No	Information on subject (2019-2020)	
1	Unit name	Metallurgical Thermodynamic I
2	Code	Met-41031
3	Classification	Engineering subject
4	Credit value	2.5
5	Semester/Year offered	1/4
6	Pre-requisite	Met-32021 Physical chemistry of metals
7	Mode of delivery	Lecture, Tutorial and Assignment
8	Assessment system and breakdown of marks	
	Test	30%
	Mid-term/ final examination	70%
9	Academic staff teaching unit	
10	Course outcome of unit; In this course, students will be able a. to explain thermochemistry and its application in metallurgy b. to define the thermodynamic method c. to explain the laws of thermodynamics d. to solve the problems in metallurgical thermodynamics	
11	Synopsis of unit; The course covers about the metallurgical thermodynamics. This course contains the first and second law of thermodynamics (enthalpy, entropy and free energy), the Clausis-Clapeyron equation and fugacity, activity and equilibrium constant. Thermodynamics and kinetics are important core subjects in metallurgy.	
12	Topic 1 The first law of thermodynamics ▪ Introduction ▪ Heat Content or Enthalpy ▪ Heat Capacity ▪ Thermochemistry and its application in Metallurgy	

- Hess's Law
- Variation of Enthalpy Change with Temperature
- Maximum Reaction Temperature: Flame Temperature

2 The second law of thermodynamics: Entropy and Free energy

- Introduction
- Entropy
- Entropy Change for a Reversible Process
- Entropy Change for an Irreversible Process
- Entropy Change for a Chemical Reaction
- Variation of Entropy Change with Temperature
- Criterion of Spontaneity based on Entropy
- Free Energy
- Criterion of Spontaneity based on Free Energy
- Calculation of Free Energy Change
- Calculation of ΔG° at High Temperature
- Gibbs Free Energy and Thermodynamics Functions
- Gibbs-Helmholtz Equation

3 The Clausis-Clapeyron Equation

- Introduction
- Application of Clausis-Clapeyron Equation to Phase Change
- Liquid Vapour (Vaporization) Equilibria
- Solid-Vapour (Sublimation) Equilibria
- Solid-Liquid (Fusion) Equilibria
- Solid-Solid Equilibria
- Trouton's Rule

4 Fugacity, Activity and Equilibrium constant

- Introduction
- Fugacity

	▪ Activity ▪ Equilibrium Constant ▪ Van't Hoff Equation ▪ Integration of Van't Hoff Equation
13	Main reference; Problems in Metallurgical Thermodynamics and Kinetics By G.S. UPADHYAYA B.Sc, M.Sc, Ph.D, F.I.M Department of Metallurgical Engineering, Indian Institute of Technology, Kanpur (India) AND K.R.DUBF B.Sc, M.Sc, Ph.D, G.Eng. M.I.M Department of Metallurgical Engineering, Indian Institute of Technology, Kanpur (India)
14	Addition Reading Material;