Detail Syllabus of 4th Year Even Semester B.Sc. Engineering

GCE4803 (Advanced Glass Technology)
Sessional: 3 hrs/week, No. of Credit: 3.00
Optical Fibers: General concept, Fabrication, Mode of signal transport, Characteristics, Applications.
Fiber-Glass Reinforced Composites: Production of glass fiber, Reinforcement mechanism, properties and Applications.
Laminated Safety Glass: Processing, Benefits, Characteristics, Applications, Cyclone resistant laminate.
Safety and Security Glass: Introduction, Bullet resistant glass, Physical attack glass, Prison shield, Train and Special purpose windows.
Reflective and Coated Glass: Introduction, On-line coating, Off-line coating, Low emissivity.
Insulated Glass Unit: Introduction, Process, Properties, Application, Condensation.
Special Purpose Glass: Metallic glass, Organic glass, Silver glass, One-way mirror, Convex mirror, Lead glass, Non-reflecting glass, Heat resistant glass, Fire rated glass, Welding glass, Glass blocks, Aquatic glazing.
Recycling of Glass: Importance of recycling, Cullet preperation, Recycling processes.

GCE4805 (Advanced Ceramics-II)
Lecture: 3 hrs/week, No. of Credit: 3.00
Ceramic Substrates: (Al_2O_3, BeO, AIN, Glass Ceramic), Processing and preparation of Thick Film, Thin Film, Multilayer Packages.
Ceramic Insulators: General concepts, Classification, Properties, Applications.
Ceramic Capacitor Dielectrics: Barium titanate, Other titanate based dielectrics composition with high Pb content, Processing of thick & thin film capacitors, Integrated capacitors. Relaxor Dielectrics.
Piezoelectric Ceramics: Piezoelectric and electrostrictive materials, Powders & Processes, Piezoelectric ceramic applications.
Electro-optic Ceramics and Devices: Different Materials, PLZT compositional systems, Powders & Processes, Hysteresis loop, Electro optic properties, Applications.
Sensors: Oxygen sensor, Principles of operation, Solid electrolyte sensors, Semiconductor sensors, Thermistors and related sensors.
Ceramic Superconductors: High T Superconductors, Structure of Y-Ba-Cu oxide system, Powder synthesis, Theory of Superconductivity, Applicanions.
Ceramic Membranes: General concepts, Types, Properties, Applications.

GCE4827 (Nanotechnology)
Lecture: 3 hrs/week, No. of Credit: 3.00
Introduction: General concept on Nanoscience and Nanotechnology, Significance of nanoscale, Emergence and challenges of nanomaterials, 1-2-3 dimensional nanostructured materials.
Nanomaterials: Carbon nanotube, Fullerenes, Graphene, Micro and meso-porous materials, Coreshell structure, Intercalation compounds, Nano-composite and Nano-ceramics.
Fabrication of Nanomaterials: Top-down approach, Bottom-up approach, Self-assembly and self-organisation, Inert-gas-condensation method, Mechanical attrition method, Sol-gel technique, Microemulsion technology, Powder consolidation methods, Thermal CVD, Sputtering, Vacuumarc-evaporation, Lithography, Molecular beam epitaxy, etc.
Quantum Dots: Quantum mechanical background, 3D quantum dots, Colloidal and Epitaxial growth, Quantum dots formed by ion implantation.

Magnetoresistive Nanomaterials and Devices: Basic concepts of magnetoresistance, Read-write heads and MRAM, Fundamentals of magnetic storage, Fabrication Engineering and scaling.
Application of Nanomaterials: Environmental application, Medical application, Electronic application, Industrial application, Nanomaterials in catalysis, Energy conversion and storage, Use of nanomaterials in water purification and filtration, Societal implication of nanotechnology, Adverse effect of nanotechnolgy, Future of nanotechnology.

IPE4835 (Industrial Management and Law)
Lecture: 3 hrs/week, No. of Credit: 3.00
Human Resource Management: Recruitment and selection, Performance appraisal, Industrial Relations, Trade Union, Collective Bargaining.
Organization Behavior: Different Schools of Management Thought: Scientific Management, Administrative Theory, Theory of Bureaucracy, Human Relations Theory (Elton Mayo).
Motivation: Concept, Different Theories (Maslow, ERG, Herzberg).
Communication: Purpose, Process, Barriers to effective communication, Guidelines to make communication effective.
Perception: Process, Importance, Factors influencing perception, Shortcuts for judging people-Halo effect, Stereotyping, Projection.
Productions Management: Concept, Difference from Operations Management, Types of Production (Mass, Batch, Project), Functions of production management.
Productivity: Concept, Different Inputs and Productivity Measures, Efficiency and Effectiveness, Measures to Increase Productivity.
Marketing Management: Basic Concepts of Marketing, Difference between Selling and Marketing, Elements of Marketing Mix - the 4 P's.
Marketing Environment: Mega Environment, Micro Environment, Internal Environment, Relevant Environment.
Simple Marketing Strategies: SWOT Analysis, BCG, Matrix, Industry Matrix.
Inventory Management: Concept, Functions, EOQ Models - Wilson model, Model with shortage, Model with quantity discount, Model without shortage, Selective Inventory Control-ABC, VED, FSN analysis.
Industrial Law in Bangladesh: Labor law, Payments of wages, Legislation relating employment in industries.

GCE4804 (Advanced Glass Technology Sessional*)*
Sessional: 1.5 hrs/week, No. of Credit: 0.75
Sessional based on **GCE4803**

GCE4806 (Advanced Ceramics Sessional)
Lecture: 3 hrs/week, No. of Credit: 1.50
Sessional based on **GCE4721** and **GCE4821**

GCE4800 (Project and Thesis)
Sessional: 6 hrs/week, No. of Credit: 3.00

GCE4834 (Seminar)
Lecture: 2 hrs/week, No. of Credit: 1.00

To be arranged by the department of GCE.

Detail Syllabus of Optional Courses offered in 4th Year Odd Semester (Optional-I)

GCE4725 (Pollution Control and Waste Management)
Lecture: 3 hrs/week, No. of Credit: 3.00
Sources of Pollutants and Their Remedy: Different kinds of industrial pollution and their origin and influence on human. The emission from burning coal, pet-coke, furnace oil and their analysis. The improvement of combustion process to reduce the formation of NOx, SOx, CO, etc. The fine particles released from the crushing grinding of the ceramic raw materials. The equipment and methods to arrest the release of fine particulate materials and unwanted gases to atmosphere. Chemicals used in different ceramic industries e.g. tiles, potteries refractory, and glass industries. Possibility of leaching of the chemicals to ground water and to rivers and lakes. Possible ways to stop the leaching of suitable chemicals. Different types of pollution created from the solid wastes in the ceramic and glass industries and the possibility of recycling them. Sound and noise pollutions and their minimization techniques.
Effluent Treatment Plant: General methods of effluent treatment, Treatment of wastes/effluent with organic and inorganic impurities, Design of effluent treatment plant, BOD, COD.
Rules and Regulations: National and International laws on pollution and waste management.

GCE4729 (Corrosion Engineering)
Lecture: 3 hrs/week, No. of Credit: 3.00
General Concepts: Definition and importance of corrosion, Cost of corrosion, Corrosion damages, Classification of corrosion, Future outlook, Electrochemical aspects of corrosion, Environmental effects, Metallurgical and other aspects, Corrosion Forms and Corrosion under special conditions.
Theory of Corrosion: Thermodynamic aspects of corrosion - Free energy, Cell potentials and EMF series, Diffusion processes and Double layer, Pourbaix diagram; Electrode kinetics - Exchange current density, Activation polarisation, Concentration polarisation, Combined polarisation, Mixed-potential theory, Mixed electrodes, Passivity, Mechanisms of the growth and breakdown of passive films.
Corrosion Prevention: Materials selection; Alteration of environment, Design, Cathodic and anodic protection, Inhibitors and Passivators, Metallic coatings, Inorganic coatings, Organic coatings.
Corrosion Testing: Classification, Purpose, Surface preparation, Measuring and Weighing, exposure techniques, Standard expression for corrosion rate, NACE test methods, Linear polarisation, AC impedance, Small amplitude cyclic voltammetry, In-vivo corrosion, Paint tests, Seawater test.
Corrosion in Industries: High temperature corrosion, Corrosion in boiler plants, Gas-turbine blades, Chemical industries, Petroleum, Building and Fertilizer industries.
GCE4731 (Foundry Engineering)
Lecture: 3 hrs/week, No. of Credit: 3.00
Introduction: Concept of foundry establishment, General methods of molding and casting, Pattern making and pattern allowances, Core making, Necessity of Feeding, Principles of gating design.
General Molding Method: Classification of molding methods, Sand system, Characteristic of molding sand aggregate, Non sand system, Use of clay, Water and additive in molding, Characteristics of molding clay, Types of additives, Testing and Control of molding sand aggregates.
Special Molding and Casting Processes: Sodium silicate process, Investment casting, Lost foam casting, Vacuum molding, Die casting, Centrifugal casting, Slush casting, Squeeze casting,

Continuous casting.
Solidification and Crystallization: Nucleation and growth of solid, Solidification of pure and impure metals and alloys, Control of solidified structure, Formation of dendrites, Segregation, Solidification shrinkage.
Metals Cast in Foundry: Metals cast in foundry, Classification of foundry alloy, Families of cast irons and melting practice, Ferrous and Non-Ferrous foundry practices.
Structure of Cast Product: Formation of granular structure, Ingot structure, Formation of Chill Zone and Columnar Zone, Equiaxed crystals, Control of grain structures of casting.
Defects in Casting: Different Types of casting defects, Inspection and Quality control.

GCE4733 (Metal Joining Technology)
Lecture: 3 hrs/week, No. of Credit: 3.00
Introduction: General Idea, Classification, Advantages.
Soldering: Basic operations, Surface cleaning, Uses of Flux, Classification and Properties of soldering flux, Flux removal procedure.
Brazing: General concept, Types, Characteristics, Filler metal and Flux, Advantages and Disadvantages.
Welding: Basic operation, Types, Different welding positions, Oxyfuel welding, Manual metal arc welding, Gas shielded arc welding, TIG, MIG, Resistance, Thermit and other special types of welding.
Metallurgy of Welding: Crystallization in the weld metal, Structure of weld joint, Weldability of various metals and alloys.
Distortion and Defects in Welding: Different Types of defects and distortion associated with welding.
Quality Control, Testing of Welds: Control prior welding, In process inspection, Testing and quality control of weldments.

Detail Syllabus of Optional Courses offered in 4th Year Even Semester (Optional-II)

GCE4835 (Energy Engineering and Furnaces)
Lecture: 3 hrs/week, No. of Credit: 3.00
Different Sources of Energy: Solid, Liquid and Gaseous fuels, Alternative fuels, Characterization, Properties and their Applications.
Dryer: Classification of dryers, Their operations and maintenance, Sources of heat for drying & drying schedule, Defects at green stage- causes & remedies, Heat and mass transfer in dryers, Rate of drying, Drying mechanism of non porous and porous solids, Shrinkage and case hardening, Through circulating and suspended bed drying, Drying equipment- for solids pastes slurries and solution.
Study of Different Furnaces/Kilns: Types of industrial furnaces and kilns. Components of total furnace systems, Evolution of kilns in ceramic industries, Furnaces/kiln construction materials.
Heat/fuel economy: Sources of heat loss in furnace, Thermal efficiency in operation of furnace, Waste heat recovery - Recuperators & Regenerators.
Dynamics of Gas in a Furnace: Importance of draught, Classification of draughts. Deduction of the equations for natural draught & chimney height.
Burners and Fire boxes: Grate firing systems, Mechanical stokers, Selection of burners, Burner components and classification of burners.
Temperature Measurement: Principle, Thermometric properties, Heat work measurement, Resistance thermometer, Thermocouple, Radiation & Optical pyrometers. Temperature controllers.

GCE4837 (Materials for Energy Conversion and Storage)

Lecture: 3 hrs/week, No. of Credit: 3.00

Electro-chemical Cells: Primary Cells: Leclanche cell - construction, shelf-life, cell reactions & performance; Flat type dry Leclanche cell; Magnesium dry cell; Air-depolarised cell; Various oxide-depolarised cells; Chloride-depolarised cells. **Secondary Cells:** General considerations; lead-acid accumulator – construction, capacity, efficiency, cell reactions; Alkaline cells – construction, Cell reactions, Capacity, Efficiency; Silver-zinc accumulator – construction, Cell reactions & performances

Fundamentals of Fuel Cells: Direct and indirect energy conversion; Fuel cells and related systems; Air-depolarised fuel cells, Electrode processes; Choice of cell reactions; Thermodynamic efficiency of fuel cells; Electromotive force of fuel cells; Rates of electrode processes. Temperature dependent Fuel Cells, Application of fuel cell systems and future of the fuel cells.

Materials for Solar Energy Conversion: Solar radiation; Selective surface for solar energy conversion, Types of solar selective materials, Solar reflector materials, Anti-reflection materials, Preparation of selective black surface, Production methods of coatings.

Photovoltaic System: Photovoltaic devices, Semiconductor pn junction principles, Types of solar cells, Solar cell construction, Solar cell modules, Storage batteries, Design of photovoltaic systems.

Bioconversion and Biomass: Photosynthesis, Biogas Generation, Digester and their Designs, Materials for biogas and biomass and their application.

GCE4839 (Manufacturing of Engineering Materials)

Lecture: 3 hrs/week, No. of Credit: 3.00

Metal-Casting Processes and Equipments: General concepts, Different types, Casting techniques for single crystal components, Inspection of castings, Foundries and foundry automation.

Forming and Shaping of Plastics and Composite Materials: Extrusion, Injection molding, Blow molding, Rotational molding, Thermoforming, Compression molding, Transfer molding, Cold forming and solid phase forming, Processing elastomers, Processing reinforced plastics,

Processing Metal-Matrix and Ceramic-Matrix composites, Manufacturing honeycomb materials, Economics of forming and shaping plastics.

Forming and Shaping Ceramics and Glass: Shaping ceramics, Forming and shaping glass, Techniques for treating glass, Design consideration.

Material-Removal Processes and Machines: Fundamentals of cutting, Cutting-tool materials and cutting fluids, Machining process for producing round shapes, Machining process for producing various shapes, Nontraditional machining processes.

Fabrication of Microelectronic Devices: Semiconductor and silicon, Crystal growing and wafer preparation, Film deposition, Oxidation, Lithography, Etching, Diffusion and Ion implantation, Metallization and testing, Bonding and packaging, Reliability and yield, Printed circuit board.

Computer-Integrated Manufacturing System: Manufacturing systems, Computer-aided manufacturing, Computer-aided process planning, Computer simulation of manufacturing process and systems, Group technology, Cellular manufacturing, Flexible manufacturing systems, Just-intime production, Artificial intelligence, Factory of the future.

GCE4841 (Unit Operation)

Lecture: 3 hrs/week, No. of Credit: 3.00

Properties and Handling of Particulate Solids: Characterization of solid particles properties of particulate masses, Pneumatic transportation of particulate materials, Storage of solid materials.

Size Reduction: Principles of comminution, Energy and power requirement, Size reduction equipment- Crusher, Grinders, Ultrafine grinders and Cutting machines.

Mixing of Solids and Pastes: Mixer devices for paste & plastic masses, Mixing criteria, Mixing index, Mixer for dry powders, Rate of mixing.

Mechanical Separation: Screening equipment, Screen equipment, Screen effectiveness and capacity, Filtration equipment, Principles of filtration & clarification Centrifugal filtration, Cross flow filtration, Gravity settling processes, Flocculation, Sedimentation, Centrifugal settlers, Principles of centrifugal sedimentation.

Transportation of Materials: Solid: Classification of conveying equipment. Operation principles of belt, chain, flight screw, pneumatic & hydraulic conveyors. **Fluid:** Membrane pump, Piston pump.