Undergraduate Information Booklet

Materials and Metallurgical Engineering

Celebrating 70 years of
Materials education in Bangladesh

BUET

Bangladesh University of Engineering and Technology

2022

Undergraduate Information Booklet

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Disclaimer:

The information contained in this booklet is intended to provide guidance to those who are concerned with the undergraduate studies in Materials and Metallurgical Engineering. The Department of Materials and Metallurgical Engineering (DMME) of Bangladesh University of Engineering and Technology (BUET), Dhaka reserves the right to add, alter or modify, without prior notice, the contents of this booklet. The department shall bear no responsibility for any inconvenience caused to or expenditure incurred by any person because of the information contained in this booklet.

Welcome!

Dear Undergraduate Student:

On behalf of our faculty, staff, and upper-class undergraduate and graduate students, I welcome you to the Department of Materials and Metallurgical Engineering (MME). You are now entering the world of materials – an area of science and engineering that is exciting, demanding, and rewarding. The opportunities and challenges for MME graduates are almost limitless. Preparing you for these challenges and a productive and rewarding career is our primary mission. We are anxious to assist you so that your experience during your undergraduate education is a productive and enjoyable one.

The Department will celebrate its 70-year anniversary in 2022. Being a founding department of BUET we have a long and proud history. Our alumni are involved in all aspects of materials. They are engineers, executives, researchers, teachers, professors, and their careers are in ceramics, metals, polymers, semiconductors, and composites.

Our program is demanding and will require a great deal of effort from you, but it is worth the effort. Along with a fundamental background in the processing, performance and structure of metals and materials, you will have the opportunity to focus your studies in cutting edge technologies such as nanomaterials, photonic and optical materials, and electronic materials.

We are very glad you joined our department. Please do not hesitate to contact me or the Undergraduate Coordinator, Ms. Oishy Roy, or any other member of the faculty for assistance during your tenure in this department.

Wishing you a successful university experience,

Sincerely,

Dr. A. K. M. Bazlur Rashid
Professor and Head
DMME, BUET, Dhaka

Preface to the Thirteenth Edition

This booklet has been prepared to provide information about the course structure, syllabus, personnel, facilities and operations of the Department of Materials and Metallurgical Engineering (MME) of Bangladesh University of Engineering and Technology (BUET). Some general aspects of the course system of undergraduate studies followed by BUET are also included.

Department of MME completed its first Self-Assessment programme in 2016 as a first step for its effort to achieve accreditation of its undergraduate programme. During this work, the course curriculum has been comprehensively modified and upgraded following a series of survey and discussion with our alumni, present students, faculties, and reverend peoples from industry. In 2019, the Academic Council approved the first two-year courses of the updated syllabus. This concise publication is for the students of undergraduate studies of the department of session January 2020 onwards who will follow the new syllabus and subsequently have the degree of Bachelor of Science in materials and metallurgical engineering.

We hope that this booklet will also provide a starting point in your search for information concerning important activities and procedures with which you will become involved. We also hope that it will also be useful to the student advisors and other faculties of the Department of Materials and Metallurgical Engineering.

Dhaka
December 2022

Dr. A. K. M. Bazlur Rashid
Professor and Head, DMME

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	Math 171
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	3.00	
		19.50	

Level – 3 / Term – I

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
MME 301	Metal Casting and Powder Processes	4.00	
MME 302	Metal Casting and Powder Processes Laboratory	1.50	
MME 309	Ferrous Production Metallurgy	3.00	
MME 310	Capstone Project	1.50	
MME 311	Electrical, Optical and Magnetic Properties of Materials	3.00	
MME 313	Mechanical Behaviour of Materials	3.00	ME 141
MME 314	Mechanical Behaviour of Materials Laboratories	1.50	
OPTION 2	HUM Option 1	3.00	
		20.50	

Level – 3 / Term – II

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
MME 300	Industrial Training	1.50	
MME 303	Metal Joining and Forming Processes	4.00	MME 313
MME 304	Metal Joining and Forming Processes Laboratory	1.50	
MME 305	Glass and Ceramic Materials	3.00	
MME 307	Polymeric Materials and Composites	3.00	
MME 308	Materials Laboratory I	1.50	
MME 310	Capstone Project	1.50	
MME 315	Characterisations of Materials	3.00	MME 211
MME 316	Characterisations of Materials Laboratory	1.50	
		20.50	

Level – 4 / Term – I

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
MME 400	Project and Thesis	3.00	
MME 401	Physical Metallurgy of Ferrous Alloys	3.00	MME 213
MME 405	Materials Processing for Micro- & Nano-Systems	3.00	
MME 408	Materials Laboratory 2	1.50	
MME 410	Capstone Project	1.50	
OPTION 3	MME Option 1	3.00	
OPTION 4	MME Option 2	3.00	
OPTION 5	HUM Option 2	3.00	
		19.50	

Level – 4 / Term – II

Course Number	Course Title	Credit Hour	Pre-Requisite Courses(s)
MME 400	Project and Thesis	3.00	
MME 410	Failure Analysis and Artefact Study	1.50	
MME 411	Materials Selection and Design	3.00	
IPE 493N	Industrial Management	3.00	
OPTION 6	MME Option 3	3.00	
OPTION 7	General Option 2	3.00	
OPTION 8	HUM Option 3	3.00	
		19.50	

Appendix 5.2

Grouping of Courses for MME Students

Module 1 Compulsory Technology-Oriented MME Courses (X0X)		
MME 101	Materials Engineering Fundamentals	3.00
MME 102	Materials Engineering Fundamentals Laboratory	1.50
MME 202	Professional Development and Communication skills	1.50
MME 206	Chemical Metallurgy Laboratory	1.50
MME 208	Computer Applications to Materials Engineering	1.50
MME 300	Industrial Training	1.50
MME 301	Metal Casting and Powder Processes	4.00
MME 302	Metal Casting and Powder Processes Laboratory	1.50
MME 303	Metal Joining and Forming Processes	4.00
MME 304	Metal Joining and Forming Processes Laboratory	1.50
MME 305	Glass and Ceramic Materials	3.00
MME 307	Polymeric Materials and Composites	3.00
MME 308	Materials Laboratory I	1.50
MME 309	Ferrous Production Metallurgy	3.00
MME 400	Project and Thesis	4.50
MME 401	Physical Metallurgy of Ferrous Alloys	3.00
MME 405	Nanostructured Materials and Thin Film	3.00
MME 408	Materials Laboratory II	1.50

Module 2 **Compulsory Core MME Courses (X1X)**		
MME 211	Crystallography and Structure of Materials	3.00
MME 213	Phase Diagrams and Transformations	3.00
MME 214	Microstudy and Heat Treatment Laboratory	1.50
MME 215	Thermodynamics of Materials	3.00
MME 217	Kinetics and Transport Phenomena in Materials	3.00
MME 219	Corrosion and Degradation of Metals and Alloys	3.00
MME 310	Capstone Project	3.00
MME 311	Electrical, Optical and Magnetic Properties of Materials	3.00
MME 313	Mechanical Behaviour of Materials	3.00
MME 314	Mechanical Behaviour of Materials Laboratory	1.50
MME 315	Characterisation of Materials	3.00
MME 316	Characterisation of Materials Laboratory	1.50
MME 410	Failure Analysis and Artefact Study	1.50
MME 411	Materials Selection and Design	3.00

Module 3 MME Optional Courses (X2X – X6X) for OPTION 3, 4, and 6		
Sub-module 3.1: MME Option 1 and 2 Select one course for each option		
MME 421	Metal Extraction and Recycling	3.00
MME 423	Industrial Metals and Alloys	3.00
MME 425	Principles of Rolling and Roll Pass Design	3.00
MME 427	Surface Engineering and Tribology	3.00
MME 429	Non-Destructive Testing and Evaluations	3.00
MME 431	Fuels, Refractories and Furnaces	3.00
MME 433	Traditional Ceramics	3.00
MME 435	Advanced Ceramics	3.00
MME 441	Advanced Polymers	3.00
Sub-module 3.2: MME Option 3 Select one course		
MME 457	Biomaterials	3.00
MME 453	Photonic and Magnetic Materials	3.00
MME 455	Electronic Packaging Materials	3.00
MME 457	Solar Cell, Fuel Cells, and Batteries	3.00
MME 461	Nuclear Materials	3.00

Module 4 **General Optional Course for OPTION 1 and 7** Select one course from each option		
Sub-module 4.1: GENERAL OPTION 1		
ME 261	Numerical Analysis	3.00
MME 281	Computational Methods for Materials Engineering	3.00
Sub-module 4.2: GENERAL OPTION 2		
ChE 487	Environmental Science and Engineering	3.00
IPE 483	Production Planning and Control	3.00
MME 481	Industrial Pollution Control and Safety	3.00

Module 5 **HUM Optional Courses for OPTION 2, 5, and 8** Select one course from each option		
Sub-module 5.1: HUM OPTION 1		
Hum 317	Financial, Cost and Managerial Accounting	3.00
Hum 319	Business Law	3.00
Hum 323	Engineering Economics	3.00
Sub-module 5.2: HUM OPTION 2		
Hum 405	Economics of Development and Planning	3.00
Hum 419	Introduction to E-Governance	3.00
Sub-module 5.3: HUM OPTION 3		
Hum 417	Sociology for Science and Technology	3.00
Hum 421	Professional Ethics	3.00

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.

MME 300 Industrial Placement [0.00]

Preparation of a comprehensive report based on 3-4 weeks employment experience in a co-op or job in industry materials manufacturing industry. The course is graded as Satisfactory or Unsatisfactory based on the performance of the student and his/her report.

MME 301 Metal Casting and Powder Processes (4.00)

Design and metallurgical aspects of casting. Materials and processes for moulding and core making. Design of gating and feeding systems. Solidification of pure metals and alloys; control of cast structures. Casting defects and their remedies. Foundry practices of industrially important alloys systems. Inspection and quality control. Design in casting. Production and characterization of metal and ceramic powders.

Condition, compaction and sintering of powders. Production of various materials by powder process. Additive manufacturing processes of materials.

MME 302 Metal Casting and Powder Processes Laboratory (1.50)

Demonstration of moulding and metal casting. Testing of foundry sands. Greensand moulding and other special casting methods. Design of gating and feeding systems. Melting and casting of common ferrous and non-ferrous materials. Study of casting defects. Preparation and characterisation of metal and ceramic powders. Effect of compaction and sintering process parameters on the properties of P/M products.

MME 303 Metal Joining and Forming Processes (4.00)

History and classification of joining processes. Principles of operation, metallurgy, and applications of different joining processes of materials. Welding design and symbols. Energy and heat flow in welds. Joining defects. Inspection, testing and quality control. Qualification and certification of welded joints. Corrosion behaviour of welded joints. Weld failure analysis. Theory of elasticity and plasticity. Mechanics of metal working. Common industrial metal working processes. Thermo-mechanical treatment in metal working. Defects induced in metal working processes. Behaviour and shaping processes of superplastic materials.

MME 304 Metal Joining and Forming Processes Laboratory (1.50)

Conduction of various types of joining of metallic and non-metallic materials. Testing of welds. Study of structure, properties, and defects of weld joints. Brazing and soldering of materials. Non-destructive tests of weld joints. Measurement of interfacial friction coefficient of ferrous and non-ferrous materials. Work hardening of plain carbon steels, aluminium, etc. Recovery and recrystallisation of work hardened materials. Formability of sheet metals. Application of rolling theory to calculate rolling schedules.

MME 305 Glass and Ceramic Materials (3.00)

Definition and scope of ceramics and ceramic materials, their classifications, properties and uses. Forming, drying, and densification processes. Glazing and decorations. Raw materials and manufacture of traditional ceramics. Scope, processing, and properties of high-performance ceramics. Prospect of ceramic industries in Bangladesh. Definition and applications of glass. Type, structure, and

properties of glass. Raw materials and manufacture of glass. Crystallisation and glass ceramics. Heat treatment and surface treatment of glass.

MME 307 Polymeric Materials and Composites (3.00)

Classification of polymeric materials. Polymerisation reactions. Structure and properties of polymers. Processing and applications of polymers. Classification of composites. Types of fibres and matrices. Elastic properties of unidirectional and random fibre composites, stress and strain distribution at fibres ends. Production of metal, ceramic, and polymer matrix composites.

MME 308 Materials Laboratory I (1.50)

Preparation and characterisation of ceramic powders. Glass and ceramic production processes. Properties of glass, ceramics, polymeric and composite materials. Geometric characteristics and anisotropic properties of composite materials. Selection of polymeric and composite materials in practical applications.

MME 309 Ferrous Production Metallurgy (3.00)

General overview of iron and steel making. Production of pig iron using blast furnace. Alternative processes of liquid iron production. Kinetics of iron oxide reduction. Principles steel making. Production of plain carbon and alloy steels by various steel making processes. Introduction to ladle metallurgy; deoxidation and refining of steel. Gases in steels and common degassing techniques. Solidification of steel by ingot and continuous casting processes, common defects and their remedies. Production of sponge iron and ferroalloys.

MME 310 Capstone Project (3.00)

This is a two-semester capstone program where students will work in a group to design and execute solution of a materials-related experimental or theoretical problem. The work involves identifying a market demand; setting up target production volume; making engineering analysis of the product; designing a production process; selecting machinery and equipment and designing a factory for its production; making technical, economic, and environmental analyses; and preparing a project proposal suitable for its submission to a financial institution for financing. The course involves intensive project-based, self-directed, group learning activities.

MME 311 Electronic, Optical and Magnetic Properties of Materials (3.00)

Fundamentals of electronic, optical, and magnetic properties of solid-state materials. Basic bonding and crystallography correlations to electronic, optical, and magnetic properties of materials. Case studies drawn from a variety of applications including semiconductor junctions, transistors, magnetic storage media, solar cells, quantum wells, lasers, and other devices.

MME 313 Mechanical Behaviour of Materials (3.00)

Fundamental concept of stress and strain. Stress-strain behaviours of various engineering materials. Static, fatigue, and creep properties of materials. Basic features of fracture and ductile-brittle transitions. Effects of various metallurgical, environmental, chemical, and physical parameters on mechanical behaviours of engineering materials.

MME 314 Mechanical Behaviour of Materials Laboratory (1.50)

Laboratory experiments on mechanical properties and behaviour of homogeneous and composite engineering materials subjected to static, dynamic, creep, and fatigue loads; behaviour of cracked bodies; microstructure-property relationships, and determination of materials properties for use in engineering design.

MME 315 Characterization of Materials (3.00)

Principles of diffraction, spectroscopy and imaging methods used in structural and compositional characterisation of engineering materials. Thermal analysis of materials. Non-destructive testing.

MME 316 Materials Characterization Laboratory (1.50)

Traditional and instrumental chemical characterisation of materials. Mechanical characterisation and microstructure-property relationships of homogeneous and composite engineering materials subjected to static, dynamic, creep, and fatigue loads. Microstructural and phase analyses of materials. Thermal characterisation of materials.

MME 400 Project and Thesis (6.00)

This is a year-long extensive theoretical or experimental research work involving modelling, design and/or construction of material, process, equipment and device of materials and metallurgical interests using structure-processing-properties-performance relation of materials.

MME 401 Physical Metallurgy of Ferrous Alloys (3.00)

Heat treatment of plain carbon alloy steels. Case hardening and surface hardening of steels. Thermo-mechanical treatment of steels including QT process. Heat-treatment of cast irons and nonferrous metals. Heat-treatment of complex-shaped components. Heat-treatment cycle design and calculation. Testing and quality control of heat-treated objects, problems associated with heat treated parts and their remedies.

MME 405 Nanostructured Materials and Thin Film (3.00)

Introduction to nanomaterials and their importance and potential applications. Classifications, fabrication techniques, and properties of nanomaterials. Characterisation of nanostructures and applications. Properties and microstructure of materials in thin film form and their interaction with the substrate. Deposition and fabrication techniques, surfaces, growth mechanisms, epitaxial and kinetic effects in thin films.

MME 408 Materials Laboratory II (1.50)

Investigation of various physical metallurgical principles used in industrial manufacturing processes of ferrous alloys. Basic processing concepts of extractive metallurgical unit operations. Statistical analysis of mechanical behaviour of engineering ceramics. Design of advanced polymers for engineering applications. Preparation and characterisation of mano materials and thin film.

MME 410 Failure Analysis and Artefact Study (1.50)

In this laboratory course students will review how materials fail in service with special industrial reference and how the Artefacts are studied. Students will solve case studies involving the examination of failures and prepare failure examination report. In the artefact study, student will dismantle and identify materials of engineering components.

MME 421 Metal Extraction and Recycling (3.00)

Purposes and principles of ore dressing. Various ore dressing processes and their evaluation. Principles of pyro-, hydro- and electrometallurgical processes of metal extraction. Principles of refining of non-ferrous metals; secondary metal production. Classification and characterization of waste materials considering environmental issues. Fundamental principles and techniques of materials recycling. Radioactive waste treatment. Cost analysis of recycling.

MME 411 Materials Selection and Design (3.00)

Principles of materials selection in mechanical design. Review of material properties; use of property selection charts and indices. Basic materials selection process, materials selection with multiple constraints and conflicting objectives; design with shape constraints and hybrid materials; case studies. Materials processing in design; case studies. Materials and the environment. Industrial design, aesthetics, economics, regulations, forces for change.

MME 423 Industrial Metals and Alloys (3.00)

Classifications of metals and their alloys. Classification, properties and uses of plain carbon steels and commercially important alloy steels, their properties and uses. Classification, properties and uses of cast irons and common nonferrous metals and alloys.

MME 425 Principles of Rolling and Roll Pass Design (3.00)

Rolling and its importance. Sheet, bar, and thread rolling. Calculation of rolling force, friction, roll flattening and cambering. Mill modulus calculation and control of rolling mill. Basic concept of roll pass design. Calculation of temperature loss/gain, mill power, rolling speed, slip, torque, etc. Design for grade-based properties and slit rolling. TMCP and its applications in rolling for dual-phase, TRIP, patented steels, high-strength pipes, etc.

MME 427 Surface Engineering and Tribology (3.00)

Scope of surface engineering. Surface characteristics, texture, and preparation methods. Surface modification techniques: Electro- and electroless- plating, conversion coatings, spray coating, hot dipping, and weld coating methods. Vapour deposition and other advanced methods. Testing and quality control. Selection of coating materials and methods. Basic types of wear: abrasive, adhesive and

delamination wear. Frictional processes and friction coefficient. Influence of materials properties on wear resistance. Wear tests. Wear resistant materials and coatings.

MME 429 Non-destructive Testing and Evaluations (3.00)

Fundamental principles pertinent to non-destructive testing (NDT). Application of NDT in defect inspection in different components. Quality assessment techniques in NDT. Non-destructive Evaluation (NDE) principles and the role of NDE in design, manufacturing, and maintenance. Industrial applications of probability of flaw detection, material properties characterization, impact and fatigue damage evaluation, adhesion, etc.

MME 431 Fuels, Refractories and Furnaces (3.00)

Classification, types, and petrographic constituents of coal. Coke manufacturing processes. Distillation of crude oil and reforming of petroleum products. Manufacture and uses of other gaseous fuels. Classification, properties, and application of refractory materials. Raw materials and manufacturing processes of various types of refractories, Heat transfer and waste heat recovery in furnaces. Classification of furnaces and theories of furnaces design. Control of furnace atmosphere and pyrometry.

MME 433 Traditional Ceramics (3.00)

Introduction to traditional ceramics. Raw materials, processing, properties, batch composition and their effects on the properties. Rheology and properties of clay. Classification, batch formulation, body preparation and fabrication processes of white ware and heavy clayware products. Drying, firing and evolution of microstructure. Glazing and decorations. Properties and testing. Case studies of industrial problems relating traditional ceramics production.

MME 435 Advanced Ceramics (3.00)

Processing of advanced ceramics, thin films and coatings. Processing, characterisations, properties and applications of high-performance ceramics including different classes of engineering ceramics, electronic and other functional ceramics, bioceramics and nanoceramics.

MME 441 Advanced Polymers (3.00)

Physics of polymeric materials. Analysis of advanced and emerging polymer technologies. Design of advanced polymers. Properties and processing of biopolymers, biocompatibility issues, application of biopolymers in medicine and tissue engineering applications. Application of polymers in clean energy, electronics, smart materials and sensors applications.

MME 451 Biomaterials (3.00)

Chemical, physical, and biological properties of synthetic polymer, metal, and ceramic biomaterials. Relationship between the structure of biomaterials and their interaction with blood, soft and hard tissue. Mechanical properties, fabrication, degradation mechanisms, and performance testing of materials in biomedical use. Failure of implants. Regulatory aspects.

MME 453 Photonic and Magnetic Materials (3.00)

Optical materials design for semiconductors, dielectrics and polymers. Physics of light-matter interactions. device design principles and device processing. Origin of magnetism in materials. Magnetic domains and domain walls. Magnetostatistics, anisotropy, antiferri- and ferromagnetism. Magnetisation dynamics. Spintronics, magnetism in thin films and nanoparticles. Magnetotransport phenomena and magnetic characterisation.

MME 455 Electronic Packaging Materials (3.00)

Introduction to electronic packaging. Semiconductors and microelectronic devices. Hierarchy of packages, wafer level packaging. Integrated circuits, packaging and assembly, sealing and encapsulation, board assembly, packaging and electronic products. The role of materials in electronic packaging, functions and constraints of packages, packaging materials and properties, material processes, future trends. Thermal and mechanical reliability, reliability qualifications, experimental methods and tools for reliability analysis. Failure modes and mechanisms, failure analysis.

MME 457 Solar Cell, Fuel Cell and Batteries (3.00)

Solar radiation. Semiconductors. Electric power from solar cells, principles of operation, characteristics. Power losses and efficiency. Sizing and construction of solar-cell systems. Production and storage of hydrogen. Water electrolysis. Electrical energy from fuel cells. Thermodynamic and kinetic calculations for electrolysis- and

fuel cells. Safety in hydrogen handling. Storage of electrical energy in batteries. Applications of solar cells, hydrogen and fuel cells in stationary and mobile systems. Economical and energy analyses for the introduction of energy systems based on renewable energy resources and hydrogen.

MME 461 Nuclear Materials (3.00)

Properties and selection of materials for optimum design of nuclear steam systems. Implications of radiation damage to reactor materials and material problems in nuclear engineering. Overview of nuclear steam systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials.

MME 471 Industrial Pollution, Control and Safety (3.00)

Status of environmental quality in industries. Causes of industrial pollution. Sources and characteristics of industrial wastes. Solid wastes, raw-waste constituents, air pollutants etc. Pollution control in various industries. Industrial waste management. Scope of industrial safety, safety in operating systems, personal safety and equipment, setting standard for safety. The role of government in industrial safety. Management responsibilities for safety and health. Legal aspects of safety.

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.

Chem 411 Organic Chemistry and Polymer Science [3.00] (Optional Course)

Organic chemistry: Saturated and unsaturated aliphatic hydrocarbon, alkylhalides, alcohol and ethers. Aromatic compound and their reactions. Aldehydes, ketones, carboxylic acids and their derivatives. Amines and their derivatives. Phenols and arylhalides. Amino acids and proteins. Heterocyclic compounds: Introduction, aromatic and nonaromatic heterocycles, five, six and condensed ring heterocycles. Polymer Chemistry: Introduction to polymer chemistry. Types of polymers.

Polymerisation processes and techniques. Properties of polymers, plastics, fibres, elastomers and rubber.

ChE 487 Environmental Science and Engineering [3.00]

Water pollution: Introduction to environmental engineering; environmental legislations and regulations; environmental ethics; wastewater characterisation; origin and sources of water pollutions' impact of wastewater discharge to water bodies; physical, chemical and biological treatment approaches of wastewater; nutrients removal; sludge and solid waste management. Air pollution: origin and fate of air pollutants, atmospheric dispersion; stationary and mobile sources; source control. Noise pollution: noise effects; community noise sources and criteria; noise control. Case study: steel mills, metal finishing industry.

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.

Hum 317 Financial, Cost and managerial Accounting [3.00]

Financial Accounting: Introduction to Accounting, Accounting principles and assumptions, Accounting as information systems. Recording system: double entry mechanism, Accounts and their classification, Accounting equation, Accounting cycle: Journal, Ledger, Trail balance. Preparation of Financial statements considering adjusting and closing entries. Financial statements analysis and interpretation: ratio analysis–Tests for profitability, liquidity, solvency and overall measures. Cost and Management Accounting: cost concepts and classification. Overhead Cost: meaning and classification, allocation of overhead cost. Job order costing: preparation of job cost sheet. Inventory valuation: absorption costing and variable costing technique. Cost volume profit analysis: meaning, break-even analysis, contribution margin approach, sensitivity analysis. Short-term investment decisions: relevant and differential cost analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of capital investment. Concept of working capital, need for working capital.

Hum 319 Business Law [3.00]

Principles of law of contract: Basic Principles, offer and acceptance, performance of the contract and termination of the contract. Partnership Act, 1932: Nature of partnership, rights and liabilities of partners and dissolution of partnership business. Law relating to sale of goods: Definitions, transfer of ownership and performance of the contract. Company law: The Companies Act, 1994 with special reference to the amendments and ordinances applicable to Bangladesh focusing on formation,

incorporation, management and winding up of companies. Labour law: Bangladesh labour code, 2006 Factory Act (1965), Law of Compensation (1965).

Hum 323 Engineering Economics [3.00]

Introduction to Economics: defining Economics, fundamental economic problems, Economics and Engineering. Microeconomics: cardinal approach to utility analysis and derivation of consumer demand, demand and supply analysis, determination of price and output, elasticity of demand and supply; ordinal approach to utility analysis, indifference curve analysis, marginal rate of substitution, substitution effect and income effect; theory of production, production function, types of productivity; concepts of market and market structure; cost analysis and cost function; optimization. Macroeconomics: major macroeconomic issues, national income accounting, savings, investment, employment and inflation; monetary policy, fiscal policy and trade policy with reference to Bangladesh; project appraisal: payback period, benefit cost ratio (BCR) analysis, net present value (NPV), internal rate of return (IRR), sensitivity analysis. Economics of development: understanding economic growth and development; contemporary models of development and underdevelopment; poverty, inequality and unemployment; development problems related to agriculture, industry and the environment.

Hum 405 Economics of Development and Planning (3.00)

Concept of development and underdevelopment, causes of underdevelopment. Characteristics of less developed countries. Theories of development: Lewis 2-Sectoral growth model. Hirshman's unbalanced growth and Rostow's stages of growth theory. Alternative strategies for development: balanced versus unbalanced growth. Investment criteria. Issues of economic development: poverty, inequality and unemployment in relation to development. Development problems related to agriculture, industry and population of Bangladesh. Industrialisation, trade, foreign aid and foreign private investment. Planning and its types: physical, financial project, sectoral and national planning. Stages of planning. Financing economic development: domestic resources for investment: savings, taxation. borrowing: internal and external. Role of taxation and borrowing in financing of economic plan. Deficit financing. Role of government in economic development. Project preparation, project appraisal and project evaluation. Cost-benefit analysis.

Hum 417 Sociology, Science and Technology [3.00]

Nature and scope of sociology; Relationship of science, technology and society; Research methodology; Culture and civilization; Technology, social ethics and social

values; Socialization and leadership development; Social stratification; Technology and social inequality; Techniques of production systems; ICT and social organizations; Environment and Technology; Social change in Bangladesh.

HUM 419 Introduction to E-Governance (3.00)

Concepts of government and governance, industrial framework, legitimacy and authority, democracy, political leadership, bureaucracy, good governance, corporate governance, local governance, environmental governance, defining e-governance, e-governance and citizen engagement, e-governance and public service delivery, public-private partnership for e-government system, legal and ethical issues in e-government, e-government development index (EGDI), ICT policy and e-governance in Bangladesh.

Hum 421 Professional Ethics [3.00]

Definition and scopes of Ethics. Different branches of Ethics. Social change and the emergence of new technologies. History and development of Engineering Ethics. Science and Technology necessity and application. Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Ethical Expectations: Employers and Employees; inter-professional relationship: Professional Organization- maintaining a commitment of Ethical standards. Desired characteristics of a professional code. Institutionalization of Ethical conduct.

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.

IPE 483 Production Planning and Control [3.00]

Element of production planning and control, Types of production systems. Forecasting; methods and their application; aggregation planning; master production scheduling, MRP, coding and standardisation; capacity planning, inventory management. ABC analysis. Production scheduling techniques, CPM and PERT, line balancing, capacity planning. Plant location and layout, work study and method study, plant performance measurement. Introduction to product development and design. Computers in production planning and control and MRPII, JIT.

IPE 493 Industrial Management [3.00]

Management: Evolution of management thought, classical quantitative and behavioural schools, interaction schools, interaction between organisations and their environment. Management principles, management functions, the management team, management by objectives. Organisational structures, co-ordinations and span of control, the information organisation, authority delegation and decentralisation, groups and committees, managing organisational change and conflict. Motivation, performance satisfaction, leadership, training, incentive systems, performance appraisal. Quality management: Fundamentals of quality management, TQM, TQC, and control charts. Marketing management: Marketing concepts, sales and marketing strategies.

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 261 Numerical Analysis [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 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.

Phy 401 Solid State Physics [3.00]

Classical free electron theory, Fermi surface, Fermi energy, density of states, electron in a periodic potential, Kronig-Penny model, band structure calculations, Clausius-Mosotti relation, polarisation mechanisms, direct and indirect band gap semiconductors, extrinsic semiconductors, transport, optical and photoelectrical phenomena in semiconductors, metal-semiconductor junction, theories of superconductor, mechanisms of superconductivity, theories of magnetism, types of magnetic materials, practical applications of solid state physics.

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.

Appendix 5.5
MME Course for Students of Other Departments

MME 195 Engineering Materials – I (3.00)
For IPE students (Level 1 Term 2)

Properties of metals, ceramics and polymers; processing of materials from liquid, solid and paste; choosing materials for products. Atomic, molecular, crystalline and amorphous structures for metals, ceramics and polymers. Elastic and plastic behaviour of materials. Behaviour of ceramic materials, glasses and polymeric materials. The behaviour of materials in service: fracture, ductile-brittle transition, fatigue, creep, oxidation and degradation, corrosion and corrosion protection. Materials as mixtures of elements: mixtures near and far from equilibrium, phase diagrams, phase changes. Non-ferrous metals: production and uses. Iron and steel production: production and uses; types of cast iron, effects of impurities. Plain carbon steel: the iron-iron carbide phase diagram, constituents and structures of plain carbon steels; Heat treatment of steels. Alloy steels: principles and effects of alloying, different alloy steels and their uses.

MME 291 Metallic Materials (3.00)
For ME students (Level 2 Term 2)

Concept of malleability, ductility, toughness, fatigue resistance and other properties. Mechanical and non-destructive tests of metals. Pig iron: production and uses. Cast iron: production, types, uses and effects of impurities. Steels: Bessemer and open-hearth steels, production and uses. Plain carbon and different types of alloy steels. Bearing metals, light alloys, common metals and their alloys. The Fe-Fe3C equilibrium diagram. Types of heat-treatment. Case carburizing and nitriding.

MME 292 Metallic Materials Sessional (1.5)
For ME students (Level 2 Term 2)

Experiments based on MME 291.

MME 293 Shipbuilding Materials (3.00) For NAME students (Level 2 Term 1)

Metals as materials of construction. Industrially significant properties of metallic materials. Production, properties and uses of pig iron, cast iron and carbon steels.

Nonferrous alloys. Protective coatings. Ferrous alloys: plain carbon, alloy, tool, stainless, heat-resisting and creep-resisting steels etc. The Fe-Fe3C equilibrium, different types of heat-treatment operations. Case hardening of steels. Cement, ferro-cement, timber, rubber, glass and plastics.

MME 294 Shipbuilding Materials Sessional (0.75)
For NAME students (Level 2 Term 1)

Experiments based on MME 293.

MME 295 Engineering Materials – II (2.00) For IPE students (Level 2 Term 1)

Ceramics: Ceramic raw materials, preparation, characterisation and processing; principles and mechanisms of ceramic drying and firing processes; defects and properties of ceramics; glazing and decoration; conventional and engineering ceramics; newer industrial ceramics. Glasses: Kinetics of crystallisation and phase separation of glass, glass transition; viscosity, chemical durability and thermal, electrical, optical, and mechanical properties of commercial glasses; relation of physical properties to glass structure and composition; tests of glass. Polymers: Structure and properties of polymers and copolymers; thermoplastics and thermosets; product design; commercial processing of polymers; properties and testing of polymers; polymers and the environment. Composites: Theory of composites; fabrication, structure and uses of different types of composites; properties of composites.

MME 296 Engineering Materials Sessional (1.50)
For IPE students (Level 2 Term 1)

Metallographic sample preparation. Microstudy of ferrous and nonferrous materials. Microstudy of clay-based ceramic materials and semi-crystalline polymers. Study of the manufacturing processes of ceramics and glasses. Anisotropic properties of composite materials.