



राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR
(Institute of National Importance)
G.E.Road, Raipur – 492010 (C.G.)

Phone : (0771) 2254200
Fax : (0771) 2254600
Website : www.nitr.ac.in

Basic structure of the 4 years B. Tech Metallurgical Engineering Program

Courses for Semester III (Year 2)

National Institute of Technology, Raipur (C. G.)													
Course of Study and Scheme of Examination (NEW)				B. Tech. III semester								METALLURGICAL ENGG.	
S. No.	Board of Studies	Sub. Code	Name of Subject	Period/Week			Examination Scheme				ESE	Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	T.C.A.			
1	Metallurgy	MT20311(MT)	Numerical Analysis and Computer Programming	3	1	-	20	15	15	50	70	120	4
2	Electrical	EL20312(MT)	Fundamentals of Electrical Technology an Electronics	3	1	-	20	15	15	50	70	120	4
3	Metallurgy	MT20313(MT)	Introduction to Materials Science	3	1	-	20	15	15	50	70	120	4
4	Metallurgy	MT20314(MT)	Metallurgical Thermodynamics	4	1	-	20	15	15	50	70	120	5
5	Metallurgy	MT20315(MT)	Fuel, Furnaces and Refractory	3	1	-	20	15	15	50	70	120	4
6	Metallurgy	MT20316(MT)	Minerals and Ores Beneficiation	3	1	-	20	15	15	50	70	120	4
7	Metallurgy	MT20321(MT)	Numerical Analysis and Computer Programming Lab	-	-	3	30	-	-	30	20	50	2
8	Metallurgy	MT20322(MT)	Minerals and Ores Beneficiation lab	-	-	3	30	-	-	30	20	50	2
9	Metallurgy	MT20323(MT)	Fuel, Furnaces and Refractory Lab	-	-	3	30	-	-	30	20	50	2
10	Humanities	EN20324(MT)	Value Education	-	-	2	25	-	-	25	0	25	1
11	Metallurgy	MT20325(MT)	Discipline	-	-		25	-	-	25	0	25	1
TOTAL				19	6	11	260	90	90	440	480	920	33

TA= Teacher Assessment, FE= First Exam. , SE= second Exam., T.C.A.= Total of continuous assessment, ESE=End Sem. Exam.



Name of the Subject	Numerical Analysis and Computer Programming	Subject Code	MT20311(MT)
Semester	III	Board of Studies	Metallurgy
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4 (Th) + 2 (P)

Numerical Analysis

Approximations and round off errors, Truncation errors and Taylor Series, Determination of roots of polynomials and transcendental equations by Newton-Raphson, Secant and Bairstow's method.

Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss- Siedel iteration methods, Curve fitting- linear and nonlinear regression analysis.

Backward, Forward and Central difference relations and their uses in Numerical differentiation and integration, Application of difference relations in the solution of partial differential equations. Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method

Computer Programming

Introduction to computer programming in C and C++ languages. Arithmetic expressions, Simple programs. Example of some simple C program. Dissection of the program line by line. Concepts of variables, program statements and function calls from the library (printf for example) C data types, int, char, float etc.

C expressions, arithmetic operations, relational and logic operations. C assignment statements, extension of assignment to the operations. C primitive input output using getchar and putchar, exposure to the scanf and printf functions. C statements, conditional execution using if, else. Optionally switch and break statements may be mentioned.

Concepts of loops, example of loops in C using for, while and do-while. Optionally continue may be mentioned.

One dimensional arrays and example of iterative programs using arrays, 2-d arrays. Use in matrix computations.

Concept of Sub-programming, functions. Example of functions. Argument passing mainly for the simple variables.

Pointers, relationship between arrays and pointers. Argument passing using pointers. Array of pointers, Passing arrays as arguments.

Strings and C string library. Structure and unions. Defining C structures, passing structures as arguments. Program examples. File I/O. Use of fopen, fscanf and fprintf routines.

Suggested Text Books & References.



Suggested Text Books & References.

- Shastry, S.S., "Numerical Methods", Prentice Hall Inc., India, 1998.
- Noble Ben, "Numerical Methods", New York International Publications, New York, 1964.
- Stanton Ralph G., "Numerical Methods for Engineering", Englewood cliffs, N.J., Prentice Hall Inc., 1961.
- Buckingham R.A., "Numerical Methods", Sir Isaac Pitman Sons. Ltd., London, 1957.
- Bakhvalov, N .S., "Numerical Methods", Mir. Pub., Moscow, 1977.
- Grewal, B.S., "Numerical Methods", Khanna Pub., New Delhi, 1998.
- Sudhit Kaicker, "The Complete ANSI C", BPB Publications, New Delhi, 1996.
- Kernighan, B. W. and D .M. Ritchie, "The C Programming Language", Prentice Hall of India, 1998.
- Byron, S. Gottfreid, "Programming with C", Tata McGraw Hill, 2nd edition 1998.



Name of the Subject	Fundamentals of Electrical Technology and Electronics	Subject Code	EL20312(MT)
Semester	III	Board of Studies	Electrical
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4 (Th)

D.C. Motors – Operating principles, classification, characteristics, (Elect & Mechanical) starting method 3point & 4 point starter, speed control -ward Leonard control braking Application

A.C. motors –(a) Construction and operating principles of three phase induction motor, equivalent circuit, Torque slip characteristics, Star delta starter. (b) Three phase synchronous motor- working principles, starting, application.(c) Single phase Induction Motor fractional horse power motors, their applications

Semiconductors and Transistors – Intrinsic and extrinsic semiconductors, PN junction diodes, zener diode, junction transistors PNP and NPN transistors and their working in CB CE and CC configurations, Half wave and Full wave rectifier circuits using semiconductors, Basic amplifier circuit.

Electric Heating – Modes of transfer of heat, Classification of electrical heating method. Resistance heating, Infrared heating Arc furnaces Induction heating, High frequency eddy current heating, Dielectric heating, choice of frequency.

Electric welding – Resistance welding, electric arc welding, ultrasonic welding, electron beam welding, laser beam welding Requirements of good weld. Preparation of work electrodes, Electric welding equipment

Text Books:

1. Electrical Technology Vol-I & II B.L. Theraja
2. Basic Electronics – Theraja

Reference Book

1. Basic electronics – V.K. Mehata (S.Chand & Co.)
2. Basic Electronics – Tata McGraw Hill



Name of the Subject	Introduction to Materials Science	Subject Code	MT20313(MT)
Semester	III	Board of Studies	Metallurgy
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4 (Th)

Role of metals and materials in the service of mankind, brief history of materials science and metallurgical engineering, Introduction, Significance of Structure-Property correlation

Classification of materials: Metals & Alloys, Ceramics, Polymers, Composites and Semiconductors, Comparison of general spectrum of their physical, mechanical and electrical properties. Atomic Structure & Inter-atomic Bonding: Fundamentals of Atomic Structure and Chemical Bonding; Atomic Bonding in Solids Ionic, Covalent, and Metallic bonding.

Mechanical Properties of Materials: Elastic, Plastic and Viscoelastic Behaviour of materials, Stress-strain relationship, Concept of true stress, true strain flow curve,

Thermal properties of materials: Heat capacity, Thermal expansion and thermal conductivity. Electrical properties of materials: Electronic and Ionic conduction; Energy Band structures in solids ; Electron Mobility ; Temperature variation of conductivity.

Dielectric behaviour: Capacitance ; Types of polarization ; Frequency dependence of dielectric constant, Ferroelectricity and Piezoelectricity in materials.

Magnetic properties: Diamagnetic; Ferromagnetic, anti-ferromagnetic and Ferrimagnetic behaviour of Materials, soft and hard magnetic materials, superconductivity.

Optical properties: Light interaction with solids; Absorption, Transmission and Reflection, Luminescence; Photoconductivity, Lasers. Environmental Degradation of materials: Oxidation and Corrosion; Thermal and Photo Degradation, Chemical Degradation, Radiation Damage.

Materials selection: Material properties and Engineering Design parameters; General effects of processing on parameters, selection of structural, Electronic and Magnetic Materials – case studies.

Books:

1. V Raghavan – Materials Science & Engineering. – Prentice Hall of India Pvt. Ltd., New Delhi.
2. Murthy & Jena: Structure and properties of Engineering Materials ,TMH New Delhi
3. W D Callister, Jr. – Materials Science & Engineering – An Introduction – John Willey & Sons, Inc, New York.
4. J F Shackelford – Introduction to Materials Science for Engineers – Maxwell Macmilan International Editions, Singapore.



Name of the Subject	Metallurgical Thermodynamics	Subject Code	MT20314(MT)
Semester	III	Board of Studies	Metallurgy
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	-	5 (Th)

Scope and concept – Energy and its forms systems, path and state properties, Thermodynamics processes, Thermodynamic equilibrium, Reversible and Irreversible processes. First law of thermodynamics, Internal energy, Specific heat, Enthalpy and their derivative; Thermo-chemistry – Thermo-chemical laws and applications.

Second law of thermodynamics – Entropy and its derivative; Concept of free energy, Criterion of equilibrium, thermodynamic potential; Zeros and third law of thermodynamics; Heat Capacity and Entropy Changes. Sensible Heats, Transformation Heats, Reaction Heats, ΔC_p , $\Delta H=f(T)$, $\Delta S=f(T)$, Adiabatic Flame Temperatures, Heat Balances.

Chemical Potential, Gibbs - Helmholtz Equation, Criteria of Equilibria, Phase Equilibria in One Component Systems, Clausius - Claperyon Equation, Heats of Vaporization from Vapor Pressure Data, Shift in Transformation Temperature with Pressure. Fugacity, activity and equilibrium constant, Vant Hoff's isotherm, **Ellingham diagrams for oxides, sulphides, halides etc. and their applications to metallurgical processes.**

The Behavior of Gases. Compressibility Factor, Law of Corresponding States, Equations of State, Fugacity. Reactions Equilibria - The effect of temperature and pressure on equilibrium constant. Equilibria in Gaseous Systems, The Equilibrium Constant and ΔG° , Reaction Extent Problems, Equilibria in Systems Containing Condensed Phases,

Solution Thermodynamics - Thermodynamic solutions. Raoult's law. Henry's law. Sievert's law. Absolute and Partial and Integral Molar Quantities, Relative and Partial Integral Molar Quantities, Ideal Solutions, Excess Quantities, Gibb's-Duhem Equation, Tangent Intercept Method, Change in Reference State, 1 wt % Reference State Interaction Parameters. Actual solutions. Regular solutions.

Application of the laws of thermodynamics to metallurgical processes, Thermodynamics of Electro-chemical Cell and Application, interfacial phenomena, extraction and refining of materials. Kinetics of Metallurgical reactions; Collision theory; Theory of absolute reaction rates. Chemical Kinetics - Order and molecularity of reaction; Arrhenius equation

Books:

1. Introduction to Metallurgical Thermodynamics, David R. Gaskell.
2. Problems in Thermodynamics & Kinetics, G. S. Upadhyaya and R. N. Dubey.

Reference:



-
1. Chemical Metallurgy, J.J. Moore
 2. Physical Chemistry of Metals, L. S. Darken and G. Gurry, Tata Mc-Graw hill.
 3. Metallurgical Thermodynamics, ML Kapoor Part I & II
 4. Dr. Tupkary R.H.; Introduction to Metallurgical Thermodynamics
 5. A. Ghosh; Text book of Materials & Metallurgical Thermodynamics; Prentice Hall of India, Delhi, 2003



Name of the Subject	Fuel, Furnaces and Refractory	Subject Code	MT20315(MT)
Semester	III	Board of Studies	Metallurgy
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4 (Th) + 2 (P)

Metallurgical coke, manufacture, specifications, testing and properties; Coking and Non-coking coals; Characterization of coal properties (caking and swelling indices, calorific value, proximate and ultimate analysis, etc); Coal carbonization and effects of different parameters; Properties of coke, char and graphite; Fuel combustion and the effects of different factors; Combustion calculations; Alternative source of energy (viz. ferro coke, formed coke, charcoal, solar, wind, tidal, etc.) and their suitability for metallurgical and power industries. Fuel for Sponge Iron and thermal power Plants

Liquid fuels, their properties, testing and metallurgical applications. Gaseous fuels, their properties, testing and metallurgical application, manufacture of producer gas and water gas. Coke Oven Gas, Blast Furnace Gas and natural Gas. Factors affecting the choice of fuels.

Acid, basic and neutral refractories, their composition and properties; Methods of production of fire clay, silica, magnesite, chrome- magnesite, dolomite and insulation bricks; special refractories;. Testing of Refractories, Factors deciding the choice of refractory for a particular furnace and its parts.

Metallurgical furnaces, classification and uses. Thermal performance and Heat losses in Furnaces. Furnace efficiency and heat balance computation, Sankey Diagrams, Flame characteristics in combustion. Variable affecting heat utilization in flame furnaces. Burner Designs and selection. Radiant tubes & their uses. Bouyancy movement of gases; types of drafts and draft control. Large pressure drop conditions, uses of high pressure blowers and compressed air blast. Flow through tuyeres/lances. Jet movement of gases and patterns flow. Radiant heat transfer in gases and flames. Calculation of transient condition of heating of charge by Heisler Charts.

Heat recovery aspects, Waste Heat Utilization methods, Recuperator and Regenerator calculations, types of Recuperators and Regenerators and Checker brick work. Vacuum production in furnaces. Ingot heating soaking pits. Continuous Pusher type furnaces, walking beam furnaces, Roller Hearth furnaces; Bell type furnaces and other heat treatment furnaces. Direct –arc melting furnaces, salt bath furnaces.

Text Books:

1. Metallurgical furnaces- Krivadin and Markov
2. A. Rashid Chisti, Refractories. Prentice Hall of India private ltd.
3. Elements of fuels, Refractories and Furnaces – O.P. Gupta.

Reference Book

1. Gilchrist, J.D. fuels & Refractories, Macmillan, 1963



राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
NATIONAL INSITUTE OF TECHNOLOGY RAIPUR
(Institute of National Importance)
G.E.Road, Raipur – 492010 (C.G.)

Phone : (0771) 2254200

Fax : (0771) 2254600

Website : www.nitr.ac.in

-
2. Norton, Fo H. Refractories, McGraw- Hill, N.Y. 1958
 3. Butt A Metallurgical problems McGraw-Hill, Book Company London 194
 4. Efficient use of fuels, HMSO London 1953



Name of the Subject	Minerals and Ores Beneficiation	Subject Code	MT20316(MT)
Semester	III	Board of Studies	Metallurgy
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4 (Th) + 2 (P)

Mineralogy: Physical Properties of Minerals; Classification of various Rock Forming Minerals, Introduction and Preliminary study of Principle Rock Forming Mineral Groups; Quartz, Feldspar, Mica, Pyroxenes, Amphibole, Garnet, Feldspathoids. Mode of Occurrence, Origin, Distribution, Association, and Industrial uses of important Metallic (Al, Au, Cu, Cr, Fe, Mn, Sn, Pb and Zn)

COMMINUTION: Jaw and Gyratory crushers, roll crusher and their performance. Ball & rod mills - capacities and reduction ratios Hammer mills, gravity stamps and Disc crushers. Grinding - Dry and wet grinding. Open and closed circuit grinding. Laws of crushing and work index. Theory of Ball Mill operation, Rittinger's, Kick's and Bond's laws of crushing and grinding. Screening, sizing and sampling.

GRAVITY CONCENTRATION TECHNIQUES: Theory of settling, Elementary concepts of movement of solids in fluids. Stokes and Newtons Laws. Reynold's number. Free and hindered settling. Classification and its application in mineral dressing. Practice of Hydraulic and mechanical classification, working of thickeners. Hydrocyclones and Rotary filters. Heavy media separation. Principles of jigging and Tabling. Magnetic and Electro static separation. Processes with equipments used. Important controlling factors in operation.

FLOTATION TECHNIQUES: Application Froth flotation. Frothers. Collectors. Depressants. Aciivators. Ph modifiers etc., multistage flotation - Principle, equipments, and application. Differential flotation. Flotation circuits. Study of basic de-watering techniques like-sedimentation – filtration – drying., Simple flow sheets for Beneficiation of Fe, Mn, Cr, Cu, Pb, Zn and beach sands.

Text books:

1. Principles of Mineral Dressing, Gaudin, A.M.
2. Mineral Processing Technology – B.A. Wills
3. Text Book of Geology – G.B. Mahapatra

References:

1. Mineral Processing Technology, S. K. Jain
2. Unit operation in Chemical Engineering.