Lok Jagruti Kendra University
University with a Difference

Diploma in Automation & Robotics

Course Code: 025120204

Material Science

Programme / Branch Name			Diploma in Automation & Robotics			
Course Name	Material Science				**Course Code**	025120204
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				Evaluation Scheme			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOAL**
3	0	2	4	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisite

- ✓ Basic knowledge of high school-level Science

3. Rationale

Engineering Materials play an important role as the vital tool for solving the problems of material selection and application in the production and manufacturing of equipment/machines, devices, tools, etc. Therefore, an engineering diploma student must be conversant with the properties, composition, and behavior of materials from the point of view of reliability and performance of the product.

The Subject is concerned with the changes in structure and properties of matter. Many of the processes which are involved in bringing out these changes form the basis of engineering activities. The study of basic concepts of material science and metallurgy will help the students understand engineering subjects where the emphasis is laid on the application of these materials.

4. Objectives

- ✓ Understand the basic concept of Material Science and Metallurgy.
- ✓ Know about the ferrous and non-ferrous metals and alloys and their applications.
- ✓ Understand different Heat Treatment Processes.
- ✓ Find the causes and prevention of metallic corrosion.
- ✓ Judge the Scope and limitations of different materials.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1.	**Engineering Materials**	1.1. Introduction 1.1.1 Importance of Material Science 1.1.2 Definition 1.2. Classification of Material Science. 1.2.1 Engineering Materials 1.2.2 Electrical Engineering Materials 1.2.3 Biomaterials 1.2.4 Advanced Materials 1.2.5 Materials for Future-"Smart materials" 1.2.6 Nanotechnology 1.3 Properties of Materials. 1.4 Criteria for Selection of Materials. 1.5 Mechanical Behavior of Materials.	• Explain different types of bonds material, its construction and characteristics • Draw molecular arrangement in solids, liquid and gases • Describe various properties of material • Explain effects of cooling rate, grain size on materials properties	15	5
2.	**Structure of Atoms and Molecules**	2.1. Types of Bonds. 2.2. Structure of metal unit cell, BCC , FCC and HCP. 2.3. Solidification - Hume Rothery Rules. 2.4. Concept of Crystal, grain, grain boundaries and dendritic solidification. 2.5. Effect of cooling rate on material properties. Effect of grain size on properties of metal.	• Explain different types of bonds material, its construction and characteristics • Draw molecular arrangement in solids, liquid and gases • Explain effects of cooling rate, grain size on materials properties	15	7
3.	**Phase Diagram**	3.1. Equilibrium diagrams. Concept, definition and need. 3.2. Cooling curve-concept and method to plot. 3.3. Gibbs phase rule & Lever rule. 3.4. Iron carbon equilibrium diagram. Concept, need & characteristics.	• Explain the concept of equilibrium diagram • Plot cooling curves for pure metals and alloys • Draw and Interpret TTT curves and Iron carbon diagram • Explain various heat	25	12

		3.5. Time Temperature Transformation curve (TTT curve). 3.6. Heat temperature processes.	Treatment processes.		
4.	**Metal, Non-Metal & It's Alloys**	4.1. Classification of metals. 4.2. Flow diagram for the production of iron and steel. 4.3. Ferrous Metal and its alloy (Types, Properties, application, Effect of alloying Elements). 4.4. Non- Ferrous Metal and its alloy (Types, Properties, application, Effect of alloying Elements). 4.5. Classification of non-metals. 4.6. Plastics , Ceramics , Composites materials (Introduction, classification , properties, application). 4.7. Introduction of Designation and Coding	• Identify various ferrous metals and alloys based on composition and properties for prescribed application. • Test material for alloying elements content Interpret material designations. • Identify non-metallic material by judgment and lay-man tests. • Select the non-metallic material for given simple machine elements.	25	12
5.	**Electrolysis**	5.1. Introduction Electrolysis. 5.2. Types of electrolytes Construction and working of electrochemical cell. 5.3. Industrial applications of electrolysis. 5.4. Surface coating through electrolysis-setup and working. 5.5. Corrosion-types and reasons. 5.6. Powder metallurgy (Basic concept and its applications, merits and demerits).	• Select proper Electrolyte for specified application. • Select proper Electrolysis process for surface coating. • List areas of powder Metallurgy applications.	20	6
				Total Hours	**42**

6. List of Practicals / Exercises

The practicals/exercises have been properly designed and implemented in an attempt to develop different types of skills, so that students can acquire the competencies/programme outcomes. Following is the list of practicals/exercises.

Sr. No.	Practical / Exercises	Key Competency	Hours
1.	Study of Metallic and Non Metallic Material	Identify main alloying elements Reasons to add them.	2
2.	Study of ferrous and non-ferrous material using photo Spectrometer.	Learn about photo Spectrometer.	2
3.	Perform hardening process on ferrous material. Measure the hardness before and after hardening.	Study various heat treatment furnaces.	4
4.	Study of Metallurgical Microscope	Usage of Metallurgical Microscope	4
5.	Prepare ferrous micro specimens and examine them.	Study micro-structure of ferrous metal	8
6.	Prepare non-ferrous micro specimens and examine them. Also prepare report on this.	Study micro-structure of non-ferrous metal.	4
7.	Study corrosive materials to identify different types of corrosion of metals.	Types of corrosion	4
8.	Visit one relevant industry which has specifically heat treatment Processes facilities and photo spectrometer.	Practical application	--
		Total Hours	**28**

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	Ap %	C %	E %	An %
1.	Engineering Materials	10	30	20	20	10	10
2.	Structure of Atoms and Molecules	10	20	15	15	20	20
3.	Phase Diagram	20	30	20	10	10	10
4.	Metal , Non-Metal & It's Alloys	20	30	10	10	10	20
5.	Electrolysis	10	30	20	20	10	10

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

8. Textbooks

1) Materials science, R.S.Khurmi, R.S.Sedha(5th edition), S.Chand & Company Ltd. New Delhi.
2) Materials science, R.K.Rajput, Laxmi Publication, Dariya ganj, New Delhi.

9. Reference Books

1) Materials science, GBS Narang, Khanna Publishers, New Delhi.
2) Materials science and metallurgy, D.S.Nutt, S.K.Katariya and sons, Delhi.
3) Materials science and Engineering, V.Raghavan, EEE Edition, Prentice Hill, New Delhi.
4) Physical Metallurgy, Sidney Avner, Tata McGraw-Hill

10. Open Sources (Website, Video, Movie)

1) http://vimeo.com/32224002
2) http://www.substech.com/dokuwiki/doku.php?id=iron-carbon_phase_diagram
3) http://www-g.eng.cam.ac.uk/mmg/teaching/typd/
4) http://www.ironcarbondiagram.com/
5) http://uk.ask.com/web?q=Who+Discovered+Carbon%3F&qsrc=14097&o=41647924&l=dir
6) http://www.youtube.com/watch?v=fHt0bOfj3T0&feature=related
7) http://www.youtube.com/watch?v=cN5YH0iEvTo
8) http://www.youtube.com/watch?v=m9l1tVXyFp8
9) http://www.youtube.com/watch?v=98lh5Q0M0cg
10) http://www.youtube.com/watch?v=KIyGr-1snMY
11) http://www.studyvilla.com/electrochem.asp