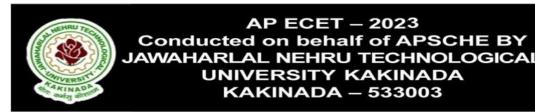


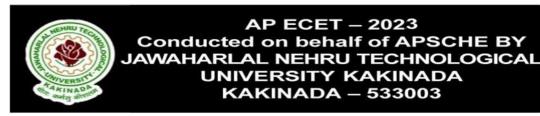
## ANNEXURE - I METALLURGICAL ENGINEERING

- **1. ELEMENTARY PRINCIPLES OF METALLURGY:** Introduction to metallurgy ores & ore dressing, Methods of ore sampling Communition Screening & Classification Minerals of commercially important metals Principles and processes of Pyro, hydro and electrometallurgy –
- **2. FUELS, REFRACTORIES AND PYROMETRY:** Classification of solid, liquid and gaseous fuels Testing and properties of important fuels-Manufacture and characteristics of Metallurgical Coke Combustion of fuels Properties, manufacture and selection of Refractories, Principles and operation of important pyrometers.
- **3. METALLURGICAL THERMODYNAMICS:** Introduction and applications of thermodynamics –First Law of thermodynamics- Thermo chemistry Second Law of thermodynamics Ellingham diagrams Fugacity, activity and equilibrium constant -Phase equilibria Solutions
- **4. PHYSICAL METALLURGY:** Structure of metals and Alloys Solidification Diffusion Binary thermal equilibrium diagrams-Iron-carbon diagram- important non- ferrous binary alloy systems Microscopic and macroscopic examination of metals and alloys.
- **5. HEAT TREATMENT TECHNOLOGY:** Heat treatment of plain carbon steels Annealing, Normalizing, Hardening and tempering of steels TTT diagrams Hardenability Grain size, Quenching media. Alloy steels & Effect of alloying elements on plain carbon steels Stainless steels, tool steels Case hardening techniques. Special heat treatment techniques such as Austempering, Martempering, sub-zero treatment Heat treatment of Nonferrous metals and alloys Age hardening Heat Treatment Furnaces and atmospheres.
- **6. FERROUS EXTRACTIVE METALLURGY:** Iron ores and preparation of iron ores Blast furnace plant and equipment blast furnace reactions irregularities and recent trends sponge iron & methods of production Ferroalloys types and applications. Steel making by Bessemer, LD, Kaldo, Open hearth and Electric furnaces –New techniques in steel making Vacuum treatment of liquid steel Ingot defects Continuous casting.
- 7. NON-FERROUS EXTRACTIVE METALLURGY: Extraction of copper Pyro and hydrometallurgical methods & refining Aluminum- Extraction, Anode effect, Refining Zinc and Lead Pyro and hydrometallurgical extraction and refining. Extraction of Magnesium by Dows and Pidgeon processes. Extraction of Titanium by Kroll's process Refining by Van Arkell's process-Extraction of Thorium and Zirconium.
- **8. MATERIAL TESTING:** Tension test. Stress- strain relationships, neckingphenomenon Ductile and brittle fracture Griffith's theory of brittle fracture Hardness tests-principles and types. Impact testing- Notched bar impact tests. Transition temperature. Fatigue, Stress cycles, S-N diagram, Factors affecting Fatigue. Creep testing creep curve, Stress rupture test. Non-destructive testing- Principles, methods and applications of liquid penetrant, Radiography, Ultrasonic Magnetic particle and Eddy current test.





- **9. MECHANICAL METALLURGY:** Plastic deformation of metals lattice defects Slip and Twinning CRSS –Strengthening mechanisms. Strain hardening Hot and Cold working Recovery, recrystallisation and grain growth. Metal forming processes-Rolling, Forging, Extrusion & Sheet metal forming processes and defects Powder metallurgy. Methods of powder production, Characterization, Compaction, Sintering and applications of Powder Metallurgy.
- **10. FOUNDRY TECHNOLOGY:** Types of foundries Basic steps in casting Patterns: Types, materials and pattern allowances, Moulding Sands properties and Testing, Moulding Processes and equipment: Sand casting, Die casting, Shell moulding, Centrifugal casting, Investment casting and CO<sub>2</sub> process-Cores: Types of Cores and properties, pouring and feeding of castings. Cast irons types Melting of Cast irons Grey, S.G and Malleable iron. Aluminium, Copper and Steel Foundry practices. Defects in Castings. Cleaning & Salvage of Castings.
- **11. WELDING TECHNOLOGY:** Basic concepts of Welding Principles and processes of various welding techniques such as Oxy-acetylene, Arc welding, Inert gas welding- TIG and MIG Special welding processes- Plasma, resistance, electro slag, electron beam, thermit and Laser. Soldering and brazing— Weldability, factors affecting weldability Heat affected Zone, Microstructure Post weld treatments —Welding defects —Inspection andtesting.





## ANNEXURE II Number of question to be set Unit wise (Total 100)

## **METALLURGICAL ENGINEERING**

UNIT NO	TOPICS	MARKS
I	ELEMENTARY PRINCIPLES OF METALLURGY	06
II	FUELS, REFRACTORIES AND PYROMETRY	05
III	METALLURGICAL THERMODYNAMICS	08
IV	PHYSICAL METALLURGY	11
V	HEAT TREATMENT TECHNOLOGY	12
VI	FERROUS EXTRACTIVE METALLURGY	12
VII	NON-FERROUS EXTRACTIVE METALLURGY	10
VIII	MATERIAL TESTING	08
IX	MECHANICAL METALLURGY	10
X	FOUNDRY TECHNOLOGY	10
XI	WELDING TECHNOLOGY	08
	Total	100

## ANNEXURE III MODEL QUESTIONS FOR METALLURGICAL ENGINEERING

1.	. Rawmaterial for production of Aluminium is	
	1)Bauxite	
	2) Cryolite	
	3) Alumina	
	4) Gibbsite	
2.	No of slip systems in FCC structure	
	1) 12	
	2) 48	
	3) 16	
	4) 03	
3.	ASTM grain size is measured by formula	
	1) $N=2^{n-1}$	
	$2)n=2^{N-1}$	
	3) $N=2^{n}-1$	
	$4)n=2^{N}-1$	
4.	In proximate analysis of coalis determined.	
	1) Hydrogen, Nitrogen, Oxygen & Carbon	
	2) Moisture, ash, Volatile matter & carbon	
	3) Hydrogen, ash, Oxygen & Carbon	
	4) Sulphure, Moisture & Carbon.	
5.	In Iso-thermal process	
	1) dp=0	
	2) dt=0	
	3) dq=0	
	4) dv=0	
6.	In LD Process Oxygen is released through the lance at a pressure of	
	1) 150-175 psi	
	2) 100-150 psi	
	3) 200-250 psi	
	4) <100 psi	