LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Chemical Engineering (708)

Bachelor of Engineering (B.E.) - Semester – I

Course Code:	**017082101**
Course Name:	**Material Science**
Category of Course:	Engineering Science Courses (ESC)
Prerequisite Course:	Chemistry-I (017081101)

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
5	**0**	**0**	**5**	**50**

Syllabus

Unit No.	Topic/	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Engineering Materials**			**5 (10%)**
	1.1 Types of bonds in material and its construction (Ionic bonds, Covalent bonds, Metallic bonds Dispersion bonds, Dipole bonds, Hydrogen bonds)	---	Manufacturing of Sugar, Paints (017083304-Unit-7.1)	
	1.2 Classification of materials	---		
	1.3 Structure of materials (Crystallography, Important Terms of Unit Cell, Types of Crystal System, Types of Unit Cell)	Classification of materials (017082101-Unit-1.2)		
	1.4 Defects in crystalline materials (Point Defect, Linear Defect, Surface Defect)	---		
02	**Mechanical Properties of Materials**			**2 (4%)**
	2.1 Mechanical Properties of Metal	---	---	
	2.2 Mechanical Properties of Polymer (Tensile Strength, Elongation to Break, Young's Modulus, Toughness)	---		
	2.3 Stress-strain Response (elastic, nonelastic and plastic deformation)	---		
03	**Thermodynamics of Materials**			**5 (10%)**
	3.1 Introduction to Thermodynamics (Thermodynamic Systems, Basic Thermodynamic Properties Intensive and Extensive Properties, Change of state, process, cycle, Pressure, Temperature, Specific Volume, Density, Specific Gravity, Energy, Power, Work, Specific Heat, Heat Transfer, Latent Heat, Enthalpy, Internal Energy, Thermodynamic Processes)	---	Calculation of Entropy change during Phase Change (017082201-Unit-8.2)	
	3.2 Laws of Thermodynamics (Zeroth Law, First Law, Second Law, Third Law)	Introduction to Thermodynamics (017082101-Unit-3.1)		
	3.3 Hess's Law of Constant Heat Summation and its Application			
	3.4 Experimental Measurement of Heat of Reaction (Water Calorimeter, Bomb Calorimeter)			
04	**Metals and Its Alloys**			**6 (12%)**
	4.1 Introduction to Metal and its alloys	---	---	
	4.2 Physical Properties of Metals	---		
	4.3 Definition and purpose of alloy,	Introduction to metal and its alloys (017082101-Unit-4.1)		
	4.4 Classification of alloys.	---		
	4.5 Alloys of Cu and its industrial applications (Copper-zinc alloys -Brasses, Copper-tin alloys -Bronzes)	---		
	4.6 Alloys of Al and its industrial applications (Duralium, Y-alloy, Mangalium, Hindalium)	---		
05	**Corrosion**			**5 (10%)**
	5.1 Introduction to Corrosion	---	---	
	5.2 Theories of corrosion (Direct Chemical Corrosion or Dry Corrosion, Electrochemical Corrosion or Wet Corrosion)	---		
	5.3 Types of corrosion			
	5.4 Protective measurements against corrosion – organic and inorganic materials, Inhibitors, Cathodic protection	Types of corrosion (017082101-Unit-5.2)		
06	**Non-Metallic Materials**			**4 (8%)**
	6.1 Classification of Nonmetallic materials	---	Manufacturing of Building Bricks, Refractory and its Types (017083304-Unit-9.4)	
	6.2 Structure and configuration of Ceramics, Refractories & Insulators, polymers, copolymers, liquid crystals and amphiphiles	Classification of Nonmetallic materials (017082101-Unit-6.1)		
	6.3 Nano Composites: role of reinforcement-matrix interface.	---		
07	**Phase Transformations**			**8 (16%)**
	7.1 Introduction to the phase rule	---		

	(Gibbs phase rule, Cooling Curves, Construction of Phase Diagrams)		Criteria for Phase Equilibrium (17083301-Unit-5.2)	
	7.2 Phase diagrams of steel (Allotropy of Iron, Iron-Carbon Phase Diagram and constituents such as ,Ferrite , Austenite,Cementite, Pearlite , Ledeburite, Peritectic, eutectic and eutectoid reactions)	Introduction to the phase rule (017082101-Unit-7.1)		
	7.3 Phase diagrams of cupronickel	Introduction to the phase rule (017082101-Unit-7.1)		
	7.4 The applications of phase diagrams (Lever Rule)	---		
08	**Electronic Properties of Materials**			**5 (10%)**
	8.1 Introduction to Electronic Properties (Ohm's law, Resistance, Current, Electric Field, Electrical Conductivity	---	---	
	8.2 Free Electron Theory (Classical free electron theory, Assumptions of classical free electron theory, Success and Drawbacks of free electron theory)	Introduction to Electronic Properties (017082101-Unit-8.1)		
	8.3 Fermi Energy (Fermi energy, Fermi level , Fermi function under different conditions of temperature and Fermi energy)	---		
	8.4 Hall effect, Dielectric Behaviour	---		
	8.5 Piezo- and Ferro-electric Behaviour	---		
09	**Characterization and Measurements of Properties**			**4 (8%)**
	9.1 Introduction	---	---	
	9.2 X-ray diffraction with reference to metals (Bragg's law, basic elements of X-ray diffractometers)	---		
	9.3 Electron microscopy, composition analysis in electron microscopes with reference to metals (Transmission Electron Microscope-TEM, Scanning Electron Microscope -SEM)	Spectroscopic techniques: Principles of Spectroscopy (017081201-Unit-3.1)		
10	**Processing of Materials**			**6 (12%)**
	10.1 Introduction	---	Settling and hardening of cement (017083304-Unit-9.2)	
	10.2 Heat treatment of ferrous and aluminum (Heat treatment of ferrous - Annealing, Normalizing, Hardening, Tempering, Case hardening , Surface hardening; Heat treatment aluminum - Solution heat treatment, Precipitation treatment, Annealing.	Introduction (017082101-Unit-10.1)		
	10.3 Preparation of ceramic powders	---		
	10.4 Evaporation and sputtering techniques			
	10.5 Chemical vapour deposition, thin film growth phenomena			

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L:	5	T:	0	P:	0

Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	5	5	MCQ	80%	80
Theory			Theory Descriptive	20%	20
Theory			Formulas and Derivation	0%	0
Theory			Numerical	0%	0
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	0		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
CO1	Understand the concept of chemical bonds, crystal structure, mechanical properties and basic thermodynamic properties in engineering materials.
CO2	Learn the concept of physical properties, application and corrosive effect of ferrous and non-ferrous materials.
CO3	Understand the classification and structure of nonmetallic materials and phase transformation diagrams of steel and copper alloys.
CO4	Gain the knowledge of electronic properties, electron microscopy techniques and various processes to improve engineering material properties.
Suggested Reference Books	
1	Materials science by GBS Narang, Khanna Publishers, New Delhi.
2	D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry
3	Material science and metallurgy by O.P.Khanna., Publisher: Dhanpat rai publications
4	Materials science by R.S.Khurmi,R.S.Sedha, S Chand & Co. Ltd, New Delhi

List of Open Source Software/Learning Website	
1	https://nptel.ac.in
2	https://www.edx.org/learn/materials-science