3rd Year, 1st Term					
Course Code	Course Tittle	L	T	P	C
Theory					
Hum 3127	Government and Sociology	3	0	0	3
MSE 3101	Transport Phenomena in Materials	3	0	0	3
MSE 3103	Materials Manufacturing Processes	4	0	0	4
MSE 3105	Welding and Materials Joining Process	3	0	0	3
MSE 3107	Physical Metallurgy of Materials	3	0	0	3
Sessional					
MSE 3104	Sessional on Materials Manufacturing Processes	0	0	3	1.5
MSE 3106	Sessional on Welding and Materials Joining Process	0	0	3/2	0.75
MSE 3108	Sessional on Physical Metallurgy of Materials	0	0	3	1.5
	Total				**19.75**

Distribution of Marks

i. Theory Courses:

Class participation, attendance and assignments	10 %
Class tests, Quizzes, Spot tests etc.	20%
Term Final Examination	70%
Total	100%

N.B. Students fail to attend 60% of the class will not allow to sit in the final exam in any circumstance.

ii. Independent laboratory/design/field work courses:

Class participation and attendance	10 %
Quizzes, Viva-Voce conducted in lab class	20%
Viva-Voce conducted centrally	20%
Performance and reports	50%
Total	100%

iii. Project/thesis (Continued for two terms):

a) *At the end of 4th year 1st Term*: 30% of the total marks to be evaluated as follows:

Presentation and (Viva-Voce conducted by a Viva-Voce committee)	10%
Supervisor	20%
Total	30%

b) *At the end of 4th year 2nd Term*: 70% of the total marks to be evaluated as follows:

Presentation and Viva-Voce (conducted by a Viva-Voce committee)	20%
Supervisor	40%
External examiner (any other teacher of the department/ a member of examination committee	10%
Total	70%

Materials Science and Engineering
Khulna University of Engineering and Technology
Khulna-9203, Bangladesh

3rd Year, 1st Term

Hum 3127: Government and Sociology

Credits: 3.0 (3.0 hrs/week)

Referred text books:

- "Perspectives on Political Order: East and West" by Ramashray Roy
- "Principles of Political Science" by Anup Chand Kapur
- "American government and politics today" by B. A. Bardes, M. C. Shelley II, S.W. Schmidt
- "Sociology" by Anthony Giddens
- "Sociology: A brief Introduction" by Richard T. Schaefer
- "Sociology: Primary Principles of Sociology with an Introduction to Social thought" (3rd Edition) by C.N. Shankar Rao

Topic covers:

Introduction of Government and Politics: Definition of government and politics; Scope and utility of government and politics; Origin and development of the state functions of modern welfare state; Role and quality of ideal citizen.
Forms of government: Definition and forms of government; Distinction between different forms of government.
Democratic theories: Classical liberalism; Conservativism; Socialism; Contemporary liberalism; Fascism, Marxism, Communism; Nationalism; Democracy in the United States, European Union, Africa and Asia.
Basic structures of Bangladesh Government: The executive, Legislative and judiciary; Constitution of Bangladesh; Basic principles and theory of governance in Bangladeshi Political system.
Introduction of sociology: Definition, nature and scope of sociology; Socio-cultural context of the emergence of sociology; Sociological perspective- Functionalism, Conflict perspective and Symbolic interactionism, Sociological imagination.
Basic Concepts of Sociology: Society, Community, Institution, Association, Organisation, Group, Kinship, Social Structure, Social stratification.
Methods and Techniques of Research in Sociology: Scientific method, Steps of scientific research; Methods and techniques of sociological research; Ethics of Research.
Culture and Socialisation: Definition and elements of culture; Basic concepts of culture- cultural lag, Cultural relativism, Cultural hybridisation, Ethnocentrism, Counter culture, Cultural shock; Definition and agencies of socialisation; Theories of socialisation; Impact of culture on socialisation and personality development.
Social Changes and Social Problems: Definition and agencies of social changes; Industrialisation, Urbanisation and Social pathology; Crime and Deviance; Globalization and changing pattern of family and marriage; Sociological conceptualization of religion and role of religion in society.

MSE 3101: Transport Phenomena in Materials

Credits: **3.0 (3.0 hrs/week)**

Referred text books:

- "Basic Transport Phenomena in Materials Engineering" by Manabu Lguchi, Olusegun J. Ilegbusi
- "An Introduction to Transport Phenomena in Materials Engineering" by David R. Gaskell
- "Fundamentals of Heat and Mass Transfer" by T. Bergman, A. Lavine, F. Incropera and D. DeWitt
- "Heat Transfer: A Basic Approach" by M. Necati Ozisik

Topic covers:

Momentum transfer: Basic properties of fluid flow; Conservation laws (equation of continuity, Navier-Stokes equation, Bernoulli equation); Flow regime; Flow in a pipe; Flow around a solid body
Basic heat transfer principles: Physical origins of rate equations of the three principle modes of heat transfer; Thermal resistance concept.
One-dimensional steady-state conduction: The plane wall; Radial systems; Conduction with thermal energy generation.
Two-dimensional steady-state conduction: Finite-difference equations (the nodal network, finite-difference form of heat equation, energy balance method).
Transient conduction: Lumped capacitance method; Plane wall with convection; Radial systems with convection; Finite difference methods.
Convection: Convection boundary layers; Local and average convection coefficients; Laminar and turbulent flow.
Heat exchangers: Heat exchanger types; Overall heat exchanger coefficient; Heat exchanger analysis: use of log mean temperature difference.
Radiation: Radiation heat fluxes; Radiation intensity; Blackbody radiation; View factor; Blackbody radiation exchange; Network method for radiation exchange in an enclosure.
Diffusion and mass transfer: Formulating diffusion in homogeneous media; Diffusion in porous media; Physical origins and rate equations; Mass transfer through chemical reaction; Chemical reaction model; Mass diffusion; Boundary conditions for mass transfer; Mass transfer in nonstationary media; Conservation of species for a stationary medium; Boundary conditions and discontinuous concentrations at interfaces; Transient diffusion.

MSE 3103: Materials Manufacturing Processes

Credits: 4.0 (4.0 hrs/week)

Referred Textbooks

- "Manufacturing Science" by A Ghosh and A K Mallik, Ellis Horwood Ltd
- "Fundamentals-of-modern-manufacturing" by Mikell P Groover, John Wiley and sons, Inc.
- "A Text Book on Production Engineering" by Swadesh Kumar Singh, Made Easy Publications
- "Manufacturing Engineering and Technology" by Kalpakjian and Schmid, Prentice Hall

Topic covers:

Manufacturing Properties of Materials: Structure of matter; Metals and alloys; Deformation and mechanical properties of materials; Control of material properties.
Foundry Practices: Properties of moulding sand; Sand additives; Pattern and mould making; Core and core boxes; Melting; Pouring; Gates and risers; Cooling and solidification; Chvorinov's rule; Solidification shrinkage; Riser design; Defects in Casting; Miscellaneous casting processes; Inspection of Casting; Non-ferrous casting metals; Cast Iron
Forming Processes: Introduction; Plastic deformation and yield criteria; Relationship between tensile and shear yield stresses; Mechanics of forming processes- rolling, forging, drawing, bending, extrusion; Various forming operations, Advantages and disadvantages of hot and cold forming; Friction and lubrication in metal forming; Defects in metal forming.
Machining Processes: Mechanics of basic machining operation; machining processes- Shaping and planing, Turning and boring, Drilling, Milling; Abrasive machining and finishing operation; Surface finish; Economics of machining operations.
Shaping Processes for Polymers, Ceramics and Glasses: Properties of polymer melts; extrusion; Defects in extrusion; Injection molding; Compression and transfer molding; Blow molding and rotational molding; Thermoforming, Processing of traditional and new ceramics; Shaping processes in glass working.

Powder Metallurgy: Principles of powder metallurgy process; Powder manufacture; Powder blending; Powder compaction; Sintering; Finishing.
Advanced Manufacturing Processes: Additive manufacturing; Laser processing and manufacturing.

MSE 3105: Welding and Joining Processes

Credits: **3.0 (3.0 hrs/week)**

Referred textbooks:

- "Metallurgy of Welding" by J. F. Lancaster
- "Modern Welding Technology" by H.B. Cary and S.C. Helzer (6th Edition)
- "Principles of Welding: Processes, Physics, Chemistry and Metallurgy" by R. W. Messler Jr.
- "Welding Metallurgy" by Sindo Kou
- "Welding Handbook" 8th Edition

Topic covers:

Materials joining methods: Introduction to permanent and semi–permanent methods of materials joining namely Welding, Brazing, Soldering, Riveting, Adhesives, Nuts and bolts and washers, Knock-down fittings, Screws.
Soldering and Brazing: Solders; Classifications of soldering fluxes and its properties; Different types of soldering methods; Basic operations of soldering: Cleaning operations; Types of brazing joint; Basic operations in brazing; Brazing filler metals; Brazing fluxes, Quality control in brazing, Brazing applications.
Fusion Welding Process: Classification of welding processes; Welding process selection criteria; Principle of fusion welding, Traditional fusion welding processes: Oxyfuel welding, manual metal arc welding, gas metal arc welding, gas tungsten arc welding; Modern fusion welding process: submerged arc welding, electro-slag welding, plasma arc welding; Special fusion welding process: electron beam welding, laser beam welding; Thermite welding; Preparation of thermite welding;
Solid State Welding Process : Resistance welding processes; Resistance spot and seam welding process; Projection welding; Pressure welding, Cold and Hot pressure welding, Forge welding, Roll welding, Explosion welding, Friction welding and Diffusion bonding.
Metallurgical Aspects of Welding: Weld metal solidification and weld–pool structure; Heat affected Zone (HAZ); Effect of welding parameters and processes on HAZ; Weld metal nucleation mechanism; Grain structure control; Effect of welding parameters on grain structure; Oxidation and de–oxidation of metals in welding; Dissolution of gases and its control; Weldability;
Develop, analyse and detect the remedies of residual stress and distortion fusion zone; Weld decay; Refining of weld metals.
Miscellaneous joining processes: Types of adhesives; selection of adhesive materials, post treatment of adhesive joined materials; Types of riveting, selection criteria of rivet joining, ceramics joining, polymer joining process.
Weld Defects: Weld metal solidification cracking; Reducing solidification cracking; Liquation cracking; Lamellar Tearing; Imperfect shape and unacceptable contour.
Weld Design and symbols: Design of the weld, Reference line of welding symbol, size of welds, field weld and reference tail, typical welding symbols.
Inspection and Testing of Weldment: Inspection prior to welding; In–process inspection; Testing of weldments: metallographic test, chemical test, mechanical test; Non-Destructive testing (NDT).

MSE 3107: Physical Metallurgy

Credits: 3.0 (3.0 hrs/week)

Referred Textbooks:

- "Introduction to Physical Metallurgy" by Sydney H. Avner, Tata McGraw Hill
- "Physical Metallurgy Principles" by R. Abbaschian, L. Abbaschian and R. E. Reed-Hill, 4th ed.
- "Fundamentals of Physical Metallurgy" by John D. Verhoeven, Wiley, New York, 1975
- "Physical Metallurgy' by Peter Haasen, Göttingen, Germany, 1996

Topic covers:

Cold working and Hot working: Cold working, effect of cold working on properties, hot working, recovery, recrystallization, nucleation and grain growth, comparison of hot work and cold work.
Phase Transformation in Steel: Allotropic changes in iron, iron-iron carbide equilibrium diagram, cast iron, steel and iron microstructures with phase relations, transformation of steel on heating and cooling, Influence of alloying elements, Time-Temperature Transformation diagram, Continuous Cooling Transformation Diagram, Effects of Alloying Elements on TTT Diagram, Mechanism of Pearlitic, Martensitic and Bainitic transformation.
Heat Treatment Processes: Annealing, Normalizing, Hardening/Quenching, Hardenability: Jominy end–quench test, mechanism of heat removal during quenching, factors effecting quenching conditions, Tempering, Austempering and Martempering process.
Surface Hardening and Surface Heat Treatment: Carburizing, Nitriding, Cyaniding, Flame hardening and Induction hardening, Laser and Electron beam hardening, Diffusion coating, Heat treatment of surface hardened materials.
Heat Treatment of Engineering Alloys: Heat treatment of cast iron–white cast iron, grey cast iron, heat treatment of non-ferrous alloy-aluminum alloy, copper alloy, nickel alloy and titanium alloy.
Application of Physical Metallurgy: Strengthening mechanisms of metals, Thermomechanical treatment, micro alloyed and Ultra high strength steel, superalloy, Control of texture.

MSE 3104: Sessional on Materials Manufacturing Processes

Credit Hours: 1.50 (3.0 hrs/week)

Course Objective:

- Introduce processes and equipment utilized in the manufacturing industries.
- Introduce the concepts of production monitoring and control processes.
- Explain different forms of production logistics in a manufacturing process.

List of Experiments

Testing on foundry sand- Permeability for Green Sand, Compactability, Moisture Determination, Sieve Analysis and Grain Fineness Number, Wet and Dry Compression Strength for Green Sand; Preparation of moulding sand mixtures; Melting and casting of ferrous and non-ferrous materials; Various casting processes; Structural analysis of cast metal; hot working and cold working process; metal working processes like rolling, forging, extrusion, wire, rod and tube drawing, sheet metal forming.

MSE 3106: Sessional on Welding and Materials Joining Processes

Credit Hours: 0.75 (1.5 hrs/week)

This laboratory course will comprehensibly help to understand about various forms of welding/joining in addition to welding defects which affects mechanical properties of welded parts.

List of Experiments

Soldering Process (Lap Joint); Brazing Process (Lap Joint); Metal Cutting and Gas Welding (Butt Joint); Starting an Arc and Running Stringer (Straight) Beads; Manual Metal Arc Welding (MMAW) Process: Gas Tungsten Arc Welding (GTAW) and Gas Metal Arc Welding (GMAW); Micro and Macro Examination of a Welded Joint; Investigation of Mechanical Properties of Welded Joint; Determination of Shear Strength of Soldered, Brazed and Resistance Spot Welded Joints; Oxygen-Acetylene Welding (OAW).

MSE 3108: Sessional on Physical Metallurgy

Credit Hours: 1.5 (3.0 hrs/week)

This laboratory course offers practical knowledge of macro- and micro-graphic studies of heat-treated steel, alloy steel, tool steel, case hardened steel and cast iron.

List of Experiments

Annealing of pre-stressed sample, Normalising of mild steel sample, Spheroidisation of high carbon steel, Quenching: study of quenching media, and time effects on hardening of steel, Tempering: study of tempering temperature and time on tempering of steel, Carburisation of steel and case depth measurement, Heat treatment of Cast iron and stainless steel.