Course Type	Course Code	Nameof Course	L	T	P	Credit
DE	NFMD509	Microwave Processing of Minerals and Fuels	3	0	0	3

Prerequisites: Knowledge of vector, differential, and integral calculus, basics of electrical and electronics engineering, organic chemistry, fundamentals of physics.

CourseObjective
The course will introduce the students to the • Course is a starting point for post-graduates and researchers to learn microwave chemistry, applications in mineral processing, • microwave-driven heterogeneous catalytic chemistry, and other unique features of microwaves.
LearningOutcomes
Upon successful completion of this course, students will develop: ● Acomprehensive understanding of the fundamentals of microwave heating. ● Ability to apply microwave heating in mineral and solid waste processing, gas, and liquid chemistry

Unit No.	TopicstobeCovered	Hours	LearningOutcome
1	**Introduction**: Process intensification- A general concept, Electromagnetic radiation, Microwaves, and applications	4	Overview of the process intensification concept, microwaves, generation mechanism, and applications in food and Other industries
2	**Fundamentals of microwave heating:** Mechanisms, microwave specific effects in single phase and multiphase systems, Transport phenomena and thermal property under microwave irradiation, Managing microwave-induced effects such as hotspots and plasma.	9	Familiarity with different heating mechanisms in microwave heating, hotspot generation, stabilization of hotspot formation in the multiphase system, introductory thermal balances, and transport phenomena
3	**Applications in mineral processing:** Heating of ores and minerals, Applications in sorting, drying, and grinding of minerals, Microwave-induced physio-chemical changes, Microwave-assisted reduction	9	Understanding the role of microwave heating in mineral processing from sorting to grinding, changes in the physical and chemical properties of minerals by microwaves, and microwave-assisted reduction of different minerals
4	**Applications in gas and liquid phase chemistry:** Bulk and nano-structured metals in a microwave field, Microwave- assisted gas, and liquid phase chemistry. Hybrid mode of heating for high-process efficiency	8	Knowledge hotspot effect in heterogeneous materials, microwave applications in batch and continuous flow chemistry. Understanding the importance of the combination of different modes of Heating for efficient processing

5	**Applications in solid waste processing**: Coal conversion through microwave heating, Microwave-assisted algal and lignocellulosic biomass conversion, Microwave-assisted polymer synthesis and conversion. Microwave-assisted gasification	8	Knowledge of existing literature on the coal, biomass, plastics, and other waste processing using microwave heating, the role of microwave heating in enhanced reaction rates and energy efficiency
6	Emerging trends and challenges, Special topics in microwave heating applications.	4	Understanding the emerging research in microwave heating applications.
	Total	**42**	

Text Book:

1. W. Cao, *The Development and Application of Microwave Heating*, Intech open- 2012

ReferenceBooks:

2. S.Horikoshi,R.F.Schiffmann,J.Fukushima,N.Serpone.*MicrowaveChemicalandMaterial Processing-A Tutorial*, Springer Nature Singapore Pte Ltd. 2018
3. S.Horikoshi,N.Serpone.*MicrowavesinCatalysis─MethodologyandApplications*.Wiley-VCH,2016.
4. Z.Fang,R.L.SmithJr,Z.Qi,Production*ofBiofuelsandChemicalswithMicrowave*.Springer,2015.
5. R. Hoogenboom, U.S .Schubert, F. Wiesbrock, *Microwave-assisted Polymer Synthesis* ,Springer,2016.