



## Approved in 44<sup>th</sup> BoA Meeting (24-11-2021)

<b>Course number</b>	: ME 520
<b>Course Name</b>	: Microwave based Manufacturing Processes
<b>Credit distribution</b>	: 3-0-0-3
<b>Prerequisites</b>	: None
<b>Intended for</b>	: UG/PG
<b>Mutual Exclusion</b>	: None

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### **1. Preamble:**

Introduce the reader to the use of microwaves in manufacturing. The basic interactions will be described, along with the basic equipment required to process materials. Examples of successful applications will be presented, as will an evaluation of the conditions or parameters needed for the successful application of microwaves to the processing of materials. Provide an assessment of the state-of-the-art of microwave processing as an industrial technology. Identify gaps, limitations, or weaknesses in the understanding of the use of microwaves in manufacturing, and suggest research and development to address these issues

### **2. Course Modules with Quantitative Lecture Hours:**

#### **Module-1: Introduction and Fundamentals (6 hours)**

Perspective, Material Interactions, Microwave generators, wave propagation, waveguide modes, microwave applicators, Safety aspects in Microwave Material Processing

#### **Module-2: Science and Modelling of microwave material interaction (10 hours)**

Power absorption model and Maxwell's equations, dielectric properties, microwave penetration and power absorbed, material behavior during microwave interaction, heating mechanisms in microwave processing of materials: non-magnetic materials (conduction loss), magnetic materials (hysteresis loss, eddy current loss and residual loss), microwave absorption in characteristically different materials: insulators, metallic powders and bulk metals, composite materials

#### **Module-3: Manufacturing Processes for Polymers (10 hours)**

Polymers, Polymer composites, microwave assisted compression moulding (MACM), vacuum assisted resin infusion microwave curing (VARIMC), mechanism of processing, roles of process parameters, case studies, lab demonstration

#### **Module-4: Manufacturing Processes for Metals and their composites (8 hours)**

Surface Engineering, Physics of Microwave Glazing and Cladding. Concept of skin depth, Role of process parameters, advantages and limitations, case studies, lab demonstration

### Module-5: Manufacturing Processes for Ceramics

(8 hours)

Microwave sintering of ceramics, process parameters in sintering, microwave drilling of ceramics, process parameters in microwave drilling, case studies, lab demonstration

#### 3. Textbooks

- Metaxas, AC and, and Roger J. Meredith. Industrial microwave heating. No. 4. IET, 1983.
- Pozar, D.M. Microwave engineering. John Wiley & Sons, 2011.

#### 4. References:

- Dieter, G.E. and David J.B., Mechanical metallurgy. Vol. 3. New York: McGraw-hill, 1986.
- DeGarmo, E.P., J. Temple Black, Ronald A. Kohser, and Barney E. Klamecki. Materials and process in manufacturing. Upper Saddle River: Prentice Hall, 1997.
- Chawla, K.K. Composite materials: science and engineering. Springer Science & Business Media, 2012.

#### 5. Similarity content declaration with existing courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	NIL	NIL	NIL

**Justification for new course proposal if cumulative similarity content is > 30%:**

Indian  
Institute of  
Technology  
Mandi