

**DEPARTMENT OF METALLURGICAL AND MATERIALS ENGG.
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN – PART I			
Course Title	Advanced Solidification Processing		
Course Code	MTHO11	No. of Credits	3
Department	MME	Faculty	Dr. VIVEKANANDHAN P
Pre-requisites Course Code	Phase Transformation and Heat Treatment	Section (if, applicable)	--
Course Coordinator(s) (if, applicable)	Dr S KUMARAN	Department	MME
Other Course Teacher(s)/Tutor(s) E-mail	--	Telephone No.	9865392902 Intercom :
Course Type	<input type="checkbox"/> Core course <input checked="" type="checkbox"/> Elective course		
Syllabus (approved in BoS)			
<p>Introduction and important thermodynamic functions: Laws of thermodynamics-enthalpy, heat capacity, applications of first law to open and closed systems including chemical reactions; entropy, free energy and their interrelationships.</p> <p>Thermodynamics of solidification; Nucleation and growth; Homogeneous and Hetrogenous solidification Pure metal solidification, Alloy Solidification, Constitutional undercooling, Mullins-Sekerka instability; Single phase solidification: Cellular and Dendritic growth; Multiphase solidification: eutectic, peritectic and monotectic; Modelling of solidification.</p> <p>Metallic glasses and Amorphous alloy solidification – Basic concepts and definitions; Glass forming ability; Experimental characterisation of struture of BMG and amorphous alloy; Comparison of the structures of metallic glasses and amorphous alloy; Properties and applications of metallic glasses. Crystal growth in Vapours; CVD process; Epitaxial growth and Whisker growth; Mechanical restrictions on thin films.</p> <p>Evolution of Phase diagrams -phase rule, free-energy-composition diagrams, solidus-liquidus lines, retrograde solidus; determination of activity and other thermodynamic parameters from phase diagrams,; thermodynamic analysis of ternary and multi component systems,interaction parameters.</p> <p>Principles of applications- principles of applications to molten slags and silicate melts; electrochemical methods and applications, aqueous systems; Interfaces-energy,shape, segregation at external and internal interfaces; solid electrolytes; Effect of high pressure on phase transformations; Point imperfections in crystalline solids.</p>			

COURSE OBJECTIVES	
<ul style="list-style-type: none"> • A study of important thermodynamic functions related to solidification of metal in molds involving the characteristics of liquid-solid phase transformations, laws of thermodynamics and other functions. • To analyze solidification processing of engineering materials in terms of the phase equilibrium, transport, and interface phenomena governing microstructure development in liquid-solid transformations. • To apply these principles to industrial solidification processes, with emphasis on microstructural capabilities and limitations. Asses the surface testing methods and comprehend the degradation properties. 	
COURSE OUTCOMES (CO)	
Course Outcomes	Aligned Programme Outcomes (PO)
Thermodynamics of solidification processes and alloys.	[1, 2]
Thermodynamic modelling of solid-liquid phase change and solutions	[1, 2]
Kinetics of solidification such as nucleation, growth, and constitutional super cooling	[1, 2, 8, 11]
Multiphase solidification.	[5, 8, 11]
Thermodynamic analysis of ternary and multicomponent system	[2, 11]

COURSE PLAN – PART II
COURSE OVERVIEW
<p>Introduction and important thermodynamic functions: Laws of thermodynamics.</p> <p>Thermodynamics of solidification; Nucleation and growth; Pure metal solidification, Alloy Solidification, Mullins-Sekerka instability; Single phase solidification: Modelling of solidification.</p> <p>Metallaic glasses and Amorphous alloy solidification – Basic concepts and definitions; Glass forming ability; Vapour solidification</p> <p>Evolution of Phase diagrams - determination of activity and other thermodynamic parameters from phase diagrams, thermodynamic analysis of ternary and multi component systems, interaction parameters.</p> <p>Principles of applications- principles of applications to molten slags and silicate melts; electrochemical methods and applications, Effect of high pressure on phase transformations; Point imperfections in crystalline solids.</p>

COURSE TEACHING AND LEARNING ACTIVITIES				
S.No.	Week/Contact Hours	Topic	Mode of Delivery	
1	1 st to 2 nd week, September	Introduction and important thermodynamic functions: Laws of thermodynamics.	Online mode and Course material	
2	3 rd Week September to 1st week October	Thermodynamics of solidification- Pure Metal and alloy solidification. Mullins-Sekerka instability; Single phase solidification: Modelling of solidification.	Online mode and Course material	
3	2 nd week to 4 th week October	Metallurgical glasses and Amorphous alloy solidification; Experimental characterisation of structure of BMG and amorphous alloy; Properties and applications of metallic glasses. Crystal growth in Vapours.	Online mode and Course material	
4	1 st week to 2 nd week November	Evolution of Phase diagrams - determination of activity and other thermodynamic parameters from phase diagrams, thermodynamic analysis	Online mode and Course material	
5	3 rd week to 4 th week November	Principles of applications, Effect of high pressure on phase transformations; Point imperfections in crystalline solids.	Online mode and Course material	
COURSE ASSESSMENT METHODS (shall range from 4 to 6)				
S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment - I	2 nd Week October	1 hr	30
2	Assignment – I	2 nd week November	1 hr	20
3	Term Paper / Seminar	4 th week November	1 hr	20
CPA	Compensation Assessment	4 th week November	1hr	30 /20
5	Final Assessment	2 nd week December	2hrs	30
COURSE EXIT SURVEY Student's Feedback				

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

MODE OF CORRESPONDENCE (email/ phone etc) : communication through class reps and E-mail
ATTENDANCE : Minimum attendance 75%. If less than 75% attendance, He /She will be prevented from writing the end semester and re-do the course. Students secured F grade should re-appear the examination as per Institute norms

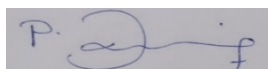
COMPENSATION ASSESSMENT : If any students miss the test in genuine ground (production of certificate or letter from the authorized personnel), She / he will be permitted for compensation assessment

ACADEMIC HONESTY & PLAGIARISM : If any students involve in malpractice in test or final examination, She /he will be prevented from writing the final assessment and awarded F grade and re-do the course (as per Instt. Regulations)

ADDITIONAL INFORMATION

Nil

FOR APPROVAL



Dr. P. Vivekanandhan
Course Faculty _____



Dr. K. Sivaprasad
CC-Chairperson _____

22-10-2020



Prof. S. Kumaran
HOD _____