

*Heaven's Light is Our Guide*

**Department of Material Science and Engineering  
Faculty of Mechanical Engineering**



**Rajshahi University of Engineering & Technology**

**Proposed Syllabus**

**for**

**The Degree of Bachelor of Science (B.Sc.) in  
Material Science and Engineering**

## Summary of Courses for the Undergraduate Studies

### 1<sup>st</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact hours/ Week	Credits
<b>Theory Courses</b>				
1.	Phy 1131	Physics	3.00	3.00
2.	Math 1131	Calculus and Differential Equation	3.00	3.00
3.	Hum 1131	Industrial Economics and Fundamentals of Sociology	3.00	3.00
4.	EEE 1191	Electrical Circuits	3.00	3.00
5.	MSE 1101	Introduction to Material Science & Engineering	3.00	3.00
<b>Sessional Courses</b>				
6.	Phy 1132	Physics Sessional	3.00	1.50
7.	EEE 1192	Electrical Circuits Sessional	3.00	1.50
9.	ME 1150	Engineering Graphics	3.00	1.50
10.	MSE 1102	Introduction to Material Science & Engineering Sessional	1.50	0.75
<b>Total</b>			25.50	20.25

### 1<sup>st</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
<b>Theory Courses</b>				
1.	Chem 1231	Chemistry	3.00	3.00
2.	Math 1231	Vector Analysis and Matrices	3.00	3.00
3.	CSE 1291	Programming Language and Data Structure	3.00	3.00
4.	Hum 1231	Communication English	3.00	3.00
5.	ME 1259	Engineering Mechanics	3.00	3.00
<b>Sessional Courses</b>				
6.	Chem 1232	Chemistry Sessional	3.00	1.50
7.	CSE 1292	Programming Language and Data Structure Sessional	1.50	0.75
8.	Hum 1232	Communication English Sessional	1.50	0.75
9.	MSE 1200	Computer Fundamentals and Ethics	1.50	0.75
10.	ME 1250	Computer Graphics	3.00	1.50
<b>Total</b>			25.50	20.25

## 2<sup>nd</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
<b>Theory Courses</b>				
1.	Math 2131	Statistics, Numerical and Power Series	3.00	3.00
2.	MSE 2101	Crystallography and Structure of Materials	3.00	3.00
3.	MSE 2103	Phase Transformation of Materials	3.00	3.00
4.	ME 2159	Basic Mechanical Engineering	3.00	3.00
5.	ME 2169	Fluid Mechanics and Machinery	3.00	3.00
<b>Sessional Courses</b>				
6.	MSE 2102	Crystallography and Structure of Materials Sessional	3.00	1.50
7.	MSE 2104	Metallography Sessional	3.00	1.50
8.	ME 2160	Basic Mechanical Engineering Sessional	1.50	0.75
9.	ME 2170	Fluid Mechanics and Machinery	1.50	0.75
<b>Total</b>			24.00	19.50

## 2<sup>nd</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
<b>Theory Courses</b>				
1.	Hum 2231	Industrial Law and Accounting	3.00	3.00
2.	MSE 2211	Crystal Defect, Deformation and Fracture	3.00	3.00
3.	MSE 2221	Strength of Materials	3.00	3.00
4.	ME 2259	Heat and Mass Transfer	3.00	3.00
5.	EEE 2291	Electrical Machines and Electronics	3.00	3.00
<b>Sessional courses</b>				
6.	MSE 2220	Materials & Metallurgical Analysis	3.00	1.50
7.	MSE 2212	Crystal Defect, Deformation and Fracture Sessional	3.00	1.50
8.	MSE 2222	Application to Computers in Strength of Materials	1.50	0.75
9.	EEE 2292	Electrical Machines and Electronics Sessional	1.50	0.75
<b>Total</b>			24.00	19.50

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### 3<sup>rd</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	GCE 3159	Glass and Ceramics Engineering	3.00	3.00
2.	MSE 3131	Surface Engineering of Materials	3.00	3.00
3.	MSE 3133	Refractories and Furnaces	3.00	3.00
4.	MSE 3135	Iron and Steel Making	3.00	3.00
5.	MSE 3141	Metal Extraction and Refining	3.00	3.00
<b>Sessional Courses</b>				
6.	GCE 3160	Glass and Ceramics Engineering Sessional	3.00	1.50
7.	MSE 3132	Surface Engineering of Materials Sessional	1.50	0.75
8.	MSE 3134	Refractories and Furnaces Sessional	3.00	1.50
9.	MSE 3142	Metal Extraction and Refining Sessional	1.50	0.75
<b>Total</b>			24.00	19.50

### 3<sup>rd</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	MSE 3213	Corrosion and Degradation of Materials	3.00	3.00
2.	MSE 3231	Foundry Engineering	3.00	3.00
3.	MSE 3235	Metal Joining and Removing Technology	3.00	3.00
4.	MSE 3241	Polymer Science and Engineering	3.00	3.00
5.	MSE 3243	Ceramics for Advanced Application	3.00	3.00
<b>Sessional Courses</b>				
6.	MSE 3232	Foundry Engineering Sessional	3.00	1.50
7.	MSE 3236	Metal Joining and Removing Technology Sessional	3.00	1.50
8.	MSE 3242	Polymers Sessional	1.50	0.75
9.	MSE 3210	Case Study in Material Science and Engineering	1.50	0.75
10.	MSE 3200	Industrial training	4 weeks	1.00
<b>Total</b>			24.00	20.50

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### 4<sup>th</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Conduct Hours/ Week	Credits
<b>Theory Courses</b>				
1.	IPE 4159	Industrial Management	3.00	3.00
2.	MSE 4131	Physical Metallurgy and Heat Treatment	3.00	3.00
3.	MSE 4111	Physical Properties of Materials	3.00	3.00
4.	MSE 4101	Materials Characterization	3.00	3.00
5.	MSE 4141	Optional-I (a) Composite Materials (b) Advanced Glass Engineering (c) Materials for Energy Conversion and Storage (d) Industrial Pollution and Control	3.00	3.00
<b>Sessional Courses</b>				
6.	MSE 4102	Materials Characterization Sessional	3.00	1.50
7.	MSE 4132	Heat Treatment and Microstructure Sessional	3.00	1.50
8.	MSE 4142	Optional-I (a) Composite Materials Sessional (b) Advanced Glass Engineering Sessional (c) Materials for Energy Conversion and Storage Sessional (d) Industrial Pollution and Control Sessional	1.50	0.75
9.	MSE 4100	Project and Thesis-I	3.00	1.50
<b>Total</b>			25.50	20.25

### 4<sup>th</sup> Year Even Semester

SL. No.	Course No.	Course Title	Conduct Hours/ Week	Credits
<b>Theory Courses</b>				
1.	IPE 4259	Production Planning and Control	3.00	3.00
2.	MSE 4231	Metallic Alloys and Material Selection	3.00	3.00
3.	MSE 4233	Industrial Metal Working Process	3.00	3.00
4.	MSE 4243	Powder Metallurgy and Nanotechnology	3.00	3.00
5.	MSE 4241	Optional-II (a) Transport phenomena in Metal Processing	3.00	3.00

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		(b) Advanced and Smart Materials (c) Plastic, Fiber, and Rubber Technology (d) Quality Control and Material Handling		
<b>Sessional Courses</b>				
6.	MSE 4232	Failure of Materials and Artefact Study	3.00	1.50
7.	MSE 4200	Project and Thesis-II	6.00	3.00
8.	MSE 4210	Seminar	3.00	0.75
<b>Total</b>			27.00	20.25

**Summary of the Courses of Undergraduate Studies  
at a Glance**

SL. No.	Year	Semester	Total Credits Hours
01	1 <sup>st</sup>	Odd	20.25
02	1 <sup>st</sup>	Even	20.25
03	2 <sup>nd</sup>	Odd	19.50
04	2 <sup>nd</sup>	Even	19.50
05	3 <sup>rd</sup>	Odd	19.50
06	3 <sup>rd</sup>	Even	20.50
07	4 <sup>th</sup>	Odd	20.25
08	4 <sup>th</sup>	Even	20.25
<b>Total</b>			160.00

SL. No.	Type of Courses	Total Credit Hours	Credits in %
01	Core courses of Material Science & Engineering	93.25	58.28
02	Allied Engineering Courses	39.00	24.38
03	Basic Science	18.00	11.25
04	Humanities	9.75	6.09
<b>Total</b>		160.00	100.00

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## Detail Courses for the Undergraduate Studies

### Courses of the 1<sup>st</sup> Year B.Sc. Engineering

#### 1<sup>st</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact hours/Week	Credits
<b>Theory Courses</b>				
1.	Phy 1131	Physics	3.00	3.00
2.	Math 1131	Calculus and Differential Equation	3.00	3.00
3.	Hum 1131	Industrial Economics and Fundamentals of Sociology	3.00	3.00
4.	EEE 1191	Electrical Circuits	3.00	3.00
5.	MSE 1101	Introduction to Material Science & Engineering	3.00	3.00
<b>Sessional Courses</b>				
6.	Phy 1132	Physics Sessional	3.00	1.50
7.	EEE 1192	Electrical Circuits Sessional	3.00	1.50
9.	ME 1150	Engineering Graphics	3.00	1.50
10.	MSE 1102	Introduction to Material Science & Engineering Sessional	1.50	0.75
<b>Total</b>			25.50	20.25

#### 1<sup>st</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	Chem 1231	Chemistry	3.00	3.00
2.	Math 1231	Vector Analysis and Matrices	3.00	3.00
3.	CSE 1291	Programming Language and Data Structure	3.00	3.00
4.	Hum 1231	Communication English	3.00	3.00
5.	ME 1259	Engineering Mechanics	3.00	3.00
<b>Sessional Courses</b>				
6.	Chem 1232	Chemistry Sessional	3.00	1.50
7.	CSE 1292	Programming Language and Data Structure Sessional	1.50	0.75
8.	Hum 1232	Communication English Sessional	1.50	0.75
9.	MSE 1200	Computer Fundamentals and Ethics	1.50	0.75
10.	ME 1250	Computer Graphics	3.00	1.50
<b>Total</b>			25.50	20.25

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## Detail Syllabus of the 1<sup>st</sup> Year Odd Semester B.Sc. Engineering

### Phy 1131 (Physics)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Optics:** Theories of light, Huygens' principle and construction, Superposition of light waves, Reflection and Refraction of spherical surfaces, Lenses, Combination of Lenses, Equivalent Lens and equivalent focal length. Defects of images formed by lenses, Distortion and curvature of images, achromatism and achromatic combination of lenses.

**Waves & Oscillation:** Sources of sound, Transmitting medium, Speed of sound, Beats, the Doppler Effect, Sonic booms, Audible Ultrasonic, Infrasonic and Supersonic waves, Acoustics, Different Types of Oscillation.

**Structure of Matter:** Structure of matter, packing in solids, inter atomic distances and forces of equilibrium, different types of bonds in solids, metallic, Vander-Walls, Covalent and ionic bond.

**Modern Physics:** Atomic structure, atom model, Nature of Electron orbit, Photo electric Emission and Einstein's Photoelectric equation, Compton effect, De-Broglie's waves, Nuclear Force, Binding energy, Isotope, Isobar, Isotone, Radioactive decay, Half-life, and Mean life, Law of disintegration, successive disintegration, Theory of relativity, relative velocity, mass energy relation.

### Phy 1132 (Physics Sessional)

*Sessional: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on Phy 1131

### Math 1131 (Calculus and Differential Equation)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Calculus:** Limit, continuity and differentiability of a function, differentiation. Leibnitz theorem. Partial differentiation. Euler's theorem. Tangent and normal. Maxima and minima.

Integration by the method of substitutions. Standard integrals. Integration by parts. Definite integral and its properties. Area under plane curves in Cartesian and polar co-ordinates. Surface, area and volume of revolution.

**Differential Equations:** Formation of ordinary and partial differential equations. Solution of first order differential equations by elementary methods. Solution of differential equation of first order and higher degrees. Solution of general linear equations of second and higher orders with constant coefficient. Solution of Euler's homogeneous linear equations. Partial Differential Equations.

### Hum 1131 (Industrial Economics and Fundamentals of Sociology)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

#### **Economics:**

**The Fundamental Concept of Economics:** Definition of economics, Economics and Engineering; Micro-Economics, Basic concept of microeconomics, Demand and Supply, Elasticity, Price System and Equilibrium, Theory of production; short-run production and long-run production, the laws of returns to scale.

**Market Structure:** Perfect Competition, Monopoly and Monopolistic market. Basic concept of Macro-economics; GDP, GNP and National Income. Project Appraisal: NPV, IRR, BCR, Time value of money, Cash flow.





**Sociology:** Concept, Scope, Basic Concepts related to Social Studies.

**Society and Social Evolution:** Concept and Stages of Social Evolution with Production Techniques.

**Industrial revolution:** Industrialization, Urbanization, Impact-Technological, Socio-Economic and Intellectual. Crises of and Interventions to Family, Socialization and Ageing.

**Culture and Civilization:** Concept, Lag and Conflict, Diffusion, Cultural Layers etc., Early and Contemporary civilizations.

**Social Structure:** Concept, and nature of social structure of Bangladesh

**Population & Resources:** Dynamics and Projections of the population, Natural, Produced & Human Resources of Bangladesh. Engineering Ethics and Role of Engineers in Society.

### **EEE 1191 (Electrical Circuits)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Electrical Circuits:** Electrical power sources, Circuit elements, DC circuit analysis, Circuit laws and theorems, methods of analysis; electrical field concept, magnetic field concept and electromagnetism, capacitance and inductance, transient and steady state analyses of electrical networks for different forcing functions; effective and average values of alternating waveforms; phasor and complex-impedance; steady state analysis of ac networks, power and power factor; polyphase systems.

### **EEE 1192 (Electrical Circuits Sessional)**

*Sessional: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on EEE 1191

### **MSE 1101 (Introduction to Material Science & Engineering)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Introduction to Materials:** Scopes and applications of Material Science & Engineering. Selection of materials in view of service and fabrication requirements, and economics.

**Engineering Materials:** Concept of engineering materials, importance, metals, polymers, ceramics, composite materials, super alloy, semiconductor, and bio-materials.

**Properties of Materials:** Physical, Electrical, Mechanical, Chemical, Thermal and Optical properties of materials, Factors influencing properties.

**Solid Materials:** Basic alloying features, Solidification of Materials, Diffusion in solids, Defects in Solid.

### **MSE 1102 (Introduction to Material Science & Engineering Sessional)**

*Sessional: 1.5 hrs. /week*

*No. of Credit: 0.75*

Sessional based on MSE 1101

### **ME 1150 (Engineering Graphics)**

*Sessional: 3 hrs. /week*

*No. of Credit: 1.50*

Introduction, instruments and their uses, first and third angle projections, orthographic drawing, isometric views, missing lines and views, sectional views and conventional practices, auxiliary views.



## Detail Syllabus of 1<sup>st</sup> Year Even Semester B.Sc. Engineering

### Chem 1231 (Chemistry)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Inorganic Chemistry:** Different types of chemical bonds and their properties. Different types of solutions and their compositions. Properties of dilute solutions. Thermochemistry, chemical kinetics, chemical equilibria. Electrolytic conductance, emf. Electrochemical cells.

**Organic Chemistry:** Preparation, properties and industrial applications of aliphatic and aromatic compounds

### Chem 1232 (Chemistry Sessional)

*Sessional: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on Chem 1231

### Math 1231 (Vector Analysis and Matrices)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Vector Calculus:** Gradient of a scalar function, divergence and curl of vector functions. Line, surface and volume integrals, Gauss's theorem, Stoke's theorem, Green's theorem and their applications.

**Matrices:** Different types of Matrices. Adjoint and inverse of a matrix. Elementary transformations. Normal and canonical forms, Rank of matrices, Solution of linear equations. Quadratic forms. Matrix polynomials. Caley-Hamilton theorem. Eigenvalues and eigenvectors.

### Hum 1231 (Communication English)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Grammar:** Properties of English grammar, IPA, correction. Construction of sentences

**Vocabulary:** Scientific terms, phrases and idioms, group verb, prepositional phrases.

**Reading Comprehension:** Techniques of reading, skimming, scanning, SQ3R technique

**Writing:** Formal letter, resume, paragraph, report writing, tender and schedule, APA style sheet, email writing. Commercial correspondence and tenders, amplification, précis writing

**Modern Literature:** At least three short stories and three poems.

### Hum 1232 (Communication English Sessional)

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

**Listening:** Monologue, conversation (formal and informal), telephoning and direction; note taking skills.

**Speaking:** Basic conversation, job interview, seminar and paper presentation; formal speech, telephoning, difference between British and American English.



### **CSE 1291 (Programming Language and Data Structure)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Introduction to Digital Computer:** Main parts like I/O devices, Memory unit and CPU. Primary and secondary storage devices, different memory types, Introduction to Number System

**Languages:** Development of programming logic, algorithm, flow chart; Assembly level language and Machine level language, high level language, Compiler, Interpreter, Source and Object programs.

**Concept of Algorithms:** Development of Flowcharts to solve engineering problems.

**Introduction to C & C++ Language:** Preliminaries, Program construction and data types, I/O statements, Expressions, Decision making, Loops, Function and its Calling procedure, Recursion, Arrays and pointer, Linear and Non-linear Array, structure aduminar, Application of computer programming for solving mechanical engineering problems, Files I/O, Error Handling

### **CSE 1292 (Programming Language and Data Structure Sessional)**

*Sessional: 1.5 hrs. /week*

*No. of Credit: 0.75*

Sessional based on CSE 1291

### **ME 1259 (Engineering Mechanics)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Statics:** Basic concepts of mechanics, statics of particles and rigid bodies, centroids of lines, areas and volumes. Forces in trusses and frames. Friction. Moments of inertia of areas and masses. Relative motion.

**Dynamics:** Kinematics of particles- Newton's Second law of motion. Principles of work and energy. System of particles. Kinematics of rigid bodies, kinematics of plane motion of rigid bodies-forces and acceleration.

### **MSE 1200 (Computer Fundamentals and Ethics)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

**Computer Fundamentals:** Overview of DOS, Windows and UNIX operating systems, Essential general purpose packages for word processing, spreadsheet analysis, slide presentation etc.

**Ethics:** Computers in workplace, computer crime, rules of common privacy, protection of intellectual property.

### **ME 1250 (Computer Graphics)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

**Computer Aided Drawing:** Use of interactive menu-driven software for preparation of line drawings, graphic coordinate system; commands for draw, erase, move, rotate mirror, hatch etc., blocks and layers; dimensional drawing files, saving, editing, and plotting.

**Production Drawing:** Machine drawing, study of part drawing, study of assembly drawing, preparing complete working drawing (detail and assembly) from explodes pictorial and actual machines, dimensioning with tolerances, notes etc. representation of conventional features (threads, fasteners, gear, spring, their specification) and drawing; introduction to solid work.

## Courses of the 2nd Year B.Sc. Engineering

### 2<sup>nd</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	Math 2131	Statistics, Numerical and Power Series	3.00	3.00
2.	MSE 2101	Crystallography and Structure of Materials	3.00	3.00
3.	MSE 2103	Phase Transformation of Materials	3.00	3.00
4.	ME 2159	Basic Mechanical Engineering	3.00	3.00
5.	ME 2169	Fluid Mechanics and Machinery	3.00	3.00
<b>Sessional Courses</b>				
6.	MSE 2102	Crystallography and Structure of Materials Sessional	3.00	1.50
7.	MSE 2104	Metallography Sessional	3.00	1.50
8.	ME 2160	Basic Mechanical Engineering Sessional	1.50	0.75
9.	ME 2170	Fluid Mechanics and Machinery	1.50	0.75
<b>Total</b>			24.00	19.50

### 2<sup>nd</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	Hum 2231	Industrial Law and Accounting	3.00	3.00
2.	MSE 2211	Crystal Defect, Deformation and Fracture	3.00	3.00
3.	MSE 2221	Strength of Materials	3.00	3.00
4.	ME 2259	Heat and Mass Transfer	3.00	3.00
5.	EEE 2291	Electrical Machines and Electronics	3.00	3.00
<b>Sessional courses</b>				
6.	MSE 2220	Materials & Metallurgical Analysis	3.00	1.50
7.	MSE 2212	Crystal Defect, Deformation and Fracture Sessional	3.00	1.50
8.	MSE 2222	Application to Computers in Strength of Materials	1.50	0.75
9.	EEE 2292	Electrical Machines and Electronics Sessional	1.50	0.75
<b>Total</b>			24.00	19.50

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## Detail Syllabus of 2<sup>nd</sup> Year Odd Semester B.Sc. Engineering

### Math 2131 (Statistics, Numerical and Power Series)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Numerical Analysis:** Interpolation with equal and unequal intervals, central difference formulae, trapezoidal and Simpson's rule; solution of algebraic and transcendental equations; Bisection and Regula falsi method, initial approximation and convergence criteria of iteration method, Newton-Raphson method, solution of simultaneous linear algebraic equations, Gauss elimination method, Gauss Jordan method, Jacobi method, Gauss Seidal method. Application of Numerical Analysis.

**Power Series:** Method of Frobenius, Bessel's equation, Bessel's function, Legendre's equation, and Legendre's polynomials, Application of Bessel's function especially in heat transfer and mechanics.

**Statistics:** Review of central tendency and dispersion; moments, skewness and kurtosis; correlation and regression; elementary probability and probability distributions (e.g. Binomial Poisson and Normal distributions).

### ME 2169 (Fluid Mechanics and Machinery)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Fluid properties; Fluid statics:** Manometry, forces on submerged planes and curved surfaces, buoyancy and floatation. **Fluid dynamics:** One dimensional flow of fluid: equation of continuity. Euler's equation. Flow of fluid in pipes, Bernoulli's equation, flow through venturimeter, head losses.

**Open channel flow:** flow through weirs and notches. **Fluid Machinery:** Impulse and momentum principles, fans and blowers. Study of centrifugal and reciprocating compressors, Centrifugal and reciprocating pumps.

### ME 2170 (Fluid Mechanics and Machinery)

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Sessional based on ME 2169

### ME 2159 (Basic Mechanical Engineering)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Energy:** Concept and fundamental; forms and sources of energy- conventional and renewable energy; energy conservation and management.

**Laws of Thermodynamics:** First law of thermodynamics and its corollaries, first law applied to open and closed system; second law of thermodynamics and its corollaries; statement of third law of thermodynamics; Zeroth law, thermal equilibrium; reversibility, irreversibility, enthalpy, entropy and internal energy.

**Fuels:** Introduction to solid, liquid and gaseous fuels; conventional and alternate fuels; fuel compositions, fuel properties; proximate and ultimate analysis of fuel.

**Basic Mechanical Devices/Systems:** Introduction to steam, gas and water turbines with their accessories; internal combustion engines; refrigeration and air conditioning systems.

**Study of Steam Generating Unit:** Introduction, operation of modern steam boilers, accessories and mountings; performance study of steam generator.

### **ME 2160 (Basic Mechanical Engineering Sessional)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Sessional based on ME 2159

### **MSE 2101 (Crystallography and Structure of Material)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Solid Materials:** Types of solids: crystalline, amorphous and polycrystalline solids. Types of crystalline solids: ionic, covalent, molecular and metallic crystals. Cohesive energy of ionic crystals, lattice energy, Born-Haber cycle, isomorphism, polymorphism, enantiotropy and monotropy.

**Crystals and Crystal Structures:** The nature of crystalline states, faces, edges and interfacial angle, space lattice, unit cells and patterns, periodicity in crystals. Atomic packing: hcp and ccp structures. Construction of crystals: closed packed hexagonal and square layers of atoms, body-centered cubic crystal, and some simple ionic and covalent structures. Selected crystal structures: Pure metals, diamond and graphite, co-ordination in ionic crystals, AB-type compounds, silica, alumina, complex oxides, silicates, crystallinity in polymers.

**Representation and Study of Crystals in Projection:** Introduction, representation in two dimensions, stereographic projection and its construction, stereographic projection in small circle, stereographic net, use of stereographic projection in crystallography, gnomonic projection.

**Symmetry in Crystal:** Two-dimensional symmetry elements, the five-plane lattice. Bravais lattices and crystal systems: the fourteen space (Bravais) lattices, the symmetry of fourteen Bravais lattices.

**X-ray Diffraction:** X-rays and their generation, origin and characteristics of x-rays, optical grating and diffraction of light, crystals and diffraction of x-rays, Laue equations, Bragg's law, x-ray diffraction experiment, powder methods, single crystal method. Structure of sodium chloride crystal from X-ray studies. Avogadro's number from crystal dimension, radius ratio, effect of ion size on crystal geometry.

### **MSE 2102 (Crystallography and Structure of Material Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on MSE 2101

### **MSE 2103 (Phase Transformation of Materials)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Factors affecting the formation of alloys. Types of binary phase diagrams. The phase rule. Industrially important binary diagrams of metallic and ceramic systems including details of iron - iron carbide diagram. Diffusional, martensitic and mixed transformations. Nucleation and growth theory. Precipitation hardening. Types, mechanism and factors influencing diffusion, measurement of diffusion coefficients. Ternary phase diagrams: Composition triangles and space models, isothermal and vertical sections of isomorphous and other systems. Equilibrium and nonequilibrium freezing of typical ternary alloys.

### **MSE 2104 (Metallography Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on MSE 2103



## Detail Syllabus of 2<sup>nd</sup> Year Even Semester B.Sc. Engineering

### Hum 2231 (Industrial Law and Accounting)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

#### **Industrial Law:**

**Law of Contract:** Definition, essential elements of contract, void and voidable agreement, rules regarding offer, acceptance, and consideration; methods of termination of contract.

**Company Act:** General principles of company law relating to formation; management and winding-up.

**Labor Code 2006:** Factory-definition, rules regarding employment of women, child, & adult, safety act including fire safety, benefits and privileges of employees.

**Payment of Wages:** Payment & deduction rules.

**Trade Union Act:** Definition, legal status of a registered trade union, rules of registration, cancellation of registration, rights and privileges of a registered trade union, collective bargaining process, unfair labor practice on part of both the employees and employers, penalties for unfair labor practice, industrial disputes, lockout, boycott, go-slow, strike, illegal retrenchments, layoff, methods of settlement of industrial disputes.

#### **Accounting:**

**Financial accounting:** Definition, objectives, advantages, accounting concepts, double entry system and rules for debit and credit; transaction, capital and revenue transactions; accounts and its classification; journal, cash book, ledger, trial balance and financial statement.

**Cost Accounting:** Definition, objectives, advantages, classification of cost, cost statement, overhead costing, operating costing and relevant costing; interest formula; cash flow in engineering economy; financial and economic evaluation of a project; accounting for depreciation and income taxes.

### MSE 2211 (Crystal Defect, Deformation and Fracture)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Defects in crystals. Types, movement and properties of dislocation; dislocation multiplication. Strengthening mechanisms. Basic features of catastrophic fracture. Fracture criterion. Modes of fracture and ductile to brittle transition. The influence of microstructure on fracture. Application of fracture mechanics to practical problems. Environmental effects on fracture. Mechanisms of crack initiation and propagation. Quantitative analysis of fatigue fracture. Fatigue resistant materials. Creep deformation, grain boundary rotation and sliding, void formation and rupture mechanisms. Creep resistant materials.

### MSE 2212 (Crystal Defect, Deformation and Fracture Sessional)

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on MSE 2212

### MSE 2220 (Materials and Metallurgical Analysis)

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Principles of volumetric and gravimetric analysis. Analysis of various non-ferrous and ferrous alloys. Analysis of refractories and ceramic materials. Analysis of glass, composites and polymers. Instrumental methods of analysis.

### **ME 2259 (Heat and Mass Transfer)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Thermal properties of materials. Basic modes of heat transfer. Steady and unsteady state conduction. Numerical solutions of conduction equations. Blackbody radiation. Radiation from real surfaces, view factors. Radiation exchange. Mechanism of convective heat transfer, estimation of convective heat transfer coefficient, heat transfer from liquid metals. Heat transfer with phase change. Mechanism of mass transfer. Application of heat transfer in materials and metallurgical processes.

### **EEE 2291 (Electrical Machines and Electronics)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Transformers:** Single phase and three phase transformer; basic concept and working principle, open and short-circuit tests, transformer efficiency.

**DC Machines:** DC generator and motor; construction and operation, characteristics, starting and speed control, applications of DC motors.

**AC Machines:** Synchronous and asynchronous machines; construction and principle of operation, characteristics, starting and speed control, applications of various motors.

**Introduction to Semiconductor Devices:** Diode, transistors, FET, MOSFET, amplifiers and their applications. Introduction to silicon controlled rectifier and its applications; oscilloscope; logic circuits; A/D and D/A conversion.

### **EEE 2292 (Electrical Machines and Electronics Sessional)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Sessional based on EEE 2291

### **MSE 2221 (Strength of Materials)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Simple Stress and Strain:** Introduction, various types of stresses; tensile, compressive, shearing, bearing and thermal stresses, stress-strain diagram, Hook's law, Poisson's ratio, biaxial and tri-axial deformations, statically indeterminate members, stresses in thin walled pressure vessels.

**Torsion:** Assumption and derivation of torsion formula, torsion of hollow thin-walled shaft, shear flow, helical spring.

**Beams:** Introduction, shear force and bending moment and their diagrams, flexure formula, economic section, Unsymmetrical beam, reinforced beams, beam deflection; area moment, double integration, superposition method, moment diagram by parts, strain energy method, Castilians theorem and its application.

**Combined stresses:** Introduction, kern of section, variation of stress with inclination of element, analytical derivation, Mohr's circle, transformation of strain components, theories of elastic failure.

**Column:** Introduction, Euler's column formula, various types of column, empirical formula, eccentrically loaded column.

### **MSE 2222 (Application to Computers in Strength of Materials)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Introduction to proprietary programming language by MATLAB; Application in visualization and programming, Problem solving by MATLAB based on MSE 2221.



## Courses of the 3<sup>rd</sup> Year B.Sc. Engineering

### 3<sup>rd</sup> Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	GCE 3159	Glass and Ceramics Engineering	3.00	3.00
2.	MSE 3131	Surface Engineering of Materials	3.00	3.00
3.	MSE 3133	Refractories and Furnaces	3.00	3.00
4.	MSE 3135	Iron and Steel Making	3.00	3.00
5.	MSE 3141	Metal Extraction and Refining	3.00	3.00
<b>Sessional Courses</b>				
6.	GCE 3160	Glass and Ceramics Engineering Sessional	3.00	1.50
7.	MSE 3132	Surface Engineering of Materials Sessional	1.50	0.75
8.	MSE 3134	Refractories and Furnaces Sessional	3.00	1.50
9.	MSE 3142	Metal Extraction and Refining Sessional	3.00	1.50
<b>Total</b>			25.50	20.25

### 3<sup>rd</sup> Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/Week	Credits
<b>Theory Courses</b>				
1.	MSE 3213	Corrosion and Degradation of Materials	3.00	3.00
2.	MSE 3231	Foundry Engineering	3.00	3.00
3.	MSE 3235	Metal Joining and Removing Technology	3.00	3.00
4.	MSE 3241	Polymer Science and Engineering	3.00	3.00
5.	MSE 3243	Ceramics for Advanced Application	3.00	3.00
<b>Sessional Courses</b>				
6.	MSE 3232	Foundry Engineering Sessional	3.00	1.50
7.	MSE 3236	Metal Joining and Removing Technology Sessional	3.00	1.50
8.	MSE 3242	Polymers Sessional	1.50	0.75
9.	MSE 3210	Case Study in Material Science and Engineering	1.50	0.75
10.	MSE 3200	Industrial training	4 weeks	1.00
<b>Total</b>			24.00	20.50

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## Detail Syllabus of 3<sup>rd</sup> Year Odd Semester B.Sc. Engineering

### GCE 3159 (Glass and Ceramics Engineering)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Glass Technology:** Definition, structure and properties of glass, composition and constitution, of glasses; Properties of glass: forming methods for glasses, chemical durability, stress release and annealing, glass-metal seals.

**Glass Manufacture:** Raw materials and melting, primary forming operation, Crystallization and glass ceramics. Annealing and toughening of glass. Surface Treatment and Modification. Finishing operations.

**Application of Glasses:** Glass containers, flat glass and glazing, laboratory glassware and thermometers, glasses in the chemical industry, sight and gage glasses, electric lamps and electron tubes, illumination.

**Fibrous Glass:** Composition and properties of fiber, manufacturing processes and products, application of fibrous-glass wool, applications of fibrous-glass textile products, fibrous-glass-reinforced plastics, metallic glass and crystal glass.

**General Concept and Structure of Ceramics:** History, Definitions: traditional and engineering ceramics, types of ceramics; AX-type crystal structures,  $A_mX_p$ -type crystal structures,  $A_mB_nX_p$ -type crystal structures, crystal structures from the close packing of anions, ceramics density computations, imperfections in ceramics. Silicate Ceramics: Silica, silica glasses, silicates, layered silicates.

**Raw Materials of Ceramics and Clays:** General consideration, Clay minerals, Talc and related minerals, Silica and silicate minerals, Other raw materials, The role of various kinds ceramic material to the ceramic ware. Composition and plasticity of clays, burning of clays, color of clay products, brick making methods, terra-cotta ware, and sanitary ware.

**Processing and Glazing of Ceramics:** Material preparations, powder pressing, extrusion, soft plastic forming, slip casting, drying, firing, glass forming methods, Vitrification. Polishing, glazing, decorating, coating of the ware. Scope, processing and properties of high performance ceramics.

### GCE 3160 (Glass and Ceramics Engineering Sessional)

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional based on GCE 3159

### MSE 3135 (Iron and Steel Making)

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Production of pig iron. Modern trends in blast furnace practice. Alternative routes of iron production. Kinetics of iron oxide reduction. Evaluation of activation energy for various reaction mechanisms. Production of plain carbon and alloy steels by various steel making processes. Physical chemistry of steel making. Structure-property relationship in plain carbon, austenitic, martensitic, duplex and ferritic stainless steels. Degassing and secondary steel making. Solidification of steel ingots and continuous casting of steel products. Production of ferroalloys.



### **MSE 3131 (Surface Engineering of Materials)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Surface Phenomena:** Sorption, films of insoluble substances, adsorption by solids from solutions, electro-kinetic potential.

**Surface Texture and Surface Active Agents:** Surface characteristics, fundamentals of surface texture, application of surface active agents in metal technology: special cleaning operations, rust and corrosion inhibition, electroplating, cutting oils, miscellaneous uses, application in the textile and other industries.

**Tribology:** Mechanisms of wear – adhesive, abrasive, corrosive, fatigue and fracture wear; surface coating tribology; design for wear prevention, lubrication.

**Metallic and Non-Metallic Coatings:** Preparation of metal surfaces for coatings; methods used in applying coatings; hot dipping, electrodeposition, vapor deposition, spraying, cementation, cladding, sputtering; zinc coatings; tin coatings; nickel coatings and other metal coatings, Inorganic coatings: Vitreous or porcelain enamels, anodized oxide coatings on aluminium; surface conversion or chemical-dip coatings: anodizing, chromating, phosphating etc. Organic coatings: Paints, varnishes, enamels, lacquers, special coatings and related materials, polymeric coatings.

**Interface Phenomena:** Liquid-gas interfaces; solid-gas interfaces: surface reactions in moist atmosphere; solid-solid interfaces: polishing, lubrication.

### **MSE 3132 (Surface Engineering of Materials Sessional)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Electrodeposition processes: copper, nickel and chromium plating, effect of deposition parameters on coating properties, effect of additives. Conversion coating processes including anodizing. Hot dip galvanizing. Diffusion coating processes: chromizing, aluminizing etc. Wear and frictional behavior of materials.

### **MSE 3133 (Refractories and Furnaces)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Classification and application of refractory materials. Raw materials, preliminary treatments, and manufacturing processes of various types of refractories. Properties of refractories, their tests and uses. Heat transfer in industrial furnaces. Classification of furnaces and theories of furnaces design. Control of furnace atmosphere and pyrometry. Applications of different furnaces e.g. induction furnace, EAF, cupola, etc.

### **MSE 3134 (Refractories and Furnaces Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Measurement of true and apparent density and percentage porosity of refractory bricks. Estimation of cold crushing strength, thermal conductivity, spalling and slagging resistance of some common refractories. Design and drawing of recuperators and regenerators, iron and steel making furnaces, heat treating furnaces, ceramic kiln and glass melting furnaces etc.



### **MSE 3141 (Metal Extraction and Refining)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Purposes of ore dressing. Comminution, screening, classification, concentration and dewatering. General principles of extraction of metals. Pyrometallurgy: drying, calcining, roasting, sintering and smelting. Hydrometallurgy: leaching and separation techniques. Electrometallurgy: voltage of electrolytic cell, aqueous and fused salt bath electrolytic extraction. Principles of refining of non-ferrous metals. Secondary metal production.

### **MSE 3142 (Metal Extraction and Refining Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Pyrometallurgy: reduction of ores. Hydrometallurgy: leaching of metallic ores, concentrates and mattes; effect of variables on dissolution kinetics. Corrosion tests: anodic polarization measurements, effect of different environmental conditions, stress corrosion tests etc. Electro-metallurgy: electro-winning, electro-forming and electroplating.

## **Detail Syllabus of 3<sup>rd</sup> Year Even Semester B.Sc. Engineering**

### **MSE 3231 (Foundry Engineering)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Foundry establishment. General methods of molding and casting. Pattern and pattern allowances, core boxes. Principles of gating design. Melting furnaces and practice. Melt reaction and fluid dynamics. Solidification of pure metals and alloys, control of solidified structure. Segregation and gas porosity. Principles of feeding and solidification shrinkage. Purpose and types of special casting processes. Metals cast in foundry. Families of cast irons. Ferrous and non-ferrous foundry practices. Fettling and finishing operations. Casting defects. Inspection and quality control. Salvage of casting. Casting design.

### **MSE 3232 (Foundry Engineering Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Routine testing on foundry sand. Preparation of molding sand mixtures. Melting and casting of ferrous and non-ferrous materials. Properties of cast metals. Effect of foundry variables on structure and properties of castings obtained by different casting processes. Study of casting defects.

### **MSE 3213 (Corrosion and Degradation of Materials)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Economic aspects of corrosion. Electrochemical principles of corrosion: Thermodynamics of electrochemical cells, electrode kinetics, Butler-Volmer kinetics, anodic polarization behavior, mixed potential theory and Pourbaix diagrams. Metallurgical factors in corrosion. Forms of corrosion. Corrosion tests. High temperature oxidation: oxide defect structure, kinetics, effect of alloying etc. Corrosion control and corrosion resistant materials. Degradation of polymeric materials and paints. Corrosion control: Material selection, change of environment, design improvement, change of metal potential.

### **MSE 3235 (Metal Joining and Removing Technology)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Introduction:** History and recent advances in welding and joining technology, different types of welding and Joining techniques, Common terms used in welding and Joining, equipment and machines for welding, cutting and Joining, Hazards and safety standards in welding, Joining and allied Processes.

**Gas Flame Processes in welding, cutting and Straightening:** Definition and classification of welding, Oxyfuel gas welding, definition and classification of cutting, Oxygen torch cutting, Fuel gases for Oxyfuel gas cutting, Stack metal powder, chemical flux and underwater torch cutting, Flame Straightening.

**Arc Processes for welding and cutting:** Basic circuit and mode of metal transfer for arc welding, different types of arc welding and cutting, power sources for arc welding, metallurgical and heat considerations in thermal cutting.

**Resistance and other welding:** Introduction, Theory of resistance welding, effect of temperature, pressure and current in resistance welding, power supply for resistance welding, Different types of resistance welding processes. Different types of solid-State welding processes, welding of plastics, thermal spray coating or metallizing

**Brazing and Soldering:** Introduction, definition of brazing, nature and strength of brazed Joints, brazing metals, methods of applying braze metal, heating methods used in brazing, Flux and flux removal, post braze operations and inspections, braze welding, definition of soldering, solder metals, soldering fluxes, heating for soldering, engineering materials and their compatibility with soldering, design and strength of soldered Joints, Flux removal and Flux less soldering.

**Adhesive bonding and mechanical Fasteners:** Adhesive materials and their properties, Nonstructural and special adhesives, design considerations, Advantages and limitations, Introduction and methods for mechanical fastening, features

**Metal Removing Process:** Introduction to turning, drilling shaping planning, milling, broaching, grinding, precision and non-precision finishing processes.

### **MSE 3236 (Metal Joining and Removing Technology Sessional)**

*Lecture: 3 hrs. /week*

*No. of Credit: 1.50*

Sessional Based on MSE 3235

### **MSE 3241 (Polymer Science and Engineering)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

**Concept of Polymer:** Introduction and definition of polymer, classification of polymers, nomenclature of polymers, characteristics of different types of polymers. Natural and synthetic polymers; organic, inorganic and organic-inorganic hybrid polymers; simple molecules and macromolecules; inter-molecular forces and chemical bonding in polymers; important uses of polymeric materials; polymer waste disposal and remedies.

**Polymer Formation Reactions:** Addition polymerization, condensation polymerization, coordination polymerization, ring opening polymerization, copolymerization, degree of polymerization; mechanism of polymerization (free radical, cationic and anionic), kinetics of polymerization.

**Specialty Polymers:** Polyelectrolytes, ion containing polymers; conducting polymers, biomedical polymers, thermally stable polymer, thermoplastic, elastomers (TPE), polymer composites, polymers for combating environmental pollution.

**Characterization of Polymers:** Nature of polymer molecules in solution, size and shape of macromolecules in solution; molecular weight, number average and weight average molecular weight; molecular weight distribution, isolation and purification, fractionation, determination of molecular weight of polymer, molecular weight distribution cases.

**Structure and Rheology of Polymers :** Viscous flow, kinetic theory of rubber elasticity, viscoelasticity; mechanical model of a viscoelastic material, glassy state and glass transition; mechanical properties of crystalline polymers, crystalline melting point, relation between  $T_m$  and  $T_g$ , properties involving large and small deformation, property requirements and polymer utilization.

**Polymer Technology:** Introduction, physical properties, viscous application, plastics, fibers, elastomers, adhesives, polymer additives and compounding; Processing of polymers: Moldings, Considerations of die design for polymers, processing methods, multipolymer systems, polymeric composites and melamine.

**Polymer Analysis:** Identification, physical testing (tensile strength, flexural strength, impact strength, share strength); spectral methods, chromatographic methods, identification of typical plastic materials; testing methods - thermal, electrical and chemical.

#### **MSE 3242 (Polymers Sessional)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Analysis of common polymers based on MSE 3241

#### **MSE 3243 (Ceramics for Advanced Application)**

*Lecture: 3 hrs. /week*

*No. of Credit: 3.00*

Engineering Ceramics: Definition and scope of engineering ceramics. Structure and bonding, phase diagrams. Processing of high performance ceramics. Mechanical and thermal properties of engineering ceramics. Toughening mechanisms.

Industrial applications of engineering ceramics as tool materials, surface barrier coatings, bio-ceramics, dental ceramics, etc. Electronic ceramics:

Crystal chemistry of ceramics. Effects of crystal defects and impurities on electronic properties of ceramics. Processing, structure and properties of ceramic insulators. Ceramic materials for piezoelectric, ferroelectric and magnetic applications. Ceramic sensors.

#### **MSE 3210 (Case Study in Material Science and Engineering)**

*Lecture: 1.5 hrs. /week*

*No. of Credit: 0.75*

Submission of analyses of case studies, paper review on relevant topics, and making a tentative choice of a topic on project and thesis.

#### **MSE 3200 (Industrial Training)**

*Lecture: 4 weeks*

*No. of Credit: 1.00*

4 week industrial attachment on relevant field

