



Malaviya National Institute of Technology Jaipur

Department of Metallurgical and materials engineering

Course Details

Introduction to Engineering Materials | 26MTT101 | 3 0 0 0

PREREQUISITE:

NIL

COURSE OBJECTIVE(S):

1. Provide a fundamental understanding of the evolution, classification, and importance of engineering materials.
2. Introduce different classes of engineering and advanced materials along with their structure–property relationships.
3. Enable students to understand the selection and application of materials in real-world engineering systems.

COURSE OUTCOMES:

CO1 : Explain the historical development, atomic structure, and bonding mechanisms in different classes of materials.

CO2 : Classify engineering materials and explain the fundamentals of metals, ceramics, polymers, composites, and advanced materials.

CO3 : Develop the knowledge of fundamental principles related to materials structure, properties and engineering applications.

SYLLABUS:

UNIT I (4 Lectures): History of materials, atomic structure. Atomic bonding in solids: bonding forces and energies, primary interatomic bonds, secondary bonding with examples of metals, ceramics and polymers.

UNIT II (10 Lectures): Crystal structure and Bravais lattice, Unit cell and Miller indices, Crystal system, coordination number and packing fraction. Polymorphism and allotropy. Crystallographic directions and planes. Crystalline materials: single crystals, polycrystalline materials. Non- crystalline materials, Imperfection in solids (point defects, line defects, surface defects and volume defects). Level of Structures: macrostructure, microstructure, substructure, crystal structure, electronic structure, nuclear structure.

UNIT III (10 Lectures): Classification of engineering materials: Metals and alloys, Ceramics and Glasses, Polymers, and Composites. Structure, Fundamentals of Advanced Materials: Superalloys, High Entropy Alloys (HEA), Shape Memory Alloys (SMA), Biomaterials, Nanomaterials.

UNIT IV (12 Lectures): Physical Properties, Chemical Properties, Electrical Properties, Mechanical Properties, Magnetic Properties, Optical Properties, and Thermal Properties.

UNIT IV (4 Lectures): Applications of metals, polymers, ceramics, composites, amorphous materials, energy materials, and advanced materials.

EVALUATION

Final grades will be weighted average of performance in

Course Work	20%
Midterm Exam	30%

depending on the institute's academic policy.

Textbook(s):

1. Introduction to Materials Science, William D. Callister Jr., David G. Rethwisch, John Wiley & Sons, 8th Edition, 2010
2. Introduction to Materials Science, V. Raghvan, Prentice Hall India Learning Private Limited, New Delhi, Sixth Edition, 2015
3. Introduction to Physical Metallurgy, Sidney H. Avner, McGraw Hill Education, New York, 2nd edition, 2017

Reference book(s):

1. Engineering Materials, A. K. Bhargava, Prentice Hall India Learning Private Limited, New Delhi, 2011
2. Engineering Materials – Properties and applications of Metal and Alloys, C. P. Sharma, Prentice- Hall of India Pvt. Ltd, 1st edition, New Delhi, 2004

Online/E-Resources:

1. <https://nptel.ac.in>



Malaviya National Institute of Technology Jaipur

Department of Metallurgical and materials engineering

Course Details

Fuels, Furnaces and Refractories | 26MTT102 | 3 0 0 0

PREREQUISITE:

NIL

COURSE OBJECTIVE(S):

To familiarize and equip the students with basic knowledge about different types of fuels, furnaces, and refractories used in metallurgical industries

COURSE OUTCOMES:

CO1 : Understand about various solid, liquid, and gaseous fuels and their importance in metallurgical industries.

CO2 : Gain knowledge about different manufacturing processes of various fuels having industrial significance.

CO3 : Analyze the use of stoichiometry for evaluating combustion performances.

CO4 : Understand different constructional and working principles of different types of furnaces and refractories.

SYLLABUS:

UNIT I (7 Lectures): Definition, their importance in human life (historical background). Comparative study of solid, liquid, and gaseous fuels. Primary and Secondary fuels. Constitution, classification and grading of coal. Characterization of Coal: Proximate analysis, Ultimate analysis, Calorific value. Coal washing. Coal blending and its importance in metallurgical industries.

UNIT II (7 Lectures): Caking, Coking and Non- coking Coals. Metallurgical coke preparation, Testing and properties of coke. Formed coke, Dry quenching of coke. Manufacturing, properties and uses of Producer gas and Water gas. Properties and uses of Blast furnace gas and Coke oven gas.

UNIT III (6 Lectures): Estimation of minimum amount of air required for a fuel of known composition, theoretical and actual combustion processes - Air fuel ratio, estimation of dry flue gases for known fuel composition, calculation of the composition of fuel and excess air supplied from exhaust gas analysis.

UNIT IV (12 Lectures): Definition and Classification of Furnaces, Major furnace components. Furnace atmosphere. Natural, forced, induced, and balanced draft. Chimney height. Heat losses in furnaces and minimization. Waste heat recovery. Flue gas cleaning systems. Various types of heating elements and Electric Furnaces viz. Resistance, Arc, and Induction furnaces

UNIT V (8 Lectures): Desirable properties of refractories. Methods of classification. Modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite, and Chrome- Refractories. Metallic Refractories. Testing of Refractories. Applications of refractories in the metallurgical industries.

EVALUATION

Final grades will be weighted average of performance in

Course Work	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. Fuels, furnaces and refractories, R. C. Gupta, 1st Edition, PHI Learning Pvt. Ltd. Delhi, 2016.
2. Fuels, furnaces, refractories and pyrometry, A.V.K. Suryanarayana, 2nd edition, B.S. Publication. 2015.
3. Elements of fuels, furnaces & refractories O.P. Gupta, 6th Edition, Khanna Publishers, 2014.
4. Fuels, furnaces and refractories, J. D. Gilchrist, Pergamon Press, 1977.

Reference book(s):

1. Elements of Refractory Technology, O.P. Gupta, 1st edition, Khanna Book Publishing Co. Ltd., 2017.
2. Industrial Furnaces, W. Trinks, M.H. Mawhinney, R.A. Shannon, R.J. Reed, and J.R. Garvey, 6th edition, John Wiley and Sons, 2003.

Online/E-Resources:

1. <https://nptel.ac.in>



Malaviya National Institute of Technology Jaipur
Department of Metallurgical and materials engineering

Course Details
Mineral Processing | 26MTT151 | 3 0 0 0

PREREQUISITE:

NIL

COURSE OBJECTIVE(S):

To familiarize the students with different mineral dressing processes, practices and equipment.

COURSE OUTCOMES:

CO1 : Understand different types of comminution operations.

CO2 : Distinguish the importance of sizing and classification.

CO3 : Understand various types of concentration methods.

CO4 : Analyze different ways of separating solids from fluids.

CO5 : Understand different coal washing methods.

SYLLABUS:

UNIT I (15 Lectures): Importance of mineral processing, Comminution and liberation, Jaw crushers, Gyratory crushers, Cone crushers, Roll crushers, Ball Mill, Rod mill, Tube mill, Sizing and classification: Laboratory methods of sizing and interpretation, Industrial screening.

UNIT II (15 Lectures): Laws of settling of solids in fluids, Type of classifiers, Gravity concentration by Wilfley table, Spiral shaking tables, Jigging, Heavy media separation, Froth flotation, function of various reagents. Filtration. Electromagnetic, Electrostatic, Amalgamation techniques of concentration, Separation of solids from fluids: dewatering, thickening, filtration, dust elimination, drying.

UNIT III (5 Lectures): Material balances in Mineral Processing Operations, Ratio of Concentrate, Recovery, Grade, Selectivity Index.

UNIT IV (5 Lectures): Recent advances and practices of mineral processing used in industries and critical minerals.

EVALUATION

Final grades will be weighted average of performance in

Course Work	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. A.M. Gaudin, Principles of Mineral processing, McGraw- Hill Inc., US, 1939.
2. S.K. Jain, Mineral Processing, CBS, 2nd Edition, 2001.

Reference book(s):

1. Wills Mineral Processing Technology seventh edition, Barry A. Wills, Willey, 2006.

Online/E-Resources:

1. <https://nptel.ac.in>



Malaviya National Institute of Technology Jaipur

Department of Metallurgical and materials engineering

Course Details

Mineral Processing Lab | 26MTP151 | 0 0 2 0

PREREQUISITE:

NIL

COURSE OBJECTIVE(S):

To familiarize the students with different mineral dressing processes and equipment.

COURSE OUTCOMES:

CO1 : Distinguish different types of crushers.

CO2 : Contrast on sizing and classification.

CO3 : Analyse various types of concentration methods.

CO4 : Analyze different ways of separating solids from fluids.

SYLLABUS:

EXPERIMENT I (2 Hours): Study of various minerals and ores.

EXPERIMENT II (2 Hours): To study the construction and operation of Blake type jaw crusher, and to find its reduction ratio and production capacity.

EXPERIMENT III (2 Hours): To study the construction and operation of roll crusher and to find out its reduction ratio, angle of nip and production capacity.

EXPERIMENT IV (2 Hours): To study the construction and operation of disc pulverizer and to find the grindability index of given feed.

EXPERIMENT V (2 Hours): To study the construction and operation of ball mill and find the grindability index of the given feed.

EXPERIMENT VI (2 Hours): To study the construction and operation of rod mill and find the grindability index of the given feed.

EXPERIMENT VII (2 Hours): To study the single deck and double deck vibrating screens and to find screen efficiency.

EXPERIMENT VIII (2 Hours): To find the percentage of iron scrap present in a given feed using magnetic separator.

EXPERIMENT IX (2 Hours): To study the construction and operation of froth floatation cell.

EXPERIMENT X (2 Hours): To study the construction and operation of mineral jig.

EXPERIMENT XI (2 Hours): To study the construction and operation of pneumatic classifier.

EXPERIMENT XII (2 Hours): To study the construction and operation of spiral classifier.

EXPERIMENT XIII (2 Hours): To study the construction and operation of Wilfley table, Richard hindered settling classifier and thickener.

EVALUATION

Final grades will be weighted average of performance in

Course Work

60%

Midterm Exam	20%
Endterm Exam	20%

depending on the institute's academic policy.

Textbook(s):

Reference book(s):

1. 1. Mineral processing laboratory manual

Online/E-Resources:



Malaviya National Institute of Technology Jaipur

Department of Metallurgical and materials engineering

Course Details

Fuel, Furnaces and Refractories Lab | 26MTP152 | 0 0 2 0

PREREQUISITE:

NIL

COURSE OBJECTIVE(S):

To familiarize and equip the students with basic knowledge about characterization and testing of fuels, furnaces, and refractories used in various metallurgical industries.

COURSE OUTCOMES:

CO1 : Analyze the estimation of various properties of fuels and oils.

CO2 : Understand the working principles of thermocouples and their calibration.

CO3 : Compare different heating elements used in industrial furnaces.

CO4 : Understand the constructional and working principles of different types of furnaces.

CO5 : Understand the method of making and testing the refractory products.

SYLLABUS:

EXPERIMENT I (2 Hours): To determine the viscosity of the given fuel oil by using the Redwood and Engler's viscometer.

EXPERIMENT II (2 Hours): To determine the flash point and fire point of the given fuel oil using the Abel, Pensky-Martens, and Cleveland's apparatus.

EXPERIMENT III (2 Hours): To determine the proximate analysis of the given coal sample.

EXPERIMENT IV (2 Hours): To determine the Sulphur content of the given coal sample.

EXPERIMENT V (2 Hours): To determine the calorific value of the given fuel using the Bomb's calorimeter.

EXPERIMENT VI (2 Hours): To study about different thermocouples and their calibration.

EXPERIMENT VII (2 Hours): To study about various heating elements including measure of resistance.

EXPERIMENT VIII (2 Hours): To study the variation of resistance with respect to temperature in Kanthal / Nichrome wire

EXPERIMENT IX (2 Hours): To study about various parts of furnaces (Muffle, Induction, and Raising Hearth furnace)

EXPERIMENT X (2 Hours): To determine the packing density of refractory raw materials.

EXPERIMENT XI (2 Hours): To study of effect of composition, forming pressure & firing temperature on some properties of refractory bodies.

EXPERIMENT XII (2 Hours): To determine the spalling resistance (Thermal Resistance Shock Test) of refractory bodies.

EVALUATION

Final grades will be weighted average of performance in

Course Work	60%
Midterm Exam	20%
Endterm Exam	20%

depending on the institute's academic policy.

Textbook(s):

1. Elements of fuels, furnaces & refractories O.P. Gupta, 6th edition, Khanna Publishers, 2014.

Reference book(s):

1. Laboratory manual

Online/E-Resources: