19ME3303-MATERIAL SCIENCE AND ENGINEERING

Offering Branches	ME		
Course Category:	Programme Core	**Credits**	3
Course Type:	Theory	**Lecture-Tutorial-Practical:**	3-0-0
Prerequisites:	19BS1204-Applied Physics 19BS1102-Chemistry of Materials	**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Identify the properties of metals with respect to crystal structure and grain size
CO2	Interpret the phase diagrams of materials and describe the concept of Strengthening Mechanisms
CO3	Describe the concept of heat treatment and Case hardening of steels
CO4	Distinguish different types of steels, Tool and cast irons
CO5	Explain Properties and Applications of Nonferrous alloys and composite materials

Course Content

UNIT-1	**Materials Science and Engineering**: Introduction, Classification of Materials, Mechanical Properties of Materials, Case Study: Delhi Iron Pillar and Wootz Steel. **CRYSTALLOGRAPHY:** Unit cell, Classification, Bravais Lattices, Packing factor and coordination number in cubic systems,Miller Indices for Cubic systems, imperfections in solids: Point, Line and Volume, Slip and Twinning.Determination of grain size.	**CO1**
UNIT-2	**Mechanism of Crystallization:** Nuclei Formation, crystal growth **CONSTITUTION OF ALLOYS:** Types of solid solution- substitutional and interstitial solid solutions, Hume Rothery rules for solid solution. **PHASE DIAGRAMS:** Phase, Phase equilibrium, Gibbs Phase rule – one component system, two component system, Construction of binary phase diagram, Isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe_3C equilibrium diagram, Lever rule: Isomorphous. **STRENGTHENING MECHANISMS:** Grain Refinement, Strain hardening, solid solution strengthening, Dispersion strengthening.	**CO2**
UNIT-3	**HEAT TREATMENT PROCESSES:** stages of heat treatment, TTT and CCT diagram of eutectoid steel, Annealing: Full Annealing, Spherodizing, Stress Relief Annealing, Process Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering. **CASE HARDENING:**Flame hardening, Induction hardening, Carburizing, Cyaniding, Nitriding.	**CO3**
UNIT-4	**STEELS:STAINLESS STEELS**: Ferritic, Martensitic, Austenitic, **Tool steels:** Water Hardened, Shock Resistance, Cold-Work, Hot-Work Tool Steels, Applications and Properties. **CAST IRONS:** Structure, Properties and Applications of White Cast iron, Malleable Cast iron, Grey cast iron, Spheroidal graphite cast iron.	**CO4**

UNIT-5	**NON-FERROUS METALS AND ALLOYS:** Properties and Applications of Copper and its alloys: Cartridge Brass, Cupronickel, Gun Metal, Naval Brass, Bell Metal, Speculum metal, Phosphor Bronze, **ALUMINIUM AND ITS ALLOYS:**Duralumin, Hindalium, Magnalium, Aluminium–Scandium, **TITANIUM AND ITS ALLOYS:**α and Nearα, β Alloys, α-β Alloys. **COMPOSITE MATERIALS:** Classification of composites, particle reinforced materials, fiber reinforced composite materials and metal matrix composites.	**CO5**

Learning Resources	
Text Books:	1. R. Balasubramaniam, Callister's, Material Science and Engineering, 2/e,WileyIndia,2014. 2. S.H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGrawHill,1997.
Reference Books:	1. Donald R. Askeland, "Essential of Materials Science and Engineering", Thomson Learning, 5th Edition – 2006 2. V.D. Kodgire, "Material Science and Metallurgy", Everest Publishing House - 25th Edition – 2009. 3. B.K.Agarwal, "Introduction to Engineering Materials", Tata McGraw Hill-1stEdition. 4. V. Raghavan, "Material Science and Engineering",-PHI Learning - 5th Edition.
E-Resources & other digital Material:	1. http://materials.iisc.ernet.in/~wootz/heritage/WOOTZ.htm 2. http://met.iisc.ernet.in/~rangu/text.pdf 3. https://nptel.ac.in/courses/113106032/ 4. https://nptel.ac.in/courses/113107078/ 5.http://vvm.org.in/study_material/ENG%20-%20Indian%20Contributions%20to%20Science.pdf

CourseCoordinator HOD

Code No:**19ME3303**

PVP19

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
II.B. Tech – I Semester Model Paper
MATERIAL SCIENCE AND ENGINEERING
(ME)

Duration:3 Hours **Max Marks:70**

Note: 1. This question paper contains two papers Part A and B.
2.Part A is compulsory which carries 10 marks. Answer all questions in part A.
3.Part B consists of 5 units. Answer any one full question from each unit. Each question carries 12 marks and may have a, b, c as sub questions.
4.All parts of question paper must be answered in one place.

PART-A

5×2=10 Marks

		Blooms Level	CO
1.a)	Explain the reason for high corrosion resistance inthe iron pillar of Delhi	2	**CO1**
1.b)	What is meant by solid solution?	2	**CO2**
1.c)	Can you explain what is happening in Annealing?	2	**CO3**
1.d)	Give examples of the use of Austenitic Stainless Steels field.	2	**CO4**
1.e)	Write any two strategic applications of α-β Titanium alloys.	1	**CO5**

PART-B

5×12=60 Marks

			Blooms Level	CO	Max. Marks
UNIT-I					
2	a	You would like to develop an aircraft. What types of material properties would you recommend? What materials might be appropriate?	2	**CO1**	6
	b	Explain the difference between slip and twinning mechanisms	2	**CO1**	6
OR					
3	a	Write about Wootz steel "An advanced material of the ancient world" (6th century B.C).	1	CO1	6
	b	Discuss on Edge and Screw Dislocations with neat sketches	2	CO1	6
UNIT-II					
4	a	What is a solid solution? What are the conditions for forming extensive solid solubility of one element in another?	2	**CO2**	6
	b	Explain the principle of grain-sizestrengthening. Does this mechanism workat high temperatures? Explain.	2	**CO2**	6
OR					
5	a	Explain various invariant reactions in the Fe-Fe_3C system with a neat sketch.	2	**CO2**	6
	b	Can you explain how hardness increases in Non-Heat treatable alloys after strain hardening.	2	**CO2**	6
UNIT-III					
6	a	Define the term heat treatment. Illustratethe TTT diagram for 1080 steel and label its phases and highlight its significance.	2	**CO3**	6
	b	Explain the contrast between i) Annealing and Normalizing, ii) Carburizing and Nitriding.	2	**CO3**	6

OR					
7	a	Describe the following heat treatments: (a) Hardening (b) Tempering.	1	**CO3**	6
	b	Discuss on Flame hardening and Induction hardening.	2	**CO3**	6
UNIT-IV					
8	a	Examine why are stainlesssteels are stainless?and distinguish a) Ferritic b) Martensitic c)Austenitic stainless steels.	4	**CO4**	6
	b	Can you identify any difference between cast ironand steel? and explain applications of ductile cast iron.	4	**CO4**	6
OR					
9	a	Summarize the properties and applications of Cold worked and Hot Worked tool steels.	3	**CO4**	6
	b	Can you make a distinction between grey and white cast iron?	4	**CO4**	6
UNIT-V					
10	a	Explain the properties and applications of copper.	1	**CO5**	6
	b	What are the applications of Aluminium Scandium alloy?	1	**CO5**	6
OR					
11	a	Describe the biomedical applications of Titanium and its alloys.	1	**CO5**	6
	b	What is Particle-reinforced and Fiber-reinforced composite.	1	**CO5**	6

Course coordinator **HOD**