

## **Manufacturing Qualifier PhD Qualifier Exam**

<b>Reference Book:</b>	Manufacturing Processes for Engineering Materials, 6th edition, S. Kalpakjian & S. Schmid.
<b>Closed book exam:</b>	No Notes (Paper Or Digital Format) or Books Allowed
<b>Duration:</b>	3 hours

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This syllabus serves more as a general outline of the topic areas covered on the exam and should **not** be treated as a definitive, complete, topic list.

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### **Fundamentals of the Mechanical Behavior of Materials**

Structures: polycrystalline and single crystal, etc.

Characterization of mechanical properties: strength, hardness, toughness etc.

Heat treatments: quenching, tempering etc.

Properties of ferrous and nonferrous metals and alloys

### **Surfaces, Subsurface, Dimensional Characteristics, Inspection and Quality Assurance**

Surface and subsurface structure, integrity and properties,

Tribology

Surface texture, dimensional Metrology

Testing, inspection and quality assurance

### **Casting Processes**

Solidification of Metals

Casting structures and characteristic properties

Fluid flow and heat transfer

Ingot casting, continuous casting, investment and die

### **Deformation Processes**

Sheet metal processes, Forging, Rolling, Extrusion, Rod, Wire and tube drawing, swaging, peening, etc.

### **Material Removal Processes- Cutting**

Turning, milling, drilling, broaching etc.

Mechanics of chip formation and material removal

Tool Materials, tool wear, machinability, surface finish and integrity

Vibration and chatter

### **Material Removal Processes-Abrasive**

Grinding, lapping, polishing, honing, etc.

Abrasives, mechanics of grinding, finishes obtainable and SSD

### **Material Removal Processes-other/non traditional**

Chemical, electrical and high energy-beams based processes

Removal mechanisms and applications

## **Processing of Polymers and Reinforced Plastics**

General properties, characteristics, and applications of thermoplastics, thermosets and reinforced plastics (composites),.

Suitable processing technologies

## **Processing of Powder Metals and Ceramics**

### **Joining and Fastening Processes**

Soldering, brazing, welding, riveting, etc.

## **IC manufacture**

Key materials and their properties and fabrication

Structure of ICs

Basic fabrication steps (deposition, removal, patterning etc.)

## **Manufacturing Automation and Integrated Manufacturing**

Numerical Control

Adaptive control

Group technology and cellular manufacturing

Flexible manufacturing systems

## **Additive Manufacturing**

Polymer AM process fundamentals: Stereolithography, polyjet, fused deposition modeling, selective laser sintering, binder jet

Metal AM process fundamentals: Laser/electron beam powder bed fusion, binder jet, powder- and wire-fed directed energy deposition, wire-arc AM

Design for AM

Process and material defects

Tradeoffs between AM and conventional processes