NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-301 **Course Title**: Introduction to Metallurgy and Materials

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I : - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **3rd Semester:** √ **Autumn** ☐ **Spring**

6. Objective:

To familiarize the students with the fundamentals and other aspects of various metallurgical processes, engineering materials and their properties, etc.

7. **Details of the Course**:

S. No.	Particulars	Contact Hours
1.	An introduction to Metallurgy and Classification of Metallurgical Processes.	04
2.	Classification of Engineering Materials based on Engineering properties. A general discussion on other engineering materials plastics, rubber, polymers, ceramics, refractories, glasses, composites etc.	08
3.	Introduction of Nano-technology; its importance and applications.	03
4.	A brief discussion on important ferrous and non-ferrous materials and their production processes (flow sheets giving important parameters).	07
5.	General introduction to phase rule and phase diagrams (Binary systems). An overview of iron carbon equilibrium diagram and the critical phenomenon. Brief discussion on plastic deformation & Strain Hardening.	08
6.	Bonding in solids, crystal structure & imperfections. Plastic deformation in single crystals.	07
7.	Single crystals, polycrystalline materials and factors affecting their mechanical properties. Yield strength, tensile strength and rupture strength. Ductility and malleability, toughness and hardness of materials.	05
	Total	**42**

8. Suggested Books:

S. No.	Name of Book	Author(s)	Publisher	Year of Publications
1.	Principles of Extractive Metallurgy	J. Newton	J. Wiley	1959
2.	Materials Science and Engineering	V. Raghavan	PHI	2008
3.	Elements of Materials Science	Van Vlack	Addison Wesley	1998
4.	Engineering Materials Science	Richards	Wadsworth Pub. Co.	1961
5.	Structure and Properties of Materials	Wulff Series	John Wiley (New York)	1966
6.	Material Science	R. S. Khurmi & R. S. Sedha	S. Chand	2005
7.	Engineering Materials II : An introduction to microstructures , processing & design	Ashby, M.F., & D.R.M. Jones	Pergamon Press	2006
8.	Material Science	Callister	John Wiley	2008
9.	Principles of Material Science and Engineering	Smith	Mc Graw Hill	1990

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: CHM-03 **Course Title**: Metallurgical and Instrumental Analysis

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To acquire knowledge and become familiar with the various metallurgical analysis techniques and the instruments involved therein.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1	Principles of Volumetric, Gravimetric and Fire assay methods. Electrogravimetry, potentiometry, polarography, colorimetry and conductometry.	10
2.	Absorptimetry, Emission spectrophotometry, Atomic Absorption Spectrophotometry, flame photometry, colorimetry and X-ray fluoresence.	10
3.	Determination of gases in metal. Introduction to Thermal Analysis (DTA, TMA, TGA, DSC, etc.) Chromatography, Radio-chemical analytical methods.	12
4.	Applications of the above analytical methods to the assessment and evaluation of alloys, ores, slags, ceramics, glass and refractories.	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Instrumental Methods of Analysis	Williard H.H., Merritt L.L., and Dean J.A.	Wadsworth	1981
2.	Standard Methods of Chemical Analysis, Vol: III A	Welcher F.J.	Van Nostrand	1962
3.	Instrumental methods of Chemical Analysis	Ewing G.W.	McGraw-Hill	1985
4.	Metallurgical Analysis	Jain and Agarwal,	Khanna Publishers, New Delhi	1985
5.	Problems in Quantitative Analysis	A. Musakin,	Mir	1984
6.	A brief introduction to modern chemical Analysis	D.G.Peters, J.H.Hayes and G.M. Hieftje	Saunders	1976
7.	Quantitative chemical Analysis 5th ed.	Vogel	Longman, Harlow	1989

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code**: CHM-03P **Course Title**: Laboratory Practice in Metallurgical and Instrumental Analysis

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE:** - - **ESLE:** - -

5. Credits: 0 1 **3rd Semester:** √ (**Autumn**) ( ) (**Spring**)

6. Objective:

To acquire knowledge of equipments and become familiar with the basic analytical methods.

7. **List of experiments:**

S. No.	Experiments
1.	Determination of Cu^{2+} ions iodometrically
2.	Gravimetric estimation of aluminum
3.	Determination of Iron (III)
4.	Determination of barium as barium sulphate.
5.	Distribution coefficient of iodine between water & CCl_4
6.	Determination of acid value of oil.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MTH-308 **Course Title**: Mathematics-III

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II:** - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To understand and familiarize with the algebra of matrices and various aspects of statistics and probability.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1	**MATRICES:** Definitions and algebra of matrices. Transverse of a matrix Symmetric, skew-symmetric, Hermitian, and skew-Hermitian matrices inverse matrix, orthogonal and unitary matrices, Solution of simultaneous equations by matrix method. Triangular matrices, Rank of a matrix, equivalent matrices, elementary transformations, normal form, and eigen vectors of a matrix, Caley-Hamilton theorem. Quadratic forms.	18
2.	**STATISTICS AND PROBABILITY** Measures of central tendency and Measures of variations (Dispersions), Moments, Measures of Skew-ness and kurtosis. Random experiment, sample space, events, classical, statistical and axiomatic definitions of probability. Statements and proof of theorems on addition and multiplication of probabilities. Simple problems. Baye's Theorem on conditional probability. Random variable, derivation of formula for mean, variance and moments of random variables for discrete and continuous cases. Laws of expectation, Binomial, Poisson and normal distributions, Beta and Gamma distribution. T-distribution, F-distribution, Chi-square distribution and their applications. Method of least squares, fitting a straight line and parabola of degree 'p'. Regression and correlation Multiple and partial correlation.	24
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Fundamentals of Mathematical Statistics	S.C Gupta and V.K Kapoor	Sultan Chand and Sons, N. Delhi	2000
2.	Statistical Theory and Methodology in Science & Engg.	Brown lee	John Wiley and Sons	1965
3.	Introduction to Mathematical Statistics, 3rd Ed.	R.E. Walpole	Prentice Hall	1987

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: CIV-304 **Course Title**: Geology and Mineralogy

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II:** - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ **Autumn** ☐ **Spring**

6. Objective:

To impart the basic understanding of the formation of rocks and minerals and to expose the students to the basic erosional and depositional processes.

7. Details of the Course:

S. No.	Particulars	Contact Hrs.
1.	**Physical Geology:**	
	Introduction to the science of geology.	3
	Crust of earth and its composition.	3
	Minerals and Rocks.	3
	Weathering of Rocks; Erosion, transportation and deposition by wind, Water and ice.	6
	Introduction to geological structures.	3
2.	**Mineralogy:**	
	Rock forming minerals and ore forming minerals. Processes of mineral formation. Physical properties of minerals.	4
	Introduction to ore minerals. Principle ore minerals of Aluminum, Copper, Lead, Zinc, Antimony, Nickel, Tin, Chromium, Magnesium and Iron, their important properties, mode of formation, mode of occurrence, uses and distribution in India.	10
	Study of Refractory minerals, coal and petroleum.	4
	Total	**36**

8. Suggested Books:

S. No.	Name of Book/Author/Publisher	Author(s)	Publisher	Year of Publications
1.	Principles of Engineering Geology,	Bangar, K.M,	Standard Publishers Distributors, New Delhi.	1995
2.	Engineering Geology	Parbin Singh	Katson Publishers New Delhi.	2009
3.	Structural Geology	Billings, M.P.	Prentice-Hall India, New Delhi.	1974
4.	Geology for Engineers	Blyth, F.G.H and de Freitas, M.H.	ELBS, London.	1974
5.	Experiments in Engineering Geology	Gokhale, KVG.K and Rao, D.M.	Tata-McGraw Hill, New Delhi.	1981
6.	Textbook of Engineering Geology	Kesavulu, C.	Macmillan, India Ltd. New Delhi	1993
7.	Geology for Civil Engineers	McLean and Gribble	Spon Press, Taylor &Francis Group, London	1999

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: CIV-304P **Course Title**: Laboratory Practice in Geology and Mineralogy

2. Contact Hours: L: 0; T: 0; P: 2/2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE:** - -

5. Credits: 0 | 1 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objectives:

To impart the basic skills for determination of characteristics of rocks and minerals.

7. List of Experiments:

S. No.	Experiments
1.	The study of physical properties of minerals (form, luster, fracture, cleavage, streak, hardness, specific gravity, colour etc). 6 h
2.	Determination of specific gravity by: a. Jolly's balance b. The beam balance c. The walkers steel yard balance. 6 h
3.	Study of rocks and their characteristics (Igneous - Granite & Basalt; Sedimentary- Sandstone and Limestone; and Metamorphic - Quartzite, Marble, slate, Gneiss and Schist). 4 h
4.	Study and sketching of various types of geological structures. 6 h
5.	Determination of dip and strike with a clinometers compass. 6 h

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MEC-302 **Course Title**: Mechanics of Solids

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To familiarize with the fundamental principles of stress and strain, mechanical properties and to understand the response of members to flexural loads etc.

7. Details of the Course:

S.No.	Particulars	Contact Hours
1.	Analysis of Stresses and Strains - Two dimensional state of stress and strain, Principle stresses/strains and principle planes/ axes. The stress and strain circles. Measurement of techniques as applied to stresses, etc. Poisson's ratio, Hooke's Law, Surface and Volumetric strains, Elastic constants and their relationships. Mechanical Properties: Stress - Strain diagrams.	09
2.	Elastic and plastic behavior under multi-axial stresses. Mechanical properties at high and low temperatures under static and cyclic stresses. Members in Bi-Axial State of Stresses: Stresses and strain in thin cylindrical and spherical shells subjected to internal pressures.	14
3.	Members subject to Flexural Loads: Theory of simple bending. Distribution of normal and shear stresses, principle stresses. Built-up and composite beams. Bending movements, slope and deflection.	09
4.	Various methods of deflection. Symmetrical and un-symmetrical bending. Fracture Mechanics. Columns: Short struts subjected to axial and multiaxial loads. Euler's theorem. Critical and Eccentric loading.	10
	Total	**42**

8. Suggested Books:

S No.	Name of Book	Author(s)	Publisher	Year of Publication
1.	Mechanics of Materials	Timoshenko & Gere	Nelson Thornes	2003
2.	Mechanics of Materials	E.P. Popov	Prentice - Hall	1959
3.	Engineering Mechanics	Irwing and Shames	Prentice Hall	2000

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code**: ELE-305 **Course Title**: Electrical Technology

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To obtain sound knowledge in the basic concepts of electrical technology.

7. Details of the course:

S. No.	Particulars	Contact Hours
1.	Electric circuit laws and D.G. Circuits- super position principle. Thevenin's theorem.	10
2.	Maximum power transfer theorem. A.C. Circuits, Basic Definitions. Solution of R-L-G circuit, three phase balanced star and delta connection circuits.	19
3.	D.C generators and motors, and their characteristics, three phase alternators, synchronous and induction motors.	13
	Total	**42**

8. Suggested Books:

S. No.	Name of Book	Author(s)	Publisher	Year of Publications
1.	Principles of Elect. Engineering	Vincent Deltoro	Prentice-Hall	1972
2.	Basic Elect. Engineering	Fitzgerauld	McGraw- Hill	1981
3.	Electrical Machines	Nagrath/Kothari	Tata McGraw- Hill	2006
4.	Basic Circuit Analysis	Schaum Series.	McGraw- Hill	1992

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code**: ELE-304P **Course Title**: Laboratory Practice in Electrical Technology

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE:** - -

5. Credits: 0 1 **3rd Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To provide practical knowledge about the working of various relevant laboratory equipments.

7. **List of experiments:**

S. No.	Experiments
1.	Verification of K.V.I
2.	Verification of K.C.I
3.	Verification of Supper position theorem.
4.	Verification of Thevinin's theorem
5.	Verification of Max. Power Transfer theorem
6.	Delta-star Transformation
7.	Obtaining resonance in RLC circuits
8.	Measurement of Power and Power factor 3 load
9.	Constructional details of a single phase transformer

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-302 **Course Title**: Electrical Engg. Materials

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To familiarize with the basic principles related to the physics of materials relevant to electrical, magnetic and optical properties.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Introduction to materials-classification, properties and structure. Crystalline and Non-crystalline solids. Crystallographic directions and planes. Density computations. Some important characterization techniques. Imperfections in solids. Mechanical properties of materials. Phase transformation in alloys and some important steels.	14
2.	Electrical properties of materials. Some important resistor alloys. Dielectric materials and their electrical properties. Semiconductors, their properties and applications. Novel electrical characteristics- Ferroelectricity and piezoelectricity.	20
3.	Magnetic properties of solids - types of magnetism, magnetic domain. Soft magnetic materials and hard magnetic materials, their properties and applications. The Influence of Temperature on Magnetic Behavior. Superconductivity.	08
	Total	**42**

8. Suggested Books:

S. No.	Name of Book	Author(s)	Publisher	Year of Publications
1.	Introduction to solid state Physics	C. Kittel	Wiley	1986
2.	Solid State Physics	Dekker	Prentice Hall	1965
3.	Physical Metallurgy Principles	Reedhill	Affiliated East West Press Pvt Ltd.	2008
4.	Theoretical Structural Metallurgy	Cottrell	Arnold	1962
5.	Electricity and Magnetism	H.E. Duckworth	Holt, Rinehart , Winston	1960
6.	The Structure and Properties of Materials Vol.4	Rose, Sheppard, Wulff.	John Wiley (New York)	1966

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code**: MME-303 **Course Title**: Electronics Engineering Materials

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **3rd Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To familiarize with the basic principles related to the physics of materials relevant to electrical, electronic, magnetic and optical properties.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Crystal structure: crystalline state, Bravais lattices, Miller indices, reciprocal lattice. Common crystal structures. Interference phenomenon. Bragg's diffraction. Crystal imperfections.	06
2.	Free electron theory, conduction in Metal and alloys conductor, resistors.	06
3.	Growth of single crystal, zone refining technique.	03
4.	Semiconductors: their properties and applications.	03
5.	Magnetism: Magnetic Properties of materials, diamagnetism, paramagnetism, ferromagnetism, black wall, domain dimensions. Anti-ferromagnetism ferrimagnetism. Ferrites, Magnetic Materials: Fe, Si, Ni, Co. Hard magnetic materials.	10
6.	Dielectric materials, electric & optical properties, polarization in static and alternating field, piezoelectricity, polarizability and dielectric constant, optical transition in solids, absorption and emission of radiation, dielectrics, capacitors, inductors. Superconductivity and Superconductors.	14
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Introduction to solid state Physics	C. Kittel	Wiley	1986
2.	Solid State Physics	Dekker	Prentice Hall	1965
3.	Physical Metallurgy Principles	Reedhill	Affiliated E-W Press Pvt Ltd.	2008
4.	Theoretical Structural Metallurgy	Cottrell	Arnold	1962
5.	Electricity & Magnetism	H.E. Duckworth	Holt, Rinehart, Winston	1960
6.	The Structure & Properties of Materials, Vol IV: Electronic Properties	Rose R M, Shephard L A, Wulff J	Wiley Eastern Ltd.	1987
7.	Material Science	Callister	Wiley	2008

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code**: MME-401 **Course Title**: Thermodynamics of Materials

2. Contact Hours: L: 3; T: 2; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 5 **4th Semester:** ( ) **Autumn** (√) **Spring**

6. Objective:

To comprehend the laws of thermodynamics and their applications to metallurgical systems.

7. **Details of the Course**:

S. No.	Particulars	Contact Hours
1.	**Introduction:** Basic concepts, postulates, and basic problems of thermodynamics. Reversible and irreversible reactions. First law of thermodynamics: Enthalpy. Heat capacity.	10
2.	Thermochemistry. Hess's law. Flame temperature. Second law of Thermodynamics: Entropy and its change, Carnot cycle. Free energy and Gibb's Helmholtz equation. Third law. Fugacity, activity and equilibrium constant. Free energy calculations. Activity measurement. Ellingham diagram. Richardson diagram. Solutions: Introduction – Le Chatelier principle. Partial molal quantities. Gibb's Duhem equation. Ideal, non-ideal and dilute solutions. Raoult's and Henry's laws. Alternative/standard states. Sievert's law, mixing excess functions.	20
3.	Regular solutions. Classius-clapeyron equation. Phase rule: liquid-vapour, solid-liquid, solid-vapour equilibria, and Trouton's rule. The thermodynamics of electro-chemical reversible cells. Introduction to statistical thermodynamics. Thermodynamics of inter phases.	12
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Physical Chemistry of Metals	Darken & Gurry	CBS	2002
2.	Physical Chemistry of Iron and Steel making	C. Bodsworth	English Longman's Books Society & Longman's Green & Company	1972
3.	Introduction to Metallurgical Thermodynamics	David R Gaskell	Mc Graw-Hill	1995
4.	Problems in Metallurgical Thermodynamics & Kinetics	G.S Upadhyay & R.K Dube	Pergamon Press	1985
5.	Principles of Extractive Metallurgy	Rosenquist	McGraw-Hill	1983
6.	Phy. Chemistry of Met. Processes	A.K. Biswas and G.R. Bashforth	Asia Publishing House, New Delhi	2005
7.	Text Book of Materials and Metallurgical Thermodynamics	Ahindra Ghosh	PHI	2003

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-402 **Course Title:** Introduction to Manufacturing Processes

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: | -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **4th Semester:** | √

Autumn **Spring**

6. Objective:

To provide the fundamentals of knowledge about various manufacturing processes.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Historical perspective of manufacturing processes, classification of manufacturing processes, their advantages and disadvantages. Important methods of each manufacturing process	08
2.	**Machining:** Basic principles of lathe machine & operations performed on it. Basic description of machines & operations of shaper-planer, drilling, milling, grinding. Unconventional machining processes , Machine tools	06
3.	**Casting:** pattern & allowances. Molding sands & its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola furnace. Die-casting & its uses.	06
4.	**Metal forming:** Basic metal forming operations & uses of such as-forging, rolling, wire & tube drawing/making & extrusion, & its products/applications, press work & die & punch assembly, cutting & forming, its application. Hot working vs Cold working.	06
5.	**Powder metallurgy**: powder metallurgy process & its applications, plastic-products manufacturing, galvanizing & electroplating.	
6.	**Joining methods:** Fusion welding processes, solid phase welding, gas welding, arc welding, TIG welding, MIG welding, Submerged arc welding, electro slag, welding, electron beam welding, laser welding, cold pressure welding, ultrasonic welding, friction	08

7.	welding and explosive welding; brazing and soldering; principles involved, process details and equipment used for above welding processes. Plastic part manufacturing methods, injection moulding, blow moulding, compression moulding and transfer moulding.Thermo forming, rapid proto typing etc.	08
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books/Publisher	Author	Publisher	Year of Publications
1.	Forging & forming metals	S.E. Rusinoff	D.B. Taraporevala	1969
2.	Theory of metal forming & metal cutting	S.K. Sinha S.C. Prasad	Dhanpat Rai	1995
3.	Mechanical Metallurgy	G.E. Dieter	McGraw Hill	1988
4.	Manufacturing Processes for Engg. materials	Kalpakjian & Schmid	Pearson Education	2001
5.	Manufacturing Proceeses	B.H Amstead, Ostwald, Begeman	John Wiley & Sons	1976
6.	Process & Materials Of Manufacturing	Roy A Lindberg	PHI	1977
7.	Elements of Workshop Technology; vol. I & II	Hajra , Chaudhary	Media Promoters & Publishers.	2016

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MTH-404 **Course Title**: Numerical Methods and Computer Programming

2. Contact Hours: L: 2; T: 2; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **4th Semester:** [ ] Autumn [√] Spring

6. Objective:

To learn the principles of numerical solutions of equations and computer programming.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	**NUMERICAL METHODS:** Finite Differences: Difference table and its usage. The difference operators ▲, ▼ and the operator E.	02
2.	Interpolation: Interpolation with equal intervals. Newton's advancing difference formula. Newton's backward differences formula. Interpolation with unequal intervals. Newton's divided differences formula. Lagrange's interpolation formula. Spline functions.	05
3.	Central Differences: The central difference operator $ and the averaging operator μ, Relations between these operators. Gauss forward and backward interpolation formula, Sterling, Bessel's Laplace and Everetts formulae.	06
4.	Numerical Solution of Algebraic and Transcedental Equations. Graphic Method, Regula - Falsi Method, Balzano's Bisection Method, Newton - Raphson Method and its geometrical significance.	06
5.	Numerical Integration: Numerical integration. General Quadrature Formula, Trapezoidal rule. Simpson's one-third and three-eight rules, Weddells' rule, Hordy's rule.	06

6.	Numerical solution of ordinary differential equations. Numerical solution of ordinary differential equations, Picard's method, Taylors series methods, Euler's method, Runge-Kutta method.	04
7.	**COMPUTER PROGRAMMING:** The application of Computer, Digital computer organization. Flow charts and decision tables. FORTRAN programming preliminaries. Fortran integer and real constants. Fortran variables and the names of variables. Fortran operations and expressions for addition, subtraction, multiplication, division and exponentiation. Mathematical functions. Arithmetic statements. Input-output statements. Format free statements. Simple computer programmes. Transfer of control: Control statements. The GoTo statements. The arithmetic IF statement. The logical IF statement. Relational operators. Elementary format specifications. Format description for PUNCH statement. The Do statement. Examples.	07
	C^{++} programming, simulation and modelling, Computing methods in Engineering problem solving in general and Metallurgical Engg. Problem in particular, working principal of genetic algorithm, artificial neural networking, fuzzy logic techniques, soft computing technique like fuzzy regression, fuzzy neuron nets etc.	06
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Numerical Analysis for Scientists and Engg.	MK Jain	New Age International (P) Ltd.	1997
2.	Mathematical numerical analysis	SC Scarborough.	Oxford & IBH Publishing Co.	1966
3.	Numerical methods, software and analysis	John R Rice	McGraw-Hill	1985
4.	Numerical Methods in Science and Engg.	S Rajasekaran	S Chand	2003

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MTH-405P **Course Title:** Laboratory Practice in Numerical Methods and Computer programming

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE:** - - **ESLE:** - -

5. Credits: 0 1 **4th Semester:** [ ] Autumn [√] Spring

6. Objective:

To provide basic knowledge about the problem formulation and writing of computer programs to solve the same.

7. List of Experiments:

S. No.	Particulars
1.	Given a set of N numbers A_1, A_2, A_3…….. A_N, to write a program and arrange them in an ascending sequence.
2.	To draw a flow chart and to write a Computer Program to compute the Scalar Product of two vectors X and Y given by Scalar Product X_iY_i where the quantities X_i,Y_i (i=1, 2,...15) are known.
3.	To write a Program and then compute the roots of the quadratic equation $Ax^2 + Bx +C=o$ for different values of A, B and C.
4.	The formula for computing standard deviation( ) of normal distribution is where x_i represents an individual number of group numbers, $\bar{x}$ the arithmetic mean of the group of numbers, and N the size of group of numbers. Draw a flow chart and compute the standard deviation of a given set of 500 numbers x_i, x_2 ....., x_{500}.
5.	Program to find a real rost of F(x) =0 by Newton Raphson Method.
6.	Program to evaluate the integral of F(x) between limits A and B using Simpsone and Trapezoidal rule
7.	Program to solve an ordinary diffrential equation dy / dx = f (x,y) using Enler method.

8.	Program to compute the solution of $dy / dx = f(x,y)$, $y(x_o) = y_o$ using the classical Runge - Kutta Fourth order method.
9.	To write a program to compute and print the values of the safe loading S for R = 25(25)250 where $S = 17,000 - 0.485\ R^2$ for $R < 120$ $18,000/1 + R^2/18,000$ for $R >/ 120$

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-403 **Course Title:** Non-Destructive Testing and Evaluation

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **4th Semester:** [ ] [√]

Autumn Spring

6. Objective :

To familiarize with the basic methods of Non- Destructive Testing technique, principles, test procedures and equipment involved therein.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Importance of testing in the quality control of materials/product.	05
2.	Significance of N.D. Testing. Principle , procedure and equipment for conventional methods of NDT such as- Liquid penetrant, Magnetic particle, Eddy current, radiography, Ultrasonic and acoustic emission, optical and acoustic hollo-graphy and thermo-graphy, In-situ metallographic examination.	22
3.	Comparison and selection of NDT methods.	08
4.	Advantages, limitations, applications of each N.D. Testing methods.	07
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Non-Destructive Evaluation and Quality Control	ASM Metals Handbook	American Society of Metals, Metals Park, Ohio	2001
2.	Non-Destructive Testing	Mc Gonnagle, W T	McGraw Hill Book Co	1988
3.	Non-Destructive Testing	Louis Cartz,	ASM International, Metals Park Ohio	1995
4.	Non Destructive Testing	Barry Hull and Vernon John	ELBS / Macmillan	1989

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NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MEC-412 **Course Title:** Heat Transfer and Fluid Flow

2. Contact Hours: L: 3; T: 0; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **4th Semester:** ( ) **Autumn** (√) **Spring**

6. Objective:

To understand the basic principles of heat transfer and fluid flow.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Modes and Laws of heat transfer. **CONDUCTION:** Steady State and unsteady state. Heat flow through composite walls. Heating and cooling of plates, cylinders and spheres. **CONVECTION:** Free and forced convection. Reynolds, Crasshoofs, Nusselt and Station numbers.	10
2.	**RADIATION:** Emissivity, absorptivity, reflectivity and transmissivity. Simple Heat transfer between black and gray surfaces. Re-radiating surfaces. Heat losses from furnaces. Combined effects of conduction, convection and radiation. Steady and unsteady heat flow in some metallurgical processes, e.g melting, solidification, heating/cooling of ingots and billets, etc.	16
3.	**FLUID FLOW:** Viscosity and Newton's law of viscosity. Newtonian and non-Newtonian fluids. Conservation of mass and continuity equation. Energy of fluids. Euler's and Bernoullis equations. Loss of energy due to friction. Flow through pipes. Laminar and Turbulent Flow, Reynold's number. Compressed air and air blasts. Energy used for compression. Compressor and blower efficiency characteristics.	16
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Engineering Heat Transfer	Gupta & Prakash	Nem Chand & Bros.	1976
2.	A Text on Heat transfer	S.P. Sukjhatme	Universities Press (India) Pvt. Ltd	2005
3.	Heat transfer	Holman	McGraw-Hill	1976
4.	Heat transfer	Domkundwar	Dhanpat Rai Publishing Company (P) Ltd.	2005
5.	Fluid Mechanics	Khurmi	S. Chand & company	1987

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** ECE-405 **Course Title:** Electronics and Metallurgical Industrial Instrumentation

2. Contact Hours: L: 2; T: 0; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 2 **4th Semester:** ☐ **Autumn** ☑ **Spring**

6. Objective:

To gain knowledge about the basics of electronics, and to familiarize with the working principles of metallurgical industrial electronic instruments.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Construction, symbol and characteristics of semiconductors diodes, transistors and silicon-controlled rectifiers. Rectifiers and invertors. Motor control.	13
2.	Induction and dielectric heating. Electric arc furnaces and their accessories. Ultrasonic waves and their applications. Pulse, digital and switching circuits and systems. Transducers.	15
3.	Measurements of current, voltage, power and energy. Cathode-ray oscilloscope and its applications.	10
4.	Temperature control, gas flow and fluid flow controls, PID, load cells, and strain gauge etc.	04
	Total	**42**

8. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Pulse Digital and Switching Wave Form	Millman & Taub.	Tata McGraw - Hill	2007
2.	Integrated Electronics	Millman & Halkias.	McGraw-Hill	1972

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: ECE-406P **Course Title:** Laboratory Practice in Electronics and Metallurgical Industrial Instrumentation

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE:** - - **ELSE:** - -

5. Credits: 0 1 **4th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To become familiar with the working of relevant electronic devices.

7. List of Experiments:

S. No.	Experiments
1.	Diode & zener diode characteristics.
2.	Common emitter configuration D.C characteristics and amplifier.
3.	Emitter follower and common basic amplifier.
4.	To assemble a two stage cascaded amplifier and study its performance.
5.	Differential amplifier.
6.	Feedback amplifiers, current series and current shunt.
7.	RC phase shift oscillator.
8.	Basic logic gates.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT: Metallurgical & Materials Engineering

1. Subject Code: MME-501 **Course Title:** Kinetics of Materials

2. Contact Hours: L: 4 ; T: 1 ; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 5 **5th Semester:** √ **Autumn** **Spring**

6. Objective:

To provide an understanding of the thermodynamic principles and kinetics pertaining to the metallurgical processes/systems.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Brief review of generalized systems, solutions and laws/ postulates.	02
2.	Statistical thermodynamics, thermodynamics of interfaces. Phase rule, liquid-vapor, solid-vapour, solid liquid and solid-solid equilibria, heterogeneous equilibria. Equilibrium and temperature-pressure diagrams, their applications to various metallurgical systems.	10
3.	Chemical kinetics and its related laws, theories of reaction rates, reaction mechanism, kinetics of important metallurgical processes.	08
4.	Concept of activated state and activated energy. Diffusion in solids, Fick's laws and Kirkendal effect. Diffusion in direct/indirect reduction and agglomeration processes. Kinetics of heterogeneous metallurgical operations: viz Gas-solid, slag metal, and other such systems. Kinetics of solid state transformations. Mass transfer in solid, liquid and gaseous systems.	22
	Total	**42**

9. Suggested Books:

S. No.	Name of the Book	Author(s)	Publisher	Year of Publications
1.	Physical Chemistry of Metals	Darken and Gurry	CBS	2002
2.	Thermodynamics of Materials	David V Ragone	John Wiley & Sons, Inc.	1995
3.	Thermodynamics	Partington	London Constable	1987
4.	Chemical Kinetics.	Laidller	Paperback	2008
5.	Thermodynamics for Chemists	Glasstone	EWP	1988
6.	Theory of Rare process	Glasstone, Laidller and Evring	Elsevier Science B.V.	1975
7.	Thermodynamics of Solids	R.A. Swalin	John Wiley Sons Inc.	1966
8.	Metallurgical Thermochemistry	Kubaschewski	Pergamon	1993
9.	Introduction to Chemical Metallurgy	R.A. Parker.	Pergamon press, NY	1978
10.	Chemical Metallurgy .	J J Moore	Heinemann Ltd.	1990

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-501P **Course Title:** Laboratory Practice in Thermodynamics & Kinetics of Materials

2. Contact Hours: L: 0 ; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE :** - -

5. Credits: 0 1 **5th Semester:** √ (Autumn) ☐ (Spring)

6. Objective :

To familiarize with the conduct of different experimental studies.

7. List of Experiments

S. No:	Experiments
1.	Determination of Specific Heat by Bomb calorimeter (Adiabatic)
2.	Determination of Specific Calorimetry (Isothermal)
3.	Measurement of Partial Molar Volume
4.	Study of Thermo-Analytical Techniques of Dissociation of Carbonates
5.	To study the calcination of $CaCO_3$ and calculate the percentage decomposition by varying time and temperature.
6.	To study the effect of time and temperature on the kinetics of roasting of CuS.
7.	To study the cementation process for extraction of copper from $CuSO_4$ bath with iron.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-502 **Course Title:** Principles of Metal Extraction and Refining Processes

2. Contact Hours L: 4 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 5 **5th Semester:** √ **Autumn** ☐ **Spring**

6. Objective:

To familiarize with the processing of ores and to extract valuable minerals.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Location of principal ore bodies and extracting plants. Indian Mineral resources and metallurgical industries. Estimated tonnage of metals produced /imported /exported by India. Purpose of Mineral Dressing, scope and limitation of available methods. Classification of ores.	01
2.	Communition units like jaw crusher gyratory, cone crusher, Roll and impact crusher, attritor and other grinding units, their performance, applications and limiting reduction ratio. Sizing and classification. Methods of sizing, both Laboratory and Industrial. Various types of screens. Classification as a means of sizing. Laws of classification.	05
3.	Principles of Metallurgical Processes as applied to ores and concentrates for the extraction of metals: Importance of physico-chemical processes in metal extraction and refining. Roasting processes: drying and calcination, oxidizing, sulphatizing, chlorination, flouri-nation and reducing roasting, Sintering and other agglomeration processes, Smelting processes: reducing, oxidizing electro-thermic, metallothermic and reaction smelting processes, Refining processes: liquification, fractional re-crystallization, distillation, oxidation, chlorination, Sulphidizing and carbon refining processes, Hydro-metallurgical processes: leaching, refining of leach solutions, recovery of metals; electrolytic and bacteria processes, Electro-metallurgical processes: Principles, advances, processes and	15

	applications of electro- refining, electrolytic cleaning, electro-polishing, electro-forming, electro-leaching, electro-machining, etc. Regeneration of electrolytes. Slags and their functions in extractive Metallurgy. Principles of working of the equipment used for roasting and agglomeration. Hearth roasters, flash roasters, fluidized bed roasters, sintering machines, etc.	
4.	Over view of the Physico-Chemical principles and processes of metal extraction. Production /extraction of heavy metals (Cu, Pb, Zn, Sn, Ni, Cr, Sb, Co). Light metals (Al, Mg, Ti) and precious metals (Au, Ag, Pt). Rare metals (W, Mo, Zr, U, Be) and semi-conductor metals (Ge, Si). Detailed flow sheets for the extraction/production of the above metals	21
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Powder Metallurgy and Particulate Materials Processes	German R.M	Metal powder industries federation	2005
2.	Mineral Processing Technology	Wills B.A.	Pergamon Press.	1992
3.	Principles of Mineral Processing	Gaudin P.M.,	Tata McGraw Hill.	1987
4.	Elements of ore dressing	A.F.Taggart	John Wiley	1951
5.	Unit operations	Meab and Smith	Mc Graw Hill	1997
6.	Theory of Metallurgical processes	A.Volsky and E.Surgiovskaya	Mir Publishers	1991
7.	Non-Ferrous Extractive Metallurgy	H.S.Ray & Abraham	East-West press Narosa Publishing	2008
8.	Hydrometallurgy	Venkatachalam	Pergamon press, NY	1998

9.	Introduction to Chemical Metallurgy	R.H. Parker	Mc Graw Hill	1978
10.	Principles of Extractive Metallurgy	Terkel Rosenqvist	Mc Graw Hill	1983
11.	Extractive Metallurgy	J.D.Ghilchrist	Willey	1989
12.	Extractive Metallurgy	J. Newton	Willey	1959
13.	Unit Processes in Extractive Metallurgy	Pehlke R D	East American Elsevier Publishing Co.	1993
14.	Non-Ferrous Metallurgy	W.H.Dennis	Sir Issac Pitman & Sons Ltd	1980
15.	Non Ferrous Production Metallurgy	J.L. Bray	John Wiley & Sons	1985

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-502P **Course Title:** Laboratory Practice in Mineral Processing

2. Contact Hours: L:0 ; T: 0; P: 4

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE:** - -

5. Credits: 0 2 **5th Semester:** √ ☐

Autumn Spring

6. Objective:

To provide understanding of the basic construction, and principles of working different mineral processing equipments.

7. List of Experiments

S.No:	Experiments
1.	To study the parts of a Jaw Crusher and to operate it using different ore materials and various gape settings, and determine the reduction ratios.
2.	To study the size reduction of an ore by a roll crusher using different roll settings.
3.	Use a laboratory ball mill to reduce a given crushed ore to a - 200 µm size fraction using different milling times and changing the weight of the grinding medium. Make energy calculations. Compare the energy efficiency of attritor with ball mill.
4.	To perform Sieve Analysis on a given dry milled Ore for 1/2, 1 and 2 hrs and to calculate i) percentage loss in screening, ii) the average size of particles and iii) plot various sizing curves.
5.	To study the effect of any one of the following grinding variables on the performance of the ball mill or rod mill; i) Ball load or rod load ii) time of grinding.
6.	Conduct the Classification of a mill product using a) Spiral Classifier b) A Cyclone.
7.	Concentrate a given Sulphide Ore (Chalcopyrite, Sphalarite, Galena) by Froth Flotation and list the reagents used.
8.	Concentrate a given Ore using: a) Shaking Tables b) Magnetic Separator, and c) Jigs.
9.	Study of a) Hammer mill, and b) Impact mill.
10.	Study the working of a) Screens, and b) Grilles
11.	Study of a Thickener. Dewatering a given slurry by thickening. Determination of Fines carried by thickener overflow.
12.	Filtering a given slurry under normal gravity and using Vaccum Filteration.
13.	Heavy media separation of Coal

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-503 **Course Title:** Material Characterization

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **5th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To understand the basic principles of the techniques used for the study of metal samples.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Macro and Micro examination of meterials, principle of a Metallurgical microscope, microscopic objectives, chromatic and spherical abrasion, different types of objectives.	03
2.	Properties of objectives. Magnifying power, Numerical aperture, resolving power, curvature of field and vertical resolution. Oil immersion objectives. Eyepieces- Negative, amplifying eyepieces, measuring and reticle type; low reflection coating. Types of Microscopes. Illuminating source, light collimators, cooling cells, light filters, diaphragms. Vertical illuminators, bright field and dark field illumination, prism and plan glass reflector, calcite prism, oblique illumination, conical stop illumination, critical Kochler illumination method, principles and techniques of photomicrography.	10
3.	Microscopy and Photomicrography with ultraviolet light. Microscopy with polarized light, principle of polarized light microscopy, equipment and technique. Principles of phase contrast microscopy and its application. Interferometry, principles and equipment details, Use and techniques of structure of metals. Maintenance and care of optical parts. Metallography: Examination of samples by low and high power microscopy. Preparation of metallic samples for microscopic and Microscopic examination. Etching of samples for metallographic examinations (Micro and Macro) Quantitative Microscopy:- Estimation of grain size, size distribution of inclusions from measurements on a two dimensional section, Image analysis through computers.	08
4.	X-Ray production. Characteristics of X-Rays. X-Ray diffraction. Diffraction theory and Techniques -Laue, Powder and rotating crystal	06

	techniques. Intensity calculations and structure determination.	
5.	Electron Microscopy and its applications to Metallurgical studies. Techniques of specimen preparation for electron microscopy.	04
6.	Principles of Electron diffraction. Electron Emission phenomenon. Field ion Microscopy,	04
7.	Introduction to techniques such as – Auger Electron spectroscopy, scanning tunneling microscopy, Atomic force microscopy.	04
8.	Electron Probe micro analysis etc. Detailed study of Radiographic techniques.	03
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	The principles of Metallographic practice	Kehl	Mc Graw Hill	1949
2.	Practical Metallography	Greeves and Wrighton	D.Van Nostrand Co.	1957
3.	Structural Metallurgy	Barreet	PHI/ Mc Graw Hill	1979
4.	Modern Microscopy	V.E. Cosslett	Mc Graw Hill	1966
5.	Modern Metallographic Techniques and their Applications	Phillips V A	Wiley Eastern	1971
6.	Metallography: Principle and practice	Vander Voort	Mc Graw Hill	1984
7.	ASM Handbook, Volume 10, Materials Characterisation	Whan R E (Ed)	ASM international	1986
8.	Elements of X-ray Diffraction	Cullity B D	Prentice Hall, Inc	2001

2.	Optical Microscopy Of Metals	R.C.Gifkins	Sir Issac Pitman And Sons	1970
3.	Electron Microscopy and Analysis	P.J Goodhew J. Humphreys R Beanland	Taylor and Francis	2001

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-503P **Course Title:** Laboratory Practice in Material Characterization

2. Contact Hours: L:0 ; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE:** - -

5. Credits: 0 1 **5th Semester:** √ ☐

Autumn Spring

6. Objective:

To familiarize with the preparation of metallographic specimens and to study macro and microstructures of different metal specimens.

7. List of Experiments

S. No:	Experiments
1.	Detailed study of a Metallurgical Microscope.
2.	Preparation of a standard specimen for microscopic examination.
3.	Electro-polishing of a given specimen.
4.	Microstructure studies of the following: * Hypo- eutectoid, eutectoid and Hyper-eutectoid Steels. * Various types of cast irons. * Cu, Al, and their alloys. * HSS, Tool Steel, Stainless Steel, etc.
5.	To determine the average grain size by linear intercept method.
6.	Study of Twining in Pb-Sn alloys under a Metallurgical microscope.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-504 **Course Title:** Corrosion and Surface Engineering

2. Contact Hours: L: 2 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **5th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To familiarize with the basic knowledge of corrosion behavior of materials and their protection methods.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Corrosion principles: Electrochemical aspects, Importance and cost of corrosion. Computation of corrosion rates, Thermodynamics of corrosion, Passivation, Mixed potential theory of corrosion and its application.	12
2.	Different forms of corrosion and their control: Uniform Corrosion, Selective Corrosion Including Pitting Corrosion, Crevice Corrosion, Intergranular Corrosion, Filiform Corrosion, Stress Corrosion Cracking, Corrosion Fatigue, Fretting Corrosion, Cavitation Corrosion, Leaching, Erosion-Corrosion and Microbial Corrosion.	12
3.	Principle behind protection of materials against corrosion: Cathodic and anodic protection, inhibitors, coatings and design. Decorative coatings by electroplating. Corrosion Testing Methods. IS specification.	08
4.	High Temperature corrosion & oxidation of Metals and Alloys: Rate Laws, Kinetics and Mechanics. Wagner's parabolic law of Oxidation. Hot Corrosion, Corrosion in Mixed Gaseous Environment. High temperature materials.	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Corrosion Engineering	Greene, N.D., M.G. Fontana,	Tata McGraw Hill	2005
2.	Corrosion–For science and engineering	Kenneth R Trethewey and John Chamberlain	Longman Inc	1996
3.	Metallic corrosion and prevention	Raj Narayan	Oxford Publications,	1988
4.	Corrosion and corrosion control – An introduction to corrosion science and engineering	Herbert H. Uhlig and R. Winston Revie	John Wiley & Sons	1985
5.	ASM hand book – Vol 13: Corrosion		ASM International	2001
6.	Principles and prevention of corrosion	Denny A. Jones	Prentice Hall Inc.	1996
7.	Corrosion and corrosion protection handbook	Philip A. Schweitzer	ASM	1983
8.	An introduction to Electro-metallurgy	Sharan & Narain	Standard Publisher	1999

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-504 P **Course Title:** Laboratory Practice in Corrosion and Surface Engineering

2. Contact Hours: L: 0 ; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE**: - -

5. Credits: 0 1 **5th Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To gain knowledge about the methods used to evaluate the corrosion characteristics of different materials under different conditions.

7. List of Experiments

S.No:	Experiments
1.	To study the microstructure of a corroded sample.
2.	To understand the working principle of pH meter.
3.	To study the galvanic corrosion of metals by weight loss method.
4.	To study the effect of cathodic protection on given couple of metallic samples.
5.	To study the influence of various inhibitors on corrosion protection.
6.	To understand the working principle of potentiostat. Aqueous corrosion.
7.	To identify the electrochemical corrosion parameters of some metals/alloys.
8.	To study the High temperature oxidation of metals/alloys.
9.	Electroplating Cu, Ni, Cr, etc.
10.	Anodizing of aluminum.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-505 **Course Title:** Extractive Metallurgy of Iron and Production of Ferro- Alloys

2. Contact Hours: L: 2; T: 2; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **5th Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To provide knowledge about iron making from iron ore through blast furnace route and to understand the alternative methods of iron production.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Iron - Raw materials and their preparation. Blast furnace stoves and blast preheating. Blast furnace design, construction and instrumentation. . Thermal and material balance sheets.	14
2.	Burden calculations. B. F. slags and their behavior slag-metal reactions. Modifications, high top pressure, humidification. Oxygen-enriched blasts, solid, liquid and gaseous injection through hot blast, alternative methods of iron production. Sintering and palletizing.	18
3.	Introduction to ferro alloys, Production of ferro-alloys (Fe-Mn, Fe-Si, Fe-Mo,). Alternative methods of iron production such as: DRI, COREX, ROTARY KILN, SHAFT AND STRATEGIC-UDY PROCESSES.	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Production of Iron and Steel Vol.I	G.R. Bashforth	Chapman & Hall	1965
2.	Iron Making	A.K. Biswas	SBA Publications	2005
3.	Iron Making	Tupkary R. H	Khanna Publishers, New Delhi	2008
4.	Sponge Iron Production by Direct Reduction of Iron Oxide	Amit Chatterjee	PHI	2010
5.	High Metal Production by Smelting Reduction of Iron Oxide	Amit Chatterjee	PHI	2010
6.	Physical chemistry of Iron & Steel making	Ward R.G.	ELBS	1999
7.	Physical chemistry of Iron & Steel making	Bodsworth C.	ELBS/Edward Arnold Pub.	1988

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-601 **Course Title:** Powder Metallurgy

2. Contact Hours: L: 2 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **6th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective :

To impart knowledge on principles of metal powder processing and methods to make metal powder based engineering products.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	The importance of Powder Metallurgy.	01
2.	Various methods of producing metal powders. Characteristics of metal powders and their correlation with the various methods of production. Hazards in metals powder production.	08
3.	Testing and classification of powders. Treatment of metal powders prior to compacting - Mixing and conditioning of metal powders.	05
4.	Compacting of cold and hot pressing and their limitations.	05
5.	Design of dies. Rolling, slip casting, forging and extrusion of metal powders. Explosive compaction. Factors influencing the properties of compacts.	04
6.	Sintering - its significance in powder metallurgy, sintering environments, importance of controlled atmosphere for sintering. Sintering equipment and their classification. Factors influencing sintering of metal powders. Techniques of activated sintering. Post sintering operations and the properties of sintered products/ compacts.	10
7.	Various powder products including dense, porous, hard, refractory, magnetic, dispersion strengthened and composite materials.	06
8.	Products for electrical contacts, friction parts etc.	03
	Total	**42**

8. Suggested Books:

S.No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Powder Metallurgy: Science Technology and Applications	Angelo P C & Subramanian	PHI	2008
2.	Powder Metallurgy	Sinha A K	Dhanpat Rai & Sons	1982
3.	Powder Metallurgy of Iron & Steel	German, R M	John Wiley & Sons, NY	1998 1990
4.	Metals Handbook, Vol.7, Powder Metallurgy		Metals Park, Ohio, USA	
5.	Powder Metallurgy Opportunities for Engineering Industries	Ramakrishnan	Oxford and IBH Publishing Co Pvt Ld	1987
6.	Powder Metallurgy Applications, Advantages and Limitations	Erhard Klar	American Society for Metals	1983
7.	Mechanical Alloying	Soni P R	Cambridge International	2002
8.	Powder Metallurgy	Sands and Shakespeare	George Newes Ltd, London	1966

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code**: MME-602 **Course Title:** Electronic, Magnetic and Dielectric Materials

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **6th Semester:** [ ] [√]

Autumn Spring

6. Objective:

To familiarize with various electronic, magnetic and dielectric materials and to study their varied applications.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Free electron theory and its limitations, Metallic conduction and factors affecting conductivity, semi-conductor materials and techniques of processing semi-conductors. Oxidation, diffusion, ion and electron beam, ion implantation, plasma technology etc. MOS, MNOS and SOS etc. technologies, Gas I.C. technologies etc. Doping, Hall effects, p-n junctions etc. Ionic and super-ionic conduction, single crystal growth.	15
2.	Magnetic materials; dia, para, ferro, ferri, anti-ferro, ceramic magnetic materials. Magnetism, theory of magnetism, Hard and soft Magnetic materials, their classification and applications, technology of their production, precipitation hardening magnetic alloys, permanent magnetic materials.	10
3.	Di-electric materials, Piezo,and ferro electric materials, doping and electric breakdowns, ferrites, transformer and switching materials, Optical materials, lasers etc.	07
4.	General discussion on the performance of materials in the development and growth of : - Electrical , electronics and telecommunication equipment/ system, - Energy sector, and - Bio-Medical	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Introduction to Solid State Physics	Kittel	Wiley	2004
2.	Physical Metallurgy Principles	Reed Hill	Affliliated East West Press Pvt Ltd.	2006
3.	Materials Science & Engineering	Raghvan, V	PHI	2008
4.	Theoretical Structural Metallurgy	Cottrell	Arnold	1962
5.	Structure and properties of materials, Vol. IV	Wulff Series	John Wiley	1966
6.	Semiconductors	Smith, R.A	Cambridge University Press	1986

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-603 **Course Title:** Physical Metallurgy

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **6th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To provide the knowledge of structure property correlation regarding different metals and alloys.

7. Details of the Course:

S.No.	Particulars	Contact Hours
1.	Brief review of Structure of metals and imperfections and their influence on the properties of materials. Classification and their influence on the properties of materials. Solid solutions - their characteristics and governing factors Classification - primary, secondary solid solutions and intermetallic compounds.	16
2.	Solidification and nucleation, thermal curves, phase rule and equilibrium diagrams and Iron carbon equilibrium diagram and the crical phenomena. Binary and ternary systems. Eutectic, eutectoid, peritectic, peritectoid, monotectic, and precipitation reactions. Binary system - Cu-Ni, Cu-Zn, Cu-Be, Cu-Al, Al-Zn, Al-Si, Al-Mg, Pb-Sn etc. Isothermal transformation of Fe-C systems. Ternary alloys -white metal, Ni-Silvers fusible alloys. Diffusion in solid state and its mechanism. Laws of diffusion. Kirkendal effect, Factors governing diffusion. Specifications of ferrous and non-ferrous alloys.	26
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Principles of Physical Metallurgy	Reed Hill	Affiliated E-W Press Pvt.Ltd.	2008
2.	Engineering Physical Metallurgy	Lakhtin	MIR Publishers	1998
3.	Introduction to Physical Metallurgy	Avner	Tata Mc Graw Hill	2008
4.	Physical Chemistry Of Metals	Darken & Gurry	CBS	2002
5.	A Textbook on Physical Metallurgy	A K Mitra	CBS	2005
6.	Cast Iron Technology	Tiwan	CBS	2009
7.	Physical Metallurgy- Principles And Practice	V.Raghavan	Prentice Hall Of India	2007
8.	Material Science And Engineering	W D Callister	John Wiley And Sons	2000
9.	Physical Metallurgy	Hansen Peter	Cambridge University Press	1987

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-603P **Course Title:** Laboratory Practice in Physical Metallurgy

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE:** - - **ELSE:** - -

5. Credits: 0 1 **6th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To study the microstructures and to familiarize with the measurement of micro-hardness of different materials.

7. List of Experiments:

S. No.	Experiments
1.	Study BCC, FCC, HCP crystal models (Computer aided studies)
2.	Study of Burgers vector in edge and screw dislocations.
3.	Measurement of Micro-hardness on the surface of a steel specimen.
4.	Stereographic projections - construction of Wulff's net.
5.	Microstructure study of various standard samples of steel, non-ferrous alloys (binary and ternary systems), and cast irons.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-604 **Course Title:** Mechanical Behaviour of Materials

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **6th Semester:** [ ] [√]

Autumn **Spring**

6. Objective:

To develop basic understanding of the response of engineering materials to mechanical loading.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Introduction to elasticity, stress-strain curves, toughness and stiffness.	03
2.	Yield phenomena, Slip-formation of slip line, slip bands, cross slip, twinning.	03
3.	Strain hardening, theories, stress curves for single and poly crystals, effect of grain size, temperature, speed, Bauschinger's effect, texture and preferred orientation.	06
4.	Effect of solutes and precipitates on yield stress and hardening.	02
5.	Influence of defects on the mechanical properties. Recovery, recrystallization and grain growth.	03
6.	Fracture -theory, classification and strength. Ductile to brittle fracture.	05
7.	Testing of materials, principles and its significance, measurement of load, length and deformation. Tests -static, tension and compression, static shear and bending, hardness and impact.	10
08.	Fatigue and creep	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Mechanical Metallurgy	Dieter G E	Mc Graw Hill	1988
2.	Physical Metallurgy	Reedhill	Affiliated E-W Press Pvt.Ltd.	2008
3.	Introduction to Dislocations	D. Hull & D.J. Bacon	Butterworth Heinemann	2001
4.	Mechanical Behavior Of Materials	T.H. Courtney	McGraw Hills	1990
5.	Mechanical Behavior Of Materials	M.A. Meyers & K K Chawla	Prentice Hall	1999

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-604P **Course Title:** Laboratory Practice in Mechanical Behaviour of Materials

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE**: - - **ELSE:** - -

5. Credits: 0 1 **6th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To gain knowledge about the working of different material testing equipments, and principles of testing etc.

7. List of Experiments:

S. No.	Experiments
1.	Tensile test - preparation of a steel specimen and its testing.
2.	Measurement of Brinells Hardness of some alloys/steel specimens.
3.	Testing of a given sample for: a. Rockwell Hardness b. Vickers Hardness.
4.	Determination of the impact strength of a given sample (L.C.Steel, M.C. Steel, H.C.Steel and C.Iron) by Izod and Charpy method.
5.	Cupping Test of a given sheet metal.
6.	Study of the various types of fractures occurring in different materials.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-605 **Course Title:** Joining of Materials

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **6th Semester:** ☐ **Autumn** ☑ **Spring**

6. Objective:

To familiarize with the materials joining processes, principles and the equipments involved therein**.**

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	Principles and classification of joining methods. Some important commercial applications of brazing and soldering.	05
2.	Conventional and special/recent welding practices including submerged, Laser, Plasma, MIG, TIG, Electron beam welding, solid-state welding processes, etc.	05
3.	Welding equipments, Structure of welds and fusion zones.	03
4.	Transformations in parent metal, design of weldments, slag-metal equilibria, gas pick up by welds and its influence. Weld cracking and its prevention. Preheating of base metals. Preheating temperature etc. Heat treatment of welds. Testing and quality control of welds-Macro and micro examinations etc.	15
5.	Metallurgical aspects of welding. Weld defects and testing. Joining of metals and non metallic materials (Adhesive joining).	10
6.	Weldability of carbon, stainless steel and other alloy steels, cast irons, Cu, Al, Ti and their alloys, etc. ISI and other specifications.	04
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Modern Welding Technology	Howard B Cary, Helzar S.	Pearson Prentice Hall	2005
2.	Manufacturing Engineering And Technology	Kalpakjian R.S. Steven	Prentice Hall	2001
3.	Welding Engineering And Technology	R.S. Parmar	Khanna Publishers	2002
4.	Welding Technology	Gower A. Kennedy	Macmillan Publishing Company	1974
5.	Welding – Principles And Application	Larry Jeffus	Delmar Thomson Learning	1999
6.	Principles Of Welding	Robert W Messler	John Wiley Sons	1999

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-605P **Course Title:** Laboratory Practice in Joining of Materials

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **MSLE:** - - **ELSE**: - -

5. Credits: 0 1 **6th Semester:** [ ] Autumn [√] Spring

6. Objective:

To gain knowledge about the various joining methods and the working of equipments involved.

7. List of Experiments:

S. No.	Experiments
1.	Preparation and joining of two surfaces by soldering and brazing.
2.	Welding of cast irons, Aluminum, Copper and their alloys.
3.	Arc Welding of steel parts/welding to fill a hole in a steel trough.
4.	Gas welding of a given sample.
5.	Macro and Micro- examination of a welded joint.
6.	Determination of the strength properties of a welded joint and weld defects.
7.	Heat-treatment of a weld.
8.	Welding by other modern techniques for which facilities may be available.
9.	Welding of dissimilar metals i.e. Steel, cast iron, Stainless Steel, Mild steel, etc.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-606 **Course Title:** Composites

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **6th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To impart basic knowledge about the preparation, characterization, and applications of composite materials.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	An introduction to composites.	02
2.	Theoretical and actual strength of solids. Cleavage and shear strength, strength of bulk metals and fibres, etc.	06
3.	Strengthening Mechanisms in composites. Fibre composites, various types of fibres elastic fibres. Elastically and plastically deformable matrix.	06
4.	Effect of fibre orientation on composite strength. Fracture of fibres/ matrix/ composites.	05
5.	Dynamic properties of composite materials - fatigue, creep, high temperature properties, etc.	06
6.	Production of some commercially important composite materials (Resin matrix, ceramic matrix and metal matrix, reinforced plastics, glass fibre and carbon fibre). Directional solidification of eutectic, etc. Joining of composites.	06
7.	Applications of composite materials; civil construction of	04
8.	structure/panels, aerospace industries, automobiles and other surface transport industries, sports components etc.	07
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Composite Materials	Chawla K K,	Springer Verlag, New York	1998
2.	Composite Materials: Engineering & Science	Mathews F L and Rawlings R D	Chapman & Hall , London	1994
3.	Ceramic Matrix Composites	Chawla K K	Chapman and Hall, UK	1993
4.	Modern Composite Material	Broutman L J, and Krock	Addison Wesley Publishing Company	1967
5.	Composite Materials: Science and Applications	Deborah Chung D	Springer International, USA	2004
6.	"Composites" Metals Hand Book Vol.21, 9th Edition		ASM	1989

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code**: MME-607 **Course Title:** Tour, Training and Professional Interview

2. Contact Hours: L: 0 ; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 2 **6th Semester:** [ ] [√]

Autumn **Spring**

6. Objective:

To gain practical knowledge about the actual working of the industries, processes involved and the functioning of the industrial equipments etc.

7. Details of the Course:

S.No	Particulars
1.	Each student will be required to undertake practical training during the winter vacations for about 10-16 weeks in metallurgical industries. Each student will submit a training report in the department and give details of the jobs he was assigned during the practical training at the industry where he has taken such practical training. Separate report for the training taken at different industries will be required to be submitted by each candidate.
2.	The students will also be required to go for a long industrial/educational tour to visit various industries and educational Organizations of Metallurgical concern. Each student will submit a tour report on completion of the tours.
3.	The tour and training report as submitted by each student will be assessed by the staff members and evaluated for sessional awards.
4.	A viva-voce examination will be conducted by an External Examiner for assessment of Tour and Training undertaken by each student and for his/her professional achievements, Group discussing during the 7^{th} and 8^{th} semester course work.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: HSS-701 **Course Title:** Industrial Economics & Management

2. Contact Hours: L: 2; T: 1; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To gain knowledge about the concepts involved in industrial economics and management.

7. Details of the Course:

S. No.	Particulars	Contact Hours
1.	INDUSTRY: Introduction to industry, Industrialization, Benefits of industrialization. Economics and social effects of industrialization. MANAGEMENT: Meaning of management, functions and principles of management, industrial change and development.	08
2.	MANAGEMENT OBJECTIVES: Defining management objectives, Testing of objectives, Primary, secondary and social objectives of management.	07
3.	PERSONNEL MANAGEMENT: Importance of personnel management. Main functions of personnel department. Selection, training and placement of manpower resources. ECONOMIC SCIENCE: Division of economics and development of economic life	09
4.	CONSUMPTION: Nature of human wants and their satisfaction - utility, law of diminishing marginal utility, Law of demand and supply, elasticity of demand.	06
5.	PRICE DETERMINATION: Concept of markets, - competent and monopoly markets - price and output determination under perfect competition and monopoly.	07
6.	PRODUCTION: Meaning of production, production function, laws of production.	05
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books/Publisher	Author(s)	Publisher	Year of Publications
1.	Elementary Economic theory	K.K. Dewett and JD. Verma	Premium Pub. Co.	1964
2.	Indian Economics	K.K. Dewett & J.D.Verma	S. Chand	1971
3.	Introduction to Economics	M.L. Seth	L.N. Agarwal	1964
4.	Principles of Management	George Terry	R.D. Irwin	1977

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-702 **Course Title:** Steel Technology

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ ☐

Autumn Spring

6. Objective:

To understand the basic principles of steel making

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Brief history and earlier methods of steel making. Mixers and their merits. Desiliconization and desulphurization of B.F iron.	06
2.	Steel making by Bessemer and side blown converters O.H and Duplex/Triplex methods, Electric-Arc and Induction processes. Basic oxygen processes -L.D KALDO, ROTOR, LDAC, and top and bottom blown practices.	10
3.	Physico-Chemical principles of each of the above practices. Inclusions in steel. Deoxidation and vacuum treatment of steels.	05
4.	Electroslag refining. Ingot mould and base plate preparation for casting. Steel casting practice. Ingot defects and their control. Continuous casting practice of steel and its merits. Principles and production of alloy steels - HSLA, Tool and die, stainless, spring, magnetic and silicon steels etc.	15
5.	Recent trends in plain and alloy steel technology. Instrumentation in steel works. Indian Steel plants and practices.	06
	Total	**42**

8. Suggested Books:

S.No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Iron Making and Steel Making – Theory and practice	Ahindra Ghosh and Amit chatterjee,	PHI	2008
2.	Introduction to Modern Steel Making	Tupkary,R.H.	Khanna Publications, New Delhi	1994
3.	The Making, Shaping and Treating of Steel	Richard J Fruchal	AISE Steel Foundation	1998
4.	Manufacture of Iron and Steel, Vol 2	Bashforth, GR	Chapman & Hall, London	1965
5.	Introduction to Steel making	R.H.Tupkari	Khanna Publishers	2004
6.	Physical Chemistry of Iron and Steel Making	R.G.Ward	Edward Arnold Publications	1999
7.	Physical Chemistry of Iron and Steel Making	C.Bodswarth	Edward Arnold Publications	1988

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-703 **Course Title:** Phase Transformation and Heat Treatment of Materials

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): **Theory:** - - **Practical**: - -

4. Relative Weightage: **M-I**: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To develop understanding of phase transformations in metals and alloys and to give insight into the microstructural changes occurring due to different heat treatments.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Importance of heat treatment, different types of heat treatment processes and their application.	04
2.	Surface hardening treatments.	02
3.	Alloying elements - their effects on Fe-C system.	06
4.	Heat treatment -various processes and their applications.	08
5.	Harden-ability - its significance and factors affecting harden-ability. Case hardening - various processes and their applications. Associated phase transformations.	08
6.	Heat treatment of plain carbon and alloy steels, Non-ferrous alloys (Al, Cu, Ni and Co base alloys, bearing alloys, etc.). Plain and alloy cast irons and their heat treatment.	10
7.	Phase transformations, classification, mechanics, thermodynamics, and kinetics of solid state transformations.	04
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Principles of Physical Metallurgy	Lakhtin	MIR Publications	1988
2.	Heat Treatment Principles and Techniques	Rajan and Sharma	Prentice Hall of India (P) Ltd,	2004
3.	Handbook of Heat Treatment of Steels	Prabhudev, K H.	Tata - McGraw Hill Publishing Co.	2000
4.	Heat Treatment of Metals	Vijendra Singh	Standard Publishers Distributors,	1998
5.	Metals Handbook Vol.4	American Society for Metals	ASM Metals Parks, Ohio, USA	2001
6.	Steel and its Heat Treatment	Karl-Erik Thelning	Butterworths London	1984
7.	Theory of Heat Treatment of Metals	Novikov I	MIR Publishers, Moscow	1978
8.	Phase transformations in metals and alloys	Porter & Easterling	Chapman and Hall, London	1997

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-703 P **; Course Title:** Laboratory Practice in Phase Transformation and Heat Treatment of Materials

2. Contact Hours: L:0 ; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ESLE:** - -

5. Credits: 0 1 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To gain practical knowledge about the effects of various heat treatment on the structure and properties of materials.

7. List of Experiments

S.No:	Experiments
1.	Jominy-end-Quench test for determination of harden ability
2.	Effect of the heating time and temperature, and cooling rate on the structure & properties of alloys.
3.	Study of the isothermal transformations in Fe-C systems
4.	Annealing and normalizing of alloys.
5.	Case carburizing, nitriding, cyaniding, & flame hardening
6.	Heat treatment of tool steels.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. **Subject Code:** MME-704 **Course Title:** Mechanical Working of Materials

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II:** - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ ☐

Autumn Spring

6. Objective:

To familiarize with the fundamentals involved in understanding the response of engineering materials to mechanical loading and to understand basics of different metal working processes, equipments involved etc.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	**Metal working:** Classification of metal working(forming processes, mechanics of metal working, flow stress determination, temperature in metal working, effect of strain rates, metallurgical structure. Friction and lubrication. Workability, residual stresses.	10
2.	**Rolling:**, classification of rolling processes, rolling mills, hot roling and cold rolling, rolling of bars and shapes, defects in roled products.	04
3.	**Extrusion:-** classification of extrusion processes, extrusion equipment, hot extrusion and cold extrusion, defect in extruded products.	04
4.	**Forging:-** classification of forging processes, forging equipments, open die and closed die forging, forging die materials, forging defects.	03
5.	**Drawing of rods, wires and tubes**. Rod wire and tube drawing processes, drawing equipments, defects in rods wires and tubes. High velocity forming, press forming of metals - principles, processes and equipments. Analysis of forces operative during various metal	06

	working processes.	
6.	**Sheet Metal forming:-** Forming methods; shearing, blanking, bending, stretch forming, deep drawing, super plastic forming, defects in formed parts.	04
7.	**Non-conventional Forming Methods:-** Explosive Forming, Magnetic Forming, Electric discharge forming, Laser Forming.	05
8.	**Polymer Working Processes:-** Extrusion, Molding, Thermoforming Principle, processes and Equipment employed	06
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Mechanical Metallurgy	Dieter	Mc Graw Hill	1988
2.	Metals Handbook, Vol.14, Forming and Forging		Metals Park, Ohio, USA	2001
3.	Handbook of Metal Forming	Kurt Lange	Society of Manufacturing Engineers, Michigan	1988
4.	Metal Forming Fundamentals and Applications	Tylan Altan, Soo Oh, Harold Gegel	ASM, Metals Park, Ohio, USA	1983
5.	Mechanical Treatment of Steel,Vol.4	Bashforth G R	Chapman & Hall	1968

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-704 P **Course Title:** Laboratory Practice in Mechanical Working of Materials

2. Contact Hours: L: 0; T: 0; P: 2

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: MSLE: - - **ELSE:** - -

5. Credits: 0 1 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To familiarize the students with the construction and working of different metal working equipments and to perform different tests.

7. List of Experiments

S. No:	Experiments
1.	To perform fatigue testing and drawing of S-N Curves
2.	To perform the Stress - Rupture Test.
3.	Study of the construction and working of a creep testing machine.
4.	To perform wire drawing operation.
5.	To perform rolling of materials.
6.	To perform the forging operation.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MTH-703E **Course Title:** Operation Research (Elective-I)

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II:** - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To familiarize with the fundamentals of operations research and its associated fields.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Nature and Development of Operations Research	05
2.	Problem formulation, Linear Programming Problem, Graphical Method, Simplex Method, Two phase, Simplex Method.	12
3.	Big M method, Transportation and Assignment Models. Replacement	10
4.	Models - Simple Problems. Game Theory: Two person Zero Sum Game. Sequencing Models- Processing n-jobs through two Machines, Processing n-jobs through three machines.	09
5.	Queuing Theory: Single- Channel Poisson Arrivals with Exponential Service (M/M/I) Model.	06
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Linear programming	S.I. Gass	Mc-Graw Hill	1994
2.	Operations Research An Introduction	Hamidi A.Taha	Pearson Education Prentice Hall	2005
3.	Theory of Games and Linear Programming	S.Vajda	John Wiley & Sons	1960
4.	Operation research	Kanti Swarup & P.K.Gupta	Sultan Chand and Sons	2007

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-706E **Course Title:** Ceramic, Glass and Polymer Technology (Elective-I)

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

This course aims at providing the fundamental knowledge about ceramics, glasses and polymers, and to understand their processing, properties and applications.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	**Ceramics:-** Introduction to ceramics, structural characteristics of ceramic materials, crystal binding, structural imperfections, phase equilibria and microstructure of ceramic system. High temperature reactions and their kinetics. Classification and applications of ceramic materials. Ceramic powders - their preparation, characterization, mixing and compaction, various methods of forming ceramic products. Calcination, firing and finishing of ceramic products, glazing and enameling. White wares, abrasives etc. Testing and quality control of ceramic products. Synthesis of advanced ceramic materials like PSZ, Si-N, Si-C, Alumina, etc.	20
2.	**Glass:-** Classification of glass, glass manufacturing and finishing operations. Factors influencing glass formation. Structure of glass. Mechanical, electrical, thermal, optical and other important properties of glasses. Applications of glasses.	12
3.	**Polymers:-** Classification of Polymers, Properties of polymers, Methods of Polymerization, common polymer resins such as phenolic resins, Amines resins, epoxy resins, and polyesters.	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Polymer Science	Gowariker, Viswnathan, Jayadev Sreedhar	New Age International Ltd.	2005
2.	Fundamentals of Ceramics	Michael Barsoum	McGraw Hill Publishing Co.	1997
3.	Foundations of Materials Science and Engineering	William F.Smith	McGraw-Hill Inc, New York	1993
4.	Introduction to Fine Ceramics	Nobuka Ichinose	John Wiley	1987
5.	Composite Materials: Engineering & Science	Mathews and Rawlings	Chapman & Hall, London,	1994
6.	Ceramic Matrix Composites	Chawla K K	Chapman and Hall, UK	1993
7.	Modern Composite Materials	Broutman and Krock	Addison Wesley Co.	1967
8.	Physical Ceramics for Engineers	VanVlack K H,	Addison Wesley Co.	1964
9.	Introduction to Ceramics	Kingery, W D	John Wiley, USA	1960
10.	Modern Ceramic Engineering-properties, processing and use in design.	David W. Richerson	Marcel Dekker, Inc.	1992
11.	Introduction to the principles of ceramic processing.	Reed J.S	Wiley Interscience	1988

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-707E **Course Title:** Metallurgy of Nuclear Materials (Elective-I)

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II:** - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To provide the knowledge about various nuclear processes and to study the different radio-active materials.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Structure of nucleus.	04
2.	Radioactivity, Fusion and fission.	06
3.	Nuclear reactors and the construction, Nuclear power production- Indian Scenrio.	08
4.	Nuclear materials -Fuels elements, moderators, coolants, reflectors, control rods and other structural materials. Cannon materials and their properties. Production of nuclear grade metals- U, Th, Zr, Nb and Ta etc processing of spent fuel.	12
5.	Radiation growth theories, Radiation damage, radiation hazards etc. Radio isotopes and their uses, Disposal of radioactive wastes, Occurance and processing of nuclear materials in India.	10
	Total	**40**

8.Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Materials in Nuclear Applications-vol.1,	Gupta C K	CRC	1989
2.	Nuclear Fuel Elements: design fabrication and performance	Frost	Pergamon	1982
3.	Fundamental Aspects of Nuclear Reactor Fuel Elements	Olander D R	NTIS	1976
4.	Nuclear Reactor Fuel Elements, Metallurgy and Fabrication	Kaufman A R,	John Wiley	1962

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-708E **Course Title:** Transport Phenomena in Metallurgical Processes (Elective-I)

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (**Autumn**) ☐ (**Spring**)

6. Objective:

To familiarize with the fundamentals of heat, mass and momentum transfer in various metallurgical processes.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Mass transfer processes and Metallurgical Kinetics-Rate controlling step. Diffusion- Laws of diffusion; steady state one dimensional; Pseudo-steady state diffusion; unsteady state diffusion. Diffusion in gases, liquid and solid. Convection and Mass Transfer in Fluids under Laminar and Turbulent flow. Mass transfer between a fluid and a solid. Boundary Layer – Mass Transfer Coefficient. Fluid flow viscosity, Differential mass and momentum balances.	08
2.	Variables K-influencing Dimensionless groups in Mass Transfer – Analytical, Solution of Mass Transfer co-relations. Mass Transformer between two fluids – film and Boundary Layer Theories, Surface renewed theory of Mass transformer. Theory of reaction rates. Mass transfer processes, convective mass transfer, concept of mass transfer coefficient.	10
3.	Gas-solid and gas liquid interfacial reaction – Adsorption – Slow surface reactions in high temp. metallurgy. Thermodynamics activity of absorbed atomic species. Reaction kinetics, Basic definition and concepts, reaction rate theories, Slag Metal Reaction – Electrochemical Kinetics at High Temp. Nucleation and growth – Homogeneous and Heterogeneous Nucleation – Nucleation of CO	14

4.	Bubbles in molten iron and in de-oxidation of steel. Diffusivity and mechanism of diffusion. Some special topics- Diffusion of gases through porous solid. Role of Merangoni Effect in Fluid Mass Transfer. Heat Transfer and Reaction Rates. Heat conduction equations and their applications. Convective heat transfer and radiative heat transfer.	08
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Basic Fluid Mechanics	Kothandaraman C.P. and Rudramoorthy, R.	New Age International	1998
2.	Fundamentals of Engineering Heat and Mass Transfer	Sachdeva, R C	New Age International	1996
3.	Fundamentals of heat and Mass Transfer	Kothandaraman C P	New Age International	1997
4.	Transport Phenomena	Byron Bird R, W E Shawart	John-Wiley & Sons Inc.	1994
5.	Introduction to Fluid Mechanics	Robert, W Fox	John Wiley & Sons	1994
6.	Mechanics of Fluids	Irving H Shames	McGraw Hill, New York	1992
7.	Transport Phenomena	Bird R.B, Stewart E.S and Light foot	John Wiley & Sons	2002
8.	Transport Phenomena in Metallurgy	Geiger GH and Poirier DR	Addison Wesley	1973
9.	Rate Processes in Metallurgy	Mohanty AK	PHI	2000

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-708E **Course Title:** Chaotic dynamical systems and control (Elective-I)

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM**: - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

This course aims at providing the fundamental knowledge about chaotic dynamical systems and control.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Principles of dynamical systems: orbits, fixed and periodic points, bifurcations, transition to chaos, Feigenbaum's constant, Sarkovskii's theorem, period 3 window; The role of critical orbits: the Schwarzian derivative, Stability of fixed l points and basin of attraction	
2.	Models of controlled systems and controlled goals	
3.	Methods of controlling chaos: Feed forward control: piecewise constant dither control; OGY method: linearization of Poincare' map; Delayed feedback-method of time-delayed feedback; Linear and nonlinear control- Open plus closed loop (OPCL), SG method based on Lyapunov function; Adaptive Control- direct or indirect (identification- based) parametric adaptive control;	21
4.	Discrete time control: low-order examples	
5.	Neural networks in the field of chaos control	
6.	Generation of chaos: chaotization in multidimensional discrete systems; dynamics of variation of chemical potentials in multidimensional system and slow approach to equilibria	
7.	Chaotic mixing: mixing of stirred fluids, increasing rate of mixing by increasing chaoticity	
8.	Fractals: iterated function systems	21
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Non-linear dynamics and chaos	Steven H, Strogatz	Westview Press, USA ; marketed in India by Levant Books, Kolkata	2007
2.	An Exploration of Chaos	J Argyris, G Faust, M Hasse	North Holland, Amsterdam	1994
3.	Introduction to Applied Non-linear Dynamical Systems and Chaos	Stephen Wiggins	Springer, NY	2003
4.	An introduction to Difference Equations	Saber Elyadi	Springer, NY	2005

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-709 **Course Title:** Literature Survey of Project Work

2. Contact Hours: L: 0 ; T: 3; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: SYNP: - - **PRE:** - -

5. Credits: 0 2 **7th Semester:** √ (Autumn) ☐ (Spring)

6. Objective:

To carry out the basic work with regard to the literature survey, preparation of design and fabrication of the experimental set up etc, list of required consumable and non-consumable items etc.

7. Details of the Course:

S. No	Particulars
1.	Each student will undertake a project work, involving complete literature survey, design and fabrication of some working process models, and /or a laboratory experimentation, and presentation of results, under the supervision of a faculty members to be fixed in a meeting of the faculty members of the department keeping in view the students choice of project topic, their aptitude, facilities available and the availability of staff.
2.	The project will be assigned before the conclusion of the 6th semester examination and students will start working on literature survey etc., when 7th semester classes commence. A write-up and a complete list of consumables and non-consumable items to be needed by each student to complete the project work will be submitted to the teacher concerned in a fairly typed form for assessment and for arranging the materials from the market, if necessary, so that the practical work is started just at the commencement of the 8th semester classes. Each student will submit a complete literature survey of the project work assigned to the concerned supervisor for assessment.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code**: MME-710 **Course Title:** Guided Reading, Group Discussion and Seminar

2. Contact Hours: L: 0 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: [-][-] **Practical**: [-][-]

4. Relative Weightage: GD: [-][-] **WUP:** [-][-] **PRE:** [-][-]

5. Credits: [0][1] **7th Semester:** [√] **Autumn** [ ] **Spring**

6. Objective:

To prepare the students for the group discussions, preparation of talks/seminar etc.

7. Details of the Course:

S.No	Particulars
1.	A co-curricular activity based on guided reading and seminar talks. This will involve a detailed study of a topic of interest production in the candidates own style. Each student will be required to give seminar talks on the subject of interest. The handouts of the talks will be submitted by the student before the talk is delivered. These seminar talks will prepare the students for proper survey of literature, compilation of information so gathered and presentation of the same to the audience. The handouts submitted by the students will be in accordance with the standard of technical papers.
2.	The award of sessional will be based upon the preparation and presentation of seminar talks and performance in the group

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-801 **Course Title**: Foundry Technology

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **8th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To familiarize with the fundamentals of foundry technology principles, casting processes, equipments etc.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Introduction: Application and advantages of types of foundries.	03
2.	Moulding sands-classification and testing, core sands. Binding, parting and facing materials, additives.	05
3.	Patterns: Classification and design, pattern allowance.	05
4.	Core making equipment and processes.	03
5.	Gating & risering.	03
6.	Cupola & other Melting furnaces. Manufacture of cast iron, malleable iron, S.G. Iron -Gray cast iron. Classification and distribution of flake size and shape in gray cast iron.	06
7.	Melting, alloying, casting of non-ferrous alloys. Steel foundry practice, moulding and casting. Classification of casting methods and equipments used.	05
8.	Solidification processes-Directional solidification etc. Casting defects.	06
9.	Cleaning, Inspection, quality control and salvaging of castings.	03
10.	Quality control and testing of castings.	03
	Total	**42**

8. Suggested Books:

S.No	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Principles of Metal Casting	Heine R W., Loper, C.R. Rosenthal	Tata-McGraw Hill Publishing Co Ltd	1995
2.	Principles of Foundry Technology	Jain P.L	Tata McGraw Hill	1995
3.	Metal Casting : Principles and Practice	Ramana Rao T V.	New Age International Publishing	1996
4.	Foundry Engineering	Srinivasan N K.	Khanna Tech Publications	1994
5.	ASM Metals hand Book, Vol 15, Casting		ASM International	2001
6.	Foundry Technology	Beeley P R.	Butterworths, London	1982
7.	Fundamentals of metal casting technology	Mukherjee P.C.,	Oxford and IBH Publishing House	1996

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1. Subject Code: MME-801 P **Course Title:** Laboratory Practice in Foundry Technology

2. Contact Hours: L:0; T: 0; P: 2

3. Examination Duration (Hrs): Theory: [-][-] **Practical**: [-][-]

4. Relative Weightage: MSLE: [-][-] **ESLE:** [-][-]

5. Credits: [0][1] **8th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To familiarize with the conduct of various tests on the foundry sands, moulds and castings.

7. List of Experiments

S.No:	Experiments
1.	AFS Sieve analysis of foundry sands
2.	Sand testing: determination of: a. Moisture content b. Clay content c. Permeability d. Flowability e. Hot strength f. Refractoriness
3.	Mould testing: Determination of: a. Green strength b. Dry strength c. Collapsibility d. Hardness e. Tensile & compression strength
4.	Moulding & casting: a. Preparation of moulds b. Melting, degassing, defluxing & grain refinement c. Making of castings d. Inspection & Testing

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-802 **Course Title:** Failure Analysis

2. Contact Hours: L: 4; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 5 **8th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To understand the basic fundamentals responsible for the failure of materials and to identify the fracture surfaces.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Engineering aspects of failure and failure analysis.	02
2.	Fundamental sources of failures.	02
3.	General practice in failure analysis.	06
4.	Toughness and fracture – mechanics.	06
5.	High and low temp. failures. Mechanisms of and the influence of structural environmental parameters on failure. Identification of types of failure.	10
6.	Service failures of cold formed parts, forgings, castings, weldments.	10
7.	Case studies - failures in power plants, etc.	06
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books/	Author(s)	Publisher	Year of Publication
1.	Deformation and fracture mechanics of Engineering materials	Hertz berg R W	John wiley & sons, New York	1983
2.	Fundamentals of Fracture mechanics	Knott. J.F	Bullerworths London	1973
3.	Fracture Mechanics	Evalds H L and RJH Warnhil	Edward Arnold Ltd, Baltimore,	1984
4.	Applications of Fracture Mechanics for the selection of Materials	Campbell, Underwood J H, and Gerberich W	American Society for Metals, Metals Park Ohio	1982
5.	Metallurgy of Failure Analysis	Das A.K.	Tata Mc Graw Hill	1992
6.	Analysis of Metallurgical Failures	Colangelo V.A.	John Wiley	1985
7.	Testing of Metallic Materials	Suryanarayana AVK	PHI	1979

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-803 **Course Title:** Entrepreneurship Development and its Scope in Metallurgy

2. Contact Hours: L: 2 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 3 **8th Semester:** ( ) **Autumn** (√) **Spring**

6. Objective:

To gain basic knowledge about the procedures and formalities involved in the setting up of industries, marketing management and other related issues.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Entrepreneurship Development: Characteristics of entrepreneurs.	04
2.	Entrepreneurship - Risks and rewards, Role of society, self assessment, motivation and human behaviour etc in entrepreneurship development qualities.	08
3.	Business exercises. Forms of business organizations and formation of companies. Procedures and other formalities for setting up of new Industries, incentives, subsidies and concessions available for industries.	10
4.	Various Institutions and Organizations for promotion of industrial development sources of financial assistance.	06
5.	Identification of opportunities for setting industries, Techno-economic feasibility studies, Financial viability, and ratios assessment for fixed and working capitals, project scheduling.	06
6.	Marketing management, consumer behavior, demand and supply, projections, predictions and forecasts.	04
7.	Industrial laws. Factory wages, and workmen compensation acts. Preparation of a project Report.	04
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Entrepreneurship	Robert D Hisrich, Michael P Peters and Dean Shepherd	Tata McGraw Hill	2007
2.	Entrepreneurship – Successfully Launching New Ventures	Bruee R Barringer and Duane Ireland	Prentice Hall	2006
3.	Entrepreneurship in Action	Pearson Mary Coulter	Prentice Hall of India	2006
4.	Entrepreneurship– Strategies and Resources	Marc J Dollinger	Pearson Education	2003

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-804E **Course Title:** Polymer Technology (Elective-II)

2. Contact Hours: L: 3 ; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **8th Semester:** [ ] **Autumn** [√] **Spring**

6. Objective:

To familiarize with the fundamentals of polymers.

7. Details of the Course:

S.No	Particulars	Contact Hours
1.	Polymer and their characterization.	05
2.	Polymer chemistry, polymerization its kinetics and mechanism.	05
3.	Physical and Mechanical properties of polymerization. Polymer isotics Reactions and their design. Rheology of polymers.	12
4.	Physical properties, Testing and applications of polymeric materials. Polymer processing equipment and unit operations.	10
5.	Introduction to resins, rubber and plastics, their properties and applications. Introduction to inorganic and some special type of polymers	10
	Total	**42**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publication
1.	Polymer Science	Gowariker , Viswnathan, Jayadev Sreedhar	New Age International Ltd.	2005
2.	Foundations of Materials Science and Engineering	William F. Smith	McGraw-Hill Inc, New York	1997
3.	Plastics: Materials and processing	Brent Strong A	Prentice-Hall, New Jersey	2000
4.	Polymer Processing	Morton-Jones D.H	Chapman and Hall, New York	1989
5.	Plastic Materials	Brydson J A	Butterworths, London	2004

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-805 E **Course Title:** Metallurgy and Application of Super Alloys (Elective-II)

2. Contact Hours: L: 3; T: 1; P: 0

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: M-I: - - **M-II**: - - **ASM:** - - **ME:** - - **PRE:** - -

5. Credits: 0 4 **8th Semester:** [ ] Autumn [√] Spring

6. Objective:

To familiarize with various super-alloys and their applications.

7. Details of the Course:

S. No	Particulars	Contact Hours
1.	Historical review, Classification of Super alloys based on Fe, Co and Ni, specifications, preparation and physical characteristics of super alloys, Role/effect of alloying elements.	12
2.	Applications of super alloys. Influence of aggressive environments such as those involving chlorine and sulfurs.	08
3.	Structural ceramics, their properties and advantages over conventional high temperature materials and super alloys.	10
4.	Structural ceramics based on Oxides (Alumina, Zirconia and Thoria etc) and Non-Oxides (Carbides, Nitrides, Silicides, etc). Their synthesis, properties and applications.	10
	Total	**40**

8. Suggested Books:

S. No.	Name of the Books	Author(s)	Publisher	Year of Publications
1.	Powder Metallurgy of Super alloys	G.H. Gessinger	Butterworths Monographs	1984
2.	Modern developments in Powder Metallurgy Vol. 1 & 5	E. N. Aqua , C. I. Whitman	Metal Powder Industries Federation	1985
3.	Super Alloys "A Technical Guide"	Mathew J. Donachie, Stephen J. Donachie	ASM International	2002
4.	Super alloys " Fundamentals and applications"	Roger C.Reed	Cambridge University Press	2006

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

NAME OF DEPARTMENT : Metallurgical & Materials Engineering

1**. Subject Code:** MME-806 **Course Title:** Project Work and Project Viva

2. Contact Hours: L: 1 ; T: 1; P: 6

3. Examination Duration (Hrs): Theory: - - **Practical**: - -

4. Relative Weightage: INTASM: - - **PR:** - - **PRE:** - - **VV:** - - **EE:** - -

5. Credits: 1 0 **8th Semester:** [ ] Autumn [√] Spring

6. Objective:

To familiarize the students with the preparation of project proposals, collection of literature, conduct of experimental work, analysis of data and presentation of results etc.

7. Details of the Course:

S. No	Particulars
1.	Each student will undertake a project work, involving complete literature survey, design and fabrication of some working process models, and /or a laboratory experimentation, and presentation of results, under the supervision of a faculty members to be fixed in a meeting of the faculty members of the department keeping in view the students choice of project topic, their aptitude, facilities available and the availability of staff.
2.	The project will be assigned before the conclusion of the 6th semester examination and students will start working on literature survey etc when 7th semester classes commence. A write-up and a complete list of consumables and non-consumable items to be needed by each student to complete the project work will be submitted to the teacher concerned in a fairly typed form for assessment and for arranging the materials from the market, if necessary, so that the practical work is started just at the commencement of the 8th semester classes. Final project report will be submitted by each student after making a presentation of his results/findings etc before his/her supervisor and other faculty members. Final assessment of his/her project work will be done on the basis of a viva-voce examination by an external examiner.