Appendix 5.1

Undergraduate Course Curriculum for MME Students

Level – 1 / Term – I

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
EEE 155	Electrical Engineering Fundamentals	3.00	
EEE 156	Electrical Engineering Fundamentals Sessional	1.50	
Hum 123	English	3.00	
Math 171	Calculus and Ordinary Differential Equation	3.00	
MME 101	Materials Engineering Fundamentals	3.00	
MME 102	Materials Engineering Fundamentals Laboratory	1.50	
Phy 102	Physics Sessional	1.50	
Phy 125	Physics - I	3.00	
		19.50	

Level – 1 / Term – II

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
Chem 133	Physical Chemistry	3.00	
Chem 135	Inorganic Chemistry	3.00	
Chem 136	Physical and Inorganic Chemistry Laboratory	1.50	
Hum 102	English Language Practice Sessional	1.50	
Math 175	Partial Differential Equation and Vector Analysis	3.00	
ME 141	Engineering Mechanics	3.00	
Phy 169	Physics - II	3.00	
Shop 182	Machine Shop, Sheet Metal and Carpentry	1.50	
		19.50	

Level – 2 / Term – I

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
CSE 287	Computer Programming	3.00	
CSE 288	Computer Programming Sessional	1.50	
IPE 204	Engineering Graphics and Introduction to CAD	1.50	
Math 273	Matrices, Series Solutions and Fourier Analysis	3.00	
MME 202	Professional Development and Communication Skills	1.50	
MME 211	Crystallography and Structure of Materials	3.00	
MME 215	Thermodynamics of Materials	3.00	
Phy 201	Physics - III	3.00	
		19.50	

Level – 2 / Term – II

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
Math 275	Probability and Statistics	3.00	
MME 206	Chemical Metallurgy Laboratory	1.50	
MME 208	Computer Applications to Materials Engineering	1.50	CSE 287, CSE 288
MME 213	Phase Diagrams and Transformations	3.00	
MME 214	Microstudy and Heat Treatment Laboratory	1.50	
MME 217	Kinetics and Transport Phenomena in Materials	3.00	
MME 219	Corrosion and Degradation of Metals and Alloys	3.00	
OPTION 1	General Option 1 [Note a1]	3.00	
		19.50	

Note [a1]: Select one optional course from Module 6.1.

Appendix 5.3

Detail of MME Undergraduate Courses for MME Students

MME 101 Materials Engineering Fundamentals [3.00]

Classification and characteristics of materials, application of materials to society. Introduction to the structures and properties of metals, ceramics, polymers, composites, and electronic materials. Processing, selection and design of materials. Properties and behaviour of materials in services. Non-destructive evaluation.

MME 102 Materials Engineering Fundamentals Laboratory [3.00]

Identification of common industrially important metals, ceramic and polymer materials. Hands-on experience on sample preparation, characterization, and data analysis for introductory studies of crystal structures and microstructures, and physical, mechanical and chemical properties of materials.

MME 202 Professional Development and Communication Skills [1.50]

Career module: Introduction to materials science and engineering as a career, the work place, personality types and personal leadership development, communication issues in sales, market driven innovation, building teams, team attributes and team life cycle, team development and team problem solving, brainstorming technique, managing team conflict. Project management module: Projects - client and supplier issues, team role in projects, introduction to project and project management, project planning, tracking and controlling projects, risk management and risk assessment. Communication module: Modes of communication, development of communication skills through presentation and discussion of selected topics, essential features of report and thesis writing, case studies.

MME 206 Chemical Metallurgy Laboratory [1.50]

Corrosion tests of metals exposed to different environment. Two metal corrosion. Determination of limiting current density. Electro and electroless deposition of metals and alloys. Anodising, hot dip galvanisation and diffusion coating processes. Leaching and kinetics of dissolution. Electrowinning, electroforming and electroplating.

MME 208 Computer Applications to Materials Engineering [1.50]

MATLAB computing environment, matrix generation, plotting. Array operations, linear equation and other numerical techniques. Curve fitting. Programming and debugging. Data import and export, data structures. Image processing. Statistical tools. Solving materials engineering problems in MATLAB.

MME 211 Crystallography and Structure of Materials [3.00]

Elements of crystallography, concept of symmetry and symmetry operations, stereographic projections, determination of crystal structure using X-ray diffraction. Crystalline imperfections. Deformation and yielding of crystalline solids. Strengthening methods.

MME 213 Phase Diagrams and Transformations [3.00]

Introduction, importance, classifications, construction, and interpretation of phase diagrams. The nature, mechanisms and kinetics of phase transformations and microstructural changes in the solid state. Phase transformations through diffusional and diffusionless transformations, and spinodal decompositions. The use of phase transformations to control microstructures.

MME 214 Microstudy and Heat Treatment Laboratory [1.50]

Metallography of steels, cast irons and nonferrous metals and alloys. Hands on experience on conduction of heat treatment of ferrous and nonferrous alloys. Microstudy of heat-treated carbon and alloy steels, and nonferrous alloys. Case hardening of steels and microstudy of case-hardened steels.

MME 215 Thermodynamics of Materials [3.00]

Introduction to classical thermodynamics and the concept of equilibrium. Application of basic thermodynamic principles to phase equilibria and chemical reaction equilibria, solution theory, electrochemical equilibria and surface thermodynamics. Empirical treatment for homogeneous reaction rates. Thermodynamics of irreversible processes.

MME 217 Kinetics and Transport Phenomena in Materials [3.00]

Thermal properties of materials. Basic modes of heat transport. Analytical and computer-based methods for solving transport problems. Fick's laws of diffusion, Steady-state and non-steady state of diffusion, diffusion mechanisms and driving force for diffusion. Mass transport in ceramic and polymers. Non-Fickian and anomalous diffusion and mass transport in fluids and pores. Combined mass transfer and chemical reactions. Kinetics of homogeneous and heterogeneous reactions. Solid state transformation kinetics.

MME 219 Corrosion and Degradation of Metals and Alloys [3.00]

Electrochemical principles of corrosion cell analogy, concept of single electrode potential, reference electrode, polarization, passivation. Eight forms of corrosion, hydrogen damage. Corrosion testing and corrosion prevention. Modern theory of corrosion – principles and applications. High temperature corrosion, Pilling-Bedworth ratio, oxide defect structure, and oxidation kinetics. Chemical degradation of non-metallic materials. Identification of potential solutions for corrosion problems.

MME 281 Computational Methods for Materials Engineering [3.00]

Errors analysis, interpolation and approximations. Finding roots of equations. Solving linear algebraic equations. Unconstrained and constrained optimizations. Curve fitting. Numerical differentiation and integration. Solution of ordinary and partial differential equations. Case studies of using numerical techniques in solving materials-related engineering problems.

Appendix 5.4

Detail of Non-Departmental Courses for MME Students

Chem 133 Physical Chemistry [3.00]

Solutions: Types of solution, measure of compositions, solubility. Dilute solutions and colligative properties. Surface chemistry" Adsorption isotherms. Colloids: sol, gel and emulsion. First law of thermodynamics, thermochemistry, second law of thermodynamics, free energy and spontaneity of chemical reactions, chemical equilibrium of homogeneous and heterogeneous reactions, thermodynamic treatment of equilibrium constant. Electrochemistry, electrical properties of solutions, electrochemical cells, ionic equilibria.

Chem 135 Inorganic Chemistry [3.00]

Modern concepts of atomic structure, isotopes and application of radioactive isotopes. Periodic table and its applications, general treatment of the elements in different groups: main group elements, transition metals and noble gases. Different types of chemical bonds, molecular geometry, modern concept of bonding: valance bond theory and molecular orbital theory. Modern theories of acids and bases. Chemistry of coordination compounds: Introduction to coordination chemistry, Crystal Field Theory (CFT) and Ligand Field Theory (LFT) for metal complexes, geometries of metal complexes, thermodynamic and kinetic aspects of metal complexes.

Chem 136 Physical and Inorganic Chemistry Lab [1.50]

Acid base titration, redox titration, conductometric titration, determination of equilibrium constant, alum preparation from aluminium can.

CSE 287 Computer Programming [3.00]

Introduction to digital computers; Programming languages, algorithms and flow charts; Structured programming using C: variables and constants, operators, expressions, control statements, functions, arrays, pointers, structures, unions, user defined data types, input-output and files; Object-oriented programming using C++: introduction, classes and objects, polymorphism, function and operator overloading, inheritance.

CSE 288 Computer Programming Sessional [1.50]

This course consists of two parts. In the first part, students will solve programming problems to verify practically the theories and concepts learned in CSE 287. In the second part, students will learn program design.

EEE 155 Electrical Engineering Fundamentals [3.00]

Electrical units and standards. Electrical networks and circuits theorems, introduction to measuring instruments. Alternating current, RLC series, parallel circuits, magnetic concepts and magnetic circuits.

EEE 156 Electrical Engineering Fundamentals Sessional [1.50]

Laboratory experiments based on EEE155

Hum 123 English [3.00]

English Phonetics: The places and manners of articulation of English sounds; vocabulary; English grammar, construction of sentences; grammatical problems; reading comprehension; composition writing; précis writing; amplification; report writing. commercial correspondence, tender and quotation; prose pieces by some renowned writers.

Hum 102 English Languages Practice Sessional [1.50]

English phonetic: ways of correct English pronunciation, dialogue: improving speaking skill, composition: spoken composition on general topics, vocabulary: improving stock of words, listening comprehension: improving listening skill through audio-visual methods, correspondence: business communication including writing for mass media.

IPE 204 Engineering Graphics and Introduction to CAD Sessional [1.50]

Product graphics: Drafting codes as per ISO, tolerances and dimensioning, ensuring co-auxiliary, perpendicularly and parallelism compatible to manufacturing and assembly requirements, schematic product symbols for welding and piping systems. System graphics: Working drawings of cumulative and non-cumulative assemblies, dimensioning of assembled parts, use of standard parts threads, fasteners and springs, detailing of assembled parts. CAD: Constructing geometry, transformation. Viewing and chipping perspectives, modelling: generation of curves and surfaces, and introduction to solid modelling, automatic dimensioning and generation of bill of materials.

Math 171 Calculus and Ordinary Differential Equations [3.00]

Differential Calculus: Limits, continuity and differentiability. Successive differentiation, Leibnitz's theorem. Partial differentiation, Euler's theorem. Tangent and normal. Maximum and minimum. Integral Calculus: Integration by substitution. Integration by parts. Standard integrals. Definite integrals and their properties. Area under plane curves in Cartesian and polar coordinates. Surface area and volume of solids of revolution. Ordinary Differential Equations: Definition. Formation of differential equations. Solutions of first order differential equations by various methods. Solutions of differential equation of first order and higher degrees. Solutions of linear differential equations of second and higher orders with constant coefficients. Solution of homogeneous linear differential equations.

Math 175 Partial Differential Equations and Vector Analysis [3.00]

Partial Differential Equations: Introduction. Solutions of linear and nonlinear partial differential equations of first order. Linear equations of higher order. Equations of the second order with variable coefficients. Vector Analysis: Multiple product of vectors. Linear dependence and independence of vectors. Differentiation and integration of vectors together with elementary applications. Line, surface and volume integrals. Gradient, divergence and curl. Various formulae. Integral forms of gradient, divergence and curl. Gauss's divergence theorem, Stokes' theorem and Green's theorem.

Math 273 Matrices, Series Solutions and Fourier Analysis [3.00]

Matrices: Definition of matrix. Different types of Matrices. Algebra of matrices. Adjoining and inverse of a matrix. Rank and elementary transformations of matrices. Normal and canonical forms. Solution of systems of linear equations. Quadratic forms. Matrix polynomials. Caley-Hamilton theorem. Eigenvalues and eigenvectors. Series Solution: Solution of differential equations in series by method of Frobenius. Bessel's functions, Legendre's polynomials and their properties. Fourier Analysis: Real and complex form of Fourier series. Finite Fourier transform. Fourier integrals. Fourier transforms and their uses in solving boundary value problems.

Math 275 Probability and Statistics [3.00]

Introduction. Sets and probability. Random variables. Properties describing distributions. Treatment of grouped sample data. Some discrete probability distributions. Normal distributions. Sampling theory. Estimation theory. Tests of hypotheses. Regression and correlation. Analysis of variance.

ME 141 Engineering Mechanics [3.00]

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. 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.

ME 243 Mechanics of Solids [3.00]

Stress analysis: statically indeterminate axially loaded member, thermal and centrifugal stresses. Stresses in thin and thick-walled cylinders and spheres, Beams, shear forces and bending moment diagrams. Various types of stresses in beams. Flexure formula. Deflection of beams: integration and area moments methods. Introduction to reinforced concrete beams and slabs. Torsion formula, angle of twist, modulus of rupture, helical springs. Combined stresses:

principal stress, Mohr's circle. Columns. Euler's formula, intermediate column formulas, the secants formula. Flexure formula of curved beams. Introduction to experimental stress analysis techniques. Strain energy, failure theories.

Phy 125 Physics I [3.00]

Combination of lenses, defects of images, optical instruments, resolving power of optical instruments, interference of light, diffraction of light, polarization of light; Simple harmonic motion, combination of simple harmonic oscillations, damped oscillation, forced oscillation, two-body oscillations, progressive wave, stationary wave; Electrostatic force and electric field, electric potential, capacitors and dielectrics, magnetic field, Ampere's law, Biot-Savart law, Kirchhoff's law, electromagnetic induction.

Phy 102 Physics Sessional [1.50]

Sessionals based on Phy 125.

Phy 169 Physics II [3.00]

States of matter, elastic properties of solids, theorems related to flow of liquids, mechanics of fluid flow, viscosity, surface tension; Crystalline and non-crystalline solids, Bragg's law, defects in solids, bonds in solids, band structures, metals, semiconductor and insulator; Heat and work, Maxwell's distribution of molecular speed, first law of thermodynamics, second law of thermodynamics, Carnot's theorem, entropy and disorder, Maxwell thermodynamic relations, third law of thermodynamics.

Phy 201 Physics III [3.00]

Special theory of relativity, particle properties of waves, wave properties of particles, constituents of atomic nucleus, radioactivity, nuclear reactor, postulates of quantum mechanics, Schrödinger equation, uncertainty principle, operator, eigenvalue and eigenfunction, one-dimensional problem. Concepts of nanomaterials, synthesis and characterisation of nanomaterials, applications of nanostructured materials, production, characterisation and applications of thin films. Production, characterisation and applications of thin film, defects in thin films, electron transport and optical properties of thin films.

Shop 182 Carpentry Sheet metal and Machine Shop [1.50]

Carpentry: Wood working tools and machines. Types of sawing: common cuts in wood works; types of joint: defects of timber; seasoning; preservation; shop practice; practical job with particular emphasis on pattern making. Sheet metal: Sheet metal working tools, machinery and materials; patterns and uses. Punching, drilling and riveting; folding edges; soldering, types of solders, fluxes and practice. Machine shop: Kinds of tools - common bench and hand tools; marking and layout tools; measuring tools; cutting tools; machine tools; bench work with job. Types of drilling machine, shaper machine, lathe, milling machine and their practice.