.
2. **Name a property of ceramics.**
High hardness.

3. **What is sintering?**
Heating powder below melting point to bond particles.
 4. **What is powder preparation?**
Producing fine particles for shaping.
 5. **What is compaction?**
Pressing powder into shape.
 6. **What are composites?**
Materials made from two or more constituents.
 7. **What is PMC?**
Polymer Matrix Composite.
 8. **What is MMC?**
Metal Matrix Composite.
 9. **What is CMC?**
Ceramic Matrix Composite.
 10. **What is drying in ceramics?**
Removing moisture before sintering.
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10 Long Questions

1. Explain **processing steps of ceramics**.
2. Discuss **powder preparation methods**.
3. Explain **sintering process and mechanisms**.
4. Describe **hot compaction process**.
5. Discuss **applications of ceramics**.
6. Explain **processing of composite materials**.
7. Compare **PMC, MMC, and CMC**.
8. Explain **fiber reinforced composites**.
9. Discuss **finishing methods of ceramics**.
10. Explain **advantages and limitations of composites**.

UNIT V – MICROELECTRONICS FABRICATION

Short Questions (with Answers)

1. **What is wafer?**
Thin slice of semiconductor material.
2. **What is lithography?**
Pattern transfer process.
3. **What is oxidation?**
Formation of oxide layer on wafer.
4. **What is PCB?**
Printed Circuit Board.
5. **What is SMT?**
Surface Mount Technology.
6. **What is yield?**
Percentage of good products.
7. **What is IC?**
Integrated Circuit.

8. **What is micromachining?**
Machining at micro scale.
 9. **What is nanotechnology?**
Technology at nanometer scale.
 10. **What is E-manufacturing?**
Use of internet in manufacturing.
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Long Questions

1. Explain **crystal growth and wafer preparation**.
2. Discuss **thin film deposition techniques**.
3. Explain **lithography process in detail**.
4. Describe **bonding and packaging methods**.
5. Discuss **PCB manufacturing process**.
6. Explain **surface mount technology (SMT)**.
7. Discuss **IC fabrication process**.
8. Explain **reliability and yield in microelectronics**.
9. Discuss **role of CAD in microelectronics**.
10. Explain **nanotechnology and micromachining applications**.